THE ENCYCLOPÆDIA BRITANNICA

THIRTEENTH EDITION

COMMONWEALTH MYCOLOGICAL
24 NOV 1959

THE ENCYCLOPÆDIA BRITANNICA

First	Edition . . .	1768
Second	Edition . . .	1777
Third	Edition . . .	1788
Fourth	Edition . . .	1801
Fifth	Edition . . .	1815
Sixth	Edition . . .	1823
Seventh	Edition . . .	1830
Eighth	Edition . . .	1853
Ninth	Edition . . .	1875
Tenth	Edition . . .	1902
Eleventh	Edition . . .	1910
Twelfth	Edition . . .	1922
Thirteenth	Edition . . .	1926

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ENCYCLOPÆDIA BRITANNICA

A DICTIONARY OF ARTS, SCIENCES, LITERATURE & GENERAL INFORMATION

The Three New Supplementary Volumes constituting with the Volumes of the Latest Standard Edition

THE THIRTEENTH EDITION

VOLUME III

PACIFIC *to* ZUYDER ZEE

and INDEX

LONDON

THE ENCYCLOPÆDIA BRITANNICA COMPANY, LTD.

NEW YORK

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E. Hd.	EARDLEY LANCELOT HOLLAND, M.D., B.S., F.R.C.S., F.R.C.P. Obstetric and Gynaecological Surgeon and Lecturer in Midwifery and Diseases of Women, London Hospital. Obstetric Surgeon to the City of London Maternity Hospital. Author of *Manual of Midwifery*; etc.	**Women, Diseases of.**
E. H. K.	LT.-COL. EDWARD HENRY KELLY, D.S.O., M.C. Chief Instructor, Field Works and Bridging School, School of Military Engineering, Chatham.	**Siegecraft and Siege Warfare.**
E. J. Di.	EMILE JOSEPH DILLON. Foreign Correspondent of *The Daily Telegraph* (London). Author of *Russian Characteristics*; *Maxim Gorky*; *From the Triple to the Quadruple Alliance*; *The Eclipse of Russia*; etc.	**Primo de Rivera Miguel; Sazonov, S. D.**
E. J. O.	E. J. OLDMEADOW. Managing Director of Francis Downman, Ltd., Wine Merchants, London. Editor of *The Tablet*. Author of *Cookery in War Time*; etc.	**Wine.**
E. Le.	EMIL LEDERER, PH.D. Professor in the Faculty of Philosophy, University of Heidelberg. Editor of *Archiv für Sozialwissenschaft und Sozialpolitik*.	**Third (Communist) International.**
E. M. Ho.	COLONEL EDWARD MANDELL HOUSE. Personal representative of the President of the United States to European Governments, 1914, 1915 and 1916. Representative of the United States in Supreme War Council, Paris. Joint Editor, with Charles E. Seymour, of *What Really Happened at Paris*.	**Paris, Conference of.**
E. N. da C. A.	EDWARD NEVILLE DA COSTA ANDRADE, D.SC., PH.D., F.INST.P. Professor of Physics, Artillery College, Woolwich. Troutan scholar, Ellen Watson scholar and Jessel scholar, University College, London. Sometime John Harling Fellow, University of Manchester. Fellow of University College, London. Author of *The Structure of the Atom*; *The Atomic Theory*; etc.	**Sound Ranging; Television.**
E. P.	ERIC PARKER. Sporting Editor of *The Field*, London. Author of *Sporting Days*; etc.	**Shooting** (*in part*).
E. Pr.	EDGAR PRESTAGE, M.A., LITT.D. Camoens Professor of Portuguese Language, Literature and History, King's College, University of London.	**Portuguese Literature.**
E. R.	COL. E. RÉQUIN. Military Representative of France on the League of Nations.	**Victory, Advance to** (*in part*).
E. Rh.	ERNEST RHYS. Editor of *Everyman's Library*. Author of *A London Rose*; *Lord Leighton*; *The Fiddler of Carne*; *The Leaf-Burners*; *Modern English Essays*; etc.	**Publishing.**
E. Ro.	ELIHU ROOT, A.M., LL.D., D.C.L. Member of the Permanent Court of Arbitration at The Hague. Formerly U.S. Secretary of State. Member of Commission recommending to League of Nations the plan on the basis of which was established the Permanent Court of International Justice. Recipient of the Nobel Prize for Peace, 1912. President of the Carnegie Endowment for International Peace. President, American Society of International Law. Author of *Military and Colonial Policy of the United States*; etc.	**Permanent Court of International Justice.**
E. Ru.	SIR ERNEST RUTHERFORD, O.M., D.SC., F.R.S. Cavendish Professor of Experimental Physics and Director of the Cavendish Laboratory, Cambridge University. Professor of Natural Philosophy, Royal Institution, London. Nobel Prizeman for Chemistry, 1908. President of the British Association, 1923. Author of *Radioactivity*; *Radioactive Transformations*; *Radioactive Substances and Their Radiations*; etc.	**Radioactivity.**
E. S. M.	EDMOND STEPHEN MEANY, M.S., M.L. Professor of History in the University of Washington. Author of *History of the State of Washington*; *Vancouver's Discovery of Puget Sound*; etc.	**Washington** (*State*).
E. Sr.	E. SAPIR. Associate Professor of Anthropology and American Indian Languages, University of Chicago. Author of *Language*.	**Philology.**
E. T.	ELIHU THOMSON, A.M., PH.D., D.SC. Consulting Engineer of the General Electric Company. Director of Thomson Laboratory of General Electric Co., Lynn, Mass. Originator of Resistance Electric Welding (Thomson Process).	**Welding** (*in part*).
E. T.-D'E.	SIR EUSTACE HENRY WILLIAM TENNYSON-D'EYNCOURT, K.C.B., F.R.S., M.I.C.E. Managing Director, Armstrong Whitworth and Co., Ltd. Director of Naval Construction at the Admiralty, 1912–24.	**Submarine.**
E. Va.	EMILE VANDERVELDE. Minister for Foreign Affairs in the Belgian Government. Formerly Minister of Justice. Represented Belgium at the Paris Peace Conference, 1919. Chairman of the Socialist Group in the Belgian Parliament. Author of *Three Aspects of the Russian Revolution*; *Le parti ouvrier belge*; etc.	**Second (Socialist) International.**

E. Vi.	ETHAN VIALL. Special Correspondent and formerly Editor of *The American Machinist*. Author of *Broaches and Broaching*; *Electric Welding*; *Gas-Torch and Thermit Welding*; *Manufacture of Artillery Ammunition*; etc.	**Thermit; Welding** (*in part*).
E. V. P.	ERNEST VINCENT PANNELL. Electrical Engineer. Technical adviser of the British Aluminium Company, New York. Author of *High Tension Line Practice*.	**Super Power.**
E. W. E.	ADMIRAL E. W. EBERLE. Admiral U.S. Navy. Chief of Naval Operations, Navy Department, Washington.	**Staff, Naval** (*in part*).
F. B. M.	SIR FREDERICK B. MAURICE, K.C.M.G. Director of Military Operations, Imperial General Staff, 1915–8. Author of *The Russo-Turkish War, 1877–8*; *Forty Days in 1914*; *The Last Four Months*; etc. Contributor to *The Cambridge Modern History*.	**Robertson, Sir W. R.; Western Front; Ypres, First Battle of.**
F. C. B.*	F. C. BARTLETT, M.A. University Reader in Experimental Psychology and Director of the Psychological Laboratory, Cambridge.	**Psychology.**
F. C. S. S.	FERDINAND CANNING SCOTT SCHILLER, M.A., D.Sc., F.B.A. Fellow and Senior Tutor of Corpus Christi College, Oxford. President of the Society for Psychical Research, 1914. Author of *Formal Logic*; *Humanism*; *Studies in Humanism*; *Tantalus, or the Future of Man*; *Problems of Belief*; etc.	**Pragmatism.**
F. D. L.	SIR FREDERICK J. D. LUGARD, G.C.M.G. British Member of Permanent Mandates Commission, League of Nations. Governor-General of Nigeria, 1914–9. Governor of Hong Kong, 1907–12. Author of *Our East African Empire*; *The Dual Mandate in British Tropical Africa*; etc.	**Ruanda-Urundi; Slavery and Forced Labour; Southwest Africa.**
F. de los R.	FERNANDO DE LOS RIOS. Professor in the University of Granada.	**Spain:** *Economic History*.
F. H. B.*	FRANK HERBERT BROWN, C.I.E. Member of the staff of *The Times* (London). London correspondent of *The Times of India*. Formerly Editor of *The Indian Daily Telegraph*.	**Tagore, Sir Rabindranath.**
F. H. G.	FRANCIS HENRY GRENFELL, D.S.O. Captain R.N. (ret.). Staff-inspector of Physical Exercises, Board of Education, London.	**Physical Training** (*in part*).
F. H. Ni.	F. H. NIXON. H.M. Treasury, London. Late Director of the Financial Section of the Secretariat of the League of Nations. Member of British Official Financial Mission to Poland, 1924.	**Poland:** *Financial and Economic History*.
F. Ho.*	FRANK HORTON, D.Sc., F.R.S. Professor of Physics, Royal Holloway College, University of London. Formerly Lecturer at the Cavendish Laboratory, Cambridge. Late Fellow of St. John's College.	**Transmutation of Elements.**
F. J. D.	F. J. DROVER. Engineer-Captain in the R.N. Author of *Marine Engineering Practice*; *Coal and Oil Fired Boilers*; *Marine Engineering Repairs*; etc.	**Rotor Ship; Star-Contra Propeller; Thermo-Electric Pyrometer.**
F. J. C. H.	FOSSEY JOHN COBB HEARNSHAW, M.A., LL.D. Professor of History, King's College, University of London. Author of *Main Currents of European History*; *Europe in the Nineteenth Century*; *World History*; etc.	**Referendum.**
F. J. M.	F. J. MELVILLE. President of the Junior Philatelic Society, and writer on Stamp Collecting for *The Daily Telegraph*, London.	**Stamp Collecting.**
F. J. W. D.	F. J. W. DRION. Formerly member of the Netherlands States General. Editor of the *Gazette de Hollande*.	**Zuyder Zee.**
F. Kle.	FRITZ KLEIN, PH.D. Member of the staff of the *Deutsche Allgemeine Zeitung*.	**Stresemann, Gustav.**
F. N.	FRIDTJOF NANSEN, G.C.V.O., D.Sc., D.C.L. Professor of Oceanography, University of Oslo, Norway. Leader of expedition to Greenland Sea, 1882; across Greenland, 1888–9; and towards the North Pole, 1893–6. Minister for Norway in London, 1906–8. Ambassador extraordinary for Norway at Washington, 1917–8. Awarded the Nobel Peace Prize, 1921–2; for activities during and after the War on behalf of refugees and famine stricken areas of Central Europe. Author of *Across Greenland*; *Farthest North*; *The Norwegian North Polar Expedition*; etc.	**Polar Exploration** (*in part*); **Refugees.**
F. R.	FRANK ROSCOE, M.A. Secretary of Teachers' Registration Council, London. Head of Training College for Men, and Lecturer on Education, University of Birmingham, 1900–13.	**Summer Schools:** *Great Britain*.
F. R. C.	FRANK RICHARDSON CANA, F.R.G.S. On editorial staff of *The Times* (London). Author of *South Africa from the Great Trek to the Union*, etc. Member of the editorial staff of the *Encyclopædia Britannica*, 11th edition.	**Rhodesia; Senussi; Sierra Leone; Somaliland; South Africa:** *Economic History* (*in part*); *Education*; **Tanganyika; Togo; Transvaal, etc.**

F. S.*	FREDERICK SODDY, M.A., F.R.S. Professor of Inorganic and Physical Chemistry, Oxford University. Formerly Professor of Chemistry, University of Aberdeen. Nobel Prizeman in Chemistry, 1921. Author of *Chemistry of the Radio-Elemental Matter and Energy*; *Science and Life*; *Inversion of Science*; etc.	**Rays.**
F. Si.	F. SIMON. Councillor of the Foreign Office, Berlin. Formerly Private Secretary to Herr Rathenau.	**Rathenau, Walter.**
F. W.	SIR FABIAN ARTHUR GOULSTONE WARE, K.C.V.O., K.B.E., C.M.G. Late Director General of Graves Registration and Enquiries. Permanent Vice-Chairman Imperial War Graves Commission. Editor of *The Morning Post*, 1905–11. Author of *Educational Foundations of Trade and Industry*; *The Worker and His Country*; etc.	**War Graves.**
F. Wh.	FRANCIS WHITE. Chief of the Division of Latin-American Affairs, Department of State, Washington, D.C.	**Tacna-Arica Question.**
F. W. Mo.	SIR FREDERICK WALKER MOTT, K.B.E., F.R.S., M.D., B.S., LL.D. Formerly Consulting Physician to Charing Cross Hospital, London. Pathologist to London County Asylums. Lecturer on Morbid Psychology, Birmingham University, and Fullerian Professor of Physiology, Royal Institute, London. Author of *War Neuroses and Shell Shock*; etc.	**Psychiatry.**
F. W. S.	FRED WINCHESTER SLADEN. Major General U.S. Army. Superintendent and Commandant, U.S. Military Academy, West Point.	**West Point.**
F. Y.	SIR FREDERIC WILLIAM YOUNG, K.B.E., M.I.MECH.E. Late Chief Surveyor, Liverpool Salvage Association. Commodore, R.N.R., and Head of Admiralty Salvage Section during the European War.	**Salvaging.**
G. Ad.	GUSTAV ADOR. Chairman of the Economic and Financial Committee of the League of Nations. President of the International Red Cross Committee. President of the Swiss Republic, 1919. President of the International Financial Conference at Brussels, 1920.	**Red Cross.**
G. A. S.	SIR GEORGE AUGUSTUS SUTTON, BART. Chairman, Amalgamated Press, Ltd., London. Director, Associated Newspapers, Ltd. Director of Publicity, National War Bonds Campaign, 1917.	**Savings Movement:** *Publicity.*
G. B. B.*	GEORGE BARR BAKER. Formerly Director of American Relief Administration and member Executive Committee, Commission for Relief in Belgium. Attached to the Director-General of Relief under the Supreme Economic Council, Paris, during the Peace Conference, 1919.	**Relief Work.**
G. Bo.	GEORGE BONCESCU. Rumanian correspondent of *The Times* (London).	**Transylvania.**
G. B. S.*	GEORGE BERNARD SHAW. Novelist, dramatist and writer on social questions. Author of *Socialism and Superior Brains*; *The Common Sense of Municipal Trading*; *Common Sense about the War*; *Peace Conference Hints*; *The Intelligent Woman's Guide to Socialism and Capitalism*; etc.	**Socialism:** *Principles and Outlook.*
G. C. D.	G. C. DIXON. Literary Editor, *The Daily Mail* (London). Author of *From Melbourne to Moscow.*	**Ward, Sir Joseph G.**
G. D. H. C.	GEORGE DOUGLAS HOWARD COLE, M.A. University Reader in Economics, Oxford. Formerly Fellow of Magdalen College, Oxford. Author of *The World of Labour*; *Self-Government in Industry*; *Guild Socialism Restated*; *Social Theory*; etc.	**Socialism.**
G. Do.	GEORGE DODDS, MUS.BAC. (Dundee), L.R.A.M. Co-author of *The Control of the Breath.*	**Singing.**
G. Ea.	GEORGE EASTMAN. Inventor of the Kodak. President and General Manager of the Eastman Kodak Co., Rochester, N.Y. Managing Director of the Kodak Co. Ltd., London, England; President Eastman Kodak Co. of New Jersey.	**Photography** (*in part*).
G. E. B.	GEORGE EARLE BUCKLE, M.A., LL.D. Editor of *The Times* (London) 1884–1912. Formerly Fellow of All Souls College, Oxford. Author of *Life of Disraeli* (vol. III., IV., V. and VI).	**Redmond, John E.; Wyndham, George, etc.**
G. E. F.	GEORGE EMORY FELLOWS, PH.D., LL.D. Professor of History and Political Science in the University of Utah. Formerly President of the University of Maine. Author of *Recent European History*; *Outline of the Sixteenth Century*; etc.	**Utah.**
G. E. R. G.	CAPT. G. E. R. GEDYE. Correspondent for Central Europe of *The Times*, London.	**Rhineland; Ruhr.**

G. F.	G. Flatow. Official at the Prussian Board of Trade.	**Works Councils.**
G. G. A.	Major-General Sir George Grey Aston, K.C.B. Lecturer on Military History, University College, University of London. Formerly Professor of Fortification at the Royal Naval College, Greenwich. Author of *Sea, Land and Air Strategy*; *Memories of a Marine*; etc.	**Sea Power.**
G. H.	Grace E. Hadow. Secretary of the Juvenile Group, Oxfordshire Rural Community Council, Oxford, England.	**Rural Life.**
G. H. G.	G. H. Gulliver, D.Sc. Messrs. Kirkaldy & Son, Testing and Experimenting Works, London.	**Testing Machinery.**
G. H. Ga.	George Henry Gater, C.M.G., D.S.O. Education Officer, London County Council. Formerly Director of Education, Lancashire County Council.	**Technical Education** (*in part*).
G. Ka.	Genchi Kato, Litt.D. Associate Professor of the Science of Religion in the Imperial University, Tokyo, Japan.	**Shintoism.**
G. le Q. M.	Major G. le Q. Martel, D.S.O., M. C. Deputy Assistant Director of Fortification and Works, Dept. War Office, London. General Staff Officer, Tank Corps Headquarters, B.E.F., France, 1916–8.	**Tanks.**
G. Mar.	Guglielmo Marconi, G.C.V.O. Inventor of the Marconi system of Wireless Telegraphy, and principal figure in the development of practical wireless telegraphic communication. Senator of the Kingdom of Italy. Awarded the Nobel prize for Physics, 1909.	**Wireless Telegraphy and Telephony** (*in part*).
G. M. G.-H.	Geoffrey Malcolm Gathorne-Hardy. Barrister-at-Law. Hon. Secretary, British Institute of International Affairs.	**Schleswig.**
G. N.	Sir George Newman, K.C.B., M.D., F.R.C.P. Chief Medical Officer, Ministry of Health and Board of Education, London. Author of *Notes on Medical Education in England*; *Recent Advances in Medical Education in England*; etc.	**Preventive Medicine** (*in part*).
G. O'B.	George O'Brien. Author of *Economic History in the 17th Century*; *Economic History of Ireland* (*1800–47*); etc.	**Shannon.**
G. W. C. K.	George William Clarkson Kaye, M.A., D.Sc., F.Inst.P. Superintendent of the Physics Department, National Physical Laboratory, Teddington, England. President of the Röntgen Society, 1917–8. MacKenzie Davidson Lecturer and Medallist, Royal Society of Medicine, 1921. Author of *Practical Application of X-rays*.	**Röntgen Rays; Vacuum Tubes.**
G. W. K.*	George Washington Kirchwey, LL.D. Head of the Department of Criminology, New York School of Social Work. Formerly Warden of Sing Sing Prison. Author of *Readings in the Law of Real Property*; etc.	**Punishment.**
G. W. S.	G. W. Stephens. Chairman of the Commission appointed by the League of Nations to govern the Saar Basin.	**Saar.**
H.*	Right Hon. Viscount Haldane (Richard Burdon Haldane), K.T., O.M., F.R.S. Lord High Chancellor of England, 1912–5 and 1924. Secretary of State for War, 1905–12. Chancellor of the University of Bristol. Gray Scholar and Ferguson Scholar in Philosophy of the four Scottish universities, 1876. Author of *Education and Empire*; *The Philosophy of Humanism*; etc. Joint author of *Essays in Philosophical Criticism*.	**Philosophy.**
H. A. Gk.	Harry Groesbeck. Engineer for the Walker Engraving Co., New York. Author of *Photoengraving*.	**Photoengraving.**
H. A. M.	John Harcourt Alexander Morgan, B.S.A. President of the University of Tennessee. Formerly Director of University of Tennessee Experimental Station, and Professor of Zoology and Entomology.	**Tennessee** (*in part*).
H. A. R.	Horace Arthur Rose. Formerly Indian Civil Service. Superintendent of Census (Punjab), 1901. Superintendent of Ethnography, Punjab, 1901–6. Author of *Tribes and Castes of the Punjab, 1911–19*.	**Sikhism.**
H. Ba.	Harold Balme, F.R.C.S., D.P.H. Lecturer in Surgery and Medical Superintendent, University Hospital, Tsinanfu, China.	**Shantung.**
H. Bi.*	Henri Bidou. Member of the staff of *Le Journal des Débats* (Paris). Chevalier of the Legion of Honour.	**Pétain, Marshal; Verdun, Battle of.**
H. Bre.	Harry Brearly. Author of *The Heat Treatment of Tool Steel*.	**Rustless Steel.**
H. Bu.	Harold S. Bucklin. Professor in the Department of Social Science, Brown University, Providence, R.I. U.S.A.	**Rhode Island.**

H. C. B.	HECTOR C. BYWATER. Author of *Sea-power in the Pacific*; etc.	**Pacific, Command of the.**
H. C. C.*	HENRY COPE COLLES, M.A., F.R.C.M. Musical critic of *The Times*, London. Author of *Brahms; The Growth of Music.*	**Ravel, Maurice, etc.**
H. C. Ha.	HENRY C. HARWOOD. Literary Critic, *The London Mercury*; *The Outlook* (London). Author of *Judgment Eve*; etc.	**Russell, Bertrand A. W.; Wells, H. G.**
H. Cl.*	HENRY CLAY, M.A., M.COM. Stanley Jevons Professor of Political Economy, Manchester University; formerly Fellow of New College, Oxford. Author of *Economics, an Introduction for the General Reader.*	**South Africa:** *Economic History (in part).*
H. C. N.	HENRY CLEMENT NOTCUTT, PH.D. Professor of English Language and Literature, University of Stellenbosch, S. Africa. Author of *An Interpretation of Keats's Endymion*; etc.	**South African Literature:** *English.*
H. C. P.	HENRY CLEMENS PEARSON, F.R.G.S. Editor and Publisher of *The India Rubber World*, New York. Author of *Crude Rubber and Compounding Ingredients*; *Rubber Machinery*; *Rubber Country of the Amazon*; etc.	**Rubber.**
H. C. Wo.	HENRY CHARLES WOODS. Special correspondent of *The Times* in the Balkans, 1911, and of *The Evening News* during the Balkan Wars, 1912–3. Military and Diplomatic Correspondent for *The Evening News*, 1914–5. Author of *War and Diplomacy in the Balkans*, etc.	**Veniselos, E.**
H. D.	HENRY DEVINE, O.B.E., M.D., F.R.C.P. Examiner in Psychology, Royal College of Physicians, London. Lecturer in Psychology, Maudsley Hospital, London. Medical Superintendent, Mental Hospital, Portsmouth, England. Co-Editor of *The Journal of Mental Science.*	**Psychoses.**
H. E. F.	HARVEY E. FISK. Of the Bankers' Trust Co., New York. Author of *Inter-Ally Debts.*	**Russia:** *Foreign Debts.*
H. E. H.	HARRISON E. HOWE. Editor of *The Industrial and Engineering Chemistry.*	**Research, Industrial** *(in part).*
H. E. I.	HERBERT EUGENE IVES, PH.D. Physicist, Bell Telephone Laboratories, New York. Associate Editor, *Journal of the Optical Society of America.*	**Phototelegraphy.**
H. E. Wh.	WING-COMMANDER HAROLD E. WHITTINGHAM, M.B., D.PH. Royal Air Force, Pathological Laboratory, Halton, Bucks., England.	**Sandfly Fever.**
H. F. N.	HUGH FRANK NEWALL, D.SC., F.R.S. Director of the Solar Physics Observatory, Professor of Astrophysics, and Fellow of Trinity College, Cambridge. Formerly President of the Royal Astronomical Society.	**Spectrum.**
H. F. O.	HENRY FAIRFIELD OSBORN, D.SC., LL.D., PH.D. Honorary Curator of the Department of Vertebrate Palaeontology, American Museum of Natural History. Senior Geologist, United States Geological Survey. Research Professor of Zoology, Columbia University, New York. Author of *Age of Mammals*; *Men of the Old Stone Age*; *Origin and Evolution of Life*; etc.	**Palaeontology** *(in part).*
H. G. G.	HENRY GEORGE GREENISH, F.I.C., F.L.S. Professor of Pharmaceutics in University of London, and to the Pharmaceutical Society of Great Britain. Joint Editor of *The British Pharmacopaeia.*	**Pharmacy.**
H. Gn.	HENRI GRAPPIN. Professor at the National School of Oriental Languages, Paris. Editor of the *Bulletin Periodique de la presse polonaise.*	**Paderewski, Ignace.**
H. H. Sc.	HENRY HAROLD SCOTT, M.D., F.R.C.P., D.P.H., F.R.S. (Edin.). Milner Research Fellow in Comparative Pathology, London School of Hygiene and Tropical Medicine. Pathologist to the Zoological Society of London.	**Sprue.**
H. I. P.	HERBERT INGRAM PRIESTLEY, M.A., PH.D. Professor of Mexican History and Librarian of the Bancroft Library, University of California. Author of *The Mexican Nation*; etc.	**Panama; Salvador.**
H. J. M.	H. J. MACINTIRE. Associate Professor of Refrigeration in the University of Illinois. Author of *Principles of Mechanical Refrigeration*; etc.	**Refrigeration.**
H. Ma.	HEINRICH MARCZALI. Professor of Hungarian History at the University of Budapest. Author of *Ubersicht der Geschichte Ungarns*; *Ungarische Verfassungsgeschichte*; etc.	**Tisza, Stephen, Count.**
H. M. D.	HENRY MELVILLE DOWSETT, M.I.E.E., F.INST.P. Of the Marconi Wireless Telegraph Co. Author of *Wireless Telephony and Broadcasting*; *Wireless Telegraphy and Telephony: First Principles, Present Practice and Testing*; etc.	**Wireless Telegraphy and Telephony** *(in part).*

H. My.	SIR HENRY PERCY MAYBURY, K.C.M.G. Director-General, Roads Department, Ministry of Transport, London.	**Traffic Problems.**
H. No.	HIDEYO NOGOUCHI, M.D., D.Sc. Member of the Rockefeller Institute for Medical Research. Effected the Isolation and Cultivation of the micro-organisms causing Yellow Fever, and the development of Preventive Vaccine and Curative Serum for Yellow Fever. Author of *Snake Venoms*; etc.	**Yellow Fever.**
H. Nor.	HELENA FLORENCE NORMANTON. First practicing woman barrister. Honorary Counsel to the Women's Unionist Organisation. Extension Lecturer, London University. First General Secretary of the National Women Citizens Association, 1918–9. Editor of *India*, 1919–20. Author of *Sex Differentiation in Salary*; etc.	**Women, Professional** (*in part*).
H. O'L.	HERBERT O'LEARY. Major U.S. Army. Chief of Small Arms Division, Ordnance Office, Washington, D.C.	**Pistol.**
H. P. Do.	HENRY PERCY DOUGLAS. Captain R.N. Hydrographer to the British Navy. Surveyor on Staff of Vice-Admiral, Dardanelles, 1915–6, and Dover Patrol 1918–9. Director of Naval Meteorological Service, 1917.	**Surveying, Nautical.**
H. R. A.	HON. HERBERT R. ATKINSON. Instructor at the Artillery College, Woolwich. Formerly Experimental Officer at the Small Arms School, Hythe, Kent.	**Rifles and Light Machine Guns.**
H. R. C.	HENRY REGINALD CUMMINGS. Member of League of Nations' Secretariat, Geneva. Formerly on the London and Parliamentary Staff of *The Manchester Guardian*.	**Propaganda.**
H. Re.	SIR HUGH REID, BT., C.B.E., LL.D., M.I.C.E. Chairman and Chief Managing Director of the North British Locomotive Co., Ltd. President, Royal Glasgow Institute of Fine Arts.	**Railways:** *Locomotive Design.*
H. R. Mi.	HUGH ROBERT MILL, D.Sc., LL.D. President, Royal Meteorological Society, 1907–8; Rainfall Expert to Metropolitan Water Board, 1906–19. Author of *The Life of Sir Ernest Shackleton* (1923).	**Polar Exploration** (*in part*).
H. Ro.	SIR HUMPHRY DAVY ROLLESTON, BART., K.C.B., M.D., D.Sc., D.C.L. Regius Professor of Physic, Cambridge University. Physician in Ordinary to His Majesty King George V. President of the Royal College of Physicians of London. Author of *Diseases of the Liver*; etc.	**Therapeutics.**
H. S. H.-S.	HENRY S. HELE-SHAW, D.Sc., LL.D., F.R.S. Emeritus Professor of Engineering, University of Liverpool. Ex-President, Institution of Mechanical Engineers, and Institution of Automobile Engineers, London.	**Variable Transmission Gear**
H. S. P.	HARLOW STAFFORD PERSON, A.M., PH.D. Managing Director, Taylor Society, New York. Formerly Director and Professor of Business Organisation and Management, Amos Tuck School of Administration and Finance, Dartmouth, U.S.A. Author of *Industrial Education*; etc.	**Scientific Management.**
H. St. J. B. P.	HARRY ST. JOHN BRIDGER PHILBY, C.I.E. Chief British Representative in Transjordan, 1921–4. Formerly Adviser to the Ministry of the Interior, Mesopotamia. Commanded the British Political Mission to Central Arabia, 1917–8. Author of *The Heart of Arabia*.	**Transjordan; Wahhabi.**
H. T. H.	HENRY THEODORE HODGKIN, M.A., M.B. Formerly Medical Missionary in China. Late Resident Medical Officer, Mildmay Mission Hospital, London.	**Sun Yat-Sen.**
H. We.	HERMANN WEYL. Professor of Higher Mathematics in the University of Zurich, Switzerland.	**Universe, Modern Conceptions of the.**
H. W. V. T.	HAROLD WILLIAM VAZEILLE TEMPERLEY, M.A., LITT.D., O.B.E. University Reader in Modern History and Fellow of Peterhouse, Cambridge. British Representative on the Albanian Frontiers Commission, 1921. Military Adviser at the Peace Conference, Paris 1919. Editor of *A History of the Peace Conference of Paris*. Contributor to *The Cambridge Modern History* and *The Cambridge History of Foreign Policy*.	**Plebiscite; St. Germain, Treaty of; Supreme Council; Teschen; Tirol; Treaties; Trianon, Treaty of; Versailles, Treaty of; etc.**
H. W. W.	HERBERT WRIGLEY WILSON. Chief Leader Writer on *The Daily Mail*, London. Author of *Ironclads in Action*. Contributor to *The Cambridge Modern History*.	**Rothermere, Viscount.**
I. A.*	IRENE OSGOOD ANDREWS. Assistant Secretary, American Association for Labor Legislation.	**Women, Professional;** (*in part*).
I. C.	IRENE CURIE, D.Sc. Assistant in the Radium Institute, Curie Laboratory, University of Paris. Author of various works on chemistry, particularly in connection with radioactivity.	**Radium** (*in part*).
I. F. D. M.	IAN F. D. MORROW. Formerly Senior Moderator, Trinity College, Dublin.	**William II. of Germany.**

I. H.	SIR IAN STANDISH MONTEITH HAMILTON, G.C.B., G.C.M.G., D.S.O. General Officer Commanding-in-Chief in the Mediterranean and Inspector-General of the Overseas Forces, 1910–5. General Officer Commanding the Mediterranean Expeditionary Force, 1915. Author of *A Staff Officer's Scrap Book*; *Gallipoli Diary*; *The Soul and Body of an Army*; etc.	War.
I. Ma.	SIR IAN MALCOLM, K.C.M.G., D.L. British Representative on the Suez Canal Board. M.P. for Croydon, 1910–8. Author of *The Calendar of Empire*; etc.	Suez Canal.
I. Mo.	IVOR MONTAGU. Chairman, Table Tennis Association, London.	Table Tennis.
J. A. A. P.	LIEUT.-COL. JOCELYN ARTHUR ADAIR PICKARD, D.S.O. General Secretary, National Safety First Association, London.	Safety First.
J. A. E.	SIR JAMES ALFRED EWING, K.C.B., F.R.S. Principal and Vice-Chancellor of the University of Edinburgh. President, Royal Society of Edinburgh. Hon. Fellow of King's College, Cambridge. Professor of Mechanism and Applied Mechanics in the University of Cambridge, 1890–1903. Director of Naval Education, 1903–16. Author of *The Steam Engine, and other Heat Engines*; etc.	Steam Engines.
J. A. H.	JOHN ATKINSON HOBSON, M.A. Author of *The New Protectionism*; *Taxation in the New State*; *Work and Wealth; a Human Valuation*; *Economics of Unemployment*; etc.	Unemployment.
J. A. Ro.	JAMES ALEXANDER ROBERTSON, L.H.D. Research Professor of American History, John B. Stetson University, Deland, Florida. Formerly Chief of the Near Eastern Division Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D.C. Co-Editor of Blair and Robertson's *The Philippine Islands, 1493–1898*.	Philippine Islands.
J. B. Bi.	JOSEPH BUCKLIN BISHOP. Secretary to the Panama Canal Commission, 1905–14. Author of *Our Political Drama*; *Issues of a New Epoch*; *The Panama Gateway*.	Panama Canal.
J. B. S.	JAMES BROWN SCOTT. President of the American Institute of International Law. Editor-in-Chief of *The American Journal of International Law*. Trustee and Secretary of the Carnegie Endowment for International Peace. Author of *An International Court of Justice*; etc.	Root, Elihu.
J. Ca.	JOSEPH CAILLAUX. Prime Minister of France, 1911–2. Minister of Finance, 1899–1902, 1906–9, 1911, 1913, 1925 and 1926. Author of *My Prisons*; *Whither France? Whither Europe?*	World Recovery.
J. C. A. G.	J. C. A. GERSTER. Formerly Professor of Clinical Surgery, Columbia University, New York. Emeritus Professor of Surgery, New York Polyclinic.	Surgery (*in part*).
J. C. B.	FLIGHT-LIEUTENANT J. C. BROOKE. Attached to H.M. Marine Aircraft Experimental Establishment, Felixstowe, Suffolk.	Seaplane.
J. C. E.*	JAMES CHIDESTER EGBERT. Professor of Latin and Director of University Extension of the School of Business, Columbia University.	University Extension (*in part*).
J. C. O.	JOHN CLYDE OSWALD. President of the New York Employing Printers Association, Inc. Formerly Editor of *The American Printer*. Author of *Benjamin Franklin, Printer*.	Printing (*in part*).
J. C. P.*	JOHN CLAGETT PROCTOR, LL.M. Member of the Bar of the District of Columbia. Historian of the Society of Natives of the District of Columbia.	Washington, D.C.
J. D.-P.	SIR JOHN DENISON DENISON-PENDER, G.B.E., K.C.M.G. Chairman of the Eastern Telegraph Co. and its associated cable companies. Director of the Peninsular and Oriental Steam Navigation Co. Ltd., and of the Atlas Assurance Co. Ltd.	Telegraphy, Submarine (*in part*).
J. E. H.*	JAMES E. HALE. Technical Development and Sales Engineer, Goodyear Tire and Rubber Company, Akron, Ohio.	Tires.
J. E. S. B.	COL. JOHN EDWARD SPENCER BRIND, C.M.G., D.S.O. Deputy Director of Military Operations and Intelligence at the War Office, London, 1923. Temporary Colonel Commandant attached to the Aldershot Command Staff.	Victory, Advance to (*in part*).
J. F. C. F.	COL. JOHN FREDERIC CHARLES FULLER, D.S.O. Military Assistant to the Chief of the Imperial General Staff. Chief General Staff Officer, Tank Corps, 1917–8. Formerly Chief Instructor, Staff College, Camberley. Author of *Tanks in the Great War*; *The Reformation of War*; *Sir John Moore's System of Training*; etc.	Strategy.

J. G. L.	JOHN G. LITTLE. Associate Editor of *The Railway Age*.	Railway Stations.
J. Gra.	J. GRABOWIECKI. Of the Polish Foreign Office.	Poland: *History*.
J. H.	JOHN HILTON. Director of Statistics, Ministry of Labour, London.	Strikes and Lock-Outs (*in part*); Trusts (*in part*).
J. H. B.	J. HUME BELL, ASSOC. M.I.E.E. Member of the Research Laboratory Staff, Bell Telephone Laboratories, Inc.	Telegraphy.
J. He.	JULIE HELEN HEYNEMAN. Portrait painter and literary contributor to *The Observer*, London; *Harper's Magazine*; *The Metropolitan*; *The Review of Reviews*; *The Smart Set*; etc.	Sargent, J. S.
J. H. Go.	JOHN HENRY GORVIN. General Secretary to the International Relief Credits Committee, Paris, 1921. Representative in Russia of the High Commissioner for Russian Relief, 1922–3, and of the Refugee Section of League of Nations, 1923–5.	Russia: *Agrarian Policy*.
J. H. Ho.	JACOB H. HOLLANDER, PH.D. Professor of Political Economy in Johns Hopkins University, Baltimore. Treasurer of Porto Rico, 1900–1. Financial Adviser of the Dominican Republic, 1908–10. Author of *The Abolition of Poverty*; *War Borrowing*; etc.	Porto Rico; Santo Domingo.
J. H. Je.	JAMES HOPWOOD JEANS, D.SC., LL.D., F.R.S. Secretary of the Royal Society, London. President of the Royal Astronomical Society, London. Professor of Applied Mathematics, Princeton University, U.S.A., 1905–9. Second Wrangler, Cambridge, 1898. Smith's Prizeman, 1900. Author of *Problems of Cosmogony and Stellar Dynamics*; etc.	Relativity; Solar Energy.
J. J. C.	BRIG.-GEN. JOHN J. COLLYER, C.B., C.M.G., D.S.O. Late Chief of the General Staff, Union of South Africa.	South Africa: *Defence;* South-west Africa, Campaign in.
J. J. M.	JAMES JOSEPH MALLON, M.A. Warden of Toynbee Hall, London. Hon. Secretary of Trade Boards Advisory Council. Member of the first Trade Boards established under the Trade Boards Act, 1909.	Trade Boards.
J. J. R. Mac.	JOHN JAMES RICKARD MACLEOD, M.B., CH.B., D.P.H., D.SC., F.R.S. Professor of Physiology and Associate Dean of the Faculty of Medicine in the University of Toronto, Canada. Formerly Professor of Physiology, Western Reserve University, Cleveland, Ohio. Joint winner of the Nobel Prize for Medicine, 1923. Author of *Practical Physiology*; etc.	Physiology.
J. Lo.	JEAN LONGUET. Formerly Member of the Chamber of Deputies. Member of the Executive of the French Socialist Party and of the Labour and Socialist International.	Thomas, Albert; Vandervelde, Emile.
J. M. C.*	JAMES MORTON CALLAHAN, A.M., PH.D. Professor of History and Political Science and Dean of West Virginia University. Author of *Neutrality of the American Lakes*; *Cuba and International Relations*; *History of West Virginia*.	West Virginia.
J. M. Cr.	REV. JOHN MARTIN CREED, B.D. Fellow, Dean and Lecturer in Theology, St. John's College, Cambridge.	Theology.
J. M. H. McL.	JOHN MCLEOD HENDRIE MCLEOD, M.D., F.R.C.P. Lecturer on Skin Diseases, London School of Tropical Medicine. Physician for Diseases of the Skin, Charing Cross Hospital. Late Editor of *The British Journal of Dermatology*. Author of *Textbook on the Diseases of the Skin*.	Skin Diseases.
J. Mo.*	RT. REV. MONSIGNOR J. MOYES, D.D. Canon of Westminster Cathedral. Formerly Editor of *The Dublin Review*. Domestic Prelate to H.H. Pope Benedict XV.	Pius X.; Pius XI.; Roman Catholic Church (*in part*).
J. Mt.	REV. JAMES MOFFATT, D.D., D.LITT. Professor of Church History, United Free College, Glasgow. Editor of *The Expositor*. Yates Professor of Greek and New Testament Exegesis, Mansfield College, Oxford, 1911–5. Author of *Critical Introduction to New Testament Literature*; etc.	Presbyterianism.
J. O. B.	JOHN OLIVER BORLEY. Principal Naturalist, Ministry of Agriculture and Fisheries, Great Britain.	Whales and Whaling.
J. O. P. B.	JOHN OTWAY PERCY BLAND. Formerly correspondent of *The Times*, London, in Shanghai and Peking. Author of *Annals and Memoirs of the Court of Peking*; *China, Japan and Korea*; etc.	Yuan Shih-k'ai.
J. P.	VICE-ADMIRAL SIR JOHN FRANKLIN PARRY, K.C.B. Hydrographer of the British Navy, 1914–9.	Sounding.
J. P.*	JOSEPH PROUDMAN, D.SC., F.R.S. Professor of Applied Mathematics and Director of the Tidal Institute, University of Liverpool. Late Fellow of Trinity College, Cambridge.	Tides.

J. P. M.	J. P. Maxfield. Member of the Laboratory Staff, Bell Telephone Co., New York.	**Phonograph.**
J. R. A.	James Rowland Angell, Ph.D., Litt.D., LL.D. President of Yale University. Formerly Acting President, University of Chicago, and Instructor of Philosophy in the University of Minnesota. Author of *Chapters from Modern Psychology*; etc.	**Yale University.**
J. R. Co.	John Rogers Commons. Professor of Economics, University of Wisconsin. Director, American Bureau of Industrial Research.	**Strikes and Lockouts** (*in part*); **Trade Unions** (*in part*); **Wages** (*in part*).
J. S. F.	Sir John Smith Flett, K.B.E., D.Sc., LL.D., F.R.S. Director of the Geological Survey of Great Britain, and of the Museum of Practical Geology, London.	**Petrology.**
J. S. J.	J. Share Jones, D.V.Sc., M.Sc., F.R.C.V.S. Director of Veterinary Studies, University of Liverpool, England. Formerly Editor of *The Veterinary Student* and Editor-in-Chief of *The Veterinary News*. Author of *Education of the Veterinary Student*; etc.	**Veterinary Science.**
J. S. M. W.	John Sebastian Marlow Ward, M.A., F.S.S., F.R.Anthrop.S. Head of the Intelligence Department of the Federation of British Industries. Author of *Textile Fibres and Yarns of the British Empire*; *An Outline History of Freemasonry*; etc.	**Secret Societies;** **Silk.**
J. S. P.	John S. Patton. Librarian of the University of Virginia.	**Virginia.**
J. St.	Sir Josiah Charles Stamp, G.B.E., D.Sc., F.B.A. President of the Executive, London, Midland and Scottish Railway. Vice-President, Joint Hon. Secretary and Editor, Royal Statistical Society, London. Member of the British Royal Commission on Income Tax, 1919; of the Committee on Taxation and National Debt, 1924. British Representative on the Reparation Commission's Committee on German Currency and Finance, 1924. Author of *Wealth and Income of the Chief Powers*; *Wealth and Taxable Capacity*; etc.	**Reparations.**
J. W. E.	John William Henry Eyre, F.R.S. (Edin.), M.D., M.S. Director of Bacteriological Department, Guy's Hospital, London, and Lecturer on Bacteriology in the Medical School. Professor of Bacteriology, University of London. Hunterian Professor Royal College of Surgeons, 1911–2. Author of *Bacteriological Technique*; etc.	**Serum Therapy;** **Vaccine Therapy.**
J. W. J.	Jeremiah Whipple Jenks, LL.D., Ph.D. Research Professor of Government and Public Administration, and Director of Oriental Commerce and Politics, New York University. Author of *The Trust Problem*; etc.	**Trusts** (*in part*).
J. W. T.	John Wilson Taylor, A.M., Ph.D. Assistant to the American Editor of *The Encyclopædia Britannica* (13th Edition). Formerly Professor of Greek, Ohio University.	**Savings Movement** (*U.S.A*)
K. A.	Karl Amark, Ph.D. Secretary of the Economics Association, Stockholm. Author of *Landbruget i det nittende Aarhundrede*; *Spannmalshandel och Spannalspolitik i Sverige, 1817–1830*; etc.	**Sweden:** *Financial and Economic History.*
K. H.*	Karl Hildebrand, Ph.D. Member of the Swedish Debt Board. Editor of *Stockholms Dagblad*, 1904–13. Member of the Swedish Parliament, 1907–18.	**Sweden:** *Political History.*
K. von O.	Karlludwig von Oertzen. Chief of the Intelligence branch of the personal staff of the Ministry of Defence, Berlin.	**Schlieffen, Count von.**
L. A. W.	Laura A. White, Ph.D. Professor of History in the University of Wyoming.	**Wyoming.**
L. E. H.	Leonard Erskine Hill, F.R.S. Director of the Department of Applied Physiology, National Institute of Medical Research, Hampstead, London. Formerly Professor of Physiology, London Hospital. Author of *Manual of Physiology*; etc.	**Public Health;** **Vitamins.**
L. F. E.	Capt. L. F. Ellis, D.S.O., M.C. Secretary, National Union of Social Service, London.	**Social Service.**
L. H. D. B.	L. H. Dudley Buxton, M.A. Lecturer on Physical Anthropology, University of Oxford. Author of *Peoples of Asia.*	**Races of Mankind.**
L. Hs.	Lewis Hodous, D.D. Head of the Chinese Department of the Kennedy School of Missions, Hartford Seminary Foundation, U.S.A. Formerly President of Foochow Theological Seminary.	**Taoism.**

L. M. F.	LEONARD M. FANNING. Director of Publicity and Statistics, American Petroleum Institute, and Editor of *The Oil Trade Journal*.	**Petroleum.**
L. N. Y.	L. N. YOUROVSKY. Professor of Economics, Moscow University. Chief of Currency Department in the People's Commissariat of Finance, Moscow. Author of *Currency Problems and the Policy of the Soviet Union*.	**Russia:** *Economic History;* **Sokolnikov, G. Y.**
L. of F.	RIGHT HON. VISCOUNT LEE OF FAREHAM (ARTHUR HAMILTON LEE), G.C.S.I., G.B.E. Chairman of the Board of Governors, Sulgrave Manor, Northamptonshire, England, British Delegate, Washington Conference, 1921–2. First Lord of the Admiralty, 1921–2.	**Sulgrave Manor.**
L. P.	LEON PLASZOWSKI. Professor of Polish Literature, University of Warsaw.	**Polish Literature.**
L. St.	LEONARD STEIN. Of the Zionist Organisation, London.	**Syria; Zionism.**
L. V.*	LUIGI VILLARI. Member of the Staff of the League of Nations, 1920–3. Subsequently attached to the Emigration Department of the Italian Foreign Office. Commendatore of the Crown of Italy. Author of *Italian Life in Town and Country*; *The Awakening of Italy*; etc.	**Sturzo, Luigi; Victor Emmanuel III.**
L. Wo.	MAJOR-GENERAL LEONARD WOOD. Governor-General of the Philippine Islands. Formerly Chief-of-Staff, United States Army.	**Training Camps.**
L. W. H.*	COLONEL LAWRENCE WHITAKER HARRISON, D.S.O., F.R.C.P. (Edin.), R.A.M.C. Special Medical Officer, Ministry of Health, London. Director of Venereal Department and Lecturer on Venereal Diseases, St. Thomas's Hospital, London. Author of *The Diagnosis and Treatment of Venereal Diseases in General Practice*; etc.	**Venereal Diseases.**
M. A. H.	MARY AGNES HAMILTON. Member of the Balfour Committee on British Trade and Industry. Member of the staff of *The Economist*, London, etc. Under the pen name of "Iconoclast" wrote *The Man of Tomorrow*; *J. Ramsay MacDonald*; etc.	**Snowden, Philip.**
M. A. L.	MARC A. LUESCHER. Of the B. F. Keith-Albee Vaudeville Exchange, New York.	**Variety Theatre** (*in part*).
M. B.*	MARCU BEZA, L. ES L. Consul-General at the Rumanian Legation, London. Lecturer on Rumanian at King's College, London. Author of *Rumanian People and Literature*.	**Rumanian Literature.**
M. C.*	MARIE (MADAME) CURIE, D.SC. Professor of Radiology at the University of Paris. Director of the Curie Laboratory, Paris. Author of *Traité de Radioactivité*.	**Radium** (*in part*).
M. C. B.*	MONTAGUE C. BUTLER. Secretary of the British Esperanto Association.	**Universal Language.**
M. C. S.	MARIE CARMICHAEL STOPES, D.SC., PH.D. Fellow and sometime Lecturer in Palaeobotany at University College, University of London. President, Society for Constructive Birth Control and Racial Progress. Author of *Ancient Plants*; etc.	**Palaeobotany.**
M. Fi.	MARION FITZGERALD, C.B.E. Formerly Sanitary Inspector and Health Visitor for Woolwich, London. Joint author of *The Smokeless City*.	**Smoke Prevention** (*in part*).
M. G. C.	GROUP-CAPTAIN MALCOLM GRAHAME CHRISTIE, C.M.G., D.S.O., M.C. Air Attache, The British Embassy, Washington. Formerly General Manager and Director of the Otto Coke Oven Construction Co. and Lecturer in the Imperial College of Science, University of London.	**Parachute**
M. G. F.	DAME MILLICENT GARRATT FAWCETT, G.B.E., J.P., LL.D. President of the National Union of Women's Suffrage Societies, 1907–19. Author of *Women's Suffrage*; *Women's Victory*; etc.	**Women's Suffrage**
M. Gu.	M. GUILLAUME. Managing director of *Le Petit Journal*, Paris.	**Weygand, Max.**
M. J. R.	MILTON J. ROSENHAU. Professor of Preventive Medicine and Hygiene, Harvard Medical School. Formerly Director of the School of Public Health of Harvard University and Massachusetts Institute of Technology. Author of *Preventive Medicine and Hygiene*; etc.	**Preventive Medicine** (*in part*).
M. M. H.	MAUDE E. MINER HADDEN, M.A., PH.D. Formerly conductor of Institutes at the New York School of Social Work, and of courses in Problems of Delinquency, Teachers' College, Columbia University. Author of *Slavery of Prostitution*.	**Probation.**
M. Po.	CÉSAR MARCEL POÈTE. Director of the Institute of History, Geography and Civics, Paris. Author of *L'Enfance de Paris*; etc.	**Paris.**

M. Pr.	MATLACK C. PRICE. Writer and Lecturer on Commercial Art. Author of *Poster Design*; etc.	**Posters.**
N. C. G. W.	N. C. G. WILLIAMS. Of the Eastern Telegraph Co. Ltd., London.	**Telegraphy, Submarine** (*in part*).
N. F. G.	NORMAN FORBES GRANT. Formerly Foreign Editor of *The Morning Post*, London.	**Portugal:** *Financial and Economic History.*
N. G. G.	LIEUT.-COL. NICHOLAS GEORGE GEDYE, O.B.E., B.Sc., M.INST.C.E. Consulting Engineer to the Ministry of Agriculture and Fisheries, and the Development Commission. Formerly Chief Engineer, Tyne Improvement Commission; acting Director Civil Engineer-in-Chief's department, Admiralty; responsible for reconstruction of Belgian ports after the War; Chief Civil Engineer for Docks, Harbours and Inland Waterways, Ministry of Transport.	**Port Engineering; River and Canal Engineering.**
N. H.	SIR ARTHUR NORMAN HILL, BART. Chairman, Board of Trade Advisory Committee on Merchant Shipping, London. Chairman of the Port and Transit Executive Committee, 1915–9. Secretary and Treasurer, Liverpool Steamship Owners Association, 1893–1923.	**Shipping.**
N. J.	NICHOLAS JORGA. Professor of Mediaeval and Modern History at the University of Bucharest. Author of *Die Geschichte des Osmanischen Reichs*; etc.	**Rumania:** *Political History.*
N. Le.	NATHAN LEVI. Assistant Editor of *De Volkstem*, Pretoria.	**Smuts, Jan. C.**
N. M.*	MAJOR-GENERAL SIR NEIL MALCOLM, K.C.B., D.S.O. Served Northwest Frontier, India, 1897–8; South Africa, 1899–1900, and European War, 1914–8. Editor of *The Science of War.*	**Singapore; Wilson, Sir H. H.**
N. M. Pe.	NORMAN MOZLEY PENZER. Author of *Cotton in British West Africa*; *The Tin Resources of the British Empire*; *The Mineral Resources of Burma*; *Non-Ferrous Metals and other Minerals*; etc.	**Tin; Zinc.**
N. Mu.*	NADEJDA (LADY) MUIR. Daughter of the former Bulgarian Minister in London, M. Stancioff, and formerly member of the Bulgarian Diplomatic Service.	**Stambolisky, Alexander.**
N. S.	NORMAN SWINDIN, A.M.I.MECH. E. Chemical Engineer. Author of *The Flow of Liquids in Pipes*; etc.	**Pumps.**
N. W. S.	NORMAN WILSON STORER, M.E., M.INST.E.E. General Engineer, Westinghouse Electric Manufacturing Co.	**Railways:** *Electrification.*
O. Ha.	O. HALECKI, D.PH. Professor of History in the University of Warsaw. Austrian Correspondent of the International Commission of Intellectual Co-operation, Geneva.	**Universities.**
O. J. R. H.	OSBERT JOHN RADCLIFFE HOWARTH, O.B.E., M.A. Secretary of the British Association. Member of the Geographical Section, Naval Intelligence Department, London, 1915–9. Author of *Commercial Geography of the World*; etc. Joint-editor of *The Oxford Survey of the British Empire.*	**Smyrna; Straits Settlement; Thames, etc.**
O. Tu.	CAPTAIN OSWALD T. TUCK. Instructor-Captain, Royal Navy. Head of the Historical Section, British Admiralty.	**Submarine Campaigns.**
P. Ai.	PETER AINSLIE, D.D., LL.D. Editor of *The Christian Union Quarterly*, Baltimore. Instructor in Biblical Literature, Goucher College.	**Reunion, Church** (*United States*).
P. A. Me.	PHILIP AINSWORTH MEANS, M.A. Investigator for the Smithsonian Institution, Washington, D.C. Author of *History of the Spanish Conquest of Yukatan and of Itzas*; *A Survey of Ancient Peruvian Art*; etc.	**Peru.**
P. A. S.	PERCY ALFRED SCHOLES, A.R.C.M. Musical critic of *The Observer*, London. Editor of *The Music Student.* Author of *The Listeners' Guide to Music*; etc.	**Scriabin, A. N.**
P. D.	COLONEL PETER DARVINGOFF. Late Chief of the staff of the Occupation Forces in Serbia (1917–8). Chief of staff of the Macedonian Voluntary Corps (1912–3). Author of *Military Bulgaria*; *A Field Tactical Book for Officers*; etc.	**Turkey:** *Defence.*
P. B.	PIERRE FRANCIS BERNUS. Foreign editor of the *Journal des Débats*, Paris correspondent of the *Journal de Genève*; Chevalier of the Legion of Honour.	**Painlevé, Paul; Poincaré, Raymond; Viviani, René.**
P. Gu.	PETER GUILDAY. Professor of American Church History, Catholic University, Washington, D.C.	**Roman Catholic Church** (*in part*).
P. J. B.	PHILIP J. NOEL BAKER, M.A. Sir Ernest Cassel Professor of International Relations, London School of Economics; late Fellow of King's College, Cambridge. Author of *The Geneva Protocol.*	**Sanctions and Guarantees.**

P. K.	PHILIP HENRY KERR, C.H. Secretary of the Rhodes Trust, London. Formerly Editor of *The State*, South Africa, and of *The Round Table*. Secretary to the Prime Minister of Great Britain, 1916–21.	**Rhodes Scholarships.**
P. L.	PAUL LAMBOTTE. Director of Fine Arts for Belgium. Government Commissioner for Fine Art Exhibitions. Author of two volumes in the *Collection des artistes belges contemporains*.	**Rousseau, Victor.**
P. Lo.	PERCY LONGHURST. Author of *Wrestling*.	**Wrestling.**
P. M. H.	PETER MARTIN HELDT. Engineering Editor of *Automotive Industries*. Author of *The Gasoline Automobile*; etc.	**Speed Indicator; Tractors.**
P. M. S.	SIR PERCY MOLESWORTH SYKES, K.C.I.E., C.M.G. Formerly General Officer commanding in Southern Persia. Assistant Commissioner, Perso-Baluch Boundary Commission, 1896. Consul-General for Khurasan 1905–13. Consul-General, Chinese Turkestan 1915. Appointed to raise South Persian Rifles with title of Inspector-General 1916. Author of *Ten Thousand Miles in Persia*; etc.	**Persia; Persian Campaigns.**
P. P. C.	PETER P. CARNEY. Manager, Publicity Department, Remington Arms Co., Inc.	**Shooting** (*in part*).
P. R. W.	LIEUT.-COL. PERCY REGINALD WORRALL, D.S.O., M.C. Served in France, Gallipoli and Italy, 1914–8.	**Smoke: in Warfare.**
P. Vi.	SIR PAUL Y. VINOGRADOFF. Formerly Corpus Professor of Jurisprudence, Oxford University. Fellow of the Russian Academy, Petrograd. Member of International Academy of Comparative Law, Geneva. Author of *Villainage in England*; *The Growth of the Manor*; *Outlines of Historical Jurisprudence*; *Self-Government in Russia*; etc.	**Rasputin; Russia:** *History* (*in part*).
R. A. M.	ROBERT ANDREWS MILLIKAN, PH.D., SC.D. Chairman of the Administrative Council, California Institute of Technology. Formerly Professor of Physics, University of Chicago. Author of *A First Course in Physics*; etc.	**Physics.**
R. A. Y.	ROBERT ARTHUR YOUNG, C.B.E., M.D., F.R.C.P. Physician, Middlesex Hospital and Hospital for Consumption and Diseases of the Chest, Brompton, London.	**Respiratory System, Diseases of the.**
R. C. B.	ROBERT CLARKSON BROOKS, PH.D. Professor of Political Science, Swarthmore College, Pennsylvania. Author of *Corruption in American Politics and Life*; *Political Parties and Electoral Problems*; etc.	**Progressive Party; Recall.**
R. Cr.	DAME RACHEL ELEANOR CROWDY, D.B.E. Chief of Social Questions and Opium Traffic Section, Secretariat League of Nations. Principal Commandant of V.A.D.'s in France and Belgium, 1914–9.	**White Slave Traffic.**
R. D.*	ROBERT DOWSON, M.INST.C.E. Engineer, Messrs. C. A. Parsons Co. Ltd., Heaton Works, Newcastle-on-Tyne, England.	**Turbine, Steam** (*in part*).
R. F. C.	R. F. CHOLMELEY, O.B.E., M.A. Headmaster of Owen's School, London. Ex-President of the Headmasters' Association.	**Secondary Schools** (*Great Britain*).
R. F. M.*	R. F. MORKILL. Signals and Telegraph Superintendent, Metropolitan Railway, London.	**Railways:** *Signalling*.
R. H. Lo.	ROBERT HEINRICH LOWIE, PH.D. Associate Curator (Anthropology), American Museum of Natural History; formerly Associate Professor in the University of California, and lecturer at Columbia University, New York. Author of *Primitive Society*; etc.	**Social Anthropology.**
R. M. H.*	RAY M. HUDSON. Director of the Bureau of Simplified Practice, Department of Commerce, Washington, D.C.	**Standardisation.**
R. M. K.	SIR ROBERT MOLESWORTH KINDERSLEY, C.B.E., BART. Director of the Bank of England. Head of the firm of Lazard Bros. & Co., Bankers, London. President of the National War Savings Committees, London.	**Savings Movement** (*Great Britain*).
R. M. Lu.	COL. RUSSELL MORTIMER LUCKOCK, C.M.G., D.S.O. Formerly Commandant, Small Arms School, India. General Staff Officer, 4th Army 1916–8. Brigade Commander, 1926.	**Victory, Advance to:** *Amiens, Battle of*; *Bapaume-Péronne, Battle of*.
R. M. W.*	ROBERT MARK WENLEY, LL.D., D.SC., F.R.S. (Edin.) Professor of Philosophy in the University of Michigan. Director, American University Union in Europe, 1925–6. Author of *Aspects of Pessimism*; etc.	**Scepticism.**

R. N. R. B.	R. N. Rudmose Brown, D.Sc. Lecturer in Geography, University of Sheffield. Member of the Scottish National Antarctic Expedition, 1902–4, and of the Scottish Arctic Expeditions, 1909, 1912 and 1914. Author of *Spitzbergen*; etc.	Spitsbergen.
R. Pa.	Sir Richard Arthur Surtees Paget, Bart. Fellow of the Physical Society of London. Assistant Secretary Admiralty Board of Invention and Research, London, 1915–8.	Voice Sounds.
R. P. Be.	Richard Perry Bedford. Assistant in the Department of Architecture and Sculpture, Victoria and Albert Museum, London.	Sculpture.
R. Po.*	Roscoe Pound, A.M., Ph.D. Carter Professor of Jurisprudence and Dean of the Faculty of Law, Harvard University. Sometime Commissioner of Appeals of the Supreme Court of Nebraska. Author of *Readings on Roman Law*; etc.	Women, Legal Position of (*in part*).
R. Rn.	R. Romein. Member of Transit Section, League of Nations, Geneva.	Rhine; Vistula.
R. S. R.	Robert Sangster Rait, C.B.E., LL.D. Historiographer Royal for Scotland. Professor of Scottish History and Literature in the University of Glasgow. Author of *The Scottish Parliament*; *History of Scotland*; etc.	Scotland.
R. St.	Sir Ronald Storrs, C.M.G., C.B.E. Governor of Jerusalem, Jaffa and Judea. Formerly Military Governor of Jerusalem.	Palestine.
R. T. G.	Sir Richard Tetley Glazebrook, K.C.B., D.Sc., F.R.S. Chairman of the Aeronautical Research Committee, London. Zaharoff Professor of Aviation and Director of the Department of Aeronautics at the Imperial College of Science and Technology, London, 1920–3. Fellow of Trinity College, Cambridge.	Research, Industrial (*in part*).
R. Van O.	Major R. Van Overstraeten, D.S.O. Member of the Order of Leopold and the Legion of Honour. Aide-de-Camp to His Majesty the King of the Belgians. Graduate of the Belgian Staff College.	Victory, Advance to (*in part*); Yser, Battle of the.
R. W. S.-W.	Robert William Seton-Watson, Litt. D. Masaryk Professor of Central European History at King's College, University of London. Founder and Joint-editor of *The New Europe*, 1916–20. Joint-editor of *The Slavonic Review*. Author of *The Rise of Nationality in the Balkans*; *The New Slovakia*; *Sarajevo*; etc.	Pasic, Nicholas; Peter I., King of Serbia; Serbia; Yugoslavia.
S. A. B.	Sara Annie Burstall, M.A., J.P. Headmistress of Manchester High School for Girls, 1898–1924. Honorary Lecturer on Education at the University of Manchester. Author of *English High Schools for Girls*; etc.	Women, Education of (*in part*).
S. B. McC.	Samuel Black McCormick, M.A., D.D., LL.D. Chancellor Emeritus, University of Pittsburgh, Pennsylvania.	Pittsburgh.
S. d'A.	Silvia d'Amico. Italian author and journalist. Dramatic Critic of the *Idea Nazionale*, Rome.	Pirandello, Luigi.
S. de M.	Salvador de Madariaga. Spanish critic and writer. Author of *Shelley and Calderon*, and essays on Spanish and English Poetry.	Spain: *Political History*; Spanish Literature.
S. F.	Simon Flexner, M.D., D.Sc., LL.D. Director of Laboratories of Rockefeller Institute for Medical Research, New York; Formerly Professor of Pathological Anatomy, Johns Hopkins University, Baltimore. Author of *The Pathology of Tox-albumin Intoxication*; etc.	Spinal Meningitis.
S. Fr.	Sigmund Freud, M.D., LL.D. Professor of Neurology, Vienna University. Director of the *International Journal of Psycho-analysis*.	Psycho-analysis.
S. H. W.	Captain Stanley H. Wilton, R.N. (Ret.). Late Assistant Director of Naval Ordnance, Admiralty, London.	Range Finder (*in part*).
S. L.*	John Randolph Shane Leslie. Editor of *The Dublin Review*. Author of *Life of Cardinal Manning*; *Life of Sir Mark Sykes*; *The End of a Chapter*; *The Oppidan*.	Papacy.
S. La.	Seabury Lawrence. Of *The New York Times*.	Yachting (*in part*).
S. L. C.	Stevenson Lyle Cummins. Colonel, Army Medical Service (ret.). David Davies Professor of Tuberculosis, University College of South Wales and Monmouthshire, Cardiff.	Tuberculosis (*in part*).
S. Le.	Stephen Butler Leacock, Ph.D. William Dow Professor of Political Economy, McGill University, Montreal. Author of *The Elements of Political Science*; and of many literary satires including *Nonsense Novels*; *The Hohenzollerns in America*; *The Garden of Folly*; etc.	Prince Edward Island; Quebec (*Prov.*).

S. L. M.	SUSAN LANGSTAFF MITCHELL. Late Assistant Editor *The Irish Statesman*. Author of *The Living Chalice*; etc.	**Yeats, William Butler.**
S. McC. L.	SAMUEL MCCUNE LINDSAY, PH.D., LL.D. Professor of Social Legislation in Columbia University, New York. President of New York Academy of Political Science, New York. Author of *Railway Labor in the United States*; *Financial Administration of Great Britain*; etc.	**Prohibition.**
S. Me.	STANLEY MELVILLE, M.D., M.R.C.S. Radiologist, St. George's Hospital, London. Radiologist, Charing Cross Hospital, W. London Hospital, and Hospital for Sick Children, Great Ormond St., London.	**Radiotherapy and Röntgenology.**
S. S. C.	S. S. COOK, M.I.N.A. Technical Manager, Parsons Marine Steam Turbine Co., Ltd., Wallsend-on-Tyne, England.	**Turbine, Steam** (*in part*).
St. J. E.	ST. JOHN GREER ERVINE. Dramatist and Novelist. Dramatic Critic of *The Observer*. Author of *The Magnanimous Lover*; *Mixed Marriage*; *Jane Clegg*; and other plays.	**Shaw, George Bernard.**
S. V.	SERGE VORONOFF. Director of Experimental Surgery in the Physiological Station of the Collège de France. Director of the Laboratory of Biology, Ecole des Hautes Etudes, Paris. Author of *A Study on Old Age and Rejuvenation by Grafting*; etc.	**Rejuvenation.**
Sv. A.	SVANTE AUGUST ARRHENIUS, D.Sc., D.PH., F.R.S. Director of the Physico-chemical Department of the Nobel Institute, Stockholm. Formerly Professor of Physics at Stockholm University. Nobel Prizeman for Chemistry. Author of *Chemistry in Modern Life*; etc.	**Physical Chemistry.**
S. W. H.	SIDNEY WEST HARRIS, C.B., C.V.O. British Representative, Permanent Advisory Committee of the League of Nations on the Traffic in Women and Children. Assistant Secretary, Home Office, London.	**Reformatory Schools** (*Great Britain*).
T. C.	LIEUT.-GEN. SIR TRAVERS EDWARDS CLARKE, G.B.E., K.C.B., K.C.M.G. Quartermaster-General to the British Armies in France, 1917–9, and Quartermaster-General to the Forces, 1919–23. Deputy Chairman and Chief Administrative Officer to the British Empire Exhibition, 1923–5.	**Supply and Transport.**
T. E. L.	THOMAS EAST LONES, M.A., LL.D. Formerly Senior Examiner in H.M. Patent Office, London. Author of *Aristotle's Researches in Natural Science*; *Zinc and Its Alloys*.	**Peat.**
T. E. P.	THOMAS ERIC PEET, M.A. Brunner Professor of Egyptology, University of Liverpool. Author of *The Mayer Papyri*; *Egypt and the Old Testament*; etc.	**Tutankhamun.**
T. F. P.	COLONEL THOMAS FORTUNE PURVES, O.B.E., M.I.E.E. Engineer-in-Chief to the British Post Office. President, Institution of Post Office Electrical Engineers.	**Telephony, Submarine.**
T. G. G. H.	LIEUT.-COL. T. G. G. HEYWOOD. General Staff Officer, British Territorial Army Air Defence Formations.	**Serbian Campaigns.**
T. H. L.	SIR THOMAS HAROLD LYLE, K.B.E., C.M.G. Formerly British Consul-General, Bangkok, and Consul at Chiengmai.	**Siam.**
T. K.*	THÉODORE KOMISARJEVSKY. Theatrical Producer. Formerly Producer and Art Director of the Moscow State and Imperial Theatre.	**Stage and Stage Production.**
T. N. C.	THOMAS NIXON CARVER, PH.D., LL.D. Professor of Political Economy, Harvard University. Author of *The Distribution of Wealth*; *Principles of Political Economy*; etc.	**United States:** *Wealth and Income.*
T. P. N.	T. PERCY NUNN, M.A., D.Sc. Principal and Professor of Education, London Day Training College, University of London. President of Training College Association, 1915. Author of *Education Reform*; etc.	**Teaching; Vocational Training.**
T. Sm.	T. SMITH, M.A. Principal Assistant, Physics Department, National Physical Laboratory, Teddington, Middlesex.	**Periscope.**
T. W. A.*	SIR THOMAS WALKER ARNOLD, C.I.E., LITT.D., F.B.A. Professor of Arabic, University of London. Formerly Professor of Philosophy, Government College, Lahore. Educational Adviser to the Secretary of State for India, 1917–20. Author of *The Preaching of Islam*; *The Caliphate*; etc.	**Pan-Islamism.**
V. B.	VICTOR BRANFORD, M.A. Chairman of the Sociological Society. Author of *Interpretations*; etc.	**Sociology.**
V. H. B.	VERNON HERBERT BLACKMAN, Sc.D., F.R.S. Professor of Plant Physiology and Pathology, Imperial College of Science and Technology, London. Formerly Professor of Botany, Leeds University.	**Photosynthesis; Plant Physiology.**

V. L. C.	VARNUM LANSING COLLINS, A.M. Secretary of Princeton University. Author of *The Continental Congress at Princeton*; *Guide to Princeton*; etc.	**Princeton University.**
V. M. C.	V. M. CAMBRIDGE (MRS.). President of the Middlesex Ladies' Athletic Club. Honorary Editor of *The British Olympic Journal.*	**Winter Sports.**
W. A. B.*	W. A. BROWN, D.Sc. Assistant Professor of Botany (Plant Pathology) in the Imperial College of Science and Technology, London.	**Plant Pathology.**
W. A. N.	WILLIAM ALLAN NEILSON, LL.D. President, Smith College, Northampton, Mass. Author of *Essentials of Poetry*; *The Facts about Shakespeare*; *A History of English Literature.*	**Smith College.**
W. A. R.	WILLIAM ALFRED REID, LL.M. Foreign Trade Adviser of the Pan American Union. Lecturer on Latin American Commerce at the School of Foreign Service, Georgetown University; Lecturer on International Commerce at the School of Diplomacy, American University, Washington, D.C.	**Plata, Rio de la; Recife; Santos.**
W. B. B.*	WILLIAM BRAMWELL BOOTH. General of the Salvation Army. Author of *Books that Bless*; *Our Master*; *Social Reparation*; etc.	**Salvation Army.**
W. B. H.	WALTER B. HARRIS, F.S.A. Moroccan Correspondent of *The Times* (London). Author of *The Land of an African Sultan*; *Travels in Morocco 1888–9*; *Morocco that Was*; etc.	**Tangier.**
W. Bn.	WILLIAM BATESON, M.A., F.R.S. Late Director of the John Innes Horticultural Institution, Merton Park, Surrey, and Professor of Biology, Cambridge University. Author of *Mendel's Principles of Heredity*; *Problems of Genetics*; etc.	**Sex.**
W. B. P.	WILLIAM BARCLAY PARSONS, LL.D., D.S.D., D.S.M. Member of Parsons, Klapp, Brinckerhoff and Douglas, Engineers, New York. Formerly chief engineer of the Rapid Transit Commission, New York City, and advisory engineer of the Royal Commission on London traffic. Author of *Rapid Transit in Foreign Cities*; etc.	**Urban Transportation.**
W. Br.	WILLIAM BROWN, M.D., D.Sc., M.R.C.P. Psychotherapist and Lecturer on Psychotherapy, King's College Hospital, London. Wilde Reader in Mental Philosophy, Oxford University. Director of the Psychological Laboratory at King's College, London.	**Psychotherapy**
W. B. St.	WALTER BARLOW STEVENS, M.A., LL.D. President of the State Historical Society of Missouri. Director of Exploitation, St. Louis World's Fair, 1904. Secretary, City Planning Commission of St. Louis, 1912–6. Author of *History of St. Louis*; etc.	**St. Louis.**
W. B. W.	WILLIAM BASIL WORSFOLD, M.A. Barrister-at-Law. Formerly editor of *The Star*, Johannesburg. Author of *The Reconstruction of the New Colonies under Lord Milner.*	**South Africa:** *Political History.*
W. Cl.	SIR WILLIAM HENRY CLARK, K.C.S.I., C.M.G. Comptroller-General of the Department of Overseas Trade, London. Member for Commerce and Industry of the Council of the Viceroy of India, 1910–6. Comptroller-General of the Commercial Intelligence Department of the Board of Trade, London, 1916–7.	**Trade Facilities.**
W. E. I.	MAJOR-GENERAL SIR WILLIAM EDMUND IRONSIDE, K.C.B., C.M.G., D.S.O. Commandant, Staff College, Camberley, Surrey. Commander-in-Chief, British Forces in Russia, 1918–9. Author of *Tannenberg: the first thirty days in East Prussia.*	**Russia, Campaign in; Russo-Polish Campaign; Tannenberg, Battle of.**
W. E. R.	W. E. RAPPARD.	**Switzerland:** *Economic and Financial History.*
W. F. S.	WALTER FLEETWOOD SHEPPARD, M.A. Senior Wrangler, and sometime Fellow, Trinity College, Cambridge. Formerly Assistant Secretary Board of Education, London.	**Probability.**
W. G. C.*	WILLIAM GEORGE CONSTABLE, M.A. Assistant Keeper of the National Gallery, London. Lecturer at the Wallace Collection. Fellow of St. John's College, Cambridge.	**Painting.**
W. G. J.	W. GARMON JONES, M.A. Associate Professor of History, University of Liverpool, England.	**Welsh Literature.**
W. Gr.	WALTER GRAVELL, PH.D. *Ober Regierungsrat* in the Statistical Offices of the Reich, Berlin. Member of the German Statistical Society. Author of *Abhandlungen über Bevolkerungs-, Berufs- und Betriebsstatistik*, etc.	**Prussia**
W. Gra.	RIGHT HON. WILLIAM GRAHAM, M.A. M.P. for the Central Division of Edinburgh. Member of the Royal Commission on the Income Tax, 1919; Financial Secretary to the Treasury, 1924. Author of *The Wages of Labour*, and writer to newspapers and journals on social, industrial and economic questions.	**Taxation; Wealth and Income.**

W. H. C.	W. H. Coates, LL.B. Secretary of Nobel Industries, Ltd. (London).	Turnover Tax.
W. H. Cr.	Walter H. Crockett. Editor of University Publications, University of Vermont. Author of *The History of Vermont and the History of Lake Champlain.*	Vermont.
W. H. D.	William Harbutt Dawson. Writer on German social, economic and municipal questions. Author of *The German Empire, 1867–1914*; *Evolution of Modern Germany*; etc.	Pan-Germanism.
W. H. Dr.	Rev. William Hamilton Drummond. D.D., LL.D. Secretary of the International Congress of Free Christians and other Religious Liberals. Formerly editor of *The Inquirer.*	Reunion, Church (*in part*).
W. H. Hl.	W. Howard Hazell. Chairman, Hazell, Watson & Viney, Ltd., Printers, London. Chairman of the Council of the London School of Printing. President, London Master Printers' Association, 1923–4. President, Federation of Master Printers, 1925–6. Author of *Office Organisation for Printers*; etc.	Printing (*in part*).
W. H. S.	William Henry Salter, M.B.E., M.A., LL.B. Treasurer and Joint Hon. Secretary, Society for Psychical Research, London.	Psychical Research.
W. H. Wr.	William Hammond Wright. Astronomer at the Lick Observatory. In charge of the Lick Observatory's Expedition to the Southern Hemisphere, 1903–6.	Telescope.
W. J. C.	William James Cunningham, D.M. Professor of Transportation, Harvard University. Assistant Director of Operations, U.S. Railroad Administration 1918–9.	United States: *Communications* (*in part*).
W. J. Ho.	W. J. Howcroft. Formerly Coach in Swimming to entrants for the Olympic Games.	Swimming.
W. J. M.	William James Mayo, M.D., F.R.C.S., Sc.D. Joint Founder of the Mayo Foundation for Medical Education and Research, Rochester, Minnesota. Surgeon of the Mayo Clinic.	Surgery (*in part*).
W. J. W.	William John Watson, M.A., LL.D., F.S.A.(Scot.). Professor of Celtic Languages, Literature and Antiques, Edinburgh University. Author of *Specimens of Gaelic Prose*; *Specimens of Gaelic Poetry*; *Notes on the Study of Gaelic*; *Celtic Place-Names of Scotland.*	Scottish-Gaelic Literature.
W. K. McC.	William Kidston McClure, C.B.E. Correspondent of *The Times* (London) in Rome. War Correspondent of *The Times* on the Italian Front, 1915–7. Author of *Italy's Part in the War*; *Italy in North Africa*; etc.	Vittorio Veneto, Battle of.
W. Li.	Walter Lippmann, A.B. Editor of *The New York World.* Formerly Associate Editor of *The New Republic.* Author of *The Political Scene*; *Liberty and the News*; *Public Opinion*; etc.	Joseph Pulitzer (*in part*).
Wm. A.	Sir William James Ashley, Ph.D., M.A., M.Com. Formerly Vice-Principal and Professor of Commerce of the University of Birmingham. Member of numerous British Committees on Economic Questions. Author of *Introduction to English Economic History and Theory*; *The Rise in Prices*; *The Economic Organisation of England*; etc.	Safeguarding of Industries.
W. M. F.	William Marshall Freeman. Barrister-at-Law. Recorder of Stamford. Chairman, Wholesale Profiteering Tribunal, Pottery Industry.	Property, Law of.
W. Mi.	William Miller. Correspondent of *The Morning Post* (London) in Athens and Rome. Author of *The Latins in the Levant*; *The Ottoman Empire and its Successors*; *A History of the Greek People* (*1821–1921*); etc.	Salonika; San Marino; Thrace.
W. M. M. R.	William Montagu Martyn Robinson. Late Commander R.N.	Torpedo.
W. M. P.	Warren Milton Persons, B.S. Professor of Economics, Harvard University, and Editor of *The Review of Economic Statistics.*	Trade Forecasts.
W. M. St.	William Mott Stewart, LL.B., LL.H. Director of the Census, U.S.A. Formerly secretary and statistician of the U.S. Tariff Commission.	Urbanisation.
W. P.	Walter Payne, O.B.E. Chairman and Managing Director, New Oxford Theatre, London, and London Pavilion; President, Society of West End Theatre Managers, London.	Theatre.
W. P. MacA.	Colonel William Porter MacArthur, M.D., D.S.O., B.Ch., F.R.C.P. Professor of Tropical Medicine, Royal Army Medical College, London.	Tropical Medicine.
W. P. P.*	Wolf Pocklington Pond. Editor of *The Spur*, New York. Correspondent of *The Sporting Chronicle*, Manchester.	Polo (*in part*).

W. R. H.	WILLIAM REGINALD HALLIDAY, B.A., B.LITT. Rathbone Professor of Ancient History in the University of Liverpool. Formerly Lecturer on Greek History and Archaeology, University of Glasgow. Author of *Lectures on the History of Roman Religion*; etc.	**Roman Religion.**
W. S. A.	SIR WESTCOTT STILE ABELL, K.B.E. Chief Ship Surveyor, Lloyd's Register of Shipping, London. Formerly Professor of Naval Architecture, University of Liverpool, and member of numerous Board of Trade and other committees on shipping matters. Author of *The Ship and her Work*.	**Shipbuilding.**
W. S. G.	WALTER SHERMAN GIFFORD, A.B. President American Telephone and Telegraph Company, New York. Director Bankers Trust Co., American Surety Co., etc.	**Telephony.**
W. Si.	W. SIEROSZEWSKI.	**Pilsudski, Marshal.**
W. S. L.	W. S. LACHER. Managing Editor of *Railway Engineering and Maintenance.*	**Railways:** *Tracklaying.*
W. S. Ro.	WILLIAM SPENCE ROBERTSON, PH.D. Professor of History in the University of Illinois. Author of *Francisco de Miranda and the Revolutionising of Spanish America*; *Rise of the Spanish American Republics*; etc.	**Venezuela.**
W. v. B.	WILHELM VON BLUME, D.JURIS. Professor of Law, Tübingen University, Germany. Co-operated in the drafting of the constitution of Württemberg, 1919.	**Saxony; Thuringia; Württemberg.**
W. We.	WALDEMAR CHRISTIAN WESTERGAARD, M.L., PH.D. Head of the Department of History, Pomona College, Claremont, California. Author of *The Danish West Indies*.	**Virgin Islands.**
Y. K.	YOUSUF KEMAL, BEY. Deputy for Sinope. Formerly Foreign Minister of Turkey.	**Turkey:** *Economic History.*
Z. V.	ZINAIDA A. VENGEROVA. Russian literary critic. Author of *Essays on European Literature*; etc.	**Rakovsky; C. G. Zinoviev. G. E.**

THE ENCYCLOPÆDIA BRITANNICA

THE THIRD OF THE THREE NEW VOLUMES

PACIFIC TO ZUYDER ZEE

PACIFIC, COMMAND OF THE (*see* 20.434).—From the close of the Far Eastern conflict of 1904–5 to the outbreak of the World War, nine years later, strategical conditions in the Pacific Ocean were undisturbed by any development of consequence. Over the northwestern quarter of that ocean the collapse of Russian sea power had left Japan in undisputed mastery. Southward from Kamchatka to the Philippine archipelago there was scarcely a point at which she could not have deployed her navy in full force, since almost everywhere along this route of thousands of miles her ships would have found base facilities within their reach. The Russian Pacific Fleet had been destroyed, nor could it be replaced within the calculable future.

Great Britain, knowing her interests to be safeguarded by the alliance with Japan, reduced her force on the China Station to a mere cruiser squadron. Germany, it is true, continued to strengthen the defences of Tsingtao, the naval fortress of Kiaochow which served as a refuge for her small Asiatic fleet; but in view of Japan's supremacy in armament it was clear that this German outpost in Shantung did not materially affect the strategic situation. At Manila in the Philippines the United States kept a few secondary ships of war, but took no steps to develop the naval resources of this fine harbour. Guam, an American island of the Marianas group, lying 1,500 m. to the west of the Philippines, ranked only as a fuel station, though its position invested it with unique strategic value.

Conditions After the War.—Such, then, were the conditions prevailing in 1914. The Far Eastern seas, which had long been the arena of conflicting claims to supremacy, had now passed definitely, and, as it seemed, permanently, under the control of a single Power. Subsequent events have tended to consolidate the strategic predominance of the Japanese Empire. The conquest of Tsingtao early in the World War eliminated the only German stronghold in the Pacific. Domestic convulsions in Russia, by apparently reducing the naval forces of that State to impotence, have rendered still more remote the prospect of Vladivostok again becoming the headquarters of a formidable fleet. The Treaty of Versailles and the agreements reached at the Washington Conference (*q.v.*) have a direct bearing on the naval problems of the Pacific. Under the Versailles Treaty, the former German islands north of the Equator passed into the custody of Japan, while those south of the Equator were transferred to the British Empire. The League of Nations mandate forbids the use of these islands for warlike purposes, and does not permit of their being fortified. None the less, they constitute an important element from the naval point of view. This will be made clear on reference to a chart of the Pacific.

Radius of Fleet Action.—In that vast expanse of ocean every problem of strategy is fundamentally a question of base facilities. Modern fighting ships have a narrow radius of action, dimensioned by their relatively meagre fuel capacity. In time of war individual cruisers may roam the sea for weeks, even for months, at a stretch, replenishing their bunkers as opportunity offers. This, however, is not possible for an organised fleet, attended by the smaller craft which are essential as watch-dogs to the heavy ships. From experience gained in the World War it is estimated that a battle fleet, with its proper complement of ancillary units can remain at sea under war conditions not longer than four days. This does not mean, however, that such a fleet would be free to conduct operations at some point four days' distant from its nearest base, to which, accordingly, it must return for fresh supplies of fuel. To be within reach of attack the objective must not be farther away than two days' travel at ordinary speed. Special circumstances might permit of a longer sojourn at sea, but to all intents a battle fleet within the war zone is restricted to a cruise of 96 hours. With this essential fact borne in mind, the intimate relationship between strategy and geography requires no demonstration.

Potential Naval Bases.—In consequence of recent international negotiations, the number of potential naval bases in the Pacific has been substantially increased, with the result that squadrons, if not whole fleets, may henceforth be able to operate in waters which formerly lay beyond their reach. It is true that a great many of these islands are mere atolls, affording little or no shelter for large vessels and lacking even the most rudimentary naval resources; yet some could be used as emergency bases and fuelling stations, for which reason their existence cannot be ignored. Students of naval history need no reminder of the important part that was played in the South Atlantic operations of the British Fleet during the World War by the remote coaling base at Abrolhos Rocks, off the Brazil coast. Since 1919 Japan has exercised mandatory powers over several island groups situated far out in the Pacific. Strategically, her most important acquisitions are the Peleliu Islands (500 m. east of the Philippines); the Carolines; the Marianas Islands, excepting Guam, which is American territory; and the Marshall group, these latter being some 1,700 m. to the southwest of Hawaii. Light naval vessels, aircraft and submarines, judiciously distributed among the islands named, would represent a serious menace to a hostile force advancing towards Japan from the east. So much for the reaction of the Versailles Treaty on Pacific strategy.

The Washington Treaty.—Of equal significance in the same connection is the Five-Power Treaty concluded at Washington

in Feb. 1922. This covenant has not only reduced very considerably the battle fleets of the leading naval powers, but has in some degree nullified the effect of the territorial changes in the Pacific for which the Versailles Treaty was responsible. Under the Washington Treaty the British Empire, the United States and Japan agreed to maintain the *status quo* as to fortifications and naval bases in a series of highly important strategic positions in the Pacific. The United States, for example, is pledged not to improve in any way the shore defences or naval works in the Philippines, Guam or the Aleutian Islands; Japan accepts the like obligation in regard to the Bonin Islands, Formosa and other insular possessions; while the British Empire is debarred from adding to the naval resources of Hongkong. Since the zone to which this agreement applies begins east of the meridian of 110° east long., Singapore lies beyond it, and is therefore not affected.

The Hawaiian Islands are also exempted, though they are more than 2,000 m. from the American mainland. Their position makes them invaluable as the pivoting centre of a fleet charged with the task of defending not only the western seaboard of the United States, but the outlying territories of Alaska and Samoa. Despite its capital importance as a strategic focal point, Hawaii has yet to be adequately developed as a fleet headquarters. In 1925 the naval base at Pearl Harbour, near Honolulu, was not accessible to the heaviest battleships in ordinary conditions of tide, nor could it be approached at all by battleships whose normal draught had been increased through damage or other cause. Extensive dredging operations are projected to remedy this state of affairs, and the building of new docks, magazines, etc., is contemplated. Singapore, like Hawaii, is mainly, if not entirely, a defensive factor in the general problem of Pacific strategy. First utilised as a naval harbour in 1882, it has been for many years the southern base of the British China Squadron. The new dockyard begun in 1924–5, is designed to meet the requirements of a battle fleet, the presence of which at Singapore would doubtless be an indirect but none the less effectual deterrent to plans for the invasion of Australia or New Zealand.

Conclusions.—Broadly speaking, no single Power or combination of Powers could ever aspire to command so enormous an area of sea as the Pacific Ocean. The most that can be done by any State which has a vital interest—whether territorial or economic—in the Pacific is to take appropriate measures for maintaining the integrity of its particular sphere of influence. So long as warships are as dependent upon shore communications as is now the case, overseas naval operations on a major scale within the limits of that ocean would probably entail an expenditure of force which, if not altogether prohibitive, would be out of proportion to the object in view. Although the United States and Japan both maintain imposing fleets in the Pacific, and the British Empire may eventually have a considerable force available in the southern area, it is difficult to see how any one of these Powers, or even two Powers acting in concert, could dominate more than a relatively small sector of an ocean that extends from the Arctic to the Antarctic regions, is 10,000 m. across at its greatest breadth and covers nearly one-half of the entire surface of the earth. (*See* also SINGAPORE; WASHINGTON CONFERENCE, etc.)

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PACIFIC ISLANDS: *see* OCEANIA.

PADEREWSKI, IGNACE JAN (1860–), Polish pianist and statesman (*see* 20.443), with characteristic generosity created the Paderewski Fund in 1900, the object of which was to encourage American composers by offering prizes for composition. His unprecedented success as a pianist all over the world never caused him to forget his own country, and to the Poles in America he delivered the following inspiring message: "The vision of a strong and independent Poland has always been the lodestar of my existence. Its realisation is still the great aim of my life." In 1910, when his compatriots were celebrating the 500th anniversary of the victory of Grünwald over the Teutonic knights, he presented them with a munificent gift in the shape of a memorial which was unveiled at Cracow in the presence of representatives from all parts of Poland. In 1911 the University of Lemberg bestowed on him the degree of doctor of philosophy, *honoris causa*.

When the World War broke out in 1914, his chief desire was to work for his country, to whose service he dedicated his encyclopaedic knowledge, his unfailing memory, his power of work, his eloquence and prestige, as well as his powerful connections in both hemispheres. He was président d'honneur of a non-party group of Poles who met at Vevey in the autumn of 1914 to organise a "General Committee of Assistance for the victims of the War in Poland." The Committee was definitely founded in Jan. 1915 under the presidency of the great novelist, Sienkiewicz. M. Paderewski established branches in Paris and London; he then proceeded to the United States, there to coordinate the work of the 4,000,000 Poles who had formed a "central committee of assistance" and who were in touch with the Vevey committee. On his arrival, he called on his countrymen to stand together, informing them that he belonged to no party and came only to stretch out his hand "as a beggar." He remained nearly four years in the United States, giving numerous concerts and making speeches in order to collect funds and enlist public opinion in America in the cause of Poland. He not only collected enormous sums, but created a pro-Polish movement in the United States, which developed with amazing rapidity.

As honorary president of the Polish National Department of Chicago, and as the friend of President Wilson and Colonel House, M. Paderewski exercised an increasing influence in the political circles of Washington, with the result that President Wilson on Jan. 22 1917 alluded to a "united, independent and autonomous Poland." Not only Poland, but all the Allies, had reason to be grateful to M. Paderewski for his services, and it was said of him that "his propaganda and eloquence contributed largely to the enthusiasm with which the citizens of the great American republic threw themselves into the formidable struggle against Germany." Though he had to fight unaided, with only his personal resources, against the formidable propaganda of the Central Powers, he was completely successful; for by Nov. 1916 every Polish organisation in the U.S.A. was represented in the Polish National Department of Chicago, except the small Socialist group. For more than two years, up to 1918, M. Paderewski guided the political and military destinies of 4,000,000 individuals. On the day after the notorious manifesto of the Austro-Hungarian and German Emperors of Nov. 5 1916, promising the establishment of a Kingdom of Poland, he drew up a declaration of protest which was signed by many eminent Poles who felt that the offer was a perfidious one.

Foreseeing in Feb. 1917 that the U.S.A. would soon enter the War, M. Paderewski induced the Polish National Alliance to found a preparatory school for Polish officers at Cambridge Springs. It was, however, only after the decree which authorised a Polish army to be raised in France that M. Paderewski succeeded in Nov. 1917 in obtaining from that wise and generous statesman, Newton Baker, permission to recruit volunteers. He took a most active part in the recruiting, maintaining enthusiasm by numerous speeches. With the aid of the British Govt. he succeeded in obtaining from the Canadian Govt. a vast military camp, Niagara on the Lake, where more than 22,000 Polish volunteers were trained by Canadian officers. In Aug. 1917 the Polish National Committee, founded at Lausanne, chose M. Paderewski as its representative to the Washington Govt., and it was in consequence of representations made by him that Mr. Lansing officially recognised the committee.

After the victory of the Allies, M. Paderewski by no means considered his task at an end. He arrived in London in Dec. 1918, and was cordially received by British statesmen. Mr.

Balfour and Mr. Lloyd George placed the cruiser "Concord" and several torpedo-boats at his disposal, and he proceeded to Poland by sea in the company of a British Mission under Colonel Wade. He disembarked at Danzig on Dec. 24 1918. His popularity was already immense; and on arriving at Posen on the 26th he was welcomed with indescribable enthusiasm, although the German soldiers fired on the buildings in which he was staying. At Warsaw he was acclaimed by over 100,000 persons. He declared himself independent of all political parties; and after difficult negotiations, during which an attempt was made on his life, he succeeded on Jan. 17 1919 in forming a coalition ministry, of which he became Prime Minister as well as Minister of Foreign Affairs. He obtained for Poland official recognition by the various Powers, and thus regularised her international situation. The existence of various military groups named after their respective leaders seemed an obstacle to national unity, so M. Paderewski decided to suppress them, and at the first meeting of the Diet he demanded that a national army be formed. In spite of opposition this demand was granted.

M. Paderewski was always treated with special goodwill by the British Govt., which at his request sent over capable instructors to organise the Polish national police. As Prime Minister and Minister of Foreign Affairs he went to Paris on April 6 1919 as Poland's first delegate to the Peace Conference. His efforts were successful, and he returned to Poland in May and again in July, to reassure the doubtful and to preach, as before, the doctrine of conciliation. On two different occasions, on May 23 and July 31, the Diet renewed its vote of confidence in him and expressed the gratitude of his country. But as it was impossible for him to make a National Union a reality, and, above all, to conclude peace with the Soviet Govt., in view of the violent opposition of the military party, he decided to resign office (Nov. 27 1919). Deepest regret was expressed at his resignation; and his name was proposed for the presidency of the republic, but he preferred to stand aside. He defended the interests of his country, however, at the Conference of Ambassadors and before the League of Nations, where his generosity and pacific spirit were fully appreciated.

Though desiring conciliation, he could not in Poland's name accept the decision of the Conference of Ambassadors regarding Teschen in July 1920 without raising a solemn protest against the conduct of Czechoslovakia in this connection. While dealing with the question of Danzig and the relations between Poland and Lithuania at the League of Nations, he realised that a certain section of opinion was hostile to him; he therefore decided to abandon his political career in Feb. 1921, and retired to his Californian estate, returning afterwards to resume his musical career. His many distinctions include the Grand Cross of the Order of Leopold of Belgium and the Grand Cross of the Order of the British Empire. (H. Gn.)

PAGE, THOMAS NELSON (1853–1922), American author and diplomatist (*see* 20.450), was appointed ambassador to Italy by President Wilson in April 1913. In 1914 he announced his discovery of the house, 66 Piazza di Spragna, in which Byron had lived at Rome in 1817. In 1915 he induced the Italian Govt. to raise the ban on the re-exportation of cotton goods dispatched by American shippers via Italy to other countries. He earned the gratitude of the Italians by his relief work during the Avezzano earthquake in 1917. He resigned the ambassadorship in April 1918 and returned to America, dying at Oakland, Va., Nov. 1 1922.

Page's later writings included *Robert E. Lee, Man and Soldier* (1911); *The Land of the Spirit* (1913); *Tommaso Jefferson, Apostolo della Libertà* (1918, prepared for an Italian series); *Italy's Relation to the War* (1920); *Italy and the World War* (1920) and *Dante and His Influence* (1922).

PAGE, WALTER HINES (1855–1918), American writer and diplomat, was born at Cary, N.C., Aug. 15 1855. His father, Allison Francis Page, was descended almost exclusively from English ancestors; his mother, Catherine Frances Raboteau, was Scotch and French Huguenot in origin. Perhaps Page's finest inheritance from his father's family was a strong devotion to the cause of the Union, while from his mother he inherited a love of literature. From the standpoint both of mind and character, therefore, Walter Page's inheritance was a rich one; it gave him an energetic, clear-seeing brain, a predominant moral sense, a profound patriotism on national lines, a devotion to public service and a faith in education as the essential basis of the self-governing citizen. Even as a child Page displayed these qualities.

At the age of 16, in Jan. 1872, after a preparatory course at the Bingham Military School at Mebane, N.C., and a year at Trinity College, Page entered Randolph-Macon College at Ashland, Virginia. The greatest influence in his life at this time—and an influence that continued to the end—was Thomas Randolph Price, professor of Greek. Professor Price had two great enthusiasms—English and Greek literature; he became deeply attached to Page, both as a boy and as a student, and devoted much time to his training. Price made another great contribution to Page's education, for he obtained his appointment as one of the first 20 fellows of the new Johns Hopkins University at Baltimore, with the result that the young man, in Oct. 1876, found himself one of a group of five ambitious Grecians sitting at the feet of America's greatest classicist, Basil L. Gildersleeve. Page read intensively the Greek tragedians, orators, historians and philosophers, and though, in the philological sense, he never became a great Greek scholar, he did drink in a knowledge of antiquity and a feeling for Greek literature which deeply influenced all his subsequent habits of thought as well as his own literary style.

Page's health, always frail, broke down in March 1878 and he consequently left Johns Hopkins without a degree. He met much discouragement in his efforts to get a start in life. A winter (1878–9) spent teaching English at the high school at Louisville convinced him that his nature demanded an active life among men, and in 1880 he became editor of the St. Joseph *Gazette*. But a small Missouri town did not hold Page's interest long: he broke away in the summer of 1881 to make a tour of the Southern States, writing a series of brilliant articles that were simultaneously printed in several leading American newspapers —one of the first cases, if not the first, of the now familiar newspaper syndicate. The next two years Page spent as literary editor of the New York *World*, but in 1883 he resigned and returned to Raleigh, North Carolina. For two years he edited the *State Chronicle*, a weekly newspaper, as distinguished for the vivacity of its editorial style as for the unconventionality of its opinions.

Page was only 28, but he had completely reasoned views on all Southern questions. He ridiculed the current worship of Confederate officers, especially the tendency to regard a war record as almost the exclusive qualification for public office; advocated primary education for both the white and the black, the development of scientific agriculture, the building of modern highways, the creation of local industries and the lessening of ecclesiastical influence in all departments of life. All these changes North Carolina has since introduced to a degree that has given her the leadership among Southern States; the youthful Page, however, was 40 years ahead of his time, and, after two rather tempestuous years, in which he found himself denounced as a "Southern Yankee," he had to confess failure, dispose of his paper and resume his life in New York.

His Literary Career.—Page's opportunity came in 1887 when he joined the staff of *The Forum*, a monthly review then in serious difficulties. In four years he transformed a bankrupt property into a profitable one, and made it one of the most influential organs of public discussion in the English language. He resigned his editorship in 1895 and entered the Boston publishing house of Houghton, Mifflin and Company. For two years he was literary adviser and associate editor of *The Atlantic Monthly*, and in 1898 became editor-in-chief of that venerable New England magazine. His tenure was brief, however, for in 1899 he joined Frank N. Doubleday in establishing the publishing house of Doubleday, Page and Co., and founding *The World's Work* magazine, of which Page served as editor from 1900 to 1913. For 14 years Page led the active career of a publisher and editor, but he spent a large amount of time as lecturer and writer advocating the causes which had always been his chief interest in life.

Of these the leading one was popular education, especially in the backward South. As a member, first of the Southern Education Board and afterwards of the General Education Board, he played his part in distributing the Rockefeller millions for this purpose. His speeches were probably the most powerful influence in awakening the Southern States to their cultural shortcomings. By initiating the movement for the eradication of the hookworm, he started the work that has since taken shape in the International Health Board. He served on President Roosevelt's County Life Commission, and was a leader in introducing Dr. Seaman A. Knapp's demonstration work in agricultural areas. All these years he closely followed political affairs, and in 1911 was one of the first to proclaim the presidential qualifications of Woodrow Wilson, whom he had known for many years. One of Wilson's first acts, after his inauguration, was to appoint Page ambassador to Great Britain.

Ambassador in London.—For his five years in London Page's life had been a preparation. His deepest convictions—his passion for democracy, his belief that British institutions and literature formed the most solid basis of civilisation, his long advocacy of British-American co-operation as the most satisfactory method of solving world problems—were all put to the severest test in the five arduous years of his ambassadorship. He had established familiar and congenial relations with the British public and British officialdom—especially with the Foreign Secretary, Sir Edward Grey—when the World War began. Up to that time Page had also worked in complete harmony with President Wilson. Early in his London days the ambassador began writing the President his impressions of British life and British society—letters which the President greatly enjoyed and valued. It was owing mainly to his prompting that President Wilson persuaded Congress to repeal the discriminating Panama tolls. He continued this correspondence throughout the War.

In the War Page saw above all an attempt of Germany to grasp the hegemony of Europe, and to substitute the Prussian conception of autocracy for the democratic ideal which he regarded as the true path of human progress. It soon became apparent, however, that President Wilson did not then accept this interpretation of events. It was mainly this difference that caused the historic divergence between Page and Wilson. To the outside world Page maintained an attitude of strict neutrality; in his private communications to the President, however, he made no secret of his complete sympathy with the cause of the Allies, and his general disagreement with the policy of the Administration. As Washington did not grasp his view of the struggle, Page's efforts, for the first year, were ceaselessly devoted to keeping Great Britain and the United States on friendly terms. When the "Lusitania" was sunk, Page in his letters and cablegrams to Wilson strongly advocated an American declaration of war against Germany. He insisted then, as he did afterwards, that American intervention at that time would have brought the War to an early end with an Allied triumph. At all subsequent crises he kept constantly to his main argument—that the War was a life-and-death struggle between autocracy and democracy, and that the United States could determine the result in only one way, by intervention with all its military, financial and economic power. Page's great moment came on April 2 1917, when President Wilson asked Congress to declare the existence of a state of war with Germany, and in his speech used arguments that Page had been forcing on his attention for three and a half years.

Page had never been in robust health; he was not a hale man when he began his work in London in 1913, and the anxieties and labours of a terrible period gradually exhausted his physical frame. He had meditated resignation many times, and consented to remain only at the earnest request of President Wilson. In Aug. 1918, however, he became so ill that the President acquiesced in his retirement. In early Oct. he sailed on the "Olympic" and reached New York so weak that it was necessary to carry him from the ship on a stretcher. His one wish was to return to "the sandhills" of his early home in North Carolina. There he died on the evening of Dec. 21 1918, in his 64th year. He was survived by his wife (formerly Willia Alice Wilson, whom Page married Nov. 15 1880), and by three sons and one daughter. Several memorials to his life-work have been established, of which the most important are the Page School of International Relations at Johns Hopkins University, Baltimore, Md., and a tablet erected to his memory by his British admirers in Westminster Abbey.

BIBLIOGRAPHY.—The chief authority on Page's career is *The Life and Letters of Walter H. Page*, by Burton J. Hendrick (2 vol., 1922; 3rd vol., 1925). *The Intimate Papers of Col. House* (2 vol., 1926) and *Twenty-Five Years* (2 vol., 1925) by Viscount Grey of Fallodon are also valuable. *The Rebuilding of Old Commonwealths* (1902) gives in eloquent language Page's aspirations for the revitalisation of the Southern States. *The Confessions of a Publisher* (1905) gives his creed on his trade. In 1909 Page also published under the name of Nicholas Worth, *The Southerner*, a novel whose main purpose was to serve as a background for preaching his favourite ideas on the South. In parts it is semi-autobiographical, but only in parts. Page's literary fame will rest on his letters. (B. J. H.)

PAGET, VIOLET: *see* LEE, VERNON.

PAINLEVÉ, PAUL (1863–), French politician, was born in Paris Dec. 5 1863. He was educated at the École Normale Supérieure and became a doctor in mathematical science, soon showing himself to be a mathematician of the first rank. He became a professor at the Sorbonne, and while still quite young he was elected a member of the French *Académie des Sciences*. From the time of the Dreyfus case his interest in politics increased; in 1906 he was elected deputy for Paris, as an independent Socialist and took a special interest in all questions relating to the army, navy and air force. It was not, however, until the World War that M. Painlevé occupied a political position of any great importance. In M. Briand's cabinet, formed on Oct. 29 1915, M. Painlevé became Minister of Public Instruction and of Inventions; but finding himself in disagreement with M. Briand in regard to the conduct of the War, he ceased to be a member of the Briand Govt. when the latter was reconstructed on Dec. 12 1916.

In March 1917 M. Ribot became premier and gave the portfolio of Minister of War to M. Painlevé, who proceeded to appoint Gen. Pétain in place of Gen. Nivelle as commander-in-chief of the French Army. On the resignation of M. Ribot, M. Painlevé himself formed a cabinet on Sept. 12 1917. He would have included the Socialists in his Government, but owing to their exaggerated demands he was unable to come to an agreement with them. In addition to being premier, M. Painlevé continued to be Minister of War. On Oct. 19, in consequence of a vote of the Chamber, he felt that his majority was insufficient, and therefore resigned; but he at once reconstituted his cabinet, replacing M. Ribot by M. Barthou at the Ministry for Foreign Affairs. A few days later, after the Italian disaster at Caporetto, he went to Rapallo at the same time as Mr. Lloyd George to meet the Italian premier, Signor Orlando. These discussions resulted in the creation of the Supreme Allied Council at Versailles, Gen. Foch being chosen by M. Painlevé as the chief representative of France. On Nov. 13, the Chamber having refused to postpone questions regarding "defeatism," M. Painlevé resigned and was succeeded by M. Clemenceau.

After some years of restricted political activity, M. Painlevé with M. Herriot helped to form the *cartel des gauches*, which obtained a majority in the general elections of May 11 1924. The two heads of this group, M. Herriot and M. Painlevé, became premier and President of the Chamber respectively. The Radicals now organised a kind of ministerial strike, with the result that M. Millerand was forced to resign the Presidency of the Republic. The attempt to replace him by M. Painlevé failed, and M. Doumergue was elected President. In April 1925 M. Herriot was forced to resign after a defeat in the Senate on financial questions and M. Painlevé succeeded him as premier, taking over the portfolio of War as well. M. Caillaux became Minister of Finance, a position of special importance at that time of financial crisis.

In June M. Painlevé went by air to Morocco, where owing to the offensive of Abdel-Krim a difficult situation had arisen; later he sent out Marshal Pétain to organise resistance and

Courtesy of The Hispanic Society of America

"AFTER THE BATH" BY JOAQUIN SOROLLA Y BASTIDA

direct á counter-offensive. In July he found it was impossible to remain in power without the support of a section of the opposition, for the Socialists refused to accept the fiscal policy of M. Caillaux. In Oct., therefore, with a view to gaining the support of the extreme left, M. Painlevé himself took over the Ministry of Finance from M. Caillaux. But on Nov. 21 he found himself with a minority in the Chamber owing to his financial proposals. He was succeeded as premier by M. Briand; and, both in that Government as well as in the one formed by M. Briand in March 1926, M. Painlevé continued to hold the portfolio of War. An able mathematician, M. Painlevé was made a member of the academies of science of France, Bologna, Stockholm and Upsala as well as of the Reale Accademia dei Lincei in Rome. Among his various works on mathematics may be mentioned: *Leçons sur le frottement* (1895); and *Leçons sur la théorie analytique des équations différentielles* (1897).

(P. B.)

PAINTING (*see* 20.459).—The end of the 19th century saw in painting the triumph of "impressionism" in its widest sense.[1] With the heterodoxy of the 19th century become the orthodoxy of the 20th, a movement developed in revolt against impressionism, giving to painting between 1900 and 1926 a distinctive character. This movement, like impressionism, is mainly French in origin, though elsewhere it has taken colour from national characteristics. But changes have been greater in appearance than reality. Impressionism is very much a living force; older academic traditions still survive and have even gained strength from a reaction against impressionism; while the practice of the rebels has paid more heed to older standards than have their doctrines.

Across these main movements cut the influence of the War. At first it threatened to limit artistic output severely, but the check was only temporary. A huge demand arose in the belligerent countries from individuals and public bodies for illustrative, propagandist or commemorative work, which bore fruit in posters and cartoons; in the formation of official collections such as those in the Imperial War Museum and in Canada; and in decorative paintings for memorial purposes. The chief interest of this work is that of a document, showing what men did, felt and thought during the War, and of giving a summary of the condition of art at the time in various countries. The aim of the British and Canadian official collections was definitely to preserve a pictorial record of the War in all its aspects, and, consequently, much of the work is primarily the skilful application of a technique to this task, and not the expression of a new vision or a personal emotion.

The same applies to most memorial decorations, and, though in all countries the posters were the work of prominent artists, their appeal was only in part aesthetic, designed as they were mainly to excite hatred, cupidity, pity and self-sacrifice. Yet by putting the production of the poster into the hands of artists, and by helping to revive and stimulate wood engraving and lithography, the War had considerable influence on the graphic arts. Otherwise, its immediate effects have been small. It has perhaps strengthened the nationalist spirit in art, as a result of a cessation of international intercourse during the War and of the creation of small independent states. It may also have given a new impulse to a search for structure and design, by reducing life so much into terms of machinery and organisation; and by the depth and variety of the emotions it aroused may have stimulated the tendency to use form and colour for the expression of personal feeling rather than for the reproduction of nature. Probably, too, by making a definite breach with 19th century ideas, the War cleared the way for the development of new aesthetic standards. But the most important modern movements in art were in being before the War.

[1] Unfortunately for clarity of exposition, the term "impressionists," originally applied to the group of artists round Claude Monet, painters in a high key using a palette limited to white and the spectral colours, has been extended, especially in England, to include all painters whose main aim is the reproduction of the visual appearance of a scene as a whole. In this wider sense the term is here used throughout.

I. THE REACTION FROM IMPRESSIONISM

The Later Impressionists.—Of movements which attained full development in the 19th century, impressionism in its purest form is still represented in France by Claude Monet, in Belgium by Emil Claus and in Great Britain by Lucien Pissarro. Of its many developments and adaptations, the neo-impressionism, based on the analysis of colour in nature into its constituent elements, which are then placed by means of juxtaposed spots of paint upon the canvas, to be recombined by the eye, survived in 1926 only in modified form. Paul Signac, one of its original exponents, has substituted for spots brick-like rectangles in his oil paintings, and increased use of line in his water-colours. Another variation, pointillism, in which colour already mixed on the palette is applied in spots, is represented by Henri Martin and Henri le Sidaner. Paul Albert Besnard, appointed in 1924 director of the École des Beaux Arts, Paris, had adapted the impressionist analysis to deal with complicated problems of double lighting which in England have interested Charles Sims and Ambrose McEvoy in portraits and figure pieces. Jacques Émile Blanche, on the other hand, derives more directly from Manet in his bold brushwork and the simplified masses of his design.

In England, the spectral palette and high key has been only a passing phase with most painters. Wilson Steer in both portrait and landscape passed to a narrow palette including black, in work marked by much subtlety of tone and colour and great feeling for light and atmosphere. After a period of more positive colour, he returned in his latest work to a limited range of browns, greys, blues and greens, and a simplified direct handling analogous to that of water-colour. George Clausen, once the leading disciple of Bastien-Lepage in England, has interested himself in mural work, and gives increasing attention to design in his sensitive interpretations of misty, sunlit landscape.

Study of tone and design based on silhouette gives a common basis to members of the Glasgow school, such as Sir James Guthrie, E. A. Walton (1860–1923), Sir John Lavery and D. Y. Cameron. These served as starting-point for Sir William Orpen, combined in later work with vivid colour used decoratively, ingenious use of double lighting, and a strong bent for satire and caricature. The death of J. S. Sargent in April 1925 removed an outstanding figure, witness to whose reputation was the remarkable total (£182,585) realised by a two-days' sale in July of part of the contents of his studio. Vivid realisation of external aspect by singularly direct and forcible means, based on impressionist practice, was his peculiar power. This was best displayed in portraiture and landscape; a series of mural decorations in the Boston Museum of Fine Arts, completed just before his death, consisting of mythological scenes executed in golden ochre on a blue ground, are accomplished but lifeless. Of the group of painters who, under the influence of Millet and Bastien-Lepage, carried the realism of Courbet and Manet into the field and workshop, the chief survivors in 1926 were Lucien Simon and Charles Cottet in France, Max Liebermann in Germany, Joaquin Sorolla in Spain and Ettore Tito in Italy. In Great Britain the once prominent Newlyn group has fallen into obscurity; in Sweden Anders Zorn, best known by his portraits and etchings, is dead; and the Hague School of Holland has no important living representative.

Transition Painters.—Between these representatives of impressionism in the widest sense and those of the modern movement stand many painters combining in varying degrees characteristics of both groups. Among these are the decorative painters, who have necessarily never fully accepted impressionism and realism. As early as 1892 the Rose Croix group in France had urged that painting should be idealist and monumental in character, with myth and allegory as its subject. These ideas survive, combined with impressionist influences, in the balanced and harmonious compositions of René Menard, whose descent is from Puvis de Chavannes, in the mural decorations of Henri Martin, and in the work of Amand-Jean, whose flowing arabesque and pastel tints relate him to the 18th-century decorators. Akin to these painters, but closer to the

modern movement and more purely decorative in intent, is the broadly handled work of Jules Flandrin (b. 1871). Another group of decorative painters take realism as a starting-point. Among these is Frank Brangwyn (b. 1867), one of the few English painters with considerable European influence and reputation. His later work, such as the eight mural paintings, symbolising the dynamic forms of nature, for the 1915 Panama Pacific Exposition, and the twelve panels finished in 1925 in the dome of the State House of Missouri, is dexterous and schematised in handling, and combines romantic and allegorical treatment of material drawn from the daily life of commerce and industry with a sensuous materialism.

A comparable figure is Ignacio Zuloaga (b. 1870), the leader of a group of Basque and Castilian painters, including Ramon and Valentine de Zubiaurre, Gustavo de Maeztu and Federico Beltran-Masses, who consciously aim at expressing Spanish national character in their art. With them a romantic conception of subjects drawn from contemporary Spanish life is given decorative form by emphasis on silhouette, simplification of form and broad masses of colour, often combined with a low horizon and a panoramic background; though sometimes the realism degenerates into caricature and the decorative treatment into the production of cardboard figures against a stage drop-scene.

Among British painters, Augustus John is best known by his portraits, which combine accomplished drawing and power to record a likeness with the decorative use of broad masses of colour, considerable simplification and occasional distortion of forms. His larger subject pieces are apt to be empty and mechanical. Sir C. J. Holmes is conspicuous among landscape painters for his emphasis on structure and design; and the well-planned architectural and mountain pieces of Sydney Lee unite sombre dignity with painstaking study of detail. William Rothenstein has abandoned the low key and sombre colour of his earlier work for a decorative treatment and a more vivid palette in his later paintings. The Munich decorative school, as seen in its most important product, Franz Stuck (b. 1863), inherits from Böcklin the realistic treatment of mythological and allegorical materials. Its once important and widespread influence has waned; but it forms part of the bridge between the archaeological and historical painting which formerly dominated Germany and more modern movements. Allied to this school is the Swiss Ferdinand Hodler (1853–1918) by the emphasised contours and calculated distortions of his later work. But in his symbolic mystical outlook he resembles another important German forerunner of the modern movement, Hans von Marées (1837–87), neglected in his lifetime but now the object of adulation, who turned from Courbet and Manet to Rubens and Delacroix in developing a grandiose decorative art.

Degas and His Influence.—Another important divergence from the main trend of later 19th-century art is seen in France in the art of H. G. E. Degas (1834–1917) and Pierre Auguste Renoir (1841–1919). Their close association with the impressionists was reflected in the choice of subjects from contemporary daily life, and at times in their use of colour. But Degas mainly descends from the great draughtsmen of France. A convinced realist, bitterly opposed to the romantic and symbolic, he never sought the ideal beauty of Ingres, but turned to use the more absurd and bizarre attitudes of everyday life. His realism is synthetic, and represents the building-up, from many sketches and from a retentive memory, of the essential character of a form or movement; and his vision is classic in its impersonal, almost ironic quality. So with his design, which, despite its apparent disregard of the rules of classical composition, yet shows a complete balance of strains and stresses round a pictorial centre, revealing the influence of Chinese and Japanese art. Round Degas centres a group of realistic draughtsmen, such as Henri de Toulouse-Lautrec (1864–1901)—whose fevered and excited vision inspired much modern work—Louis Legrand and J. F. Raffaelli.

Jean-Louis Forain (b. 1852), chiefly known for his political and social cartoons, has the realism and ironic spirit of Degas, but less power of design and feeling for colour. As an etcher, however, he is in the front rank. The later work of T. A. Steinlen (1859–1923), well known by his journalistic work, is significant of modern tendencies in the increased emphasis given to the third dimension and the use of simplified forms. Renoir inspired no special group which calls him master, nor was he the exponent of an aesthetic creed. His earlier work was much under impressionist influence, in its easy vivacity recalling Fragonard. Later, he grafted impressionism on to a romantic decorative manner inspired by the Venetians and Rubens, searching for increased solidity and simplicity in his forms, so disposed as to give somewhat the quality of a bas-relief to his paintings. Meanwhile, his colour became less naturalistic, ultimately being dominated by the famous Renoir carnation.

In Great Britain, the realism and satire of the figure subjects of Walter Sickert (b. 1860, A.R.A. 1924) are a link with Degas, also the growing breadth of treatment in his later work. He adds, however, a characteristically English humour. In landscape, his search for accurate record of tone relations and an incursion into the use of the spectral palette bring him nearer the impressionists. His influence in transmitting French influence to several younger painters has been considerable. Henry Tonks (b. 1862), professor at the Slade School, has also done much to mould the younger generation, by his enthusiasm for drawing. As a painter, his choice of theme links him to the English painters of domestic genre; his realism and sense of humour to Hogarth; his handling of colour to the impressionists. Literary and satiric intention is uppermost in the work of Max Beerbohm but he is also notable for his delicate linear draughtsmanship and skilful design.

II. THE MODERN MOVEMENT

Post Impressionism.—The modern movement has been given various labels, such as post-impressionism and expressionism, but its manifestations are so various that no one term can satisfactorily describe it. These manifestations however, have a common origin and character, in being a reaction against impressionism, with its aim of representing visual appearance as a whole at a given time, without reference to shape or appearance as they may be known to exist under other conditions; and in proposing to substitute form arranged into a coherent design to make a new reality and not a reproduction of nature. In this, certain modern painters claim to be returning to the tradition embodied in the work of Raphael, Poussin, David and Ingres, as opposed to the romantics and realists; and to be breaking away from subordination to external and visible things in order to utilise them in expressing the artist's emotions.

From this latter aspect of the movement arises the term "expressionism"; and divergence as to the kind and quality of emotion to be expressed is one cause of the differences between various modern groups. The general character of the movement helps to account for other distinctive features. Colour becomes less naturalistic, and is used to emphasise the solidity of objects, is purely decorative, or assumes a mystical and symbolic character; and anxiety to avoid a transcript of nature has stimulated return to the subject picture, which calls for constructive effort. But the modern movement owes much to the impressionists. It was they who helped to discredit the formulas and aims of academic art; put powerful weapons in the painters' hands by applying to art scientific discoveries regarding light and colour; and won recognition of the artist's freedom to express his personal vision of things. It was on this basis that the chief initiators of the movement built. These fall into two groups, the one including Cézanne, Seurat and Henri Rousseau, whose emphasis tends to be on structure and design; the other including Gauguin, Van Gogh and Gustave Moreau, in whom symbolist and expressionist elements are more marked.

Cézanne.—Paul Cézanne (1849–1906) gives a clue to understanding of his aims and methods by his own words, that he wished to do Poussin over again according to nature, and to make of impressionism something solid and durable like the art of the museums. His sympathies were all with the later Venetians,

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"THE WAY DOWN TO THE SEA" BY AUGUSTUS JOHN

This painting is one of the best known examples of the earlier work of Augustus John. It not only shows the power of his draughtsmanship, but, with its characteristic of definite contours enclosing areas of colour, relates him to the 15th Century Italian painters.

Rubens, Poussin and the baroque masters such as the Caracci and El Greco, whose craftsmanship, bravura and well-organised design he admired. These tastes found expression throughout his life, but are most evident in his earlier work. In this he used little colour; but under the influence of the impressionists, especially Pissarro, he extended his palette considerably (though still retaining black and the earth colours) and turned to a more intimate study of nature. Contemplation of her, he held, reinforced by reflection and study of underlying causes, creates in the artist's mind a vision of the structure underlying the external, visible world, which to him becomes a series of organic relations between solid forms, which he should seek to realise on canvas. Cézanne's method was to establish the relations between the planes enclosing an object or group of objects by recording all the subtle differences in their colour due to differences in their relation to the light. But it was the form, not the light around it, which interested Cézanne. He worked slowly and painfully; and such was his desire for keeping every element of his work in correct relation that one alteration would often lead to complete repainting. The legend of Cézanne's technical incompetence is partly due to his constant self-depreciation and to the amount of work he left unfinished in despair or disgust. Though his ultimate rank as a painter is still in the balance, his influence underlies much modern painting.

Seurat, Rousseau and Others.—Georges Seurat (1859–91), like Cézanne, found inspiration in the 16th- and 17th-century masters. At the same time modern scientific research into colour led him to develop a neo-impressionist technique, which has obscured his power of expressing structure and of welding form into balanced and monumental design. But he has exercised much influence, especially on the cubists, whose studio walls often carried reproductions of "Le Chahut," one of his last pictures.

Henri Rousseau (1844–1910), "le douanier," a very different figure, was once an octroi official in Paris (whence his nickname). He is the type of the primitive who tries to paint things as he knows them to be rather than as they appear. He used, for example, to measure his sitters with a footrule, and transfer these measurements to canvas. His work, which includes portraits, views of the suburbs of Paris, exotic landscapes based on recollections of military service in Mexico and figure compositions, is marked by emphasis on solidity, precision of handling, adjustment of the relative size of objects according to their importance as elements in design, and at times by a symbolic element.

In contrast to Rousseau is Gustave Moreau (1826–1898), a strange figure bred in the strictest academic tradition, who borrowed romantic fire from Delacroix and Chasseriau, and fed his imagination upon the myths of Greece and the East. He emerged from many years' retirement to become at the end of his life professor at the École des Beaux Arts, where his influence helped to breed a group of young painters with symbolist tendencies. As a teacher Moreau always encouraged self-expression based on close study of the old masters. In his own work Moreau stood for the use of painting to express the emotions, and built up a decorative art which sought to combine sombre rich colour with linear arabesque.

Gauguin and Van Gogh.—Paul Gauguin (1848–1903) was more definitely a *chef d'école* than any of the group now under consideration. After an impressionist phase, he became in Brittany the centre of the well-known Pont-Aven group, and there developed theories which were to govern all his later work. In 1891 he went to the Pacific Is., and, except for a brief return to France, spent the rest of his life there. Admiration of the primitive was at the base of Gauguin's art. Rejecting impressionism as a mere reproduction of nature not inspired by thought, he held that study of nature awakes emotions in the artist which he has to express by bringing into relation symbols, consisting of forms and colours. Though these colours and forms in his pictures might not actually exist in nature, he claimed them to be the pictorial equivalent of the grandeur, profundity and mystery of Tahiti. His latest work most completely embodies these ideas in its use of boldly simplified contours enclosing areas of rich purples, greens, reds and oranges. His art is primarily decorative and intellectual, revealing a less strenuous effort to express a third dimension than does Cézanne's. His symbolism, though not primarily literary, towards the end moved in that direction.

Akin to Gauguin in his outlook and use of colour is Vincent van Gogh (1853–90). Born in Holland, his early work shows the influence of the older Dutch masters and of the Hague School; association with the impressionists in Paris and with Gauguin at Arles led him to develop the use of heavy masses of vivid colour arranged in bold patterns, emphasised by black outlines and writhing arabesques of paint. A passionate lover of nature, and a mystic and idealist by temperament, Van Gogh believed that the artist's creative power was given to him to make men happy. Vehement personal passion is the note of his work. His colour ultimately became quite non-naturalistic, and was solely directed towards expressing his emotions in the face of nature; and his surface texture serves to increase the arresting, disquieting quality of his work. The third dimension did not play a dominant part in Van Gogh's work. His design, in which decorative simplification became increasingly marked, shows strongly the influence of Japanese art.

Symbolism and Fauvism.—The characteristic aims of the preceding group of painters—rejection of naturalistic representation, emphasis on solidity and structure, organised design, and the symbolic use of form and colour—appears in varying degrees in the work of their successors. The influence of Cézanne, which has modified or supplanted that of others, took some time to develop, and the first well-marked group appeared round Gauguin at Pont-Aven. Prominent therein was Paul Sérusier (b. 1864), who was one of the first to formulate a doctrine based on the ideas of Gauguin, Cézanne and Odilon Redon. He drew round him a group of *symbolistes* which included Maurice Denis (b. 1870), Pierre Bonnard, K-Xavier Roussel and Edouard Vuillard. This doctrine declares that a work of art must aim at the expression of an idea. Since it uses form for this purpose, it must be symbolic; and since the form as to be organised, it must be synthetic and decorative. The basis of the doctrine is a belief in correspondence between external forms and subjective states—not by association, but direct. Sérusier and Denis have given these ideas a mystical and religious application, largely under the influence of the *quattrocento* Italians.

In Bonnard (b. 1867) and Vuillard (b. 1867), however, the purely decorative element is uppermost, in a graceful and refined but over-precious treatment of material drawn from everyday life, influenced by Japanese art, and marked by elusive and delicate harmonies of green, blue, rose and yellow combined with grey. Closely akin to this *symboliste* group is another, whose best-known members were pupils of Gustave Moreau. The religious symbolic pictures of George Desvallières (b. 1861) are characterised by the use of arabesque and rich exotic colour; the more realistic art of Charles Guérin (b. 1874) by its decorative aim and search for tonal rather than for linear unity. The influence of Moreau, modified by the pupil's own temperament, is well seen in the fantastic, savagely distorted nudes and mysterious, sombre landscapes of Georges Roualt.

Matisse.—Far better known is his fellow-pupil Henri Matisse (b. 1869), who represents the expressionist side of symbolism. Academic and neo-impressionist phases never obscured a very personal use of line and colour whose decorative quality relates him to the Chinese and Japanese. A period of arbitrary distortions of the human figure, partly inspired by the study of negro art, marked a further stage in breaking away from representational art. These distortions, his apparently anarchic design and his decorative use of colour earned for Matisse the title of "Chef des Fauves," though he has not formed the centre of a well-marked group, despite his wide influence. It is difficult to acquit him sometimes of painting *pour épater le bourgeois;* but his latest work shows increased discipline and restraint, and is notable for the use of a sensitive contour enclosing delicate and harmonious colour.

Somewhat the same power is seen in the Italian painter and sculptor Amédée Modigliani (1884–1920), though his work is far more mannered than that of Matisse and lacks feeling for colour. Kees van Dongen (b. 1877 in Holland) mingles the influence of Matisse with that of Toulouse-Lautrec, and mainly shows the application of a *fauviste* recipe to the painting of fashionable Parisian society.

Different from the *symbolistes* and *fauves*, but equally in reaction against impressionism, are the painters who return to the outlook and methods of the *quattrocento* Italians. Among these are Jean Frélaut (b. 1879), notable for his sincere interpretations of the country and people round Morbihan in Brittany; and Félix Vallotton (1865–1926), whose angular, precise contours and definite colour pattern relate him to the primitives, and have won him the nickname of the "Cabanel of the Salon d'Automne." A definite Pre-Raphaelite tendency is represented in England by Joseph Southall, head of the Birmingham School of Art. Henry Lamb combines the influence of the Italian Primitives with that of Gauguin and Augustus John, in a dignified and sensitive art whose emphasis is largely on design. He has influenced among others Stanley and Gilbert Spencer, whose work is delicate and sincere, but tends to a conscious archaism. Eric Kennington, whose war paintings attracted much attention, has Pre-Raphaelite leanings, but is primarily academic in outlook.

Cubism.—To the manifestations of the modern movement so far considered, cubism is a marked contrast. It was a reaction not only against impressionism but against fauvism, and professed to stand for the introduction of order and discipline into painting. Some opponents of cubism, indeed, saw therein a return offensive of the academics. It owes its name and in part its origin to Matisse, from whose association with Picasso and others the movement took shape in 1908; and in conjunction with a similar group which included Albert Gleizes and Jean Metzinger, cubism won its first public recognition in the Salon d'Automne of 1913. To the influence of Cézanne and Seurat, which mainly inspired the movement, was joined that of negro and Polynesian art, in which there is a simplified treatment of the human form which emphasises its bulk and solidity, and a complete disregard of normal appearance in the effort to express an idea. Thus the cubists came to reject the reproduction of natural appearance. Nature, they hold, merely serves to awaken in the artist emotions which he expresses by a series of abstract forms, ordered and arrayed by his will. Thus cubism aims at creating a kind of visual music. In its most austere form it avoids curved lines and colour as pretty and sentimental; and even holds that a picture is not a decoration since that term implies dependence upon external objects.

From the first, great emphasis was laid on the expression of a third dimension. This aroused difficulties, which have separated the cubists into distinct groups. Expression of a third dimension introduced an element of resemblance to nature. Some painters accepted this so that their pictures are little more than arrangements of realistically painted cubes and cylinders; others rebelled against such a restricted art, and made of cubism merely an exercise in the expression of three-dimensional form. The purists, however, argued that art is not concerned with Euclidean space but with a special pictorial space, which we feel by our whole personality expanding or contracting before a picture; and that it is not the painter's business to create an illusion of a third dimension but to make live on a two-dimensional surface a reality of three dimensions. Further difficulties have been caused by development of a theory of simultaneity which justifies presenting on the same canvas several aspects of the same object. This often only comes to a mechanical arrangement of a number of separate impressions, whose disentanglement may be a source of interest, but makes cubism descriptive rather than pictorial.

Picasso.—Pablo Picasso (b. 1881 at Malaga) has been the dominating force in the movement, but by no means typifies it. With him cubism has been only a phase. To a realistic period, mainly influenced by Toulouse-Lautrec, succeeded a group of reddish nudes, solidly constructed from simplified planes, which ushered in the cubist period. The earlier work in this showed some conformity to natural appearance, and was mainly in *grisaille;* later the forms became more abstract, the design more arbitrary and the colour more brilliant, sand and similar substances being embedded in the paint to give relief and variety of surface. Later came the influence of Ingres, especially in Picasso's drawings, some of which conform closely to natural appearance, with only enough distortion to give flow and rhythm. The chief characteristic of Picasso is his versatility. But it is doubtful whether he has achieved more than a series of exercises in different manners.

Other cubists have also reverted to representation. Georges Braque, whose long adherence to geometric forms, straight lines and sombre colour made him the purist of the movement, has executed admirable settings for the Russian ballet, and turns still life groups into flat patterns of attractive colour. Metzinger, one of the popularisers of cubism, paints artificial arrangements of natural forms, coarsely modelled with emphatic local colour; Auguste Herbin has become a heavy-handed landscape painter in the Cézanne tradition; Leopold Survage in his treatment of the figure has become almost academic. Of the leading figures in the movement, Juan Gris and Fernand Leger alone still exemplify its doctrines; and in general the influence of cubism may be said to have passed, save in giving a solid and mechanical quality to the work of those who once practised it.

Between the extremes of cubism and fauvism stands a considerable group of artists who derive something from both, but mainly witness the influence of Cézanne. Of these Albert Marquet (b. 1875) is primarily a painter of Paris and of the Seine, whose use of well-defined planes, with their tonal relations accurately expressed, is apt to degenerate into an ingenious system of notation. Jean Puy (b. 1876), in his landscapes of wide-stretching countrysides, has notable feeling for subtle variations in colour and tone. With Othon Friez (b. 1879) the organising instinct is uppermost, but he shows considerable power of retaining fresh and unspoiled his original conception. More consciously decorative than Cézanne, his mural paintings sometimes show the influence of Gauguin. Jean Marchand (b. 1883) and Dunoyer de Segonzac (b. 1884) are among those to whom cubism has been a gymnastic to develop understanding of form, but who rely on colour and tone to give solidity and a sense of space.

Marchand's early promise has scarcely been fulfilled, his recent work being empty and its colour forced. Segonzac has developed the use of the palette knife and thick impasto, working in a scheme of dark browns, greys and greens which are apt to be monotonous. His war paintings, which reflect a very personal emotion based on his own experience, are themselves the colour of Flanders mud. André Derain (b. 1880) is one of the most influential of younger painters. After a period influenced by Van Gogh and the neo-impressionists, he produced a series of truculent nudes and landscapes, which showed cubist and fauve influence in their simplified and distorted forms. His later work is more sober and naturalistic, though apt to be heavy and mannered. Mannerism also marks the dramatic landscapes of Maurice Vlaminck (b. 1876), with their heavy skies and contrast of sombre greens with vivid reds and pinks. Maurice Utrillo (b. 1883) mingles impressionist influence with that of Cézanne in his landscapes. Before the War, a limited palette, including black and white, and considerable attention to atmosphere and texture marked his work; replaced later by greater definition of forms and forcing of local colour. Marie Laurencin mingles the influence of Matisse and Renoir in her paintings of women and children, whose sprightliness does not conceal the lifeless formula on which they are based.

Futurism.—Modern art in most countries is an extension or adaptation of French ideas and methods. Spain has produced Picasso, but cubism is entirely Parisian in origin; and so much of the modern spirit as appears in Catalan painters such as Sunyer and Casals is derived from France. Futurism, however, is indigenous to Italy. The term has been loosely used, especially

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"ARLEQUIN" BY PABLO PICASSO

Picasso has been a major influence in recent painting. His Spanish heritage of irony and his dazzling French facility have sparkled now in blue, now in pink, with prismatic brilliance. This Harlequin from his "blue" period shows Picasso's mastery of linear composition and spatial relations before he undertook to show in one canvas all the facets of a subject conceived as a moving, variable idea.

in England, to denote the modern movement as a whole; but strictly it applies to the doctrines of a group of Italian poets, sculptors and painters, first presented to the world in 1909 in a manifesto signed by F. T. Marinetti, the poet and high priest of the movement. These doctrines apply to art a general philosophy of life, based on the modern scientific theories which express all matter in terms of energy; and while denouncing all that the past has done (whence the name futurism) holds that movement and conflict are the dominant characteristics of modern life. Cubism, as dealing only with the static aspects of life, it rejects; impressionism it takes as a starting point, but claims to have surpassed.

The futurist's aim is to represent, not the appearance of objects at some particular point in their course, but the sensation of movement and growth itself. One method, which connects futurism with cubism, is to combine on one canvas not only what the artist sees, but what he knows and remembers about an object. Another, peculiar to futurism, is the use of "force lines." Every object, it is argued, is at a given moment the temporary outcome of continuously acting forces, whose character is indicated by the lines and planes enclosing it. Thus an object becomes simply the beginning or prolongation of rhythms conveyed to the artist by contemplation thereof; and these he represents in his picture by lines arranged to clash, harmonise or interplay in order to express states of mind such as chaotic excitement, happiness or interest. Colour the futurists use arbitrarily to assist in conveying these sensations.

Luigi Russolo is the most logical and orthodox of the futurists. The work of others, such as Carlo Carra, is little more than a catalogue of information about a number of different objects; though Umberto Boccioni, who has applied futurist theories also to sculpture, sometimes redeems his work by an interesting design. The gaily coloured, tapestry-like patterns of Gino Severini were among the more attractive futurist paintings; but his recent work under cubist and academic influences has become entirely commonplace. His career typifies the fate of futurism, which has found no new recruits, and has had but transient influence.

III. NATIONAL TENDENCIES

Great Britain.—The British vorticists share some doctrines with the futurists; but the main forces shaping the modern movement in Great Britain are French. This movement first took shape in the studio of Walter Sickert, and resulted in the formation of the Camden Town group under the presidency of Spencer Frederick Gore (1878–1914), which developed into the more eclectic London group whose first president was Harold Gilman (1876–1919). At the same time Roger Fry (b. 1866), by his writings and by assisting to organise post-impressionist exhibitions in 1910 and 1912 at the Grafton Galleries, did much to make known the character of the modern movement in France. and to assimilate more closely thereto the English movement. Gore and Gilman represent the movement in its earlier stages. Gore's earlier impressionism was modified under the influence of Cézanne and Van Gogh by increased attention to structure and design, which for a time obscured his charming sense of colour. This reappeared in his latest work, done mainly at Richmond. Gilman emerged from a period influenced by Whistler and painters of the Vuillard type to one which gave increased emphasis to the third dimension and showed the influence of Van Gogh in the use of brilliant colour and the texture of paint.

Charles Ginner, whose work is akin to Gilman's, though without its vitality, describes their art as aiming at "the plastic interpretation of life through intimate research into nature." The emotions aroused by nature in the artist he must express by deliberate and objective transposition of nature on to canvas, so that he reveals the qualities in her which have moved him. The variety of line and colour in nature, joined to the artist's personality, will produce a decorative composition. This neo-realism (as Ginner calls it) is based on the attitude of Cézanne and Van Gogh towards nature; but gives an English turn to that attitude by emphasising the part played by nature as compared with that of the artist. The French point of view is more evident in the work of the London group. Some of its members are still slaves to a French formula; others have based on French teaching a more individual art, notably W. B. Adeney, Roger Fry, Duncan Grant and Vanessa Bell. Grant's feeling for delicate and harmonious colour and for pattern gives his art characteristic quality, which over-absorption in problems of three dimensional form has at times obscured. C. W. R. Nevinson, having explored in turn impressionism, futurism and cubism, abandoned the geometric convention which marked his war paintings, to reveal an academic art masked by previous experiments.

Distinct in character is the vorticist movement, which had its origin in 1913 among certain members of the Camden Town group, and had as its leading figures the painters Percy Wyndham Lewis, Cuthbert Hamilton, Frederick Etchells, Edward Wadsworth and William Roberts, the poet Ezra Pound and the sculptor Henri Gaudier-Brzeska (1891–1915). Like futurism, it holds that modern art must be based on the character of modern industrial civilisation, whose features are complexity and dominance of the machine; and, since England is pre-eminently the type of the modern industrial country, this art will be an English art. But it rejects futurism as merely the cinematographic representation of a series of impressions; and joins the modern movement as a whole in claiming that the artist's work is not to copy nature, but to create new realities. Every phase of emotion has its appropriate means of expression in some particular form of some particular material, whose appeal is direct and not by association or allegory. These forms take shape and proceed out of the artist's "vortex" (hence the name of the movement), which is a general conception in his mind of relations in the universe through which ideas pass and take concrete shape, just as the general equation of a circle in analytical geometry becomes one particular circle when definite quantities are substituted for the algebraic symbol.

In 1920 the vorticists seceded from the London group to form the X group; but their first exhibition showed some modification in their practice. The earlier vorticist work was geometric and abstract, and owed much to cubism. Hamilton represents this phase; but others have turned towards expressing the structure of natural forms in the way exemplified by the work of Wyndham Lewis, while J. McKnight Kauffer has exploited geometric conventions with much success in posters. The interest of the earlier vorticist painting lies in disentangling in sequence the elements from which it is constructed; otherwise, though sometimes showing new and interesting combinations of shapes and colours, it presents only a barren world of geometrical forms.

United States.—In the United States, cubism, futurism and vorticism have all had their exponents among the younger painters, but have inspired no work of permanent interest or value. Modern French art has nevertheless materially modified the impressionism which had become a dominant force in American painting. Impressionist ideas had marked the work of the Society of National Artists, once representative of the advanced elements in American painting. On the dissolution of this body, many of its members joined the older National Academy, thereby establishing impressionism as one form of orthodoxy, exemplified in the landscapes of Twachtman and Robinson among the older men. Problems of light and atmosphere are likewise the main interest of Dewing, Childe Hassam and J. Alden Weir (d. 1920), and of the sea painters Carlsen, Dougherty and Waugh. The work of these men is primarily an echo of European ideas and the methods of an older generation.

More recently, however, various forces have tended to shape a distinctly American school. Among these is the rapid increase in the number of important art galleries throughout the country, which permits art students to study at first hand the old masters; the development of American art schools, with teachers of personality and originality, such as La Farge and Chase; and the consequent increase in the number of painters who remain in

America and find their material in characteristically American scenes. Such influences, combined with modern aesthetic theories, have resulted in more attention to problems of form and design, with greater breadth of treatment. Among figure and portrait painters, Robert Henri is notable for his versatility and vigorous, direct handling; John Sloan for his intensely realistic treatment of New York slum life; George Bellows (d. 1925) for his well designed and sympathetic interpretation of many phases of contemporary life, work and sport. Among landscapes the broadly decorative studies of suburban New York by Ernest Lawson and the vivacious rural and beach scenes of William J. Glackens may be mentioned.

Less concerned than any of these with problems of natural appearance was Albert Ryder (d. 1916), whose landscapes and figure studies are inspired by a highly romantic and very personal emotion, which links him to such painters as Delacroix. The mystical decorative compositions of Arthur B. Davies are conceived in the vein of a Fantin Latour, but are weak in design and drawing. In contrast is the strongly realistic approach of G. B. Luks, who produced several remarkable war paintings. Mural painters have also been active in America, the example set by Sargent in Boston being paralleled in public buildings at Pittsburgh, Baltimore, St. Paul, Minneapolis and elsewhere by the work of such painters (among others) as La Farge, Blashfield, and Alexander.

Germany.—In Germany the modern movement has been mainly inspired by that side of modern French art represented by Matisse and Derain. Cubism has not gained a firm footing there; though the Russian Jew, Marc Chagall, shows cubist influence in the sharply defined planes and angular design of his fantastic, vividly coloured decorations; and Lyonel Feiniger has adopted the cubist method of extension and development of planes. But arbitrary distortion and writhing arabesque have proved more congenial means of expression in an art which has always tended towards the romantic and symbolic. Native influences, such as Hans von Marées and the Munich decorative school, joined the study of El Greco and Matthias Grünewald in paving the way for an expressionist art in the full sense of the term—one which gives vent to every kind of emotion with unrestrained vehemence. A mystical temper and a mass of confused aspirations induced by the War have stimulated this development; but the movement was in being before the War, chiefly under the leadership of Wassily Kandinsky (b. 1866 at Moscow), a prominent member of a Munich group of painters, poets and musicians, whose aim was the expression through art of the "*innerer Klang*"—the soul of nature and humanity.

According to Kandinsky, colour and form have the power of producing spiritual vibrations quite apart from their ordinary meaning and associations; and a picture consists of an arrangement of form and colour whose spiritual values are in harmony with it and unite to express the artist's spiritual conceptions. Thus painting ceases to have representation as its purpose, and becomes analogous to music in its rhythmical arrangements of forms and colours. These may be borrowed from nature, but must have no external associations, and may be freely adapted and distorted to suit the artist's aim. Thus Kandinsky has points of contact both with the *symbolistes* and cubists; but he criticises the latter for reducing the construction of a picture to rules and formulas, and for paying overmuch attention merely to representing three-dimensional form.

Kandinsky's own work has become increasingly abstract in character, and consists of some early flat decorations, combining Russian and Munich influences; a group of more or less direct impressions of nature, inspired by Matisse; "improvisations" which represent spontaneous expressions of inner character; and "compositions" which, he claims, express a slowly formed and mature spiritual feeling. His most important disciple is Franz Marc (1880–1916), whose animal compositions, boldly designed in arbitrary colour, are his most typical work. The influence of Kandinsky has declined rapidly in recent years; and more relation to natural appearance is preserved in the work of the younger men. Prominent among these is Oskar Kokoschka (b. 1886 in Austria), in whose early work appears the free distortion, sharp contrasts of light and shade, bold contours and thick impasto worked into arabesques, by which he conveys his excited and very personal vision. In his later work emphasis by these means is even more emphatic and merciless. The heads of his figures are balanced on tiny bodies, bizarre monsters are introduced, and the paint is literally thrown on to the canvas, with great channels made therein to mark the dominant lines of the design.

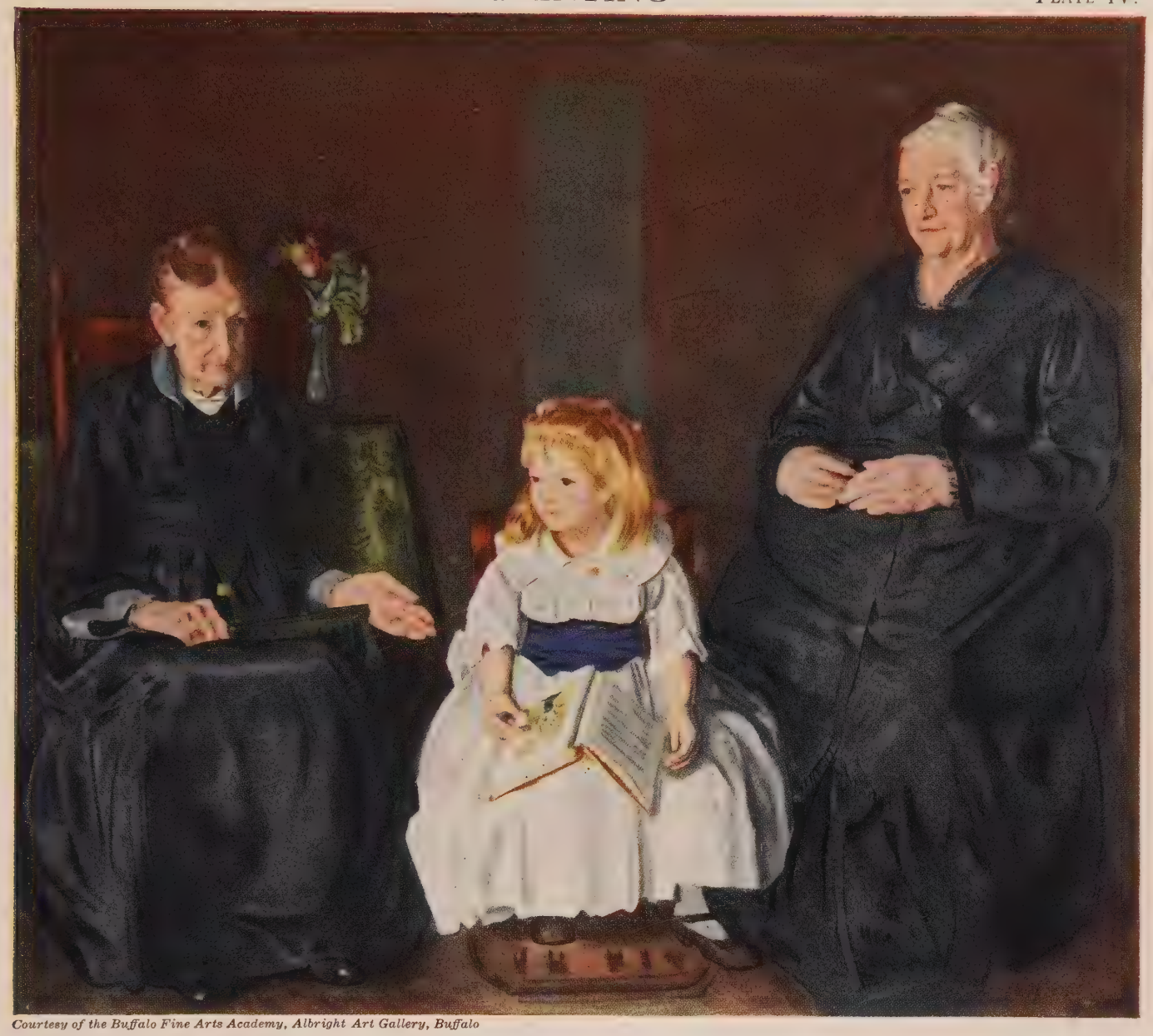
Painters of similar tendencies are Emil Nolde, Karl Hofer (whose work has affinities to that of Derain), and Karl Schmidt-Rottluff. The last, under the influence of negro sculpture, has become a coarser Matisse. The influence of an earlier generation of Frenchmen is seen in Max Pechstein (b. 1881), a founder of the "Brucke" expressionist group in Dresden, whose work owes much to Gauguin; and in Albert Werszgerber and Carl Caspar, both of whom base their design and use of colour on Cézanne. Max Slevogt (b. 1868) and Lovis Corinth (1858–1925) were among the leaders of the Berlin Secession, a split in the Berlin Kunstverein which marked the rise there of the modern movement. Both owe much to Matisse; Slevogt as a figure painter, Corinth in landscape. Associated with them in the Secession was Edward Munch (b. 1862 in Norway), who stands somewhat apart in his combination of realism and fantasy influenced by Manet, Toulouse-Lautrec and Seurat.

Russia.—In Russia the influence of French art has been no less marked than elsewhere, but has taken peculiar and characteristic shape. Towards the end of the 19th century Western, and in particular French, influence was represented by the realistic historical painters such as Ilya Repin and by a group of *plein-air* landscape painters. In reaction against their naturalism a decorative school developed, corresponding somewhat to the English Pre-Raphaelites, basing its work on old Russian art, and represented by Vassily Surikov (1848–1916) and Victor Vasnetzov.

Of this reaction the modern movement is really a development. One form it has taken is represented by Mikhail Vrubel (d. 1910), whose mystical symbolism recalls that of Gustave Moreau in its search to express things of the spirit in pictorial form; while Petroff-Wodkin is nearer to the French *fauves* in his simplified and distorted nudes and arbitrary use of colour. More important is a Petrograd group, consisting of historical painters whose aim is to reconstruct in decorative form a past epoch; not from living models dressed in costume of the period, but from the close study of every form of contemporary record. Thus the movement is primarily intellectual and literary, and has produced an art which, for all its refinement and delicacy, is inclined to be precious and a mere *réchauffé* of already used material.

Within the movement one group looks to the West. Alexander Benois has concentrated on the age of Louis XIV.; Konstantine Somov, the most individual of all, upon the period of 1830; and Eugène Lanceray upon the court of Elizabeth and Peter the Great. Stelletsky and Count Komatovsky, on the other hand, have gone to old Russia for their motives. Stelletsky is the purist of the group, his reconstructions of Russian mediaeval life being based on minute archaeological study of ikons, service books and similar sources. Nicolas Roerich has departed from strictly documentary methods in seeking to reconstruct primeval and prehistoric Russia in his fantastic flat decorations based on Russian legends, and thereby joins hands with the group represented by Vasnetzov. Rather apart is Boris Anrep (working now in England), who studied Byzantine art and the ikon, not in an archaeological spirit, but as exemplifying a means for the expression of human emotion. His work is principally in mosaic, submission to whose limitations, he holds, makes for the simplicity and directness which are often lost amid the technical possibilities of oil paint.

The close connection of modern Russian art with the theatre is another important characteristic, which has grown directly out of the decorative reaction against realism. Leon Bakst (d. 1925) represents one side of this. Originally associated with



Courtesy of the Buffalo Fine Arts Academy, Albright Art Gallery, Buffalo

"ELINOR, JEAN AND ANNA" BY GEORGE BELLOWS

(The artist's aunt, daughter and mother)

George Bellows set down fearlessly—and quite against the traditions—life as he saw it. His searching analysis and observation, and great originality in figure composition, give his work a vitality, a virility, that Americans like to call typically national.

the Petrograd historical group, he came into touch with Serge Diaghilev and became one of the chief designers of settings for the Russian Ballet. His use of line and colour relates him to the East; but, like Benois and Somov, his outlook and method are those of the West. Distinct in character is the art of Nathalie Gontcharova and M. Larionov. Using the methods of the Petrograd group, they took their material from Russian peasant art, as represented in the decoration of articles in daily use and in the "lubok," the Russian equivalent of the "images d'Épinal." This gives their earlier work notable simplicity and directness. French influence was not to be denied, however, and Gontcharova's setting for the 1914 production of the "Coq d'Or" and Larionov's "Les Contes Russes" of 1915 mark the invasion of the theatre by cubist ideas. The colour scheme was still that of Russian peasant art; but the design was based on abstract forms, and aimed at a rhythm in harmony with the music and the dances. To this development the name of *rayonnisme* has been given. Settings by French painters (notably Derain, Braque and Picasso) have strengthened French influence.

Other Countries.—Though the modern outlook in painting has had influence in Scandinavia, America and Australia, it has not taken a form specially characteristic of local conditions or national temper. Painting in Australia is mainly a backwash from English impressionism: and the accomplished pen drawings of Norman Lindsay, which attracted much attention when exhibited in London in 1923, are little more than skilful pastiches on Rops and Beardsley. In Canada, on the other hand, has developed a distinct local school of landscape painting marked by decorative breadth of handling and feeling for the distinctive character of the country. Norwegian and Swedish painting is also mainly derivative, combining impressionist or expressionist ideas from France with flat decorative treatment in broad masses of colour inspired from Germany.

Much of the criticism levelled at the modern movement, like that once directed against impressionism, is merely a violent statement of personal preference. Weightier arguments point out that the emphasis given in the modern movement to the third dimension merely exalts one element in natural appearance, and urge that since the painter works on a flat surface design must ultimately be based on the play of contour. Also, it is said, modern methods of simplification and distortion tend to become formulas which prevent sincere and spontaneous expression no less than older conventions. But contention chiefly centres round the question of representation. It is argued that a purely abstract art, which takes no account of the ideas and emotions conveyed by the objects represented, is a limited and empty affair. Rhythm in the plastic arts, no less than in literature, must emphasise some meaning; and form takes on a significance by association, if not with specific objects, yet with general ideas of mass, space and movement. Recent work has to some extent justified and admitted these criticisms, partly by the greater tendency to flat patterning as compared with expression of volume, partly by the increasing weight given to representations of natural appearance.

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PALAEOBOTANY (*see* 20.524).—Palaeobotany or the science of the study of fossil plants has three main aspects, dependent on the nature of the remains available for study.

(1) External impressions and casts of plants, such as fern leaves found in shale beds, for instance, which are given specific names and often are of value in connection with stratigraphy and the sequence of the extinct floras of various geological epochs. The identification and correlation of these fragments is essentially an international work, and depends on a wide knowledge of the type specimens in all countries.

(2) Petrifications of the inner detail and cellular anatomy of fossil plants, such as stems, seeds, etc., found principally preserved in silicified or calcified mineral balls or nodules, primarily of botanical interest in revealing the structure and life histories of extinct types. The originators of the meticulous kind of investigation they require were principally the French, English and German palaeobotanists of last century, though now petrified remains are being discovered and investigated in many countries.

(3) The peculiarly preserved "mummified" masses of plant material known as coal of whatever geological age, the exact nature and detailed structure of which has long been the subject of speculation. In spite of its huge commercial importance, it has received but scant investigation on truly scientific lines. Collaboration between palaeobotanists and chemists as well as geologists, is yielding a mass of new data, principally about British and American coals (*see* COAL).

Relations with Anatomical Botany.—Progress in palaeobotany essentially goes hand in hand with that in anatomical botany, each stimulating and filling in the gaps in the other, and it is more and more becoming impossible to discuss the anatomy or the phylogeny of the great groups of living plants without reference to their fossil ancestors.

Angiosperms.—The Angiosperms, the greatest of all living groups, have principally yielded plant "impressions" rather than anatomical material. These are common in a number of Tertiary and Upper Cretaceous horizons, and voluminous memoirs have been published on them in recent years, principally by E. W. Berry of America. The Dakota sandstones have yielded perhaps the handsomest series of large angiospermic leaf impressions in the world. From the United States also emanated substantial work on the angiospermic leaf impressions of the West Indies by Hollick (1924). A memoir from China, published at Peking (1922), is R. Florin's account of the plant impressions of early Tertiary age of Manchuria. Upper Cretaceous Angiosperms were described by Stopes and Fujii from Japan, among which is the earliest known petrified flower. This is of monocotyledonous type.

Tertiary Material.—In England, the rich deposits of Tertiary material, so long neglected, have been partly investigated by the newer methods which yield microscopic data about the cuticles, by H. Bandulska (1923–4). Similarly R. Kräusel had investigated Tertiary impressions, discovering many interesting microscopic fungi upon the remains. The Arctic floras were revised (1925) in a jubilee memoir by Seward. Whether the Monocotyledons or the Dicotyledons are the more primitive is not settled by the fossil record. With the exception of palms, fossil Monocotyledons are very few. Many discussions have raged about the evidence afforded by the angiospermic fossil floras on ancient climates, particularly centring around Dr. Knowlton of America. A greater regional diversity, and less world-wide similarity of climate over long epochs than was formerly assumed, may be taken to be the main result of closer investigation (*see* CLIMATE).

The origin and phylogenetic source of the Angiosperms is still a mystery. Authenticated leaf impressions do not go very far back, and petrified Angiosperms are exceedingly scarce in the earlier Cretaceous deposits, and unknown before that. In spite of various identifications, no reliable material of modern angiospermic type has been found as early as the Wealden in Britain or approximately the Neocomian in any part of the world. Impressions claimed to be such have proved to be portions of fern leaves with reticulate venation, such as *Dictyophyllum* (Berry and Stopes).

The earliest authentic Angiosperms in the world are from the Lower Greensand or Aptian, of England. This flora is of a rich mixed type, is markedly distinct in other ways, and contains the famous *Bennettites Gibsonianus* of Carruthers, and many conifers as well as ferns. The Angiosperms, discovered by

Stopes, are well petrified portions of secondary woods, and are of 5 genera, named *Cantia, Woburnia, Sabulia, Aptiana* and *Hythia*. They are unlike each other anatomically, one having enormous wood vessels, and another very minute, nor do they show any "primitive" or pseudo-angiospermic features. They have the characteristics of highly organised angiospermic secondary timbers.

The origin of the Angiosperms clearly lies in an earlier geological epoch. Jeffrey and his American school have enunciated the view that the soft small herbaceous plants now living are less primitive than the woody trees. The matter still awaits further data from actual species of an early geological age. Interest in such theoretical discussions has been greatly enhanced by the discovery and description by H. H. Thomas of his Jurassic genus *Caytonia*.

Gymnosperms.—Gymnosperms, of tree-like build, date back to very early palaeozoic times, and are represented by a rich variety of material, including external casts, "mummified" cuticles and well-petrified woods. A steady stream of memoirs dealing with the comparative anatomy of fossil and living Gymnosperms has been maintained.

Petrified remains of numerous genera of the modern Coniferae are found throughout the Tertiary and Mesozoic horizons. Whether the Abietineae or Araucarineae are the older stock is much discussed. The latest edition of Scott's classic textbook (1923) leaves the subject still open. The ancient gymnospermic types of the Cordaiteae were most abundant and varied in the Carboniferous epoch, but persisted into the Permian and were already well established in the Upper Devonian. Anatomically preserved stems and leaves yield some of the most beautifully petrified and satisfactory material for microscopic study. Notable early representatives of this group were found at the very base of the Carboniferous of Kentucky and described by Scott and Jeffrey. Various species form series of almost connecting links between this Palaeozoic group and the typical pteridospermic types. Very full descriptions of those interesting seed plants are to be found in Scott's "Studies."

Returning to the higher group, the Bennettitales, we have to deal with another entirely extinct, but pre-eminently Mesozoic family. A few stragglers died out in the early Tertiary, but the rich growths preserved in such perfection and abundance which proved the basis of the discoveries of Carruthers, Wieland, Lignier and Stopes, all date from the Mesozoic. Wieland's two magnificent volumes (1916) contain restorations of these unique plants which have served as the theme of countless discussions. The fructifications, preserved both as surface casts and as petrified cones, even containing the tissues of the embryos, consisted of seed-bearing cones surrounded by perianth-like bracts. The mass of seeds contained in some of those must have been enormous, *e.g., B. albianus*, Stopes, from the English Gault, had not less than several thousand seeds in one cone.

Though the external appearance and vegetative anatomy of the group were generally like those of the living cycads, the fructification irresistibly recalls that of the Angiosperms, and many authors have compared them and concluded that the Bennettitales point out the line of descent of the Angiosperms. This view does not generally commend itself. The other great Mesozoic group, the *Williamsoniaceae*, chiefly known through Nathorst's work on Swedish forms, and more recently by Thomas's beautiful species from the English Jurassic, seems to be a more popular candidate for the honour of fathering the Angiosperms. The series linked up by *Williamsoniella, Caytonia* and *Gristhorpia* is one of the most beautiful results of recent palaeobotanical work; but their angiospermic affinity is more critically treated on the Continent than in England, particularly by Gothan in Germany. The abundance of the Bennettitales in Europe and America makes the dearth of the group in Asia conspicuous, and interest thus attaches to the brief account of a trunk from Hokkaido, Japan, by A. Kryshtovovich.

Cycadales.—The modern Cycadales, though primitive among living plants, are unimportant in the fossil record, which contains but little evidence of their history.

Pteridosperms.—The Pteridosperms, a wholly extinct group, bulk largely both in actual number of specimens and in the interest and importance of their structure in the Carboniferous epoch. To impressions of their foliage, long considered true ferns, numerous generic names have been given, such as *Sphenopteris, Alethopteris*, etc. The stems and seeds investigated principally by Williamson, Scott, Oliver and Kidston were, just before 1910, all linked in association with each other to form the phylogenetically pregnant group of the "seed ferns" or Pteridosperms. Much detail has since been added, which is well summarised in Scott's "Studies."

Pteridophytes.—The Pteridophytes, or ferns proper, are extensively represented in all types of preservation in all geological epochs. Considerable detail has been added to the existing knowledge of the group since 1915. Anatomical data have been chiefly acquired about Carboniferous species. Of families with living representatives the most important extensions of knowledge have been made in the Osmundaceae in which family Kidston and Gwynne-Vaughan (1914) have been the most notable in filling in anatomical series for a wide range of geological time.

The Marratiaceae.—These are represented in the Coal Measures and Permian by the large and well preserved genus *Psaronius*, has long been well known, but knowledge was usefully clarified and increased by P. Bertrand in his paper on the anatomy of ancient ferns and Count Solms-Laubach on *Psaronius* (both in 1911) followed by Pelourde in 1912.

Tempskya, an extinct type of peculiar anatomical structure and wide geological distribution, was at last made clear by the work of Kidston and Gwynne-Vaughan. Access to their original paper, published in Russia, is difficult and reference should be made to Stopes (1915) and Seward (1924). The extinct family of the Botryopterideae, the most extensive Carboniferous family, is represented by many genera known from exceptionally detailed studies of excellent petrifactions, particularly by Bertrand, Scott, Kidston and Gordon. The sporangia and cuticle structures of many species of ferns have also been studied by the modern methods of treating mummified remains, and results from the Palaeozoic and Mesozoic supplement and give significance to the work of Bower on recent ferns.

Lower Pteridophyta.—Of the *Lycopodineae* almost the whole of our present anatomical knowledge was accumulated before 1910. The same applies to the *Calamarieae*, with the exception of Thomas's paper on the leaves in 1911 and the elaborate memoir on the Calamites of Western Europe by Kidston and Jongmans. In the more primitive groups, active interest was shown by Halle in the Devonian flora from Norway. He described the external morphology and some structural details of a number of species which have proved of the greatest morphological significance. Kidston and Lang followed with details of the Devonian flora contained in the now famous Rhynia cherts.

Psilophyton.—This has now become of peculiar interest since *Rhynia* has been discovered in plentiful anatomical material. This and other Devonian genera have been described by Kidston and Lang in several large memoirs, and a new class, the Psilophytales, has been instituted to include *Psilophyton, Rhynia* and some minor genera. The essential and most interesting morphological feature is that the simple branching plants bore sporangia at the ends of certain branches without any relation to leaves or leaf-like organs. *Sporangites* of Halle, *Psilophyton* of Dawson, and the new genera of Kidston and Lang represent the earliest known land flora, and though the genera differ in details they all show a remarkable simplicity of structure, with terminal sporangia. Their anatomy and morphology are still under discussion, and are of deep phylogenetic and morphological significance. The view put forward by Kidston and Lang, contrary to that held by most morphologists, is that this ancient family supports the idea that the sporangium of the Pteridophyta is not an organ *sui generis*. The *Characeae*, an old family still persisting, has received careful handling by J. Groves, with the discovery of many beautiful new fossil forms.

The Bryophytes are still almost unknown as fossils, but two papers on some fossil mosses have recently been published, one

by Walton and another by Weyland (1925). Certain bryophytic features in the genus *Hornea* from the Devonian have led to discussion of the morphology and phylogeny of the groups, but the gaps in the fossil records of mosses are so all embracing that one can only await the discovery of material.

Algae and Fungi.—Algae and fungi are special palaeobotanical problems, and the chief recent worker in this field is J. Pia who has published a number of smaller and one very large memoir on the Siphoneae (1920) but apparently in complete ignorance of the volume on the same subject published by the British Museum. Incidental to other genera, microscopic fungi are now frequently described, particularly in petrified woods. Memoirs on the stratigraphic aspects of fossil plants, describing fossil floras from various localities and horizons, have been numerous, notable cases being the last paper published by the great Nathorst, on the Culm flora of Spitsbergen (1920), a continuation of his famous studies of the fossil floras of the Arctic, and the magnificent memoirs by R. Kidston, on which he was engaged at the time of his death, of which four parts had been published by the Geol. Survey, with numerous plates. Kidston's unrivalled work on the British Coal Measure plants reveals the richness of our native fossil flora, and links up all branches of palaeobotanical work in complete surveys of Carboniferous genera. Some small memoirs on the German Culm come from the pen of Robert Potonié junior, the son of the famous Berlin professor. From the antipodes Dr. Walkom's series of memoirs on the fossil impressions and petrified plant remains of Queensland throw welcome light on an area of which far too little is known. The historically interesting Indian Gondwana flora is revised in a handsome memoir by Seward and Sahni (1920) and Yabe added to our very scanty knowledge of oriental fossil plants in the memoirs published by the Imperial University (1921–2). As general resumés of what has been accomplished, A. Carpentier's *Revue* of palaeobotanical works is invaluable, and we must regret that the two most recent volumes (1923) carry the subject no further than 1919.

Coal.—Among the most comprehensive works of the old school is the exhaustive memoir, *Interrelations of the Fossil Fuels*, by Stevenson (1916). An immense amount of more detailed work has been accomplished. Many of the earlier workers (Dawson, Williamson, Huxley and others) had been interested in the spores and small débris of plants to be seen in sections of some coals, and in recent years Lomax had done much to popularise in botanical and geological circles, transparent thin sections of coal showing preserved plant remains. Stimulated by the importance fuels assumed in the War, more exact correlations and investigations into coal structure were attempted. Stopes and Wheeler's *Memoir on the Constitution of Coal* (1918) was shortly followed by Stopes's paper on the "Four Visible Constituents in Banded Bituminous Coal" (1919) in which the four ingredients *Fusain*, *Durain*, *Clarain* and *Vitrain* were detected and diagnosed. These terms have passed into the universal nomenclature (*see* COAL). The chemical, coking and other properties of the constituents have been studied in further detail by Wheeler, Lessing, Sinnott, Tideswell and others. Somewhat similar work is also being carried on in Japan by Iwasaki (see *A Fundamental Study of Japanese Coal*, 1920–2) and in the United States by Jeffrey, White and Thiessen. The latter's work introduces the name "anthraxylon" to represent "woody tissue" and applies it at times where woody tissue is not proved to have existed, and treats it as though it were the equivalent of "vitrain" which it is not. In spite of this, however, rapid advance in our knowledge of the marvellous masses of mummified plants is being made.

The mass of coal is no longer looked on as a unit, but the attempt is being made to separate out its component parts and to arrive at the chemical and palaeontological structure of minute zones of coal, which contain portions differing both in their anatomical, physical and chemical natures, the ash content, coking qualities and other correlated features.

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PALAEONTOLOGY (*see* 20.579).—During the period 1910–26 the science of extinct forms of life made remarkable progress, especially in North America, where explorations and studies were less interrupted by the World War. The contact of palaeontology with other sciences—even those apparently remote like astronomy, physics and chemistry, less remote like comparative anatomy, or very intimate like geology—was one of the outstanding features of the synthetic work accomplished. Of transcendent interest, however, was the contact between mammalian palaeontology and anthropology, especially through the researches of William K. Gregory of the American Museum of Natural History and of G. Elliot Smith of London University.

Principal Synthetic Works.—Chief among the synthetic works in pure palaeontology are those of the Austrian palaeontologist Othenio Abel, *Grundzüge der Palaeobiologie der Wirbeltiere* (1912), *Die Stämme der Wirbeltiere* (1919), and *Lehrbuch der Palaeozoologie* (1920), which give masterly reviews of the whole fossil history of the vertebrates, especially in analogous and convergent adaptation. In invertebrate palaeontology the reader is referred to Amadeus Grabau's *Principles of Stratigraphy* (1913) and *Textbook of Geology* (1920–1), in which are summed up the principles derived from the teachings of Waagen and Neumayr in Germany, of Hyatt and Beecher in America, in pure palaeontology and in application to geology. A broad synthetic treatment of climate and time in relation to the evolution of life is that of the late Joseph Barrell (1917) in his *Rhythms and the Measurements of Geologic Time*. The best synthetic treatment of climate, time and geologic change in relation to the geologic origin and the migration of the different vertebrate groups is William Diller Matthew's *Climate and Evolution* (1915). The subdivisions of geologic time and the successions of faunas and climates are broadly reviewed in the *Textbook of Geology* by Louis V. Pirsson and Charles Schuchert (1915; rev. ed., vol. 1, 1921). The latest summary of the geology, past physiography and palaeontology of the world is found in the French edition of the great work of Eduard Suess, *Das Antlitz der Erde*, translated and annotated by Emmanuel de Margerie as *La Face de la Terre* (1902, 1918). The comparative evolution of the mammalia of the eastern hemisphere and of North America is broadly treated in Henry Fairfield Osborn's *Age of Mammals* (1910); while the mammals of North and South America are compared in W. B. Scott's *History of Land Mammals in the Western Hemisphere* (1913). A broad treatment of the whole subject of invertebrate and vertebrate evolution is given in Richard S. Lull's *Organic Evolution* (1917) and a synthetic review of the earth's history, from its solar beginnings to the Age of Man, in Osborn's *Origin and Evolution of Life*.

Life Epochs of Geologic Time.—The time scale in the accompanying table is taken from the work of Pirsson and Schuchert of 1915, modified by the substitution of geologic *time units* for *years*. There is a growing indisposition to reckon past time in terms of years, and a growing tendency to substitute a relative term like *time units*, because of the enormously wide discrepancy between the older estimates of geologists, based on sedimentation and the thickness of the various assemblages of rocks which taken together make up the whole geologic time scale, and the estimates of physicists, based on the slow liberation of radium from radioactive minerals. The radium estimates of the age of the earth range as high as 1,400,000,000 years for the oldest known rocks, according to Barrell, who has adopted the calculations of Rutherford and others based on the "rate of disintegration" of radioactive minerals (*see* PHYSICS). For the contrast see the table on p. 14.

The most original part of Barrell's contribution was the measurement of time from the base of the Palaeozoic to Recent time by new palaeophysiographic methods, taking into account particularly the rhythms or cycles of dry and moist climates and of elevations and depressions, theories which were originally interpreted by T. C. Chamberlin and popularly treated by Ellsworth Huntington, the physiographer of Yale University.

Life Epochs	Walcott (1893) Years	Barrell (1917) Years
Age of Man and of Mammals—Cenozoic	3,000,000	55,000,000–65,000,000
Age of Reptiles—Mesozoic	9,000,000	140,000,000–180,000,000
Age of Amphibians, Fishes, Invertebrates—Palaeozoic	18,000,000	360,000,000–540,000,000
Precambrian Time—Evolution of Invertebrates and of Unicellular Life	30,000,000	600,000,000–800,000,000
Minimum Total	90,000,000 (Geikie, 1899)	1,200,000,000
Maximum Total	400,000,000 (Geikie, 1899)	1,400,000,000

A few decades ago the physicists and mathematicians, especially Kelvin and Tait, insisted that the earth could not be more than 10,000,000 to 20,000,000 years old; now the physicists are extending the age of the life period to 1,400 million years, as estimated by Barrell (1917). The most recent determination by physicists, as reviewed by Lord Rayleigh (1921), takes into consideration the transmutation of chemical elements, for example, in the bröggerite of the Precambrian rocks at Moss, Norway:—

> Taking the lead as all produced by uranium at the rate above given, we get an age of 925,000,000 years. Some minerals from other archaean rocks in Norway give a rather longer age. . . . The helium method is applicable in some cases to materials found in the younger formations, and proves that the ages even of these are to be reckoned in millions of years. Thus the helium in an Eocene iron ore indicated 30,000,000 years at least. . . . The upshot is that radioactive methods of research indicate a moderate multiple of 1,000 million years as the duration of the earth's crust as suitable for the habitation of living beings, and that no other considerations from the side of pure physics or astronomy afford any definite presumption against this estimate.

Applying this estimate to the evolution of a familiar mammal like the horse it might be said that the four-toed horse (*Eohippus*) existed 30,000,000 years ago, a somewhat larger estimate of the life period of the horse than that demanded by palaeontologists. In the same discussion W. J. Sollas comments on the expansion of time estimates proposed by physicists:-

> The age of the earth was thus increased from a mere score of millions to a thousand millions and more, and the geologist who had before been bankrupt in time now found himself suddenly transformed into a capitalist with more millions in the bank than he knew how to dispose of (*see* GEOLOGY).

In this connection we may recall the fact that as early as 1859 Charles Darwin pointed out that the high degree of evolution and specialisation seen in the invertebrate fossils at the base of the Palaeozoic, namely, the Cambrian, proved that Precambrian evolution occupied a period as long as, or even longer than, that of Cambrian to Recent time (*see* Table I.). Poulton, the leading disciple of Darwin in England (1896), declared that 400,000,000 years was none too long for the whole life evolution period; this would allow 200,000,000 years for Precambrian time and another 200,000,000 years from Cambrian to Recent time.

Walcott's Revelation of Precambrian and Cambrian Life.—Charles D. Walcott (1899, 1914) has discovered the remains of life in the Precambrian (Proterozoic) rocks of North America and has been able to give us a fragmentary picture of the fauna and flora of that very ancient period. In Montana, at a depth of nearly 10,000 ft. below the earliest Palaeozoic rocks (Cambrian), he found evidence of ancient reef deposits of calcareous algae, which ranged upward through 2,000 ft. of strata. Above these reefs are 3,000 ft. of shales containing worm trails and the fragmentary remains of large crustacean-like organisms. From rocks of approximately the same age in Ontario, Canada, he has described sponge-like forms (*Atikokania*) which are of such generalised structure that it is difficult to decide whether they should be regarded as sponges or as archaic corals. These few plant and animal remains are all that are known from remotely metamorphosed rocks of Precambrian time, but the existence of annelids and possible arthropods marks a break into the hitherto unknown Precambrian. Walcott's most surprising discovery in Precambrian time is a monad or bacterium attributed to *Micrococcus* sp. indet. from the Algonkian of Montana, but probably related to the existing *Nitrosomonas*, one of the prototrophic bacteria, which derives its nitrogen from ammonium salts.

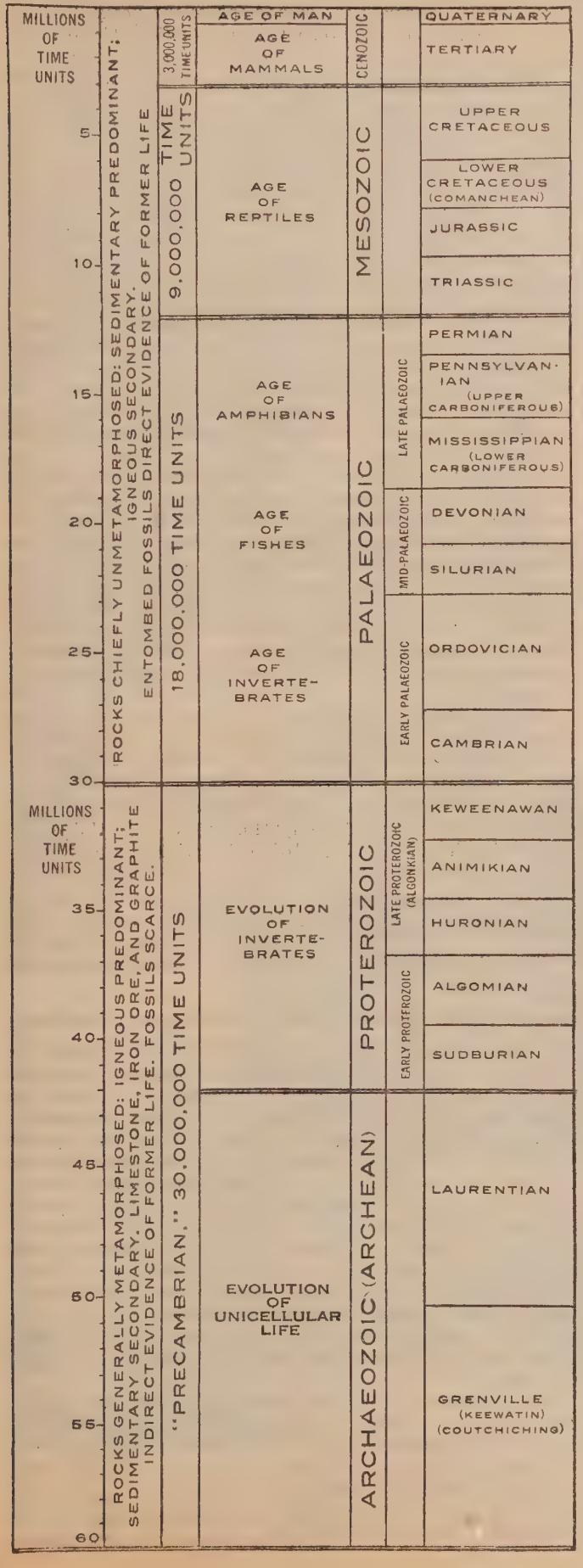
In 1910 Walcott discovered in the Cambrian (Burgess) shales of Alberta, Canada, a marvellously rich fauna whose preservation is so perfect that the setae of the worms, the jointed appendages of the trilobites, the impressions of soft-bodied medusae and holothurians, and even the alimentary tract and stomach of certain of the crustaceans can be seen on the shale surfaces almost as clearly as in living forms (Plate I.). This discovery fairly revolutionises our knowledge of the anatomy of the delicately organised as well as the chitinous-armoured forms, like the trilobites. Including the new forms contained within these Albertan shales, the Cambrian marine fauna is now known to be far more abundant than even imagined by Darwin, comprising some 1,500 species, 1,200 of which occur in North America. From Lower as well as Middle Cambrian (Burgess) faunas, it appears that the Precambrian invertebrates had probably become completely adapted to all the life zones of the continental and oceanic waters, excepting possibly the abyssal. All the principal phyla—the jointed arthropoda (including the trilobites among the crustaceans and the merostomes among the arachnids), segmented worms (Annelida), echinoderms, molluscs (including pelecypods, gastropods and primitive cephalopods), brachiopods, medusae and other coelenterates and sponges—were presumably established in Precambrian times.

The Cambrian fauna has been made known to us in large measure through the field discoveries and monographic studies of Philip Lake (1906) for Great Britain, of Walcott (1909–21) for North America and of Cowper Reed (1915) for India. The great variety and high specialisation of the Cambrian marine forms, including representatives of all the known marine invertebrate phyla, is in harmony with the trend of discovery among the vertebrates, which is to put the origin of existing families very far back into the Age of Mammals and even into the Age of Reptiles (Mesozoic). In fact, the antiquity and persistence of modern types, as distinguished from modern genera and species, is an illustration of a very far-reaching principle, namely, that the *most stable form of energy in matter known is that of the heredity chromatin* on which this extraordinary preservation of the main features of the ancestral type depends. Next to the stability of the properties of the chemical elements, which pass into each other by transmutation, the most stable physicochemical properties are those which form the heredity basis of life.

Freshwater and Terrestrial Origins.—The eurypterids appear as contemporaries of the Cambrian trilobites and traces of them are found in Precambrian rocks; they attain to their acme in Silurian time and develop into the eight-foot giants of the fauna of the Devonian of Scotland and eastern North America, suffering extinction at the close of the Palaeozoic. In 1916 appeared Marjorie O'Connell's memoir, entitled *The Habitat of the Eurypterida*, giving as the summation of her studies that throughout their entire phylogenetic history the eurypterids lived in the rivers, a conclusion accepted in the main by Schuchert (1916), with the modification that they also appeared to have lived at times in the brackish waters of more or less large bays and possibly in limited numbers even in the seas. Many other origins formerly traced to the sea have more recently been traced to fresh water.

In 1900 T. C. Chamberlin put forward the hypothesis of a prevailing freshwater origin both for the ancestral backboned animals known as chordates as well as for the much more ancient arthropods, the eurypterids. His strong influence was needed to overcome the widespread notion that all forms of life originated in the sea; and, one after another, theories of freshwater and terrestrial origin have replaced the theory of marine origin. Early in 1916 Barrell pointed out the influence of Silurian-Devonian climates on the rise of air-breathing vertebrates and freshwater origin in Devonian time under seasonal rainfall.

TABLE I. *Life Epochs and Geologic Time Units of Europe and North America* (*After Pirsson and Schuchert, 1915; issued by Osborn in 1918*).



Schuchert continues that the probable freshwater life of the eurypterids opens a vista into continental life as far back as the Upper Cambrian. Other merostomes related to the eurypterids radiated out from the fluviatile faunas of Cambrian, Ordovician and Silurian time, while in the Devonian rivers dwelt great spider-like eurypterids together with forms so similar to scorpions that they might be called river scorpions, and others that were active swimmers. O'Connell's argument regarding the freshwater eurypterids applies equally to *Limulus*, the horseshoe crab. In brief, the existence of freshwater faunas no less varied than the marine faunas is beginning to be traced back to Lower Cambrian time. O'Connell shows that the entire phylogeny of the eurypterids, which includes about 160 species from the Precambrian to the end of the Palaeozoic, distributed in 78 geologic horizons throughout the world, points to migrations like those of fishes from the headwaters of interlacing river systems and, taken with other evidence, strongly supports the theory of Predevonian river life as opposed to the general assumption of marine life of all early faunas.

It now appears that beginning in Precambrian time the trilobites, by wide adaptive radiation, reached the acme of their development in the Cambrian, displaying a high degree of articulation and specialisation of appendages, suffered a marked decline after the Silurian, and became extinct at the end of the Palaeozoic. James Perrin Smith, who has made a very exhaustive analysis of cephalopod evolution and especially of the Triassic ammonites, observes that the evolution of form continues uninterruptedly even where there is no evidence whatever of environmental change.

Principal Literature, Cambrian to Pleistocene.—A few of the major contributions to our knowledge of the life of the Palaeozoic are: *Cambrian Geology and Palaeontology* (1910) and *Cambrian Brachiopoda* (1912) by Charles D. Walcott; *Cambrian Fossils of Spiti* (1915) and other papers on the Palaeozoic of India by Cowper Reed; *A Monograph of British Cambrian Trilobites* (1906) by Philip Lake, and *A Monograph of British Graptolites* (1901) by Gertrude Elles and Ethel Wood. The foraminifera have been treated by E. Schellwien, *Monographie der Fusulinen* (1908–12); the bryozoa by R. S. Bassler, *Early Palaeozoic Bryozoa of the Baltic Provinces* (1911) and G. W. Lee, *British Carboniferous Trepostomata* (1912); the echinoderms by R. T. Jackson in his memoir on the *Phylogeny of the Echini with a Revision of Palaeozoic Species* (1912), and by Frank Springer in his monograph *Crinoidea Flexibilia* (1920) and in numerous shorter contributions. The ancient arthropods, including, besides the trilobites, merostomes and other arachnids and also insects, have been described by J. M. Clarke and R. Ruedemann in their memoir on *The Eurypterida of New York* (1912), by Alexander Petrunkevitch, *A Monograph of the Terrestrial Palaeozoic Arachnida of North America* (1913), by R. I. Pocock, *A Monograph of the Terrestrial Carboniferous Arachnida of Great Britain* (1911), and by F. Meunier, *Nouvelles recherches sur quelques insectes du terrain houiller de Commentry* (Allier) (1906–12). The literature on the Mesozoic contains more references to ammonites than to other groups, because of their abundance and palaeontological importance. The ammonite faunas of the Triassic have been described by J. Perrin Smith, *The Middle Triassic Marine Invertebrate Faunas of North America* (1914), and by Carl Diener, *The Trias of the Himalayas* (1912), *Japanische Triasfaunen* (1915), and other papers on the Triassic of the Himalayas and southern Europe (1915).

For the Jurassic there are the classic volumes by S. S. Buckman, *Yorkshire Type Ammonites* (1909–19) continued in the *Type Ammonites* (1920) and the memoir by C. Burckhardt, *Faunes Jurassiques et Crétaciques de San Pedro del Gallo* (1912) for Mexico. The studies on Cretaceous ammonites have been more local in character and include: E. Stolley's *Beiträge zur Kenntniss der Cephalopoden der norddeutschen Unteren Kreide* (1911–2), D. N. Sokolov's *Zur Ammoniten Fauna des Petschoraschen Jura* (Russian) (1912), H. Yabe and S. Shimizu's *Notes on Some Cretaceous Ammonites from Japan and California* (1921), and numerous papers by A. de Grossouvre, W. Kilian and E. Haug for France and the Mediterranean region. The silicious sponges which are so well represented in the Mesozoic have received the most careful microscopic study by the students and followers of Zittel. Pioneer work was done in England by the late George Jennings Hinde, *A Monograph of the British Fossil Sponges* (1887–1912), and this work was followed in Germany by A. Schrammen's *Kieselspongien der Oberen Kreide von Nordwestdeutschland* (1910) and R. Kolb's *Die Kieselspongien des schwäbischen Weissen Jura* (1911). Special works on other groups are: *A Monograph of the Cretaceous Lamellibranchia of England* (1899–1912) by Henry Woods, *Synopsis des Spirobranches* (*Brachiopodes*) *Jurassiques Celto-Souabes* (1915–9) by the Swiss palaeontologist Louis Rollier, and Clarke and Twitchell's *The Mesozoic and Cenozoic*

Echinodermata of the United States (1915). Among the major contributions to Mesozoic stratigraphy and entire faunas or floras may be mentioned: Victor Uhlig's *The Fauna of the Spiti Shales* (1903), Carl Renz's *Die mesozoischen Faunen Griechenlands* (1911), G. R. Wieland's *American Fossil Cycads* (1906–16), and E. W. Berry's *The Upper Cretaceous Floras of the World* (1916).

For the Tertiary life especial reference should be made to the contributions on different groups made by Thomas Wayland Vaughan (corals), E. W. Berry (plants), J. A. Cushman (foraminifera), R. T. Jackson (echinoderms), Mary Rathbun (crustaceans), A. Pilsbry (cirripedia), and others in *Contributions to the Geology and Palaeontology of the Canal Zone, Panama, and Geologically Related Areas in Central America and the West Indies* (1919). The bryozoa have been carefully described and beautifully illustrated by Ferdinand Canu and Ray S. Bassler, *North American Early Tertiary Bryozoa* (1920), while the foraminifera have been described in equal detail by Joseph A. Cushman in numerous contributions, and by H. Yabe (1921) and H. Douvillé (1911). For other groups we may note: J. Lambert's *Description des Echinides des terrains néogènes du bassin du Rhône* (1911–6), F. W. Harmer's *The Pliocene Mollusca* (1914–20), and papers by W. H. Dall on the mollusca. A general résumé of the Pleistocene vertebrate and invertebrate life is embodied in F. C. Baker's *The Life of the Pleistocene or Glacial Period* (1920). Stimulating general reviews of the progress of invertebrate palaeontology are the presidential addresses by F. A. Bather, *Fossils and Life*, British Association (1920), by Ruedemann, *The Palaeontology of Arrested Evolution* (1916), and by Clarke, *The Philosophy of Geology and the Order of the State* (1917).

Progress in Vertebrate Palaeontology

Personnel: Advent of the Fourth Generation.—The principal feature of the period has been the advent of a new generation of explorers and workers in vertebrate palaeontology who, in a sense, constitute a fourth or "20th century" group. Beginning with Cuvier (1769–1832) as founder of the science and leader of the first group, the second group embraced the British anatomists Richard Owen (1804–92) and Thomas Henry Huxley (1825–95), the French leader Albert Gaudry (1827–1908), the Swiss palaeontologist Ludwig Rütimeyer (1825–95), and the three great Americans, namely, Joseph Leidy (1823–91), Edward Drinker Cope (1840–97), and Othniel C. Marsh (1831–99). These men marshalled the first positive proofs of vertebrate evolution in Europe and America; they worked more or less independently as pioneers and laid the entire foundation of the modern classification of the Vertebrata. The leader of the third group was the Russian, Waldemar Kovalevsky (1842–83), who instituted intensive investigation of mechanical adaptation in relation to natural selection.

Of the same period are A. Smith Woodward (b. 1864) and C. W. Andrews (b. 1866) in England, Marcellin Boule (b. 1861) and Charles Depéret (b. 1854) in France, Louis Dollo (b. 1857) in Belgium, Max Schlosser in Germany, Giovanni Capellini (b. 1833) in Italy, and in America William B. Scott (b. 1858) and Henry Fairfield Osborn (b. 1857). This group includes also Samuel Wendell Williston (1852–1918), and Ramsay H. Traquair (1840–1912). Scott treated chiefly mammals, Williston chiefly reptiles and amphibians, while Osborn treated both mammals and reptiles. The principal accomplishment of this third school has been (1) to conduct world-wide exploration, (2) to correct, co-ordinate and firmly establish the great classifications proposed by the second school and (3) to fill out the details and principles of phylogeny or lines of reptilian, avian and mammalian descent. The leading explorer of this period was John Bell Hatcher (1861–1904), who brought together a large part of the materials for two great monographs of the United States Geological Survey, Osborn's *Titanotheres* and the Hatcher-Lull *Ceratopsia;* he also made the wonderful collection of South American fossils which forms the basis of Scott's monumental memoirs of the Princeton University Expeditions to Patagonia during the years 1896–9. Osborn's monograph *The Titanotheres* (an Eocene-Oligocene family of mammals), twenty-one years in preparation, has been completed but not published; others of his memoirs are the *Equidae of the Oligocene, Miocene and Pliocene of North America* (1918) and *Camarasaurus, Amphicoelias and other Sauropods of Cope* (1921). Williston's monographs are chiefly on the Cretaceous mosasaurs and the archaic Reptilia of the Perm-Trias, to which he made most notable contributions. Of this period were Florentino Ameghino (1854–1911), the distinguished vertebrate palaeontologist of Argentina and Eberhard Fraas (1862–1915) of Stuttgart. Oliver P. Hay (b. 1846) is also of this group, author of the monograph of the *Fossil Turtles of North America* (1908) and the invaluable *Bibliography and Catalogue of the Fossil Vertebrata of North America* (1902).

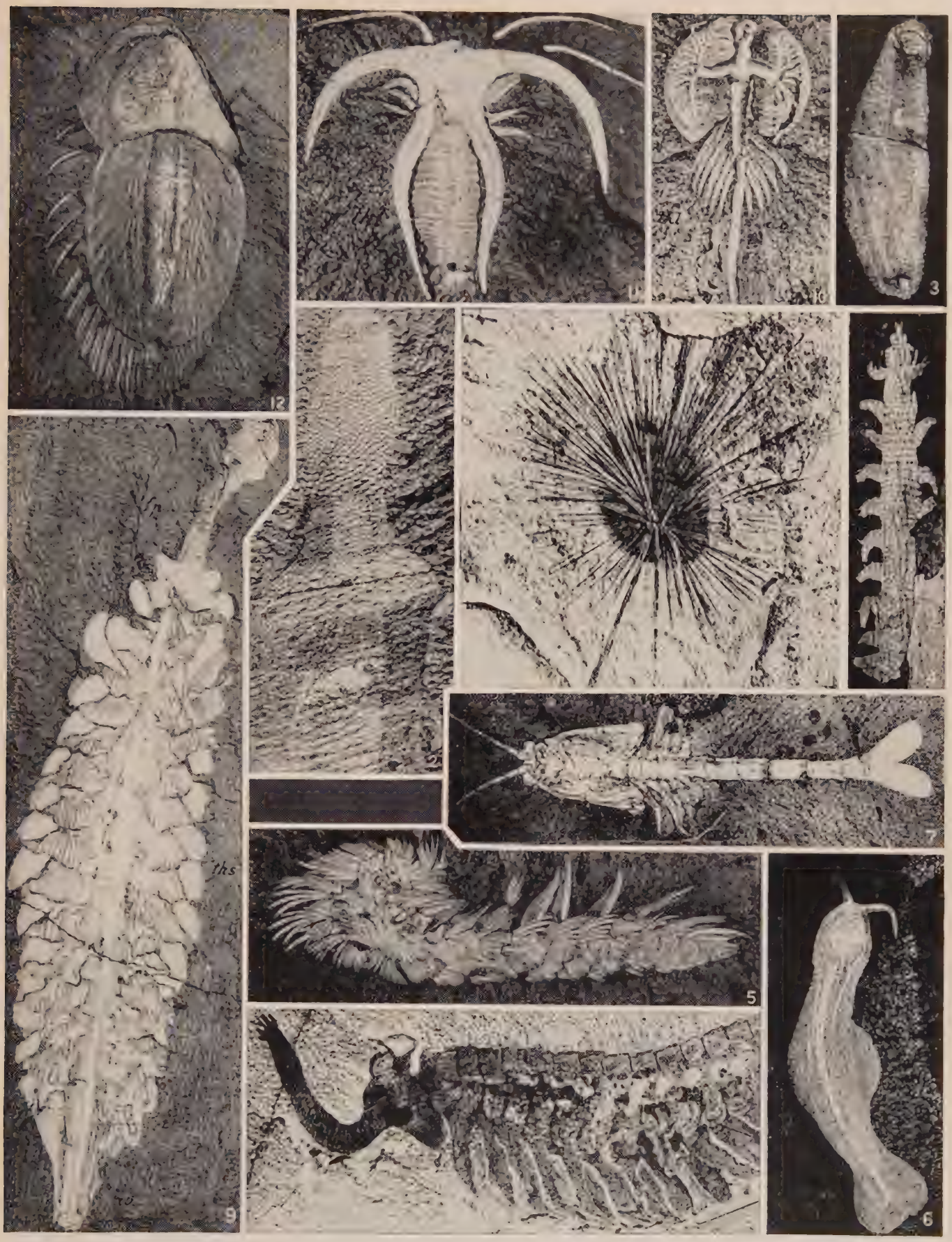
To the fourth group of vertebrate palaeontologists belongs the school trained by Professor Osborn in the American Museum of Natural History, of which the senior is William Diller Matthew (b. 1871), Walter Granger (b. 1872), Barnum Brown (b. 1873), William K. Gregory (b. 1876), Richard S. Lull (b. 1867) of Yale University, Lawrence M. Lambe (1863–1919), late of the Canadian Survey, and C. Forster-Cooper, Cambridge University. The chief intensive work of Matthew and Granger has been on the American Eocene mammalian faunas and in aiding Osborn to establish 16 Eocene-Oligocene life zones of North America very closely co-ordinated with corresponding life zones of western Europe. Brown's explorations have added greatly to our knowledge of Cretaceous dinosaurs. Of the same group are the pupils of Williston, of whom the leader is Ermine C. Case (b. 1871), who has contributed treatises on Permian life. At the same time John C. Merriam (b. 1869) has led explorations on the Pacific coast of America and inspired a school of younger workers both in vertebrate and invertebrate palaeontology. In Great Britain D. M. S. Watson (b. 1886) has taken up the work of Owen and Huxley in primary groups of fishes, amphibians and reptiles; in Austria Othenio Abel, a pupil of Dollo, is the great exponent of vertebrate evolution; in Germany Friedrich von Huene and Ferdinand Broili are leaders in sauropsidan palaeontology, other notable palaeontologists of recent years being Franz Drevermann, Ernst Strömer (b. 1871) and Otto Jaekel (b. 1863). At Upsala in Sweden Carl Wiman has inspired a remarkably progressive group of workers, while in Switzerland Hans Georg Stehlin (b. 1870) has continued in the great field of Rütimeyer.

For the principal contributions by palaeontologists of the third and fourth groups above described, the reader is referred to the Memoirs and Bulletins of the American Museum of Natural History, of the University of California, of the Carnegie Institution of Washington, to the Contributions from the Palaeontological Laboratory (Peabody Museum) of Yale University, to the Memoirs and Catalogues of the British Museum (Natural History), to the Palaeontographica and to the Memoirs of the Société Paléontologique Suisse. It is upon the researches of these workers in field and laboratory that the great synthetic volumes referred to earlier are chiefly founded, and that the following generalisations of modern vertebrate palaeontology are chiefly due.

Origins of the Great Vertebrate Stock and its Branches

Origin of Chordates.—No discovery has thus far lessened the gap between the modern Protochordates (*Amphioxus*, tunicates, etc.) and any of the known phyla of invertebrates. Some of the cephalaspid ostracoderms have been cited by Patten as favouring the view that the chordates have been derived from certain arthropods, but such resemblances are ascribed to convergence by Dollo and many others. The earliest ostracoderm remnant actually known is a dermal plate of a genus named *Astraspis* from the Upper Ordovician near Canyon City, Colo.; this represents a new family Astraspidae allied to the Psammosteidae of the Silurian and Devonian (C. R. Eastman, 1917). These chordates, heavily shielded and hence known as *ostracoderms*, were dominant in the Upper Silurian, radiating into six families and many genera, abundant in the Lower Devonian, diminishing in the Middle Devonian and becoming extinct in the Upper Devonian.

Origin of Fishes.—The earliest fish remnant actually known is the fin-spined *Onchus* from the Upper Silurian of Scotland, which appears to represent the group of acanthodian sharks, covered with fine quadrate scales like those of ganoids and with a skull structure distinctly elasmobranch. The elasmobranchs (shark and ray types) are still the oldest known gnathostomes or true jaw-bearing vertebrates, constituting (*a*) one of the four primary



Middle-Cambrian invertebrate fossils, showing diversity of animal life and similarity to recent forms. (U.S. Nat'nl Museum, permission of Smithsonian Inst.)
FIG. 1. *Choia carteri* Walcott, a silicious sponge. FIG. 2. *Ottoia prolifica* Walcott, a gephyrean annelid. FIG. 3. *Ottoia minor* Walcott, another gephyrean annelid. FIG. 4. *Aysheaia pedunculata* Walcott, a *Tomopteris*-like annelid. FIG. 5. *Canadia spinosa* Walcott, a polychaete annelid. FIG. 6. *Amiskwia sagittiformis* Walcott, a chaetognath. FIG. 7. *Waptia fieldensis* Walcott, a *Mysis*-like crustacean. FIG. 8. *Opabinia regalis* Walcott, a *Branchipus*-like crustacean. FIG. 9. Another specimen of *Opabinia regalis* Walcott. FIG. 10. *Burgessia bella* Walcott, an *Apus*-like crustacean. FIG. 11. *Marrella splendens* Walcott, a simple trilobite. FIG. 12. *Naraoia comp cta* Walcott, a curious crustacean.

PALAEONTOLOGY

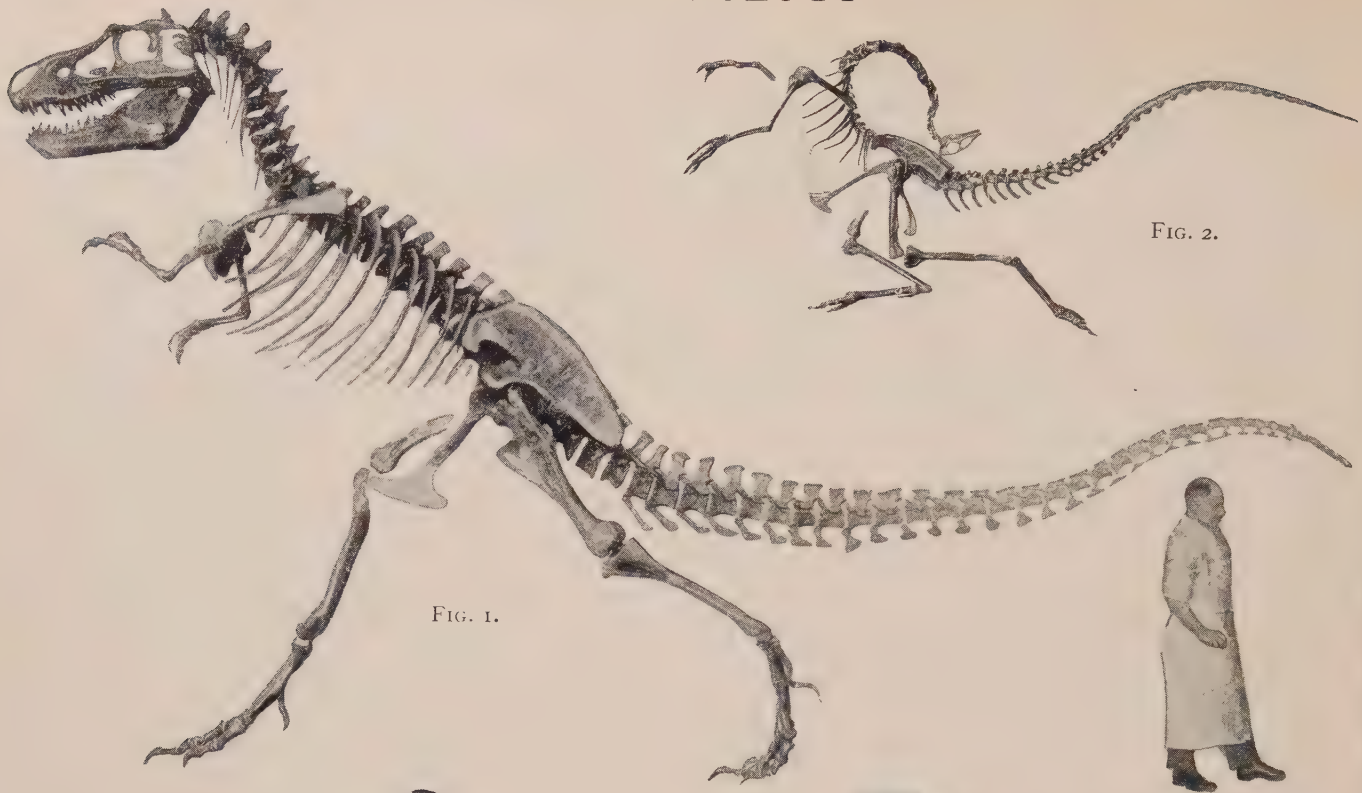


FIG. 1.

FIG. 2.

FIG. 2a.

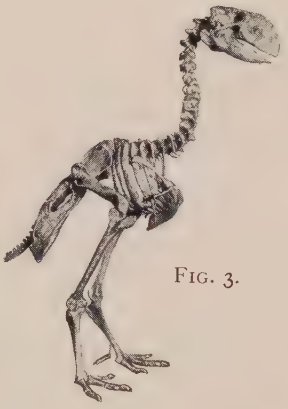


FIG. 3.

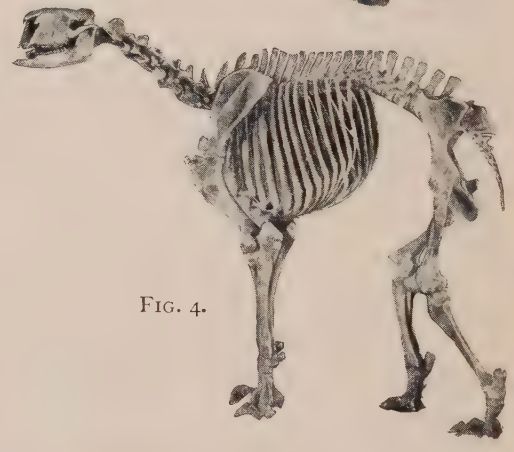


FIG. 4.

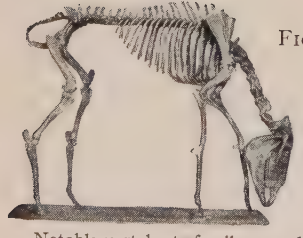


FIG. 5.

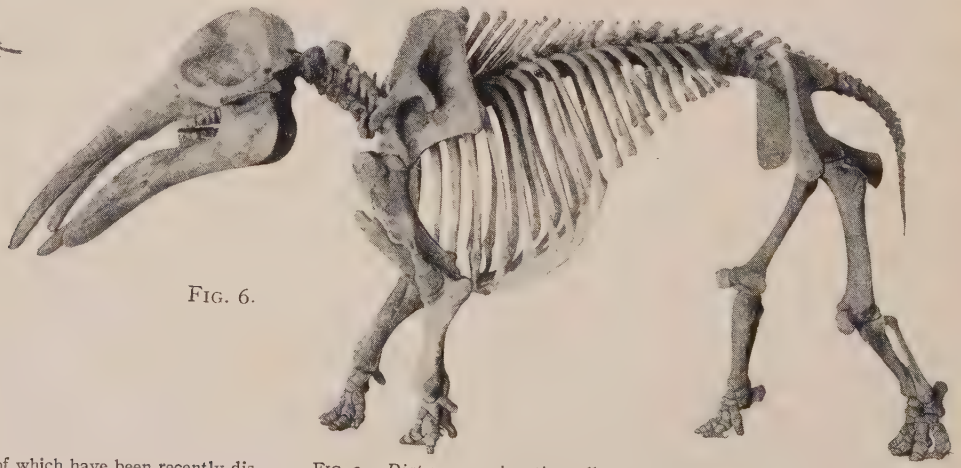


FIG. 6.

Notable vertebrate fossils, complete remains of which have been recently discovered. (By permission of the President of the American Museum of Natural History.)

FIG. 1.—*Deinodon* or *Gorgosaurus*, a mid-Cretaceous carnivorous dinosaur from Alberta, Canada, mounted in running position.

FIG. 2, 2a.—*Struthiomimus*, the "ostrich mimic," a mid-Cretaceous browsing dinosaur, from Alberta, Canada. Fig. 2 shows the complete skeleton in *rigor mortis*, fig. 2a the same skeleton partly restored.

FIG. 3.—*Diatryma*, a gigantic mollusc-eating bird, from the Lower Eocene of Wyoming.

FIG. 4.—*Moropus*, an okapi-like herbivore, from the Lower Miocene of Dakota, related to the chalicotheres of Europe and Asia.

FIG. 5.—*Pliohippus*, direct one-toed ancestor of the modern horse, from the Lower Pliocene of Nebraska.

FIG. 6.—*Trilophodon*, direct descendant of *Mastodon angustidens* of Europe and North Africa, Lower Pliocene of Texas.

All the figures are on the same scale.

gnathostome groups, *i.e.*, jawed groups, the others being (*b*) the fringe-finned ganoids (Crossopterygii), (*c*) the ray-finned ganoids and teleosts collectively known as Actinopterygii and (*d*) the lungfishes (Dipnoi). The fossil ancestors of the fringe-finned ganoids have not yet been discovered; so these animals are theoretically traced to unknown cartilaginous fishes of Silurian times. The oldest Crossopterygian actually known is the *Osteolepis macrolepidotus* of the Middle Old Red Sandstone of Scotland. There were two principal periods of adaptive radiation among the Crossopterygii, the first in Middle and Upper Devonian times, the second in Mesozoic times which produced the family Coelacanthidae, from which may have sprung the existing fishes *Polypterus* and *Calamoichthys* as degenerate offshoots. From the earlier Devonian radiation of the Crossopterygians is traced the theoretic origin of the Dipnoi or lungfishes, on the one hand, and of the oldest known amphibians on the other. The Devonian Crossopterygian skull and fins appear to be " archetypal " to the lungfish type on the one hand, and to the amphibian type on the other. Cope's genius in separating the Actinopterygii is sustained, for there is as yet no fossil evidence of the connection of this group with the Crossopterygii, other than the supposed community of origin in Silurian times. Here the reader should consult the writings of Smith Woodward, Joseph F. Whiteaves, Bashford Dean, William K. Gregory and the synthetic reviews of Osborn (1918) and Lull (1917).

Origin of Amphibians and First Tetrapods.—In this epoch-making transition from the fringe-finned fish type to the tetrapodal amphibian and terrestrial type, the prophecies of Huxley, Cope and Baur and other great anatomists of the second and third groups of palaeontologists appear to be fulfilled. The Silurian period marked the parting of the ways among the great primary groups of fishes and the first steps towards the frame of the terrestrial amphibians. Not until the Upper Devonian of Pennsylvania do we find a footprint (*Thinopus antiquus* Marsh), which may be referred to an amphibian tetrapod. The first known actual skeletons occurred in the Coal Measures (Upper Carboniferous) of Europe and America and represented four widely radiating groups. The structural gap separating the earliest tetrapod amphibians and fishes is perhaps the greatest known in the whole range of vertebrate evolution, but all modern authorities agree that the amphibians were probably derived from a Silurian or early Devonian type of fringe-finned fish. Even as far back as the Upper Carboniferous and even in the Lower Carboniferous the Amphibia were adaptively radiating into several orders and numerous families comprising highly specialised forms. During the Carboniferous we find numerous independent phyla of eel-like or burrowing, and of compressed, swimming, as well as of large-bodied, predatory forms. The latter culminate in the gigantic labyrinthodonts of the Triassic. The exact connection of any of these forms with the modern Amphibia (urodeles and Anura) is doubtful. The Anura first appear in the Jurassic, and at the present time they retain many characters reminiscent of such Palaeozoic Amphibia as the branchiosaurs and the *Eryops* group. The urodeles are first known in the genus *Hylaeobatrachus* of the Lower Cretaceous of Europe. Both groups, especially the Anura, appear to have gone through a wide adaptive radiation during the Tertiary. The connection of the modern caecilians with the ancient types is obscure. The reader is referred especially to the contributions of Williston, Case, Watson, Gregory, Broili and the synthetic reviews of Osborn (1918) and Lull (1917).

Origin of Reptiles.—The oldest-known reptiles, solid-headed *Cotylosauria* of Cope, are regarded as amphibians which had eliminated the aquatic stages in development, the oldest reptile actually known being the genus *Eosauravus* from the Coal Measures of Ohio. In other words, the cotylosaur reptiles are traceable to solid-headed stegocephalian amphibians, which, in turn, are traceable to solid-headed unknown Crossopterygians of Silurian times. The oldest and most primitive reptiles (*Cotylosauria*) occurring in the Upper Carboniferous and Permian, are thus structurally very close to certain contemporary stegocephalian amphibians. The first great adaptive radiation of the reptiles into the two grand divisions, the solid-headed (*Cotylosauria*) and the temporal-arched (*Pelycosauria*), began in the Upper Carboniferous and still more widely diverged in Permian times. As early as the Permian, occurs a mammalian-like series of reptiles which exhibits an extensive adaptive radiation and gives off one branch, the *Cynodontia*, which, in turn, survives into Triassic times and clearly approaches the mammalian grade of organisation. From the primary temporal-arched also appear the forerunners of the Mesozoic reptiles, the plesiosaurs, ichthyosaurs, dinosaurs and pterosaurs, widely separated from each other in the Triassic and thus having their branches deep down in the Permian and Carboniferous, each grand division giving rise to an adaptive radiation of its own. These have been traced in detail by such authorities as Andrews, Dollo, Abel, Von Huene, Williston and Osborn.

Here the reader is referred to the writings of Williston, Hatcher, Osborn, Merriam, Lambe, Lull and especially during the past decade to those of Charles W. Gilmore of the United States National Museum, Washington and of Dr. Robert Broom of South Africa, as well as to the synthetic reviews by Osborn (1918) and Lull (1917).

The two greatest achievements of the decade are the clearing up of the relationships of the primitive South African terrestrial Reptilia of the Perm-Trias, beginning with the solid-headed types (pareiasaurs) and ending in their highest expression, the mammal-like types known as *Cynodonts* and *Theriodonts*. The field explorations of Robert Broom and the profound comparative researches of D. M. S. Watson and of William K. Gregory have given us a clear comprehension of the habits and relationships of this first terrestrial radiation group. Williston and Case have covered the same great period in America.

Origin of Birds.—Palaeontologists still agree in endorsing Huxley's opinion that birds are " glorified reptiles." The origin of birds, according to recent reviewers such as Osborn and Gregory, brings us close to the two-temporal-arched (*i.e.*, *Diapsida*) reptiles, namely, to the stem which also gave off the dinosaurs, the pterosaurs and the smaller parasuchians (*Euparkeria*). Fossil bird remains are extremely rare. The earliest bird known is the famous *Archaeopteryx* of the Jurassic of Solnhofen, Germany. This is largely a bird, excepting in the tail, the simplicity of the feather arrangement and the possession of teeth. According to the four-winged hypothesis of origin advocated by Beebe, we should some day discover a bird with parachute-like action in both fore and hind limbs. Recent contributions of note on this subject are those of Gerhard Heilmann (1913) and of William Beebe (1915) and the synthetic reviews by Osborn (1918) and Lull (1917).

Origin of Mammals.—Evidence has been accumulating rapidly in favour of the theory that the origin of the mammals should be traced to the more progressive terrestrial mammal-like reptiles (the *Cynodontia*) of the Permian and Triassic of South Africa and Europe, as described in the studies of Broom, Watson, Haughton, Osborn and Gregory. Structurally related to these Cynodonts are the so-called *Protodonts* of Osborn, *e.g.*, *Dromatherium* and *Microconodon* of the Triassic of North Carolina. But of equal antiquity are the multituberculates, *e.g.*, *Plagiaulax* and *Microlestes*, widely spread over Europe and North America. No substantial additions have been made during the decade to our knowledge of this vague period; readers are referred to the reviews by Osborn (1918) and Lull (1917), also to the recent works of Gregory, *The Orders of Mammals* (1910) and *The Origin and Evolution of the Human Dentition* (1921).

Origin of Primates and of Man.—Combined palaeontological and anatomical evidence indicates that the source of the Primates is to be looked for among tree-living insectivorous mammals more or less closely similar to the modern tree shrews (*Tupaiidae*) of Africa. This view advanced with ability by Gregory is in general accord with the opinion that during the phase of arboreal life many of the psychic and anatomical characters of the Primates were acquired. It was not until the Lower Eocene of North America and of Europe that there appeared undisputed Primates of lemuroid affinity, *e.g.*, notharctids and tarsioids in

America, adapids and tarsioids in Europe. At this time the zoological relation of the two continents was close and it would appear that while the primitive horses were acquiring their cursorial characters on the ground, these primitive lemuroids were acquiring their distinctive characteristics in the trees.

Actual ancestors of the existing *Tarsius* of Madagascar have been found in France (*Pseudoloris*). The attempt of Ameghino to trace the higher Primates to South American types, *e.g.*, *Homunculus*, appearing in the Lower Miocene of Patagonia, is not supported, because these animals from the first are the true broad-nosed, *i.e.*, platyrrhine, type still characteristic of South America. The Old World division of the catarrhines or narrow-nosed true Primates has been traced to the *Parapithecus*, described by Max Schlosser from the Lower Oligocene of Egypt. *Propliopithecus* is possibly ancestral to the true anthropoid apes and thus possibly related to the ancestors of man himself. Darwin's broad conclusion that man was derived from " some ancient member of the anthropomorphous subgroup of Old World Primates " is fully sustained by anatomical evidence, but the precise lines of descent are still in dispute. Some hold that the human line came from Middle Tertiary anthropoid apes allied to *Dryopithecus* of France and *Sivapithecus* of India, while others (including the present writer) regard the Hominidae as a widely distinct family separated especially by its upright walking gait, by the non-divergence of the great toe, and by the retention of its tool-making thumb. A series of masterly reviews of this whole question has appeared in the American Museum publications from Gregory, whose recent memoir *On the Structure and Relations of Notharctus, an American Eocene Primate* (1920) sums up our present knowledge of this whole subject. (*See* EVOLUTION.)

The Dinosaur Fauna of Alberta, Canada.—The greatest new achievement in exploration is the revelation of the dinosaur fauna of Alberta in the fossil beds extending along the Red Deer river, which were first made known to science by explorers of the Canadian Geological Survey in 1897, 1898, 1901. The first general review of this wonderful fauna was that of Osborn and Lambe, *On Vertebrata of the Mid-Cretaceous of the North West Territory* (1902), based chiefly on the collections in the Ottawa Museum. The American Museum explorations under Barnum Brown, which extended over 10 years, have resulted in the discovery of the entire fauna of the middle portion of Upper Cretaceous time, a complete revelation especially of the dinosaur world as it approached the height of its adaptive radiation into herbivorous and carnivorous, armoured and defenceless, swift-moving and slow-moving types, which severally imitate more or less fully the long subsequent adaptive radiation of the mammals. In 1914 the Canadians renewed exploration, so that at present the Ottawa and Toronto museums have rich collections, part of which has been described by the late Lawrence M. Lambe, while Osborn, Barnum Brown and W. A. Parks have also made known a part of this wonderful fauna. Two of the greatest extremes of adaptation, namely, *Deinodon* or *Gorgosaurus* and *Struthiomimus*, are figured in the accompanying Plate II. In the same plate appear some of the outstanding American discoveries of the decade.

NEW DISCOVERIES AMONG FOSSIL VERTEBRATES

Fossil Fishes.—Dr. A. Smith Woodward's *Fossil Fishes of the English Wealden and Purbeck* (1915–8) is a beautifully illustrated memoir of the most thorough, systematic type, well sustaining the traditions set by Traquair and by the author himself in earlier works. The period dealt with affords an interesting cross-section of the stream of piscine evolution at a time when many of the old Mesozoic ganoids were dying out and the teleost fishes were beginning their remarkable expansion. Other important systematic memoirs are those by Stolley on the ganoids of the German Muschelkalk (1920) and by Stensiö (1921) on Triassic fishes from Spitsbergen. The latter memoirs contain a wealth of material of great morphological interest concerning the early stages in the evolution of the skull of the fringe-finned and ray-finned ganoid fishes; this discussion also throws light on the origin of certain elements in the skull of higher vertebrates. In this connection should be mentioned the brief but highly important paper on *Eusthenopteron* by W. L. Bryant (1919). This fringe-finned ganoid is of particular interest because the construction of its skull and paired limbs approaches the type which may be expected in the piscine ancestors of the land-living vertebrates. The arrangement of the elements on the under side of the skull of this fish raises morphological questions of wide general interest. Papers by Watson and Day (1916) and by Gregory (1915, 1920) deal with the ancestral relations of these fringe-finned ganoids with the land-living vertebrates (tetrapods).

The swarming fauna of Devonian arthrodires, ptyctodonts, cladodonts and other archaic fossil fishes from the vicinity of Buffalo, N.Y., is ably described by Bryant and Hussakof in their *Catalog of the Fossil Fishes in the Museum of the Buffalo Society of Natural Sciences* (1918). A serious difficulty encountered by all students of recent and fossil fishes is the getting in contact with the vast and scattered literature of the subject. The great *Bibliography of Fishes* by Bashford Dean and his associates Eastman and E. W. Gudger (1917) will undoubtedly stimulate research in this field.

Fossil Amphibians.—The outstanding publications in this field are *The Coal Measures Amphibia of North America*, by R. L. Moodie (1916) and a memoir on *The Structure, Evolution and Origin of the Amphibia*, by D. M. S. Watson (1919). Moodie's memoir is a valuable description and compilation of the extensive and varied fauna of swamp-living amphibians of the American Coal Measures. Watson's memoir is a brilliant and highly original contribution to the classification and phylogeny of the labyrinthodonts. Much detailed work on fossil amphibians appears in papers by Von Huene, Broom, Williston, Van Hoepen, Haughton and others.

Stem Reptiles.—In the field of the oldest reptiles, those of the Carboniferous and Permian, perhaps the most important contributions are those by S. W. Williston and D. M. S. Watson. The former, in his paper on *The Phylogeny and Classification of the Reptiles* (1917), traces the rise of the common amphibian-reptilian stock through the " Protopoda," which are so far known only from certain footprints of Upper Devonian age. According to Williston, who built on Osborn's system of 1903–4, the primitive reptilian stock early divided into the following series:—

Anapsida (Cotylosauria and their specialised descendants, the modern tortoises and turtles).

Synapsida (Theromorpha or pelycosaurs, etc.; Therapsida, or mammal-like reptiles, the latter giving rise to the mammals; plesiosaurs).

Diapsida (reptiles with two temporal arches, such as crocodiles, dinosaurs, rhynchocephalians; this stock gave rise to birds).

Parapsida (including the proganosaurs, ichthyosaurs, lizards, mosasaurs, snakes).

Watson (1917), in his *Sketch Classification of the Pre-Jurassic Tetrapod Vertebrates*, assigns a high value in classification to the characters of the brain case. A general and conservative classification of the early reptiles is given by W. K. Gregory (1920). The most primitive known reptile, *Seymouria*, from the Permo-Carboniferous of Texas, almost bridges the gap between the Amphibia and the Reptilia. Watson (1919) gives a morphological description of this reptile, accompanied by valuable figures and reconstructions of the skull and skeleton.

The habits and environments of the teeming reptilian and amphibian faunas of the Permo-Carboniferous of North America are intensively considered in a memoir by E. C. Case (1919), which also deals with the stratigraphy, climatology and palaeogeography of the late Palaeozoic.

Mammal-like Reptiles.—In no other field of fossil reptiles has the progress of discovery been more satisfactory than in that of the mammal-like reptiles of South Africa, as set forth in numerous papers, especially by Watson (1913–4), Haughton (1918), Broom (1913–4), Van Hoepen and others. The relationships of these animals with other reptiles and with the mammals have been reviewed by W. K. Gregory (1920–1).

Marine Reptiles.—These have always been of great interest on account of their secondary adaptations to aquatic life which have

been ably discussed by Abel (1912, 1919). One of the outstanding contributions of new material in this field is the *British Museum Catalogue of Marine Reptiles of the Oxford Clay*, by C. W. Andrews (1910–3). The origin and relationships of the plesiosaurs and their allies are treated by Von Huene (1921).

Dinosaurs.—The Triassic dinosaurs of Europe are of particular interest because some of them tend to connect the very diverse carnivorous and herbivorous saurischian dinosaurs of later ages. Here the leading author is F. von Huene, in a long series of papers and memoirs. *Plateosaurus*, perhaps the most primitive of these reptiles, has been fully described both by von Huene and by Jaekel (1913–6). Primitive dinosaurs from the summit of the Karroo series in South Africa (*Gryponyx*, *Massospondylus*, etc.) are described by Broom and Haughton. During the long ages of the Jurassic the gigantic sauropodous dinosaurs attained their maximum in size and specialisation. The leading feature in this field is the description of the strange and monstrous dinosaurs of the Tendaguru fauna of East Africa in the collections of the Berlin Museum, by Janensch (1914). One of the most remarkable of the North American sauropods is the genus *Camarasaurus*, which has been intensively described by Osborn and Mook (1921). *Barosaurus*, a gigantic relative of *Diplodocus*, with a tremendously heavy neck, has been described by R. S. Lull (1919). *Tyrannosaurus*, the greatest carnivorous reptile of all time, and *Struthiomimus*, a contemporaneous ostrich-like dinosaur, have been described by Osborn (1912–9). The highly varied and grotesque armoured dinosaurs, namely, the Ceratopsia and related groups, have been the subject of numerous papers by Gilmore, Brown, Lambe and others.

Pterosaurs.—The pterosaurs, or flying reptiles, have continued to excite the interest of students of flight, such as Abel (1912) Watson and Hankin (1914), Arthaber (1921). The greatest flying reptile, *Pteranodon*, is the subject of a memoir by Eaton (1910) of Yale University.

Chelonians.—An important memoir by O. Jaekel (1913–6) describes the skull, skeleton, carapace and plastron of *Triassochelys dux* from the Upper Triassic of Germany. Although widely differentiated from all other orders this reptile was the most primitive of all known chelonians. Of even greater interest is the *Eunotosaurus* from the Permian of South Africa, which Watson (1914) describes as a veritable " archichelone."

Fossil Birds.—Diatryma, a gigantic ground bird from the Lower Eocene of Wyoming, has been described by W. D. Matthew and W. Granger (1917) from a nearly complete skeleton, which is a most rare and valuable fossil. This bird, which has no near relatives, was about seven feet high and of massive proportions, with an enormous head and great compressed beak. The wings were vestigial. This high degree of specialisation at such an early epoch indicates that the modernised groups of birds were differentiated during the latter part of the Age of Reptiles.

Monographs on Special Groups of Tertiary Mammals.—The fossil mammals of the basal and Lower Eocene of the western United States are represented in the American Museum of Natural History by collections numbering many thousands of specimens which are being described jointly by Matthew and Granger (1915). Besides describing many new or little known forms these authors also deal with the relationships and morphology of the various groups of early placental mammals. In the paper dealing with the edentates and their relatives, the " palaeanodonts," Matthew (1918) advances the view that the modern Pholidota (Pangolins) are an offshoot of the primitive " palaeanodonts " of the Lower Eocene. Other papers of the same series cover the Creodonts, Insectivores and Primates.

Several mid-Tertiary mammalian groups, such as chalicotheres, entelodonts and the diceratheres, have been revised in the publications of the Carnegie Museum, Pittsburgh, by W. J. Holland and by O. A. Peterson (*see* MONGOLIA, PALAEONTOLOGIC DISCOVERIES IN). (H. F. O.)

SOME NEW DEVELOPMENTS

In recent years two aspects of palaeontological work have been actively pursued. The explorations carried out in north-eastern Asia by the American Museum, supplemented by those conducted jointly by the Chinese Geological Survey and the University of Uppsala (Sweden), have added enormously to our knowledge of the history of the geographical distribution both of mammals and dinosaurs, and will when carried to their completion leave Africa as the least known land which can have played an important part in the evolution of placental mammals.

An obscure region in the life of North America is being rapidly cleared up by the research of Matthew on the Upper Miocene and Pliocene faunas. In Europe work by Stehlin and others is gradually giving us an accurate knowledge of the structure and relationships of the older tertiary mammals, whilst those of the Pleistocene are at last receiving adequate treatment. The long known fossils of the Sivalik hills in India have been assigned to their true horizons by G. E. Pilgrim, whose collections from rocks of earlier date than those found by former workers have added many most interesting anthropoid apes to our knowledge, and will much modify our ideas of the phylogeny of some groups of mammals. From deposits in Baluchistan of Upper Oligocene age Pilgrim and Foster Cooper have made great collections mainly of anthrocotheres and rhinoceroses, the latter worker having obtained limbs and vertebrae of an extraordinary rhinoceros Baluchitherium. Subsequently Borissiak obtained from Turgai, Turkestan, a fragmentary skull, many vertebrae and ribs and the limbs of a closely similar or identical animal, which has now been mounted in Leningrad. Finally, the American Museum obtained a skull of the same type from Mongolia. These materials allow of a reconstruction of the complete skeleton. The animal so obtained is a gigantic rhinoceros, with a skull five feet in length, hornless and very long and narrow, set on an enormous flexible neck. The immense body is carried on pillar-like legs, the tridactyl hands and feet being extraordinarily elongated, so that the creature walked entirely on its toes like a horse. The height at the withers is estimated at 13 ft., considerably more than that of any living elephant, and more than twice that of the tallest other rhinoceros known.

Pilgrim has recently described a fragmentary but most important mammal fauna of Upper Eocene age from Burma remarkable in that it contains teeth of the first Titanotheres found in Asia, animals whose occurrence here is explained by the many forms found still more recently in Mongolia.

In Africa little has been done, but very fragmentary remains of Miocene mammals found near Victoria Nyanza have been described by Andrews, and others from German South West Africa by Strömer. Dietrich and Andrews have described small late Pliocene faunas from the Lakes region of Central Africa. Finally, in his last paper, C. W. Andrews recorded the occurrence of a Chalicothere in the Pleistocene fauna of Kenya.

Amongst reptiles the most important discoveries of new materials of which accounts have been published are those of the German expeditions to Tendaguru, which have obtained splendid materials of Sauropodous dinosaurs and of a small Stegosaur; of the American Museum in Mongolia (*q.v.*) and of Strömer in the Cretaceous of the Libyan desert. Strömer has described two most remarkable crocodiles, one with a very small, short-snouted and deep skull, the other with an enormously elongated flat head, presenting some resemblance superficially to a pelican's bill. Thus the work of exploration has been most actively pursued, but results of no less importance have come from the examination by modern technical methods of old materials. This work has in the main been directed to the solution, often by a co-ordination of palaeontological and embryological researches, of certain problems of morphology. It is work of a new type initiated by Dr. R. Broom.

Prof. J. Kiaer of Christiania has published a most detailed description of three genera of Anapsida (*q.v.*) from the Downtonian rocks of Norway. The animals of this group, formerly known almost entirely from material from the rocks of the same age in the south of Scotland, prove to possess a heterocercal tail of unique type in which the muscular end of the body passes downward into the lower caudal lobe, instead of, as in all fishes, into the upper. They have a pair of large eyes, between which, on

the dorsal surface of the head, is a single median nostril, placed immediately in front of a foramen for a pineal eye. The whole arrangement is remarkably like that which exists in the lamprey. The mouth, however, appears to be arranged for biting, and in no way recalls that of Pteromyzon.

Kiaer shows that the external branchial openings are small pores and that they may vary in number from seven to 13, as in hagfish. Dr. Stensiö, of Stockholm, has recently shown that the lateral line system on the body armour of heterostraci does not conform to that found in all fish, but is comparable with that of cyclostomes and appears to be inclined to group those forms, which have paired nostrils, with the Anapsida and Cyclostomes, the whole forming, with the Osteostraci, a group of bony vertebrates more primitive in their structure than the true fishes. Dr. Stensiö has also revolutionised our knowledge of the structure and understanding of the relationships of the long-known Arthrodeires. He shows that Macropetalichthys, a form known for some 60 years, had a fully ossified braincase so thick and well preserved that he has been able to determine not only the shape of the brain cavity but also the exact distribution of some of the cranial nerves and blood vessels. There is no doubt that in all points which can be determined the form agrees with the elasmobranchs, and differs from all bony fish. The possibility is opened that the living cartilaginous fish are the descendants of bony ancestors. Sir Arthur Smith Woodward has been able to show that another arthrodeire Deinichthys had ossifications associated with the palatoquadrate cartilage.

Among bony fish proper the most important work has been the description by Bryant, Stensiö and Watson of the details of the structure of the braincase, dermal skull and palate of certain Osteolepids and of the Coelacanths which prove to be their direct descendants. The most striking feature of these fish is the presence in them of a long unossified region between the basisphenoid and the basioccipital and the consequent separation of the well ossified braincase into two distinct halves. But of more general interest is the occurrence in all Osteolepids and in the oldest known Coelacanth, of an olfactory organ of amphibian type, opening to the surface of the skull by an anterior and to the palate by a posterior nostril. The structure of several carboniferous dipnoi has been described by Watson and Gill.

The palaeoniscid fish, which are the oldest representatives of the Actinopterygii, have become much better known, the structure of the braincase, palate and hyobranchial apparatus having been described by Watson and Stensiö in Carboniferous and Triassic forms. The braincases prove to be typically actinopterygian, possessing large eye muscle and aortic canals.

Stensiö has given a complete account of the osteology of the head in the remarkably elongated Saurichthids, a mainly Triassic group of fish, which prove, as A. S. Woodward long ago suggested, to be direct and relatively little advanced derivatives of the palaeoniscids. Henning has described as *Chondrosteus Hindenburgi*, a magnificent sturgeon some 12 ft. in length from the Upper Lias of Württemberg. Watson has described the structure of the Carboniferous Labyrinthodonts, all of which belong to the grade Embolomeri. In the structure of their skulls these animals prove to be directly comparable with Osteolepid fish on the one hand and with the reptile Seymouria on the other, whilst they include the ancestors of the later Labyrinthodonts, the course of whose evolution as determined by Watson has been confirmed by the work of Haughton.

Amongst reptiles the most interesting work of a morphological type has been concerned with the evolution of the skeleton of the limbs considered as one part of a machine the remainder of which consists of the muscles. Watson, W. K. Gregory and his students and Romer have reconstructed from the indication of muscle insertions on fossil bones the complete limb musculation of several Permian and Triassic reptiles, and shown that these exhibit a steady improvement of mechanical efficiency as the evolutionary series are traced upward. (D. M. S. W.)

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PALAMÂS, KOSTES (1859–), Greek poet, was born at Patras in 1859. In 1875 he went to Athens to study law and there came under the influence of the "popular," as opposed to the "purist" school of Greek, and, after several years of journalism, published in 1886 his first poetical work, *The Songs of My Country*, followed in 1889 by the *Hymn to Athena*. Appointed in 1897 secretary to the University of Athens, he was able to devote all his spare energies to poetry, while he had already issued a prose *Essay on Krystallis* (1894), in which he contrasted philosophic with descriptive poets. After the publication of *Iambs and Anapaests* and *The Grave* (1898), a series of elegies on his son's death, he became the recognised chief of the "popular" party in literature, whose organ in the Press was the review, *Noumas*. At that period the "language question" penetrated even politics, leading to the "Gospel Riots" of 1901 and the fall of the Cabinet over the translation of the *Oresteia* in 1903. Palamâs, who described himself in *The Twelve Lays of the Gipsy* as "the poet of my age and race," was considered by his admirers to be the successor of Solomos, while some critics have found in him the obscurity of Browning. Later he produced the poem on Byron, recited at the Byron centenary at Athens in 1924, and *Five Syllables and the Pathetic Whispers* (1925).

See *Poems by Kostes Palamâs*, selected and rendered into English by Th. Ph. Stephanides and G. C. Katsimbalis (1925).

PALÉOLOGUE, MAURICE GEORGES (1859–), French diplomat and writer, was born in Paris Jan. 13 1859. He entered the diplomatic service at an early age and went successively to Tangier, Rome, Germany, the East, Korea and Bulgaria. He became in 1909 deputy-director and in 1911 director of affairs in the Foreign Office. Shortly before the outbreak of the World War he was appointed ambassador to St. Petersburg (Leningrad) and retained this post until the Bolshevist revolution towards the end of 1917. He successfully exerted great efforts to consolidate the Franco-Russian alliance and to ensure the most effective military action on the part of Russia during the period of hostilities. In 1920 he was for a few months secretary-general of the Ministry of Foreign Affairs and afterwards tendered his resignation. M. Paléologue published in 1921–2, under the title of *La Russie des Tsars pendant la grande guerre*, some interesting records of his diplomatic experiences in St. Petersburg. Among his other publications are historical works; literary criticisms, notably on Vauvenargues and Alfred de Vigny; accounts of his impressions of China and Italy and several novels.

Recent works include: *Le Roman Tragique de l'Empereur Alexandre II.* (1923); *Talleyrand Metternich Chateaubriand* (1924); *An Ambassador's Memoirs* (tr. by F. A. Holt, 1923–5).

PALESTINE (*see* 20.600), a territory administered by the British Govt. under a mandate from the League of Nations which came officially into operation on Sept. 29 1923. Bounded on the north by the French sphere of Syria, on the west by the Mediterranean, and on the south by Egyptian and Hejaz territory. On the east is Transjordan (*q.v.*) which is included in the Mandate. The area of Palestine, excluding Transjordan, is something over 9,000 sq. m. of which about half is cultivable. The population at the outbreak of War in 1914 was estimated at 689,281 (534,615 Moslems, 70,000 Christians, 84,666 Jews). This was considerably diminished by war, famine, disease and exile. On Dec. 31 1925 the parallel figures exclusive of the nomadic tribes were 762,316 (522,137 Moslems, 74,624 Christians, 157,188 Jews, 8,367 others). Since the opening of immigration with the pro-

mulgation of the Immigration Ordinance (1920) 78,567 immigrants (528 Moslems, 1,863 Christians 76,176 Jews) have entered Palestine.

I. POLITICAL HISTORY

Under Ottoman Rule.—Palestine under the Ottoman Govt. was an integral portion of Syria, although the Sanjaq of Jerusalem, owing to its peculiar problems and importance, was governed by a Mutasarref referring directly to Constantinople. Owing to the economic stagnation and financial strain which affected the whole Ottoman Empire in consequence of the Italian (1911–2) and Balkan (1912–3) wars, Palestine was unable to develop herself in any way before the outbreak of the World War. Before 1913 autonomy in the Imperial Provinces extended in practice only to the right of making recommendations. The Ottoman constitution of 1908 had awakened new hopes, and in Syria and Palestine particularly so widespread a movement began in favour of decentralisation that the Turkish Govt. thought it wise to pass the Provisional Vilayet Laws of 1913 and 1914, granting real Local Government powers. It is difficult to conjecture now to what extent a naturally intelligent people, discouraged and enfeebled by four centuries of gross misgovernment, might have been helped by plans which were in fact cut short by the War and replaced by the tyranny of Jemal Pasha.

British Military Occupation.—The British occupation, established after the conquest of the country by the British forces under General Allenby in 1917, found a depleted population, the townspeople distressed, much cultivated land untilled, stocks of cattle and horses almost non-existent, orange groves ruined by lack of irrigation and commerce at a standstill. Immediately on the occupation of Jerusalem (Dec. 11 1917), a military administration was set up, at first under Brigadier-General Clayton, Chief Political Officer to General Allenby, as Chief Administrator; who was followed by Major-Generals Money, Watson and Bols, with military governors at Jerusalem and elsewhere; food was hurried up by military transport for the populace, and merchants were permitted to import goods from Egypt by the military railway. In accordance with General Allenby's proclamation, all existing rights in Holy Places were respected and maintained; further, the income of the Moslem Wakfs (pious foundations) was used exclusively for the Moslem beneficiaries in Palestine instead of being drained away to Constantinople. The administration was, from the outset, financially self-supporting. A local police force was built up, schools and law courts were re-opened, and, in April 1918, a water supply for Jerusalem, utilising springs employed for the same purpose in the days of Herod and Pontius Pilate, was installed.

Zionism.—On Nov. 2 1917, some five weeks before Lord Allenby's entry into Jerusalem, Earl (then Mr. Arthur) Balfour, at that time Foreign Secretary, had made on behalf of H.M. Govt. the following historic declaration:—

> His Majesty's Government view with favour the establishment in Palestine of a National Home for the Jewish people, and will use their best endeavours to facilitate the achievement of that object, it being understood that nothing shall be done which may prejudice the civil and religious rights of existing non-Jewish communities in Palestine, or the rights and political status enjoyed by the Jews in any other country.

The declaration was endorsed by the principal Allied Powers and embodied in the Treaty of Sèvres, where it was provided that the country should be entrusted to a Mandatory Power with a mandate to be approved by the League of Nations. After the Balfour declaration the Zionist Organisation sent a Commission, subsequently constituted as a part of the Zionist Executive, to Palestine to act as a link between the British authorities and the Jewish population. This was developed so as to take charge of the larger Jewish interests, colonisation, immigration, and education in Palestine. The military administration was, from its inception, assailed with demands on the one hand for an immediate and practical interpretation of the Balfour declaration, and on the other for a policy of entire negation until such time as that instrument should have been incorporated into some sort of Mandate formally adopted by the Powers.

The Home Govt. not being in a position to issue even general instructions, the administration, left in a situation without precedent more or less to its own resources, was limited by the legal necessity of governing the country under Ottoman Codes amplified by enactments under military law, according to the "laws and usages of war." Even so, however, two notable and, in the circumstances, exceptional steps were taken. Hebrew was recog-

nised with English and Arabic as the third official language, as, with Latin and Greek, it had been in the time of Christ, and considerable agricultural loans were advanced to land-owners. At the same time various oppressive small taxes were abolished. The Jerusalem Chamber of Commerce was established and followed by others elsewhere. The unsightly wall which had been built across Constantine's Basilica of the Nativity in Bethlehem

was removed. Early in 1920 the Moslem Nebi Musa celebrations were exploited as a manifestation of Arab national sentiment against the Zionist Jews, many of whose recent immigrants had excited animosity by unwise and tactless propaganda. Riots took place on April 4 and 5 in Jerusalem and raids were made upon Beisan and the British Garrison at Semakh.

On July 1 1920 a civil government was established with Sir Herbert Samuel as the first high commissioner of Palestine. But mutual suspicion continued, and with it further incidents. For the establishment of a civil government and the subsequent promulgation of the Mandate only brought to a head the difficulties of interpreting even the expanded mandatory text of the declaration, and with them the doubts of Arabs, Zionists and Jews throughout the World. The Jerusalem riots of 1920 were succeeded next year by a more serious outbreak in Jaffa and again by disturbances in the capital on the fourth anniversary of the declaration.[1] The high commissioner, after two years' experience of conditions in Palestine, returned to London in 1922 in order to represent to ministers the necessity of publishing some statement informing all parties concerned more precisely what was, and still more what was not, the Government's interpretation of the Balfour declaration.

This statement, which was issued as a White Paper by Mr. Churchill, the Colonial Secretary, and whose policy was formally and publicly accepted by the Zionist Organisation, explicitly disclaims the intention either of creating a wholly Jewish Palestine or of contemplating the disappearance or the subordination of the Arab population, language or culture.

> The nationality to be acquired by all citizens of Palestine, whether Jews or non-Jews, whether for purposes of internal law or international status would be Palestinian and nothing else. . . . But in order that the Jewish community (in Palestine) should have the best prospect of free development it is essential that it should know that it is in Palestine as of right and not on sufferance. That is the reason why it is necessary that the existence of a Jewish National Home in Palestine should be internationally guaranteed. . . .

The statement was rejected by the Palestine Arab Delegation, then representing the Arab cause in London, partly because they were at the time committed to demands involving almost a retractation of the Mandate and partly from an instinctive reasoning that the policy even so enunciated might ultimately render Palestine Arabs of secondary interest and importance in their own country. This new definition has nevertheless considerably affected Arab opinion, and, as it has been integrally maintained by successive Labour and Conservative Cabinets, in each of whom respectively high hopes had been placed by Zionist and Arab " revisionists," it has gone far to convince both of the futility of further agitation.

Constitution.—Three months after the beginning of the Civil Govt. the high commissioner established a nominated advisory council, consisting of 10 British officials and 10 Palestinians—seven Arabs (four Moslem and three Christian) and three Jews. Later, on the promulgation of the Mandate, it was thought advisable to confer upon Palestine a more representative constitution, and an order in council was issued in 1922, providing for the creation of a legislative council consisting of the high commissioner and 22 other members, of whom 10 were to be officials and 12 elected. The elected members were to be eight Moslems, two Jews and two Christians.

A virtual boycott of the elections on the part of the Arab population rendered these proposals abortive, and invitations were issued to leading Palestinians with a view to restoring the nominated advisory council, in the same proportion as had been intended for the elected council. The invitations were accepted, but subsequently, under pressure of extremist agitation, seven of the 10 who had accepted begged leave to retire. In July 1923 the high commissioner was instructed to offer to the Arab population equal representation with the Zionists by means of an Arab agency with functions analogous to those of the Zionist executive. This was unanimously refused, as an assumption that they needed an embassy in their own home, by Arab leaders of all sections of opinion. The present system of government is that ordinances are considered first by the high commissioner in executive council, next, after receiving the provisional approval of the Colonial Secretary, submitted to the advisory council consisting of 10 senior officials. and then published in the official Gazette; but do not, save in rare cases of special urgency, become law until at least one month after publication, so that interests affected may be given the opportunity of expressing their views. This they often do with effect.

Religion.—Complete liberty of religion prevails in Palestine. In certain matters of internal organisation, however, action has been taken to assist the communities. A purely Moslem authority has been constituted for the control of Moslem religious endowments (Wakfs) and for appointment of judges in the Moslem religious courts. To this authority, represented by an elected council, the Government has transferred certain wealthy endowments sequestrated 80 years ago by the Turks. The Council has collected large sums for the restoration, now in progress, of the Haram al-Sharif in Jerusalem, and has established a Moslem theological college and an orphanage. The Orthodox Patriarchate of Jerusalem, torn by dissensions both between the Patriarch and his Synod and with the Orthodox Arab congregation, and crippled by debts, has seen the authority of its Patriarch vindicated by a commission of inquiry, and its economic restoration begun by a financial commission, both appointed by the Government. The valuable Russian ecclesiastical properties in Jerusalem and other centres have been placed, pending final decision as to their juridical ownership, rendered ambiguous by various decrees of the Soviet Govt. and as a general measure of protection against secularisation and alienation, under an official trustee. These inevitable but unconnected actions have been in some quarters inaccurately represented as a marshalling of Orthodoxy by Protestantism against Rome. The Jewish community had possessed no recognised ecclesiastical organisation. The Government assembled in 1921 a conference of leading Jews from all parts of Palestine. Two joint chief Rabbis were elected; a Rabbinical Council was established and officially recognised. The lay community was also organised into central and local councils. In 1924 the French Protectorate of Latin Holy Places was withdrawn by the Vatican.

Police.—The police force, composed of both Arabs and Jews, has during the past seven years greatly improved in discipline, efficiency and reliability; and brigands, from biblical times the traditional terror of the highways, have been almost exterminated. A unit of Palestinian gendarmerie was raised in 1921 consisting of 500 N.C.O's. and men (Arabs, Jews and Circassians) under British officers. This force was entrusted with the defence and policing of the land frontier of Palestine. In April 1922 a force of British gendarmerie, consisting of 43 officers and 700 other ranks, reduced later by one third, was enlisted in Ireland and proved an admirable reinforcement to the other two bodies. The last Imperial regiment (sent to Palestine not at the request of the administration but by desire of the War Office) has (1926) left the country and the total garrison, not supported from the resources of the country, consists of one flight of aeroplanes and two sections of armoured cars. Some of the aeroplanes are stationed in Transjordan, and the cost to the British taxpayer (estimated for 1925–6 at £E.640,600) excluding expenditure in Transjordan, has been steadily, and may be still further reduced. Apart from the cost of the garrison, there is not and has never been any grant from the British Exchequer in aid of the civil administration of Palestine. A re-organisation of the civil forces (police, Palestine and British gendarmerie) has just taken place which will increase the British strength of the police. Both British and Palestine divisions of the gendarmerie have been disbanded, and a new frontier force constituted for employment in Palestine and Transjordan also.

Justice.—The system of justice originally established by the military administration has been amended where necessary. British judges under a Chief Justice preside over the two sections of the Court of Appeal, four district courts and two land courts.

[1] For the general atmosphere and " psychology " of these events the reader is referred to the report of the commission of enquiry (Cmd. 1540, 1921.)

All other judges and magistrates are Palestinians drawn impartially from among the qualified members of the three religious communities. Cases of religious law and personal status are still judged as under the Turkish régime by the special tribunals of the several creeds. Ottoman law, amended by ordinances of the administration, remains the foundation of the legal system.

II. FINANCIAL AND ECONOMIC DEVELOPMENT

Finance.—In 1923 there was a budgetary deficit of £E.725,000. As a result of drastic economies, the position was retrieved in 1924, and resulted in a surplus of approximately £E.263,000.

Revenue and Expenditure

Year	Revenue	Expenditure	Surplus	Deficit
	£E	£E	£E	£E
1920–1	1,422,208	1,227,056	195,152	..
1921–2	1,997,522	1,881,108	116,414	..
1922–3	1,764,585	1,837,173	..	72,588
1923–4	1,633,893	1,633,227	666	..
1924–5	2,101,072	1,806,660	294,412	..
	8,919,280	8,385,224	606,644	72,588

The rate of the tithe has since been reduced from 12½%, the Turkish figure, to 10%, thus relieving the agriculturist at a single step of one-fifth of the weight of the tax. Palestine has hitherto had the use, free of payment, of the main line of railway, and of certain other works constructed by the British army for military purposes during the War.

Communications.—There are 600 km. of metalled main roads in Palestine and 600 km. of secondary roads, serving 177 villages, of which 280 km. have been constructed or rebuilt since the establishment of the civil administration. Many hundreds of miles of tracks connecting scattered villages and settlements are used by motor and other wheeled traffic in the dry weather. In 1914 there was only one motor car in Palestine; there are now over 1,000, including more than 600 within the municipal area of Jerusalem. The military railway constructed by the Army across the Sinai desert has been brought under the management of the Palestine Railway Department. A train service is efficiently run from Egypt to Haifa, from Jaffa to Jerusalem and from Haifa to Syria. Before the War the postal services were maintained largely by separate agencies of European Powers; telegraphs were restricted; telephones unknown. There are now frequent daily deliveries of letters; 34 telegraph offices, 31 public telephone exchanges, and trunk lines to all parts of the country and Egypt answers calls in English, Arabic and Hebrew at any hour of the day and night.

Public Health.—The department of health has directed intensive and successful efforts against malaria, with the co-operation of voluntary organisations, notably the Rockefeller Foundation, by whom much necessary hospital provision is afforded, except for infectious disease, for dealing with which the department is responsible. In combating trachoma, in which the British Opthalmic Hospital of St. John of Jerusalem plays a chief part, 50,000 school children are annually inspected; infant welfare centres have been established, largely by non-official bodies, in eight towns; 20 nurses and 38 midwives have qualified in the Department's training centres and 82 nurses and four midwives in voluntary institutions. Vaccines are prepared and quarantine and disinfection of immigrants and pilgrims returning from Mecca is carried out. Free treatment is provided against rabies. The death-rate for the country is 22·53 in towns and 28·01 in districts, while the birth-rate is 47·40 and 53·68 respectively. The infantile mortality rate is 184·43 per thousand.

Education.—There are 315 Government and 489 non-Government schools. The schools maintained by Government include two training colleges, one for men and one for women. Altogether about 50,000 children, aged from 5 to 14, and about 8,800 aged from 15 to 18, receive a measure of education; being 31% of the children between the ages of 5 and 14, and 20% of those between 15 and 18. The Palestine Zionist executive spends some £E.100,000 annually on Jewish education. English, Scottish and foreign Missionary Societies also maintain schools.

Archaeology.—In 1918 the military governor of Jerusalem, in order to preserve the antiquities of the district, issued and enforced certain public orders; and, to organise public opinion, established the Pro-Jerusalem Society, an international and non-sectarian body, in which all communities and most learned societies participate through their leading members. The society encourages arts and crafts, employs a qualified architect and town planner to protect the amenities of the old and advise on the development of the new city, and has collected in subscriptions some £E.15,000. A Department of Antiquities was established in 1920, by which 2,860 historical sites have been registered and are being inspected. A central museum has been organised in Jerusalem. Work in the field has been undertaken by British, French, American and German schools of archaeology and by a Palestine Jewish Archaeological Society. A Neanderthal skull was discovered in 1925 at Tabgha by the British School.

Assistance to Farmers.—The £E.562,000 advanced by the military administration, mostly in small loans on security of land and crops, enabled peasants to buy animals and seed, and in many ways to recover from the devastation of the War. Subsequently a Department of Agriculture and Forests was established, which gives instructions in villages and promotes the use of improved instruments and methods. It assists the farmer in dealing with animal diseases and plant pests, fumigates his orange trees if affected by scale, protects his cattle from imported diseases by quarantine and veterinary control; has planted about one million trees, and, through its nurseries, has facilitated plantation by others. Altogether, four or five million timber and fruit trees have been planted in these years in Palestine. Jewish agricultural settlements came into existence during the past half century. Many were formed on uncultivated and unpromising land which has been transformed into flourishing plantations. The settlers have drained swamps, planted eucalyptus and pines, cultivated vine and almond and developed the orange trade of Jaffa.

At the outbreak of war there were 44 settlements of 87,800 acres. There are at present (1926) about 100 covering an area of 220,000 acres (6% of the cultivable area of Palestine) and supporting a population of about 24,000. Of the older settlements most were founded or largely assisted by Baron Edmond de Rothschild or the Jewish Colonisation Association acting as his agent; the later mostly by the Zionist Organisation. Largely owing to the lifework of Eliezer Ben Yahuda, a practical visionary of genius, Hebrew is definitely established as the vernacular as well as the literary language of Palestinian Jewry. The revival of Hebrew culture found in 1925 concrete expression in the formal opening by the Earl of Balfour of the Hebrew University upon Mount Scopus. Hardly less remarkable is the development in 18 years of Tel-Aviv from the suburb into the rival of Jaffa.

Natural Resources and Industry.—Before the War, industries were almost non-existent. A few soap and oil factories at Nablus and elsewhere, Baron Edmond de Rothschild's wine factories, and some hand industries, such as the Bethlehem mother-of-pearl, répresented the sum of local manufacture. Largely owing to Jewish enterprise, there are now several important factories for silicate bricks, vegetable oil, flour, salt, soap, cement, furniture, matches and textiles, as well as smaller enterprises. An important hydro-electric concession has been granted to Mr. Pinhas Rutenberg for the utilisation of the water powers of the upper waters of the Jordan and its tributary the Yarmuk. This work has not yet begun but power stations with oil engines have been erected at Tel-Aviv, Haifa and Tiberias, whereby light, power and heating are provided in these districts. Though Haifa seems likely to become the principal harbour, extensive improvements are contemplated at Jaffa, the centre of orange cultivation, and thus of more than half the total export trade of the country. The potash deposits of the Dead Sea constitute an important potential source of wealth. The balance of trade, shown below, is increasingly adverse, equilibrium being hitherto adjusted by immigration, tourists and charity.

	Imports	Exports
1922	5,471,667	1,070,171
1923	4,825,185	1,143,234
1924	5,266,349	1,281,212
1925	7,338,491	1,297,559

Limited Companies (103) have established themselves under the law of Palestine, and 52 foreign companies registered themselves locally. On the expiry of Sir Herbert Samuel's term of office (July 1 1925) Lord Plumer was appointed high commissioner.

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(R. St.)

PALESTINE, OPERATIONS IN.—The British campaigns of 1914–8 in Palestine, Egypt and Syria covered an extensive stretch of territory, from the Suez Canal to Aleppo, a distance by the land route of well over 500 miles. This land route, the oldest highway in the history of the civilised world, along which the tides of thought and trade and war have flowed between Asia and Africa since time immemorial, traverses a remarkable variety of soil and scenery: the inhospitable desert of Sinai; the fertile plains of Palestine, flanked by the high rocky citadel of the Judaean hills; the deep trench of the Jordan valley; and, finally, the Syrian plateau with those cities of ancient tale, Damascus and Aleppo.

The fighting was as diversified as the terrain; it comprised battles in the desert and in fertile country, combats in steep bleak hills and in a sweltering valley below sea level, periods of close-locked siege warfare and intervals of rapid movement. The story of the successive advances of the Egyptian Expeditionary Force (as the British Army in this theatre came to be called) and of the gradual extension of its objective—from the passive defence of the canal to the delivery of the *coup de grâce* to the Turkish Empire—falls conveniently under four main heads: the Suez Canal, Sinai, Palestine, Syria.

I. THE PROBLEM OF THE SUEZ CANAL

When Turkey entered the World War on the side of the Central Powers at the beginning of Nov. 1914, it was obvious that an advance from southern Palestine against the Suez Canal and Egypt was likely to form part of the Turkish strategical programme, largely inspired from Berlin. Seizure of the canal would paralyse the most vital line of communication of the British Empire and seriously hamper the gathering of its armies. Even the threat must immobilise considerable numbers for passive defence. The dream of reasserting dominion over their former province of Egypt was an additional lure to the Turks.

The Turkish Advance.—Between the southern frontier of Palestine and the Suez Canal lay over 100 m. of almost waterless desert. It was crossed by three routes, of which the northern, near the coast, through Rafah, El 'Arish and Qatiya to El Qantara, was the easiest and best. The Turks made their main effort on the centre route, from El 'Auja by the Wadi Muksheib, which reaches the canal about Tussum, south of Ismailia; but they also sent smaller forces by the coast road and by the southern route, through Nekhl to Suez, the most difficult of the three. The Turkish commander in Syria, Jemal Pasha, directed the enterprise, but its real brain was his Bavarian chief of staff, Col. Kress von Kressenstein. In spite of the difficulties, a force of some 12,000 to 15,000 Turks was brought within striking distance of the canal by the first days of Feb. 1915.

The British were not unaware of the danger—though they underestimated the Turkish effort—and were ready. The line of defence, which was held mainly by Indian troops, lay on the western bank of the canal, leaving the canal itself as an obstacle between the defenders and the enemy. A territorial division (the 42nd) and some Australian and New Zealand troops, who were completing their training near Cairo, formed the reserve. Warships in the canal provided gun support and compensated for the scarcity of land artillery. On the night of Feb. 2–3 the Turks made their effort, reached the canal, and actually succeeded

in pushing three pontoons full of troops across it. These were all killed or captured. An attack next day had no better success, and the Turks withdrew, unmolested by any serious pursuit.

This first Turkish raid, though it failed, proved the desert passable to large bodies of troops and thus compelled the retention of considerable forces in Egypt for the protection of the canal. It also showed the unsuitability of the defence on the west bank, since this line could not prevent the attackers from reaching the canal and interfering with the passage of shipping. No change was made in the system of defence, however, till after Lord Kitchener's visit in Nov. 1915. For during the summer and autumn of 1915 the Gallipoli campaign was in full swing and absorbed the principal efforts of both Turk and Briton. The Senussi rising in the western desert, too, occupied the attention of the G.O.C. in Egypt, Gen. Sir John Maxwell. After the evacuation of Gallipoli at the end of 1915 and beginning of 1916 Egypt contained close on 400,000 British troops, reorganising and recuperating after that gallant but ill-starred adventure. For a short time there existed within Egypt three separate and independent commands, but in March 1916 all three were united under Sir Archibald Murray.

Meanwhile, early in 1916, a line was taken up in the desert, some 8 to 10 m. to the east of the canal. Many miles of entrenchments were dug and revetted in the shifting sand, metalled roads constructed and pipe lines laid. For the Turk, freed from concern for the safety of his capital, was obviously contemplating a fresh advance on Egypt and the canal. He had in fact been busy with preparations ever since the repulse of his first effort.

This system of entrenchments, extending for some 80 m. along practically the whole length of the canal, was expensive in men as well as in material. This fact originated the first advance of the Egyptian Expeditionary Force and led to the crossing of the Sinai desert, an achievement made possible by sound and thorough organisation, and by the fine quality of the mounted troops, mainly Australians and New Zealanders, which the desert warfare developed and proved.

II. THE SINAI DESERT

Sir Archibald Murray's objective was to secure control of the Sinai desert, which he saw could be effected by an advance to El 'Arish near the Egyptian frontier. A position here would bar the northern route across the desert and flank the more southerly routes. It would also enable offensive operations to be undertaken against enemy forces concentrating in southern Palestine. But an invasion of Palestine was not seriously contemplated at this time; the advance was initiated to safeguard Egypt and the Suez Canal. Murray estimated the force necessary at five divisions and four mounted brigades, a much smaller force than that needed adequately to garrison the defensive system along the canal. Moreover, the farther the defence was removed from Egypt the less chance there was of a sympathetic rising there on the approach of the Turk.

British Advance on El 'Arish.—The first step was to occupy the Qatiya oasis, 25 m. east of the canal, and thus deny to the enemy the only district within striking distance where a sufficiency of water permitted the assembly of a large force. The construction of a broad gauge railway from El Qantara towards Qatiya was begun, and large numbers of camels were collected to form the transport of the force, since in the soft sand of the desert wheeled transport was impossible. For the guns, special "pedrails" were constructed and teams doubled. Towards the end of April 1916, the Turks made a raid on the Qatiya oasis and surprised and captured some advanced posts of yeomanry. The Anzac Mounted Div., formed in March from Australian and New Zealand troops, reoccupied the area next day. The object of the Turkish raid seems to have been to cause alarm and thus to prevent the further withdrawal of troops from Egypt for France, which had been going on during the spring of 1916.

By July the advance had reached Romani at the western end of a scattered group of oases extending for some 15 to 20 m., when a strong Turkish force entered the eastern end. This force consisted of the 3rd Div. and certain other units, totalling about 18,000 men under Kress von Kressenstein. After a pause for preparation, at dawn on Aug. 4 it attacked the British position at Romani, held by the 52nd and 42nd Divs., the Anzac Mounted Div. and some yeomanry, in all about 30,000 men, under Lt.-Gen. the Hon. H. A. Lawrence. The Turks made a determined assault but were heavily repulsed and pursued as far as Bir el Abd. Their losses, including some 4,000 prisoners, amounted to nearly half their total force. They may perhaps be accounted fortunate to have escaped at all, for intense heat and lack of water precluded the more vigorous action in pursuit, which might have made possible the annihilation of the Turkish force.

The defeated Turks retreated to El 'Arish, leaving a small detachment at Bir el Mazar till the middle of Sept., when it was dislodged by the Anzac Mounted Division. There was no further fighting till December. The progress of the British force (now under Lt.-Gen. Sir Charles Dobell) towards El 'Arish was governed by the rate (about 20 m. a month) at which the railway and its accompanying pipe-line could be laid. The water supply available in Sinai was too brackish for constant drinking by troops; even the railway locomotives could not use it for long without loss of efficiency. The Sweetwater Canal, which runs from the Nile at Cairo to the Suez Canal, was the source of the pipe-line supply; from large reservoirs and a great pumping station built at El Qantara it was forced through a 12-in. pipe to railhead. In 1917 this pipe-line was extended up to Gaza.

Occupation of El 'Arish and Rafah.—Early in Dec. the railhead was within 20 m. of El 'Arish. Elaborate water and transport arrangements were now made to enable the advanced guard of the British force to capture El 'Arish. This advanced guard was known as the Desert Column, and consisted at this time of the Anzac Mounted Div. and 42nd and 52nd Divs., under Lt.-Gen. Sir Philip Chetwode. Just as all was ready, however, the enemy hurriedly withdrew and El 'Arish was occupied without fighting on Dec. 20.

The nearest Turkish force (1,600 infantry with four guns) was located at Magdhaba, some 20 m. south of El 'Arish. A flying column under Gen. Chauvel, consisting of the Anzac Div. and Imperial Camel Corps, was at once dispatched against it. After a night march Chauvel attacked the Turks in an entrenched position at dawn on Dec. 23. By late afternoon, at a cost of under 150 casualties, he had accounted for practically the whole enemy force, capturing 1,300 prisoners and burying 100 dead.

The only Turkish force now remaining within the Egyptian frontier was a detachment of about 2,000 near Rafah, 25 m. east of El 'Arish. This was dealt with in a similar fashion by the mounted troops under Chetwode. After a night march, he surrounded the Turkish position at dawn on Jan. 9. Some hard fighting followed, for the Turks were in a strong position and put up a stout defence. It was not till close on dark that the position was assaulted. The entire Turkish force was accounted for, while the British casualities were under 500. These two brilliant actions cleared the Egyptian province of Sinai from enemy occupation. They were striking examples of the power of boldly handled mounted troops, a power the Turk was to experience very thoroughly before the end of the War. Murray had now obtained his original objective, since the possession of Rafah and El 'Arish secured the safety of the Suez Canal and Egypt.

Towards the end of 1916 he had, however, received instructions which imposed on him a more active rôle than the mere defence of Egypt. While this defence was still to be the main consideration, it was made clear to him that the War Cabinet expected some more spectacular result of the "Exodus" across the desert than the negative one of giving checkmate to Turkish designs on Egypt. At the same time they were not prepared to give Murray the additional troops he asked for. Indeed, one of his four divisions, the 42nd, was early in 1917 withdrawn to France, leaving him only three in place of the five which he held to be the minimum to fulfil the rôle demanded of him. He had the nucleus of a fourth division—the 74th—to be formed from dismounted yeomanry; and the liquidation of the western desert campaign enabled him to add a second mounted division to the force on the Palestine border.

The situation in the early spring of 1917 was this: railhead was close to the Egyptian frontier at Rafa, some 20 m. from Gaza; the British War Cabinet's policy for the Egyptian theatre had finally crystallised into instructions to Sir Archibald Murray to prepare during the summer for an offensive campaign into Palestine in the autumn; and the Turk—now definitely on the defensive—had suddenly evacuated a forward position which he had prepared at Shellal, and had sketched out a position for the defence of Palestine between Gaza and Beersheba.

The Palestine Offensive.—Gaza and Beersheba, some 25 m. apart, are the two natural gates into Palestine from the south, the former by reason of its commanding position on the coast road, the latter as the last water base on the confines of the mountainous desert to east and south. Between Gaza and Beersheba, in an almost direct line, run a series of ridges which form a natural defensive position. Murray saw that in order to carry out his instructions to prepare for an autumn offensive, it was desirable to push his railhead forward out of the desert up to the cultivated plain of south Palestine. The conditions of transport would then be entirely different and camels could be largely replaced by wheeled transport. Moreover, the capture of Gaza would make it impossible for the Turk to hold the Gaza-Beersheba line as his main defensive position.

It was decided therefore in March to attempt the capture of Gaza by a *coup de main* similar to those at Rafa and Magdhaba, but on a much larger scale. The difficulties of concentration, of supply and of secrecy were of course much increased by the necessity to employ infantry in addition to mounted troops. The Turks had at the time some 7,000 fighting troops in Gaza, another 7,000 at Tel esh Sheri'a, half-way between Gaza and Beersheba, and a small garrison in Beersheba.

The plan was, briefly, for the mounted troops to pass east of Gaza, cut the garrison's line of retreat, and hold off the arrival of any Turkish reinforcements from the north or east. The 53rd Div. was to assault the heights east and south of Gaza, while the 54th Div. protected the exposed right flank from the direction of Tel esh Sheri'a.

Attacks on Gaza.—The enterprise took place on March 26. Unfortunately, a dense sea fog came up with the dawn and caused a delay of two precious hours in the deployment of the infantry. This delay, which could not have been foreseen nor prevented, was the direct cause of the loss of the battle. For the Turkish position was strong, and it was not till 5 P.M. that the 53rd Div. secured the 'Ali el Muntar ridge which dominates Gaza from the east; at the same time, a part of the mounted troops were in the northeastern outskirts of the town. The victory was to all appearances won. In fact the garrison, as was afterwards known, was on the point of surrender. But Turkish reinforcements from the north and east were already pressing on the protective screen of the mounted troops; the horses were without water, and darkness was coming on. It had been agreed beforehand that the enterprise should be abandoned if Gaza had not fallen by dark. The reports received did not indicate a successful issue; owing to a breakdown of communications, news of the success of the 53rd Div. did not reach the British commander till about 11 P.M. Sir Charles Dobell hesitated to involve his infantry in the intricate network of cactus hedges which surrounds Gaza, while Chetwode was against exposing his mounted troops, exhausted by want of water, to the danger of being overwhelmed by the approaching Turkish reinforcements. The withdrawal of the mounted troops was ordered. This exposed the right of the 53rd Div., which had to be drawn back from the 'Ali el Muntar heights to gain touch with the left of the 54th. The battle was resumed next morning, but the Turkish garrison had been reinforced and had taken heart of grace at the unexpected respite of the previous evening. It was found impossible again to make good the 'Ali el Muntar ridge, the key to Gaza; and finally the whole force was withdrawn to the Wadi Ghazze.

This first battle of Gaza has been a matter of dispute and conjecture. By many of the troops who took part, it was held that the decision to withdraw threw away a victory already won. On the other hand, it is impossible to question that in the circumstances the order for retirement was justified. The two-hour delay in the morning lost the battle. Other contributory causes were the breakdown of communications (partly due to shortness of equipment) and lack of accurate maps, which made it impossible for H.Q. to obtain timely information of the progress of the fight.

Though the enterprise had failed, the force had secured a position on the Wadi Ghazze which would enable railhead to be advanced to within a short distance of Gaza in preparation for the autumn campaign. Murray now, however, received instructions to commence an offensive movement at once. A fresh assault on Gaza was therefore prepared. But the conditions were now very different; the Turk had closed the gap between Gaza and Beersheba by a series of works, and had greatly extended and strengthened the defences of Gaza. He had some five divisions in line and a considerable quantity of heavy artillery, so that Gen. Dobell's force had no easy task. Much hope was placed in some tanks, which were to be used in Eastern warfare for the first time. The attack was made in two stages, of which the first, on April 17 was designed to gain a position from which the final thrust on Gaza could be made. It was successful. But the decisive attack on April 19 failed with heavy loss; the tanks developed mechanical defects in the heavy sand or were put out of action by the well-placed Turkish guns; and the weight of artillery supporting the British attack was insufficient to demolish the formidable defences of Gaza. The British casualties were 7,000.

Operations before Gaza now settled into regular trench warfare. The Sinai campaign was at an end. It had fulfilled its object, the security of Egypt; and the careful and thorough organisation which had conquered the desert had laid a solid foundation for the future British successes. For this Sir Archibald Murray deserves the greatest credit. He had never been given the number of troops which he had repeatedly stated was the minimum necessary for more extended successes.

III. PALESTINE

A long pause in active operations followed the second battle of Gaza. The Turks, under German leadership, were now gathering their last resources at Aleppo for an attempt to recapture Baghdad. They christened this force the "Yilderim" ("lightning") group. The British General Staff decided to forestall this enterprise by an attack in Palestine which would divert this army southwards from Aleppo and remove the danger to Baghdad. The British Government also no doubt hoped by a spectacular success in the East to remove some of the disappointment caused to the public by the failure of Nivelle's offensive in France and the military collapse of Russia. Gen. Sir Edmund Allenby succeeded Sir Archibald Murray in July 1917, with instructions to report on the conditions in which offensive operations could be undertaken against the Turkish forces on the Palestine front.

Allenby's Plan Outlined.—Allenby based his plan on an appreciation made some time previously by Lt.-Gen. Sir Philip Chetwode, who now commanded on the Gaza front. The obvious line of advance was by Gaza, which would allow of naval co-operation, directly cover the lines of communication, and present comparatively small difficulties of water supply. But the defences of Gaza were too solid to be broken except by a slow and costly process of siege. The Turkish centre was also strong and the approach to it difficult. There remained the Turkish left, which rested about Abu Hureira, some 7 m. west of Beersheba; the defences here were weaker and less complete, and might perhaps be rapidly overwhelmed. This would provide an opportunity for the mounted troops, the arm in which lay the chief superiority of the British force over the Turkish.

A preliminary operation was necessary to capture Beersheba, which the Turks held by a detached force; for there was not room to manoeuvre between Beersheba and the Turkish left; moreover possession of the water supply at Beersheba was essential to further operations. The difficulties of capturing Beersheba and of placing a sufficient force within striking distance of the Turkish left were, however, serious. The three principal problems to be

solved were those of transport, water supply and secrecy. Until the Gaza-Beersheba line had been passed and the cultivated plain of Palestine reached, it was not practicable to use motor lorries, and the force was dependent on horsed transport and camels. This limitation greatly increased the difficulties of water supply, which was the second main problem. Its seriousness is illustrated by the fact that the striking force estimated as necessary for operations against the Turkish left required some 400,000 gallons of water daily. Of the 30,000 camels available the majority would be required to carry water. The third great difficulty was to concentrate a striking force sufficient to overwhelm the garrison of Beersheba rapidly and then attack the Turkish left, without the Turks becoming aware of the plan and taking steps to counter or avoid the blow.

In spite of the difficulties to be overcome, Gen. Allenby decided to attack the Turkish left. He estimated the total force required at seven divisions and three mounted divisions with additional artillery and aeroplanes. Four divisions and two mounted divisions were to attack the Turkish left, three divisions were to make a subsidiary attack on Gaza, and one mounted division was to watch the centre between these two wings, which would be separated by some 20 m. during the operations.

The number of divisions was made up to the required total by the 10th and 60th from Salonika and by the completion of the 75th, already in process of formation. Allenby formed his three mounted divisions into the Desert Mounted Corps, under Lt.-Gen. Sir H. Chauvel, an Australian, and his seven divisions into two Corps, the XX., under Lt.-Gen. Sir Philip Chetwode, and the XXI., under Lt.-Gen. Sir E. Bulfin. The elaborate preparations necessitated by the character of the forthcoming operations occupied the summer and early autumn. The railway across the desert was doubled; and arrangements were made for its rapid extension during operations; ammunition and other stores were accumulated; and the troops underwent special and intensive training. The development of the water supply was also a constant preoccupation.

Meanwhile, Gen. von Falkenhayn, in command of the Turkish Army at Aleppo, had realised that the security of the Palestine front was essential to the successful prosecution of the plan for the recapture of Baghdad. It was accordingly decided to drive the British back into the Sinai desert before committing the Yilderim force to the Mesopotamian adventure. All troops available at Aleppo (only three divisions) were ordered to south Palestine during September.

Both Turks and British were thus aiming to strike a blow on the Palestine front in the autumn of 1917, and each hoped to forestall the other. The poverty of the Turkish lines of communication decided this issue by the delay it imposed on the southward movements of men and stores. From Haidar Pasha, the Turkish main base on the Asiatic shore of the Bosporus, to railhead in Palestine was a distance of 1,275 m., with a single line of rail only, which, up to Aleppo, had also to serve the Mesopotamian front. The incomplete tunnels in the Taurus and the differences in gauge of the various lines necessitated five or six transhipments of all stores before they reached Palestine. Scarcity of fuel and jealousies between the German commanders and staff and the Turkish officials who controlled the working of the communications further accentuated the difficulties. Consequently, the supply problem crippled Turkish movements throughout these campaigns. The force from Aleppo was still in process of arrival on the Palestine front when Allenby struck his blow.

Disposition of the Troops.—During the days previous to Oct. 31, the date fixed by Allenby for the attack on Beersheba, the Desert Mounted Corps and the XX. Corps (10th, 53rd, 60th, 74th Divs.) were gradually and secretly moved across to the right wing from behind Gaza, where they had been in training camps by the sea. There could be no question of concealing entirely the preparations for a movement against Beersheba; but Allenby did hope to persuade the Turks that this movement was only a feint and that the real main attack was against Gaza. To this end the XXI. Corps (52nd, 54th and 75th Divs.), left opposite Gaza, began on Oct. 26 a heavy bombardment of the Turkish defences, assisted by British and French warships from the sea. The intended deception as to the real point of attack was aided by the natural nervousness of the Turk of operations by sea against his right flank. He was also perfectly aware of the great difficulties of transport and water supply in the country opposite his left flank, which he believed was sufficiently safeguarded by these natural obstacles.

The Turkish forces at the end of Oct. consisted of the VIII. Army (six divisions) under Kress von Kressenstein, holding Gaza and the Turkish centre, and the VII. Army (three divisions), holding Beersheba and the Turkish left. The VII. Army was not yet complete, one of the divisions from Aleppo being still on the lines of communication. Von Falkenhayn, who was to combine the action of these two armies, only arrived at Jerusalem on Nov. 1. The approximate fighting strengths of the Turkish and British forces were: Turks, 50,000 rifles, 1,500 sabres, 300 guns; British, 95,000 rifles, 20,000 sabres, 500 guns.

Allenby's plan for Oct. 31 was as follows: Two divisions of the XX. Corps, the 60th and 74th, were to attack the southwestern defences of Beersheba, which lay some 4 m. from the town itself, with the 53rd Div. protecting the left flank of this attack. The Anzac and Australian Mounted Divs., which had concentrated at El Khelasa and Bir 'Aslūj, were to reach a position east of Beersheba by dawn, close the Beersheba-Hebron road, and then attack and carry the town as rapidly as possible, before the Turks could destroy the wells.

Capture of Beersheba.—During the night of Oct. 30–31 the assaulting infantry and artillery moved some 8 m. to their positions of deployment, while the mounted troops undertook a ride of over 25 m. to reach a position east of Beersheba. These long and complicated night movements were only made possible by careful preparation and good staff work. At dawn on Oct. 31 the attack of the XX. Corps commenced. A Turkish forward work, Hill 1030, had to be taken, to allow the artillery to get within wire-cutting range of the main position. Hill 1030 was taken at 8:30 A.M.; the main assault was delivered at 12:15 P.M. and was successful; by early afternoon the British infantry were masters of the Turkish defences southwest of the town; they were still, however, some miles from the town itself. Meanwhile, the mounted troops, after closing the Hebron road, had been held up by a Turkish strong point at Tel es Saba, 3 m. east of Beersheba. When this was at last taken, little time remained if the town was to be captured before dark. Gen. Chauvel accordingly ordered a mounted attack at 4 P.M. The 12th Australian Light Horse Bde. charged over the Turkish trenches and rode straight into the town. This daring and well-executed charge resulted in the capture of over 1,100 prisoners and 10 guns, and saved the all-important wells from demolition. The infantry had captured another 900 prisoners, and the Turkish 27th Div. had suffered practical annihilation. While the preparations for the decisive attack on the Turkish left were being made, the XXI. Corps carried out a holding attack at Gaza on the night of Nov. 1–2. A considerable portion of the Gaza defences was carried and heavy losses caused to the Turks.

Left to themselves, the Turkish commanders would now probably have retired to a fresh position while there was yet time. But Von Falkenhayn, imbued with German principles of defence and ignorant of the qualities of the Turkish troops he led, ordered a counter-attack with all available reserves to the north of Beersheba. This led to three days' heavy fighting against the British 53rd. Div., which had been sent into the hills to guard the right flank of the XX. Corps. The 53rd Div. held its own; consequently, when at dawn on Nov. 6 the remainder of the XX. Corps (10th, 60th and 74th Divs.) attacked and broke through at Abu Hureira, the Turks had no reserves to restore the situation. By nightfall Gaza was being evacuated and the whole Turkish force was in full retreat.

The pursuit by Allenby's mounted troops was hampered by lack of water; and the Turkish rear-guards were well handled. A gallant charge at Huj on Nov. 8 by some squadrons of Worcestershire and Warwickshire Yeomanry captured three batteries of guns; but no large bodies of Turks were cut off; and the supply

question limited the number of divisions which could be used in the pursuit.

On Nov. 11 the Turks took up a position to cover Junction Station, where the railway to Jerusalem branches off the main line. After a short pause to organise for attack, Allenby's pursuing troops attacked on Nov. 13 and soon dislodged their enemy, in an action remarkable mainly for a dashing charge by a brigade of yeomanry on a strongly held hill above the village of El Mughaiyir. On the following day Junction Station was captured; Jaffa was occupied on the 16th. The capture of Junction Station definitely divided the Turkish armies; the VII. was left in the hills to defend Jerusalem, while the VIII. was in the plain to the north of Jaffa; there was no good communication between the two armies south of the line Tul Karm-Nablus.

Before Jerusalem.—Allenby had originally intended to wait until the development of his communications allowed of his whole force being brought up before turning into the difficult hills towards Jerusalem. He now decided to oppose the Turkish VIII. Army with a detachment, while with the remainder of his force he turned east and advanced on Jerusalem at once. It was a bold decision, since he had only three infantry and two mounted divisions immediately available, and the supply of these strained the resources of his transport to the utmost; the troops available had already done much hard marching and fighting; little was known of the hill country save that it was very difficult and that there was only one road fit for wheels. The Anzac Mounted Div. and the 54th Div. were left to hold the Turkish VIII. Army in the plain, while the remaining three divisions advanced into the hills, the 75th up the main road, the 52nd on its left and the Yeomanry Mounted Div. on the left of the 52nd. Both these two latter divisions were entirely dependent on pack transport. The intention was to pivot on the 75th, when that division arrived within a certain distance of Jerusalem, and to swing the left across the Jerusalem-Nablus road north of the city. It was hoped thus to compel the surrender or withdrawal of the defending Turks and to avoid fighting in the close vicinity of the Holy City.

There was some hard fighting on Nov. 20 and 21; the 75th Div. captured the crest of the ridge at Enab in a fog on Nov. 20 and on the 21st stormed the commanding hill of En Nabi Samweil; the 52nd made similar progress; and the yeomanry were at one time within a short distance of the Nablus road. But the British effort had shot its bolt; the men were suffering much from cold and wet, and the artillery support available was insufficient against strong prepared positions. The yeomanry were counter-attacked and driven back, and the 52nd and 75th could make no headway; by Nov. 24 it was evident that without fresh troops and a period of preparation Jerusalem could not be taken. The difficult passes through the hills had, however, been secured and the boldness of the advance justified.

A pause now took place while the British Army improved its communications and thus enabled the XX. Corps to be brought up from Gaza, where it had been left for convenience of supply. It took over the line opposite Jerusalem, releasing the troops which had made the first attempt to strengthen the line in the plain. Von Falkenhayn during this period ordered small local counter-attacks all along the line in the hope of disorganising Allenby's plans. But these attacks had no effect and merely wasted the best remaining elements of the Turkish force.

The second attack on Jerusalem was delivered at dawn on Dec. 8, in mist and rain. The brunt of the fighting fell on the 60th (London) Div., assisted on the left by the 74th Div. and on the right by the 53rd Div., which had previously moved up from Beersheba along the Hebron road to within striking distance. By the evening the Turks had decided to withdraw, and the city surrendered next morning. Allenby made an official entry on Dec. 11. His brilliant campaign effectively removed all danger to Baghdad from the Yilderim Army, the whole of which had of necessity been used in Palestine. The last reserves of Turkish man-power were practically exhausted; and Turkey was now in a far worse plight than when Germany had, at the commencement of 1917, undertaken the re-establishment of her military prestige by driving the British out of Baghdad. Von Falkenhayn had completely failed to grasp either the conditions of the theatre or the idiosyncrasies of Turkish troops. He was replaced early in 1918 by Liman von Sanders.

Rising of the Arabs.—The encouragement given by the British success to the Arab revolt caused an additional drain on Turkish resources. The Arab revolt had broken out a year previously, when Hussein, the Sherif of Mecca, induced the Hejaz to rise against the Turk. Jeddah and Mecca were soon captured, but the Medina garrison held out. The revolt would probably have ended in the re-establishment of the Turks, or in desultory warfare with little result, had there not appeared a young Englishman with an understanding of the Arabs and a gift for guerrilla tactics. As Col. Lawrence he became famous. He persuaded Feisal, a son of Hussein, who led the Arab forces in the field, that the true policy lay not in assaults on the Turkish garrison in Medina, which if successful would merely rid the Turks of an embarrassment, but in gradually spreading the revolt northward up to the very gates of Damascus, with propaganda as the principal weapon, and in ceaseless raiding on the long exposed Turkish communications to Medina, which would form a constant drain on the enemy's resources.

In pursuance of this policy, Feisal, with Lawrence as his adviser, moved his base of operations from opposite Medina, first to Wejh and next to Akaba, which Lawrence had captured by a dashing raid. Gen. Allenby was quick to realise the service which the Arab rising was rendering to his operations, and was always sympathetic to Lawrence's requests for equipment or other aid in kind.

Allenby's next aim was obviously to secure sufficient room for manoeuvre in front of Jerusalem in the hills and Jaffa in the plain. On Dec. 20 and 21 the 52nd Div. forced a passage of the river El 'Auja, and drove the Turks 8 m. north of Jaffa, thus improving the position in the plain. In the hills, all preparations had been made for an operation to drive the Turks farther from Jerusalem, when information was received that the Turks themselves were about to attack. Reinforcements, including the 1st Div., had reached them, and Von Falkenhayn was determined on an attempt to recapture the Holy City. The attack was pressed with great gallantry on Dec. 26, but made no impression; on the following days the counter-attack of the British XX. Corps carried them some 5 or 6 m. forward and safeguarded Jerusalem from the north. Later, the eastern flank was secured by the capture of Jericho, which took place on Feb. 21. Early in March, the line was pushed still farther north, both in the hills and in the plain, by a series of small operations. Thus by the spring a strong line had been secured, which might have been held by a reduced force in the exhausted state of the Turks.

Plans for 1918.—Meanwhile, the future of the Palestine campaign in the general plan of the Allies for 1918 had become the subject of considerable discussion. In view of the expected great German offensive in the West, there was a considerable body of opinion amongst those who directed the Allied strategy in favour of closing down as far as possible all commitments in minor theatres and of concentrating on the vital Western Front all reinforcements that could be spared from them. It was also pointed out that the maintenance of large forces on the Palestine front entailed heavy losses in shipping—which was likely to prove the Achilles' heel of the Allies—since the submarine menace was especially serious in the Mediterranean.

On the other hand, it was believed by many that neither side could force an issue on the Western Front, so formidably entrenched, and that the War could be won by the elimination of Germany's weaker Allies. They held that one more blow would force exhausted Turkey to sue for peace; and consequently advocated a further offensive in Palestine. This policy was eventually adopted. Two divisions, the 3rd and 7th Indian, were moved from Mesopotamia to reinforce Allenby's army, and all preparations for a fresh great offensive were being made, when the storm broke on the Western Front. The success of the German offensive of March 21 caused a demand on Allenby for all the troops he could spare, which of course necessitated the post-

ponement of his operations. During April and May, two complete divisions (the 52nd and 74th), 24 additional British battalions, nine regiments of yeomanry and five and a half heavy batteries were withdrawn from the Egyptian Expeditionary Force and dispatched to France. These were gradually replaced by Indian cavalry from France and Indian units from India, and the Egyptian Expeditionary Force was reorganised on an Indian basis. It required much training and organisation to weld all these new, and in some cases raw, units into an effective whole; but by the end of the summer the Egyptian Expeditionary Force was again ready to strike a decisive blow.

Preliminary Operations in 1918.—Meanwhile, in March and May, Allenby had carried out two raids to the east of the Jordan. These raids were an important part of his strategical plan. He had decided that his next great advance should be initiated from his left flank along the coastal plain, where his great superiority in the mounted army could be exploited. Therefore, the more of the Turkish Army he could draw over to the opposite flank, east of the Jordan, the easier would it be to break through on the coast when the time came. The railway junction at Deraa was a vital point in the Turkish communications. If the Turkish Command could be persuaded by demonstrations east of the Jordan that a move in force up the Hejaz railway was a possibility, and if Feisal's Arabs could be encouraged to attack Deraa and the railway where it ran down the Yarmuk valley, the Turks would be obliged to move troops east of the Jordan. With these objects the raids east of the Jordan were undertaken. Neither was a complete tactical success. The first raid reached the railway near Amman and cut it in several places, but failed to capture Amman before supply difficulties caused by vile weather necessitated its withdrawal. In the second raid, the mounted troops reached Es Salt; but the Turks could not be driven from their strong positions in the Shunet Nimrin pass; and the defeat of the left flank guard of the mounted troops, with the loss of nine guns, rendered their position at Es Salt dangerous and compelled a withdrawal.

But the two raids had the desired effect of seriously alarming the Turks for their left flank. After the second, Liman von Sanders, who was now in command, had been induced to place one-third of his total force east of the Jordan, with a corresponding weakening of his forces west of the Jordan. Allenby kept alive the opposing commander's fears for this flank by maintaining throughout the summer, in spite of the heat, a considerable force in the valley of the Jordan. In July the German units operating with the Turks made an abortive attack on part of the position of the Desert Mounted Corps. Elsewhere on the front there was little serious fighting during the summer.

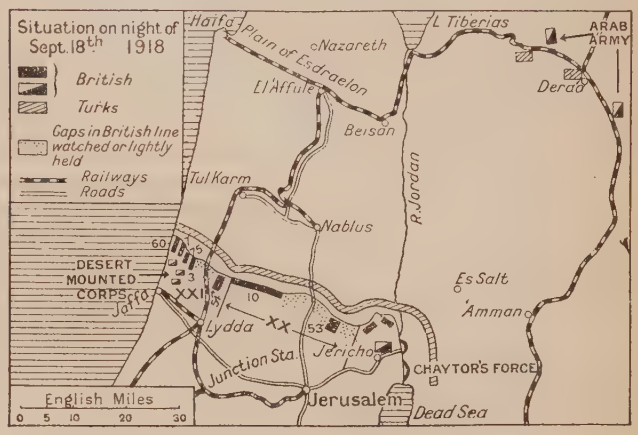
IV. SYRIA

At the end of the summer of 1918 the Turkish forces were distributed as follows, on a front of 65 m.: the VIII. Army (five divisions and three German battalions), in the coastal plain and the foothills, faced the British XXI. Corps; the VII. Army (four divisions), in the Judaean hills astride the Nablus road, faced the British XX. Corps; while the IV. Army (two divisions, one cavalry division and one composite division), in the Jordan valley and east of the Jordan, was opposed to the Desert Mounted Corps. The total fighting strength of the Turks amounted to 32,000 rifles, 3,500 sabres, 350 guns; and that of the British to 57,000 rifles, 12,000 sabres, 540 guns.

Gen. Allenby's plan was the reverse of that of the Gaza-Beersheba battle; then, he had struck the Turkish left while persuading them that his real effort was to be made along the coast against their right; now, he proposed to advance along the coast, while deceiving the Turks into thinking that their left flank was threatened. Steps were skilfully taken to simulate a concentration of troops in the Jordan valley, whereas in fact only a skeleton force, the Anzac Mounted Div. and a few battalions, was left there. The real concentration was being secretly made in the coastal plain, to which the bulk of the Desert Mounted Corps and the 60th Div. of the XX. Corps were transferred. For the success with which this concentration was concealed from the Turks to the last, British superiority in the air was largely responsible.

A simple statement in figures shows how well Allenby had succeeded in obtaining an overwhelming superiority of force at the decisive point. When his concentration was complete, he had on a 15-m. front in the coastal plain 35,000 infantry and 400 guns against only 8,000 Turks with 130 guns; and behind this mass of infantry were three cavalry divisions waiting to exploit success. On the remaining 45 m. of front he left only 22,000 infantry with 150 guns, facing 24,000 Turks with 270 guns. And the Turks were still unaware of his intentions or of the distribution of his force.

The September Offensive.—The attack was made at 4:30 A.M. on Sept. 19. The preliminary bombardment lasted only 15 min., and the infantry assault, pushed at great speed and in overwhelming strength on a broad front, was rapidly successful. By 7:30 A.M. the leading cavalry division was through the enemy's lines. The orders to the mounted troops were to ride straight north,



disregarding any hostile troops that did not directly bar their path, cross by the passes near Megiddo into the Plain of Esdraelon, and secure El Affule and Beisan to block the Turkish lines of retreat.

The leading troops of the 5th Indian Cav. Div. reached Nazareth, Liman von Sanders' headquarters, just 24 hours after their start, having covered 52 m.; they failed only by accident to capture the person of the enemy commander-in-chief. The 4th Cav. Div., moving farther to the east, covered 70 m. to Beisan in 34 hours. The advance was carried out with great dash and there were several instances of successful mounted attacks. A regiment of the 5th Cav. Div. rode over a Turkish battalion in the Plain of Esdraelon; and a brigade of the Australian Mounted Div. galloped into the village of Jenin, occupied by a numerous force of Turks and Germans, thus sealing one of the main exits from the trap in which the Turkish VII. and VIII. Armies were now caught. Meanwhile the British infantry of the XXI. Corps, after breaking through the Turkish fortified system in the plain, had wheeled to the right and driven the remnants of the Turkish VIII. Army into the hills. The 60th London Div. (Maj.-Gen. Shea) actually reached Tulkeram before dark on the 19th, having fought and marched 18 m. over very heavy going.

During the two days following Sept. 19 the XXI. Corps continued to press their pursuit, while the XX. Corps also pushed forward along the Judaean hills to Nablus. The infantry of these two corps thus shepherded the straggling remains of the Turkish VII. and VIII. Armies into the hands of the mounted troops. The Royal Air Force, with bombs and machine-gun fire, caused havoc amongst the bewildered Turkish transport, penned in and crowded on narrow hill roads. Only a few of the most determined Turks and some of the better fed and disciplined German units managed to break out to the east and cross the Jordan. The Germans fought well throughout the retreat.

Meanwhile, the Turkish IV. Army had remained inactive, ignorant of the fate of the other armies. On the 22nd it began a hurried retreat on Amman, hoping thence to escape up the Hejaz

railway to Damascus. It paused at Amman till Sept. 25, awaiting the arrival of the Maan garrison from the south. But the IV. Army was now not only too late to rescue this force, but too late to secure its own safety. Feisal's Northern Arab Army was already between it and Damascus, and the whole countryside was rising against the Turks. The Arabs under Lawrence had already contributed largely to the discomfiture of the Turks by their raids on the lines of communication near Deraa, which they cut effectively from Sept. 17 onwards. They were now in a position to delay and harass the IV. Army in its march north.

The Final Victory.—The Turkish VII. and VIII. Armies having been disposed of, Allenby ordered a part of his mounted troops to occupy Haifa, which was captured Sept. 23 by a most gallant charge of the Indian Imperial Service Brigade. The remainder were dispatched east and northeast to cut off the IV. Army and to capture Damascus. The 4th Cav. Div. was to cross the Jordan near Beisan and move on Deraa, while the Australian Mounted Div. was to make direct for Damascus by the road which runs from Nazareth to the west of Lake Tiberias, crossing the Jordan at Jisr Benat Yakub. On Sept. 25 there was a fierce fight at Tell es Semakh at the southern end of Lake Tiberias. The 4th Australian Light Horse Bde. charged in the dark over unknown ground and captured the village after hand-to-hand fighting with a force composed largely of Germans.

The Turkish IV. Army passed Deraa before the 4th Cav. Div. could head it off, but under pressure from this division and from the Arabs it gradually disintegrated. The end came on Sept. 30, when the Australian Mounted Div., which on Sept. 28 had overcome some determined opposition to its crossing of the Jordan, succeeded in getting astride the Damascus-Beirut road just outside the city, cutting off the remains of the IV. Army. Damascus was occupied next day, Oct. 1. Immediately after the capture of Damascus, malaria and influenza broke out and placed a great proportion of the British mounted forces out of action. It also seriously affected the very numerous Turkish prisoners.

There was now no formidable Turkish force in southern Syria. To complete its occupation, two columns advanced. The 7th Div. left Haifa on Oct. 1 and moved up the coast to Beirut, which it reached on the 8th, and then on to Tripoli, which was occupied on the 18th; the 5th Cav. Div., which though less affected by malaria and influenza than other formations, was considerably below establishment, advanced from Damascus by Homs (Oct. 16), Hama (Oct. 20) to Aleppo, which was occupied on Oct. 26. The last fighting took place north of the town on the 28th. On the 31st an armistice was concluded. Between Sept. 19 and Oct. 26 the British Army had moved its front forward a distance of 360 miles. During this period the 5th Cav. Div. had actually covered over 500 miles. The captures included 72,000 Turks and nearly 4,000 Germans and Austrians, 350 guns, 800 machine guns and large quantities of transport and other material. History records few victories, if any, more striking and complete.

Conclusions.—These campaigns of the Egyptian Expeditionary Force are of great strategical interest. For the military student they will always remain classic examples of the use of mounted troops and of the value of mobility. Conditions of war change, and it may be that some mechanical form of transport will entirely replace the horse as the means by which mobility can be secured. But the power of mobility as a strategical weapon, in the hands of a commander who has the knowledge and the determination to use it as did Gen. Allenby, will only be enhanced. A second strategical lesson is the advantage gained by a commander who can conceal his intentions from his opponent. In both his great battles against the Turk, Allenby completely deceived his adversary as to his plans, and had thus secured a decisive superiority before the battle was joined. Only constant foresight and careful preparation can effect this. Air superiority is a factor of increasing importance in this question of concealment of plans and movements.

Finally, the dependence of all strategy on the communications may be stressed. The Turks added to the initial handicap which their long and difficult lines of communication imposed on them by their neglect to improve these and by the inefficiency of their working. Von Falkenhayn, during his command, entirely failed to adapt his strategy to the limitations necessitated by his means of transport. On the British side, the greatest care was devoted to developing the communications in accordance with the strategical plan, and the supply services were thus able to cope even with such problems as were presented by the rapidity of the advance to Damascus and Aleppo.

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PALGRAVE, SIR ROBERT HARRY INGLIS (1827–1919), British banker and economist, was born at Westminster June 11 1827, the son of Sir Francis Palgrave, the historian (*see* 20.629). He was educated at Charterhouse and entered Barclay's Bank at Yarmouth. There he rose to a position of such importance that in 1875 he was one of three representatives of the English issuing country bankers chosen to give evidence before the select committee of the House of Commons on Banks of Issue. He edited *The Economist* from 1877 to 1883, and published many works on banking, as well as *The Local Taxation of Great Britain and Ireland* (1871). He also edited *The Dictionary of Political Economy* (1894–1906). He was knighted in 1909, and died at Bournemouth Jan. 25 1919.

PALM BEACH, Fla., U.S.A. (*see* 20.643), one of the most luxurious of the winter resorts on the east coast (population, 1920, 1,135). Opposite to it is West Palm Beach, which stretches for eight m. along Lake Worth, and advertises itself as the place "where summer spends the winter." Its population in 1910 was 1,743; in 1920, 8,659; and in 1925, according to the state census, it was 19,146. Both shared in the Florida boom that began in 1922. An extension of the Seaboard Air Line in 1924 established rail connection with the west coast, and more than 2,000 houses were built in the next 12 months.

PANAMA (*see* 60.664).—A republic of Central America, situated between Colombia and Costa Rica. It has an area of 32,380 square miles. The Panama Canal has been cut across the narrowest part from Colón to Panama, and the area, except for the towns of Panama and Colón, is for five miles on each side of the canal under the control of the United States. Panama declared war on Germany on April 7 1917, and acquired membership in the League of Nations in 1920. The inhabitants are of mixed race, the chief elements being Spanish, Indian and negro. The population according to the 1920 census was 446,098, excluding the 22,858 inhabitants of the Canal Zone. The population of Panama, the capital, in 1920 was 59,458; Colón, at the Atlantic entrance to the canal, had a population of 31,203.

POLITICAL HISTORY

The amended constitution of Dec. 26 1918 provided that the president should be elected by direct vote and should be ineligible to succeed himself. Provision was also made for three *designados* or vice-presidents, of whom the first would hold office as *ad interim* president in the event of the president dying whilst in office. In 1912 Belisario Porras was elected president for the term ending 1916. In the latter year the elections were held in disturbed civil and political conditions, and Ramón M. Valdéz was elected for the term 1916–20. Valdéz died in 1918, his term of office being completed by Ciro L. Orriola. Ernesto Lefevre was inaugurated Jan. 30 1920; but in Aug. Dr. Belisario Porras was elected to office, and inaugurated for a term of four years on Nov. 1. He was succeeded on Nov. 1 1924 by Rodolfo Chiari, who was elected for the term 1924–8. The dispute with Costa Rica over the demarcation of the boundary line between that country and Panama resulted in the United States Secretary of State notifying Panama that the White award of 1914 must be accepted (*see* COSTA RICA).

In 1922, on the recommendation of President Harding, the Hay-Bunau-Varilla Treaty of Feb. 23 1904 (*see* 20.670) was dis-

cussed at Washington for the purpose of removing causes of friction between Panama and the United States. The disputed matters were the property valuation of the Canal Zone, the establishment of a free port and arrangements for docking privileges. Panama contended that the United States had never acquired the zone in fee simple, and that the zone republic should exercise sovereign rights in fiscal jurisdiction therein. The United States contended that the treaty conferred upon its Government all such rights. Negotiations during 1923 and 1924 reached a partial deadlock in July of the latter year. Part of the trouble arose from the practice of the United States in leasing cold-storage plants and warehouses in the zone to private individuals. Panama claimed that this violated her sovereignty. It was finally agreed that the *status quo* should continue pending the negotiation of a new treaty. In Jan. 1926 no solution of the difficulties by new treaty provisions had been announced. In Oct. 1924 legislation was initiated, excluding near relatives of incumbents of the presidency from the succession and increasing the term of supreme court justices from four to 10 years. Panama has no army or navy, but maintains municipal and rural police. The police force of the zone is maintained by the United States and has no authority outside.

Education.—Primary education is compulsory for all children from seven to 15 years of age. In 1923 there were 43,215 children attending the 384 Government schools in the eight provinces of the republic, excluding the children attending the public schools of the Canal Zone. In 1911 the Instituto Nacional was established in Panama for university education. In 1923 there were 20 private educational establishments in the republic, as well as a training college for girls and a school of arts and crafts for boys.

Finance.—The Panama Govt. receives all the import duties collected, but the United States imports all canal material and supplies for Government use free of duty. Financial stabilisation began in 1920, when a fiscal agent, detailed from the Zone Q.M. Service, was placed in charge. The finances as reorganised are based on a triennial budget. A plan of long-term agricultural credits was arranged under amortised mortgages, whereby the registry of land titles was expedited. For 1922 expenditure was $6,900,217 and revenue $5,299,999; for 1923 expenditure was $7,568,124 and revenue $10,299,212, including a loan for $4,500,000 floated in New York in 1923 for road construction.

Production and Industry.—The chief products of Panama are bananas, coconuts, hides, coffee, cacao and *tagua* (vegetable ivory). Only a small area of land is cultivated. The production of sugar has increased, and the cultivation of tobacco has been encouraged by the Government. Bananas were the chief export, amounting in value to more than half the annual exports. Pearl-fishing is carried on in the Gulf of Panama, and tortoiseshell is exported. All international commerce moves through Cristóbal and Balboa, Bocas del Toro being reserved for local business. Over 90% of the total exports go to the United States, which also dominates the import business.

Trade figures (excluding the Canal Zone) for the years 1921–4 were:—

	Imports	Exports
1921	$11,372,370	$2,495,407
1922	10,268,548	2,487,478
1923	12,674,375	2,389,728
1924 (est.)	13,000,000	3,250,000

The trade of Panama (including the Canal Zone) with the United States for the same period was as follows:—

	Imports	Exports
1921	$23,144,000	$3,865,000
1922	14,517,000	3,607,000
1923	21,769,000	4,267,000
1924	26,366,000	5,004,000

The total trade of Panama with Great Britain for the same period was:—

	Imports	Exports
1921	£305,095	£138,983
1922	218,450	65,544
1923	354,026	87,587
1924	414,378	105,257

Concessions have been granted to 10 commercial undertakings for the exploitation of oil lands in the republic, the last of the concessions having been granted in May 1924. Under the terms of the contract the concessionaire is required to pay to the Government the sum of 15 cents for each hectare conceded, with a stipulated preference of developing for a term of 30 years should oil be struck. Only three companies had carried out boring operations in 1924. Panama has vast timber resources; during the year ended June 30 1924 about 5,000,000 ft. of mahogany and cedar had been shipped from the lumber camps on the Rio Congo.

Communications.—There are three railways with a total mileage of 257. Of these the Panama Railroad Co. (U.S. Govt.) has a line between Colón and Panama, a distance of 48 miles. The Chiriqui Railway, owned by the Government, runs from Pedrigal to Boquete, a distance of 33 m., with two branches, one of 17 m. from David to La Concepcion, the other from Dolega to Potrerillos, a distance of eight miles. The railway operated by the United Fruit Co. and constructed primarily for the banana trade has a mileage of 151, radiating from Almirante. Approval has been given for a contract for the construction of a railway along the Atlantic coast from the mouth of the Chagres river to Almirante. In 1923 a loan of $4,500,000 was obtained by Panama in New York City to provide funds for highway construction. Before midsummer 1925, 125 km. had been constructed. The system connects Santiago, Las Tablas and Menabé with Panama City by way of Agua Dulce, Penonomé, Ancón, Chamé and Chorrera. Nearly 30 steel bridges have been built.

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PANAMA CANAL (*see* 20.666).—The construction period of the Panama Canal covered about 10 years, but the actual work of construction was accomplished in about seven years; the first three years were devoted to preliminary preparation, during which time the thorough sanitation of the Canal Zone was accomplished, yellow fever banished, an operating plant assembled, a working force gathered, living quarters erected and a food supply provided. Reservoirs were built which furnished an ample supply of pure water to the Canal force, and to the cities of Colón and Panama, in which water- and sewer-systems were built. An out-of-date railway system was converted into an adequate one with a thoroughly modern equipment of rails, locomotives and cars.

Beginning of the Work.—The first commission was in office only a year (1904–5) and accomplished little beyond formulating plans and ordering necessary supplies. The second, with John F. Stevens as chief engineer and afterwards as chairman also, reconstructed the railway system, assembled the operating plant, collected an efficient working force and provided for it quarters, food and all necessary supplies. It also constructed wharves and docks at both terminals, and machine shops in which the locomotives, cars, steam shovels, etc., shipped in parts from the United States were put together. President Roosevelt visited the Isthmus in Nov. 1906, the visit being notable as the first instance in which an American president had passed out of the U.S. territory while in office. Col. Goethals, of the Engineer Corps of the U.S. Army, was appointed chairman and chief engineer of the third commission, on the resignation of Mr. Stevens (April 1 1907).

This commission was composed of four army engineers, an army doctor, one navy engineer and one civilian. President Roosevelt, who was convinced that the best results could not be obtained through an executive body of seven members, issued an executive order placing supreme power in the hands of Col. Goethals, abolishing the commission as an executive body, and making its members, who were heads of departments, subordinate to him, giving Col. Goethals all civil, military and other powers in the Canal Zone, and this course was subsequently approved in the Act of 1912 for the government and operation of the Canal after its completion.

Excavation and Slides.—During the next five years 75% of the entire excavation of the Canal was accomplished. The original plans provided for a total excavation of 95,000,000 cu. yd. and a total cost of $190,000,000 exclusive of $40,000,000 paid to the French Canal Company, $10,000,000 paid to the Panama Republic, and the cost of sanitation and civil administration. Changes made in the basal dimensions with the approval of President Roosevelt increased

the total excavations to 175,000,000 cu. yd. and the estimated cost to $375,210,000, inclusive of payments to the French Canal Co. and the Republic of Panama. When the Canal was declared formally complete and opened by President Wilson July 12 1920, a total of about 240,000,000 cu. yd. had been excavated and the total cost, exclusive of expenditure for naval and military defence, was only $366,650,000, of which $10,000,000 was for "slides" or breaks in walls of the Cut of which there were about 30 at different times, affecting an area of 220 ac. and increasing the excavation by 30,000,000 cu. yards.

I. ENGINEERING FEATURES

Gatun Dam.—The Panama Canal is a huge water bridge rather than a canal, for its surface for the greater part of its length is 85 ft. above sea level and is held in place by dams at either end. The largest and most important dam is at Gatun, on the Atlantic side. It spans the northern and lower end of a deep valley through which the Chagres river formerly flowed to the sea. It is 1½ m. long measured on its crest, half a mile wide at the base, 400 ft. wide at the water surface, 100 ft. wide at the top; and its crest is at an elevation of 105 ft. above sea-level. It is really two dams in one, for in its centre there is a natural hill or rock 110 ft. high. In this the spillway of the dam is constructed, and against its two sides rest the two sections of the great dam. The dam itself contains 23 million cu. yd. of material. Its outer portions are composed of rock and earth mainly from the Cut, and its centre or core of material drawn by hydraulic process from pits above and below the dam. This material is a natural mixture of sand and clay which in a watery condition flowed into the interstices of the rock and clay of the structure, making the whole at the centre a rubble-wall firmly cemented together and thoroughly impervious to water. Of the entire length of the dam only 500 ft. are exposed to the maximum waterhead of the lake, which is 85 to 87 feet. In 1919, after an exceptionally light rainfall, the maximum level of the lake was 87·16 ft. in Dec.; and in May 1920, 81·65 feet. The spillway is a concrete-lined channel, 1,200 ft. long and 285 ft. wide, the bottom being 10 ft. above sea-level, sloping to sea-level at the lower end.

Across the lake-opening of the channel is a concrete dam in the form of an arc of a circle, making its length 808 ft., although it closes a channel with a width of only 285 feet. The crest of this dam is 69 ft. above sea-level, or 16 ft. below the normal level of the lake. On the crest are 13 concrete piers with their tops 115·5 ft. above sea-level, and between these are 14 regulating gates of the Stoney type which move up and down on roller trains in niches in the piers. The gates permit a discharge of water greater than the maximum known discharge of the Chagres river during a flood. Near the north wall of the spillway is a hydroelectric station capable of generating, through turbines which are supplied with water from the lake through a forebay, sufficient electricity to meet all demands, including the lighting of the Canal and all Canal Zone towns and buildings; the machinery of the locks, the machine shops, dry-dock and coal-handling plant; and the telephone and telegraph systems. There is an emergency Diesel electric plant at Miraflores.

Dams on the Pacific Side.—At Pedro Miguel, at the south or Pacific end of the Cut, the water is held at summit level (level of Gatun Lake and the Cut, normally 85 ft. above the sea) by Pedro Miguel Lock and two flanking dams extending from the side walls of the lock to hills on either side. The distance between the hills at elevation 92 ft. is 2,000 feet. The situation of the lock at the base of Cerro Luisa made it practicable to connect with that hill by a short concrete wall, 260 ft. in length, subsequently covered with earth. On the west side a rock and earthen dam was built with a puddled and rolled impervious core, 1,400 ft. in length. The minimum width of base is 800 ft., the side slopes, 8 to 1, the top, 105 ft. above sea-level. The maximum head of water to which the dam is subjected is 40 ft., the average between 25 and 30 feet.

The Pedro Miguel Lock raises or lowers ships 31 ft.—the difference between the summit level of 85 ft. and the normal surface of Miraflores Lake—54 ft. above sea-level. The Miraflores Lake is a mile in length, and its waters are retained by the Miraflores Locks and flanking dams. The east dam at Miraflores is of concrete, and the greater part of it is the spillway of Miraflores Lake. This spillway is 432 ft. in length, with the crest of its dam 38.67 ft. above sea-level, and the supporting piers for the gates rising to 85·17 ft. above sea-level. Eight gates, similar to those in the Gatun Spillway, each 47 ft. 10¼ in. long by 19 ft. in height, and weighing 44 tons each are operated in the same way as the 14 gates at Gatun; but the dam at Miraflores is straight, instead of being in the form of an arc, as at Gatun. The west dam at Miraflores is of earth and rock and extends almost parallel with the axis of the locks to a hill to the south. Its length is 2,300 ft., top 70 ft. above sea-level, width of top 40 ft., and slope of sides approximately 12 to 1. It contains 661,000 cu. yd. of soft hydraulic material and 1,500,000 cu. yd. of rock and earth.

The Locks.—All locks are in duplicate, constructed in the same manner, and their chambers, with walls and floors of concrete, have the same usable dimensions—1,000 ft. long and 110 ft. wide. There are six pairs, making 12 in all. The side walls are from 45 to 50 ft. wide at the surface of the floor, are vertical on the chamber side, and narrowed on the outside from a point 24⅓ ft. from the floor, by means of a series of steps each 6 ft. long, to a width of 8 ft. at the top. A culvert 254 sq. ft. in cross-section, extends the entire length of each middle and side wall, and from each of these large culverts, smaller culverts, 33 to 44 sq. ft. extend to holes in the floors. Fifteen feet above the top of the culvert in the middle wall there is a U-shaped space 19 ft. wide at the bottom and 44 ft. at the top. This space is divided into three storeys; the lowest for drainage; the middle for wires that carry the electric current to operate the gates and valve machinery installed in the centre wall; and the upper a passage-way for the operators. All lock walls are 81 ft. high, except in the lower pair of locks at Miraflores, where they are 82 ft. because of the extreme tidal oscillations of about 21 ft. in the Bay of Panama. In the walls at Gatun there are 2,068,000 cu. yd. of concrete, and in those on the Pacific side 2,440,000 cu. yards. All lock walls rest on rock foundations. The approach wall at the north entrance at Gatun, 1,031 ft. long, rests upon piles driven from 35 to 70 ft. into the earth; that at the south or lake entrance 1,009 ft. long, rests on piles reaching to rock, in some places over 100 ft. below sea-level. Cellular form of reinforced concrete is used in all approach walls, except those of the lower locks at Gatun and Miraflores, where mass concrete is used because of the effect of salt water on steel reinforcement.

Lock Gates.—The lock gates, each composed of two leaves, are 65 ft. wide, from 47 ft. 4 in. to 82 ft. high, 7 ft. thick, and weigh from 390 to 730 tons. There are 92 leaves in all, and their combined weight is 60,000 tons. Each is a huge webbed steel box, the girders of which are covered with a steel sheathing. All portions of the interior are accessible, with watertight compartments providing for the adjustment of the buoyancy so as to control within limits the dead load on the bearings, making the leaf practically float in the water. This watertight compartment is subdivided vertically into three sections, each independently watertight, so that if the shell should be broken or leak, probably only one section would be affected. An air shaft, 26 in. in diameter, runs from the bottom compartment up to the top of the gate, and is also watertight where it passes through the upper half of the leaf.

The girders are made with manholes through the webs, providing communication from the top to the bottom of the leaf, and are connected by several sets of vertical transverse diaphragms of solid plates, running from top to bottom of the leaf, thus making a cellular construction, and dividing the spaces between the horizontal girders into small pockets, all of which are accessible through manholes. Each leaf rests at the bottom of its heel post upon a hemispherical pivot of forged nickel steel, and is hinged at the top to the masonry of the lock wall. It swings free on the pivot like a door, without wheels or other support beneath it. Intermediate gates are used in all except one pair of locks, and divide the space into two chambers, one 600 and the other 400 ft. in length. This makes possible a saving of water and time in locking small vessels through, for 95% of the vessels navigating the high seas are less than 600 ft. in length. The highest gates and the highest lock walls on the Canal are those of the lower locks at Miraflores, and these locks are the only ones which have no intermediate gates. The total lift from mean sea-level to the level of Miraflores Lake, 54 ft., is divided equally between the upper and lower locks. The depth of water on the mitre sills is 40 feet.

The locks are filled and emptied through the large and smaller culverts. The large culverts are controlled at points near the gates by large valves, and each of the small culverts feeds in both directions through the laterals, thus permitting the passage of water from one twin lock to another, effecting a saving of water if desired. The average time required to fill or empty a lock chamber is 8 min. if both centre and side wall culverts are used, and 12 min. if only one culvert is used. The average time to pass a vessel through the three flights at Gatun Locks is an hour, from arrival to clearance; for the one lift at Pedro Miguel half an hour, and for the two flights at Miraflores three-quarters of an hour. The time of passage of a vessel from one terminal port of the Canal to the other is 7 hours. The transit is conducted under a time schedule in order to use to best advantage the lock operating forces, assure safety in passing and conserve water in times of need.

Passage of Locks.—With the exception of small craft no vessel can pass through the locks under its own power. On arrival at the locks it is taken in tow by towing locomotives or "electric mules." These locomotives operate on cog tracks on the lock walls at the rate of two m. an hour. The usual number required for a vessel is six: two ahead, one on each wall, two slightly forward of amidships, one on each

side, the four imparting forward motion to the vessel; and two astern, one on each side, to aid in keeping the vessel in a central position and in bringing it to rest within the chamber while the emptying or filling is carried on. Smaller vessels are handled with four locomotives, the two amidships being dispensed with; while very large craft may use eight. The movements of the locomotives are directed by the pilot from the bridge of the vessel. Each locomotive is equipped with a slip drum, towing windlass and hawser, which permit the towing line to be taken in or paid out without actual motion of the locomotive on the track. The locomotives run on a level, but in passing from one lock to another they climb heavy grades.

Before a lock can be entered, a fender chain, stretched across the walls of the approach, must be passed. If all is proceeding properly, this chain is dropped into its groove to the bottom of the channel. If by any chance the ship is moving too rapidly for safety, the chain remains stretched and the vessel runs against it. The chain, which is operated by hydraulic machinery in the walls, then pays out slowly by automatic release until the vessel is brought to a stop. The chain, which weighs 24,098 lb., and is stronger than any previously made, is capable of stopping a 10,000-ton ship running at 4 m. an hour within 73 ft. or less than the distance between the chain and the first gate. If the vessel should get away from the towing locomotive and, breaking through the chain, ram the first gate, there is a second gate 50 ft. away, protecting the lock, which arrests further advance. When the leaves of this gate swing open, the vessel is towed in, and the gate is closed behind it. Then, from 105 openings placed at regular intervals in the lock floor, water pours in, lifting the vessel to the level of the lock above. This inflow, coming equally from all points, does not move the ship from a stable position. The gates are never opened or closed with a head of water on either side of them. The process of lifting is repeated until the vessel reaches the lake level. At all times the vessel is in full view of the men who are controlling it and as safe as if tied to a wharf.

The gates are opened and closed by a powerful machine invented by Edward Schildhauer, an electrical engineer in the employ of the Isthmian Canal Commission. It consists of a crank gear or wheel moving through an arc of 197°, placed horizontally in the lock wall. To the outer rim of the wheel is attached a strut or connecting rod which is fastened to the top of a lock gate 17 ft. from the pintle or hinge. When the wheel turns in either direction the gate leaf is opened or shut, the operation taking two minutes. The crank gear, constructed of cast steel, is 19 ft. 2 in. in diameter and weighs approximately 35,000 pounds. It is connected with an electric motor, and a small electric switch sets it in motion. Every operation in the passage of a vessel through the lock, except the movements of the towing locomotives, is controlled by one man in a building at the top of the centre wall commanding an unobstructed view of every part of the locks. He has before him a control board table 64 ft. long and 5½ ft. wide, which is a complete model of the locks in duplicate, with switches and indicators in the same relative positions the machines they control occupy in the lock walls. Standing by this board the operator throws the electric switches, and in response to his action he sees in the model the fender chains rise and fall, the gates open and close, the water rise and fall in the locks, and knows the exact position of the vessel at every stage of its progress. Each gate, each valve for letting in the water to the culverts and each fender chain is operated by a separate motor mounted near the machinery in chambers in the lock wall. In each machinery chamber there is a starting panel containing contactors by which current is applied to the motor, and these panels in turn are controlled from a main unit in the central control house. Some of the machinery chambers at Gatun are 2,700 ft. distant from the point of control, 90% of them are within 2,000 ft., and 50% within 1,200 feet.

II. COURSE AND ACCESSORIES

The length of the Canal from shore line to shore line is 42 m., and from deep water in the Atlantic to deep water in the Pacific 50 miles. The Canal does not, as is generally supposed, cross the Isthmus from east to west. It runs due south from its entrance in Limon Bay, through the Gatun Locks to a point in the widest portion of Gatun Lake, a distance of 11½ m.; it then turns sharply toward the east and follows a course generally southeastern till it reaches the Bay of Panama. Its terminus near Panama is about 22½ m. east of its terminus near Colón. In passing from the Atlantic to the Pacific a vessel enters the approach channel in Limon Bay, which has a bottom width of 500 ft. and extends to Gatun a distance of seven miles. At Gatun it enters a series of three locks in flight which lift it 85 feet. It then enters upon Gatun Lake, which covers an area of 164 sq. m. with a depth varying from 45 to 87 ft. and contains 183,136,000,000 cu. ft. of water. The Canal has a channel varying from 500 to 1,000 ft. in width for a distance of 24 m. to Gamboa, where the Cut passage begins. Through the lake a vessel may steam at full speed, without any risk.

The channel through the Cut, a distance of about 8 m., has a bottom width of 300 ft. and a depth of 45 ft., and extends to the locks at Pedro Miguel, the Pacific end of the water bridge. At Pedro Miguel the vessel is lowered in the single lock 31 ft. to a small lake, at an elevation of 54 ft. above sea-level, through which the vessel passes 1 m. to the two locks at Miraflores. These drop it to sea-level, and through an approach passage 8 m. long, with a bottom width of 500 ft., it passes into the Pacific. The Cut has eight angles and at these the channel is widened sufficiently to allow a 1,000-ft. vessel to make the turn. The smallest angle is 7° 36′ and the largest 29° 59′. In the whole Canal there are 22 angles, the total curvature being 600° 54′. The sharpest curve is 67° 11′. The Canal is lighted from end to end by electricity and gas. There are concrete lighthouses for range lights on the hillsides, and beacons in the Cut, in which electricity is used. The channel through Gatun Lake is marked with floating buoys lighted with compressed acetylene dissolved in acetone. The most powerful electric lights are those of the approach channels, which are visible for from 12 to 18 nautical miles. The beacons and gas-buoy lights are 850 candle-power. White and red lights are used, and in order to eliminate the possibility of confusing the lights with one another, and with the lights on shore, all range lights, beacons and buoys have individual characteristics, formed by flashes and combinations of flashes of light and dark intervals. The electric lights on the locks are suspended from brackets on concrete columns 34 ft. high, and clustered under concrete hoods in such a way as to light the lock chambers and not penetrate along the axis of the Canal.

Breakwaters.—Long breakwaters have been constructed near the approach channels in both oceans. One in Limon Bay, or Colón harbour, called the West Breakwater, extends from the bay from Toro Point at an angle of 42° 53′ northward from a base line drawn from Toro Point to Colón Light, and is 11,526 ft. in length, 15 ft. wide at the top and 10 ft. above mean sea-level. A second, also in Limon Bay, known as the East Breakwater, is without land connection, one m. in length and runs in an easterly direction at nearly a right angle with the Canal channel. It has a lighthouse on the channel end. The West Breakwater protects the harbour against "northers," very severe gales which are likely to blow from Oct. to January. The East Breakwater prevents silting in the Canal channel. The breakwater at the Pacific entrance extends from Balboa to Naos I., a distance of 17,000 feet. It lies from 900 to 2,700 ft. east of, and for the greater part of the distance nearly parallel to, the axis of the Canal prism, varies from 20 to 40 ft. in height above mean sea-level and is from 50 to 3,000 ft. wide at the top. It was constructed for a twofold purpose; first, to divert cross-currents that would carry soft material from the shallow harbour of Panama into the Canal channel; second, to furnish rail connection between the islands and the mainland.

Permanent Canal Buildings.—Upon the completion of the Canal a number of villages along the line occupied during the construction days were abandoned, the sites of several being covered by the filling of Gatun Lake. The buildings in good condition were transferred to the permanent towns located at the ends of the canal and adjoining the locks. Culebra, the former headquarters of operations, situated on the west bank of the Cut near its deepest part, was turned into an army post. The permanent headquarters were located at Balboa Heights, and the offices of the departments centred in a large 3-storey concrete administration building situated on a hill 100 ft. above sea-level, and overlooking the Pacific entrance to the Canal. On the hill in the rear of this building are the residences of the governor and other officials. On the low land in front of the building, in a site which was formerly a tidal swamp and was raised to 20 ft. above sea-level by filling with material from the Cut and hydraulic fill from excavation in the harbour, is the town of Balboa. This is laid out on both sides of a central avenue called the Prado, and contains permanent buildings of concrete blocks roofed with red tile. In addition to the dwellings of employees there are a police station, post office, fire-station, sanitary office, dispensary, clubhouse, a community house conducted by the Catholic Church, an army and navy Y.M.C.A., restaurant, churches, lodge hall, schoolhouse and playground. Effective municipal layout in a setting of great natural beauty

and an abundance of trees and shrubs make the villages very attractive places of residence. The streets are of concrete with asphalt surfacing, and the number of automobiles in use is noticeably large.

Terminal Facilities.—At the ports on both oceans have been constructed facilities ample for commercial shipping and the naval needs of the United States. Modern piers, 1,200 ft. in length by 240 ft. in width, with enclosed sheds, built of reinforced concrete and steel, are ample for the transhipping of cargo and the storage of goods consigned there for orders. At the Pacific end, at the foot of Sosa Hill, Balboa, are marine and railway repair shops, foundry, etc., covering 60 ac., thoroughly equipped and including a dry dock having a usable length of 1,000 ft. and entrance width of 110 ft., capable, like the locks and other parts of the Canal, of accommodating any vessel afloat. The depth over keel blocks is 43 ft. at mean tide. Smaller shops and a dry dock 300 ft. long and 48 ft. wide with depth of 13½ ft. are operated at the Atlantic end. Coaling plants capable of rapid bunkering are operated at both terminals, as well as oil-pumping plants connected with storage tanks for fuel oil, Diesel oil and gasolene. Storehouses supply all kinds of ship chandlery and repair material, as well as foodstuffs, beef and other fresh meats and cold storage supplies, ice, etc. Ships' every need of repair or supply can be met. Radio stations for communication with ships are operated by the U.S. Navy at Cristobal and Balboa, and also at Cape Mala, 90 m. south of the Pacific entrance, and a high-power station, primarily for government communication with the United States, is situated at Darien, midway of the Isthmus. Salvage tugs and other wrecking equipment are available for use of vessels within a radius of 1,000 m. or more of the Canal. Hotels and hospitals are situated at both terminals.

Fortifications and Military Occupation.—By executive order dated Dec. 5 1912, President Taft declared that "all land and land under water within the limits of the Canal Zone are necessary for the construction, maintenance, operation, protection, and sanitation of the Panama Canal," and title to all such land was acquired by the Govt. of the United States. The Canal Zone is thus a military reservation, and the only activities carried on by other than government forces are on land rented to steamship interests and to agriculturists under revocable licences. Heavy fortifications have been built at both entrances to the Canal and brigade posts established near the locks. Both the army and the navy have aerial forces at the Canal, and a base for submarines is maintained at the Atlantic end. The total military force is 10,000 men.

Panama Railroad.—The Panama Railroad extends between Colón and Panama on the eastern side of the Canal, and is 47·61 m. long. A branch line, extending from Pedro Miguel to Las Cascadas and crossing the Canal on a floating bridge at Paraiso, was discontinued Jan. 1 1921. The railroad as built in 1850–5 followed the course of the Chagres from Gatun to Gamboa, and was for the most part on the west side of the route of the Canal. With the building of the Canal it was necessary to relocate the railroad throughout practically its whole length. The construction of the original railroad was done by an American company in the years 1850–5 under great difficulties; its completion antedated by 14 years the completion of the first transcontinental railroad in the United States. At that time gauges had not been standardised, and a width of 5 ft. was adopted for the Panama Railroad which has been maintained since. The railroad was an essential factor in the construction of the Canal, and is an important adjunct to its operations. It is equipped with 90-lb. rails, rock-ballasted track, and automatic signals. It uses modern American rolling-stock, including oil-burning locomotives.

III. ADMINISTRATION AND FINANCE

Under an Act of Congress, approved Aug. 24 1912, the Panama Canal is governed and operated, and the Canal Zone is governed through a governor of the Panama Canal, appointed by the President, with the approval of the Senate, for a term of four years, at a salary of $10,000 a year. In addition to the operation of the Canal, the governor has official control and jurisdiction over the Canal Zone and performs all duties in connection with its civil government, it being held, treated, and governed as an adjunct to the Canal. There is one U.S. District Court in the Canal Zone, with the same jurisdiction and procedure as the same courts in the United States, the judge of which is appointed by the President. Appeals are made to the Circuit Court of Appeals of the Fifth Circuit of the United States. At Balboa and Cristobal there is a magistrate's court for minor cases, the judges being appointed by the governor. Gen. Goethals was the first governor and served until Jan. 11 1917, when he resigned and was succeeded by Col. Chester Harding, U.S.A., who held the office until March 27 1921, when he was succeeded by Col. Jay J. Morrow, U.S.A. The latter resigned in Oct. 1924, and was succeeded by Col. Meriwether L. Walker, U.S.A.

The organisation on the Isthmus includes a number of departments and divisions in charge of the various activities, as follows: Dept. of Operation and Maintenance, including the Marine Div., Mechanical Div., Dredging Div., Section of Lock Operation, Electrical Div., Div. of Municipal Engineering, Fortifications Div., and several sections; the Supply Dept., made up of the Quartermaster section, Subsistence section, Commissary Div., Cattle Industry and Plantations, and Hotel Washington; the Accounting Dept.; the Health Dept.; the Executive Dept. and the Panama Railroad. The Panama Canal has an office in Washington, D.C., and the Panama Railroad Co. has an office at 24 State street, New York.

Canal Zone Population.—A census of the Canal Zone taken in 1925 showed a total population of 37,011, of which 27,151 were civilians and the remainder military. The civilians included 2,301 adult male Americans, 2,413 American women, 2,399 American children, and people of other nationalities as follows: men, 6,928; women, 4,563; children, 8,547.

Canal Force.—The working force at the end of June 1925 numbered 12,270, of whom 2,885 were Americans, chiefly in official and clerical positions and skilled trades, and 9,385 were alien labourers, chiefly West Indian negroes. The apparent discrepancy between these figures and those of the Canal Zone census is due to the fact that many of the labourers live in the cities of Panama and Colón, which are not within the Canal Zone.

Tolls.—The Hay-Pauncefote Treaty between Great Britain and the United States, abrogating and succeeding the Clayton-Bulwer Treaty, was ratified on Dec. 16 1901. It contained this clause:

> The Canal shall be free and open to the vessels of commerce and of war of all nations observing these rules, on terms of entire equality, so that there shall be no discrimination against any such nation or its citizens or subjects in respect of the conditions or charges of traffic or otherwise. Such conditions and charges of traffic shall be just and equitable.

In 1912 Congress passed an Act for the operation and government of the Panama Canal, which was approved by President Taft on Aug. 24 of that year, and which contained the provision that "no tolls shall be levied upon vessels engaged in the coastwise trade of the United States." A formal protest against this exemption was made by Great Britain on the ground that it was a violation of the Hay-Pauncefote Treaty. In June 1914, under a special appeal from President Wilson, Congress passed a bill which repealed the Exemption Act of 1912. This was approved by President Wilson on June 15 1914. Under authority given to him by the Panama Canal Act of Aug. 24 1912, President Wilson issued a proclamation, on Nov. 21 1913, fixing the canal tolls at $1.20 per net ton of net capacity as determined by the Panama Canal rules of measurement. On Feb. 15 1915 President Wilson issued supplementary instructions that where application of the $1.20 per-net-ton rate produced a sum in excess of the sum produced by the application of the $1.25 rate on net registered tonnage as determined by the U.S. rules of measurement, the excess amount should be uncollectable. The effect of this ruling was to reduce by approximately 14% the revenue from tolls paid by ships of all nationalities using the Canal.

During the first six years of operation there was a marked increase in traffic notwithstanding the fact that the World War everywhere prevented the normal development of ocean-going commerce. After the entry of the United States into the War there was a decrease in commercial traffic, due to the diversion of certain lines of ships to trans-Atlantic service, which was more than offset by the increase in traffic growing out of the War, chiefly on account of the development of the nitrate trade with the Pacific coast of South America. With the return of normal conditions after the War traffic rapidly increased.

Canal Traffic.—The number of commercial transits, the amount received from tolls and other collections, and the current expenses of

maintenance and operation for the fiscal years ending June 30 1915–25, are shown in the following table:—

Fiscal year	Number of commercial transits	Tolls and other transit revenues	Current expenses of operation and maintenance
1915	1,072	$ 4,343,383.69	$4,123,128.09
1916	760	2,558,542.38	6,909,750.15
1917	1,806	5,808,398.70	6,788,047.60
1918	2,068	6,411,843.28	5,920,342.94
1919	2,028	6,354,016.98	6,112,194.77
1920	2,478	8,935,871.57	6,548,272.43
1921	2,892	12,040,116.70	9,328,300.14
1922	2,736	11,385,592.32	7,919,017.63
1923	3,967	17,691,844.06	7,690,777.56
1924	5,230	24,681,853.89	8,373,905.39
1925	4,673	21,582,618.16	8,116,693.44

Among nations the chief users of the Canal were the United States and Great Britain. The number of vessels passed each year for these nations and for all other nations was as follows:—

Fiscal Year	United States	Great Britain	All other nations
1915	470	465	153
1916	238	358	191
1917	464	780	632
1918	628	699	803
1919	786	602	637
1920	1,129	753	596
1921	1,210	972	710
1922	1,095	935	706
1923	1,994	1,065	908
1924	2,947	1,265	1,018
1925	2,326	1,211	1,136

The following is the saving in nautical miles, effected by the Panama Canal from European ports to ports on the west coast of America, to Hawaii and to New Zealand:—

To	From				
	Liverpool	Hamburg	Antwerp	Bordeaux	Gibraltar
Sitka, Alaska	5,666	5,528	5,528	5,376	4,950
Port Townsend, Wash.	5,666	5,528	5,528	5,376	4,950
Portland, Oregon	5,666	5,528	5,528	5,376	4,950
San Francisco, Cal.	5,666	5,528	5,528	5,376	4,950
San Diego, Cal.	5,676	5,538	5,538	5,386	4,960
Acapulco, Mexico	5,874	5,736	5,736	5,584	5,158
San José, Guatemala	6,128	5,990	5,990	5,838	5,412
Honolulu, Hawaii	4,403	4,265	4,265	4,113	3,687
Guayaquil, Ecuador	5,198	5,060	5,060	4,908	4,482
Callao, Peru	4,043	3,905	3,905	3,753	3,327
Valparaiso, Chile	1,540	1,402	1,402	1,250	824
Wellington, N.Z.	1,564	1,409	1,409	1,257	489

The following is the saving, in nautical miles effected by the Panama Canal in length of all-water routes between ports of the Atlantic-Gulf U.S. seaboard and various Pacific ports:—

To	From				
	Boston	New York	Norfolk	New Orleans	Galveston
Sitka, Alaska	7,676	7,873	8,020	8,868	8,940
Portland, Oregon	7,676	7,873	8,020	8,868	8,940
San Francisco, Cal.	7,676	7,873	8,020	8,868	8,940
San Diego, Cal.	7,686	7,883	8,030	8,878	8,950
Acapulco, Mexico	7,884	8,081	8,228	9,076	9,148
San José, Guatemala	8,138	8,335	8,482	9,330	9,402
Honolulu, Hawaii	6,413	6,610	6,757	7,604	7,677
Guayaquil, Ecuador	7,208	7,405	7,552	8,400	8,472
Callao, Peru	6,053	6,250	6,397	7,245	7,317
Valparaiso, Chile	3,550	3,747	3,894	4,742	4,814
Yokohama, Japan	3,435	3,768	4,116	5,705	5,777
Shanghai, China	1,543	1,876	2,224	3,813	3,885
Hongkong, China	351[1]	18[1]	330	1,919	1,991
Manila, P.I.	292[1]	41[1]	389	1,978	2,050
Adelaide, S. Australia	1,483	1,746	2,000	3,258	3,330
Melbourne, Australia	2,507	2,770	3,024	4,282	4,354
Sydney, Australia	3,669	3,932	4,186	5,444	5,516
Wellington, N.Z.	2,296	2,493	2,640	3,488	3,560

[1] Distance less *via* Suez.

The notable increase in business in 1924 was due mainly to the development of oil-fields in California, whence large quantities of crude oil were shipped in tank steamers to refineries on the Atlantic seaboard. These shipments declined in the following year, but the loss was partly offset by the normal growth of other trades.

Public vessels of the United States, Panama and Colombia and vessels which are sent through the Canal solely for repair at the Balboa shops are exempt from the payment of tolls, and such vessels are omitted from the statistics in the above table. From the opening of the Canal to June 30 1925, they numbered 2,613, the majority of them being American naval vessels or army transports.

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(J. B. Bi.)

PAN-AMERICAN CONFERENCES (*see* 20.671).—The fourth Pan-American Conference was held at Buenos Aires in 1910, and during the same year the Pan-American Union building, erected through a gift of $750,000 from Andrew Carnegie and $250,000 contributed by the various republics of the Union, was formally dedicated.

During the three weeks following Dec. 25 1915, the second Pan-American Scientific Congress met in Washington. Amongst the speakers was President Wilson, who urged friendly settlement of international disputes by arbitration. The Congress appointed an International High Commission, which sat at Buenos Aires in April 1916. Improvement and extension of cable, telegraph and railway services between the countries was urged. A permanent International High Commission was established to promote uniform commercial laws throughout the countries represented in the Union. In Feb. 1918 the governing board of the Pan-American Union approved a plan to establish a Section of Education to promote better knowledge of the languages and history of the American republics through educational institutions.

In Nov. 1918 a Pan-American Federation of Labour Conference met at Laredo, Texas. Delegates were present from the United States, Mexico and Central America. An influenza epidemic interfered with South American attendance, Colombia alone being represented. A permanent federation was organised. Pan-American Child Welfare Congresses met at Montevideo, Uruguay, in Dec. 1918 and in May 1919; at the second meeting provision was made for establishing at Montevideo an International Bureau of Child Welfare. In June 1919 the second Pan-American Commercial Congress was held in Washington, and in the same city, in Jan. 1920, a Pan-American Financial Congress. The sixth International Sanitary Conference was held in Montevideo Dec. 12–20 1920. It re-organised the International Sanitary Bureau, which has been active in disseminating valuable bulletins on sanitation and public health.

In Jan. 1921 a convention was held in Mexico City with the object of promoting good relations between the labouring classes of the United States, Central and South America. It was attended by Samuel Gompers and other United States Labour leaders. In June 1921 Panama proposed the formation of a Pan-American League of Nations which should function on the American continent in the same manner as the League of Nations established by the Treaty of Versailles. The suggestion, however, did not meet with the approval of President Harding and no further action was taken in this direction. In Sept. 1921 a Pan-American Postal Congress was held in Buenos Aires, at which the postal rates between the countries of the Union were discussed.

The Fifth Conference.—The fifth Pan-American Conference was held March 25–May 3 1923 at Santiago, Chile, Henry P. Fletcher, U.S. Ambassador to Belgium, being head of the U.S. delegation. Delegations from all the American republics, except Bolivia, Mexico and Peru, were present, and a large number of subjects were discussed. A proposal by Uruguay that the principle of the Monroe Doctrine be adopted by all American States was not supported by the United States delegates, and was recommended for report to the next Pan-American Conference.

Similarly, an attempt to arrive at an agreement for the limitation of naval armaments failed on account of disagreement between Brazil, Argentina and Chile. Costa Rica strongly urged the establishment of an American Permanent Court of Justice but failed to obtain the support of the Conference, because the plan submitted included arbitration of questions involving the vital interests of nations, and the matter was referred to the commission of jurists at Rio de Janeiro in 1925.

Four conventions were completed and signed, viz., an agreement under which international disputes might be investigated and settled by a commission empowered to ascertain facts; a trade-mark convention, protecting users of trade-marks in the countries where ownership of the mark is acquired through registration; a convention to secure uniformity of nomenclature in the classification of merchandise; and one providing for the publicity of customs documents. No fewer than 73 resolutions were passed, one of the most important of which created four permanent committees to assist the Union in the study of (1) the best means of developing the economic and commercial relations between the American States; (2) the international organisation of labour in America; (3) hygiene in the countries of the American continent; and (4) the best means of developing intellectual co-operation, with especial reference to co-operation between the universities and the exchange of professors and students.

It was decided to hold the sixth Pan-American Conference at Havana, Cuba, within the following five years. In Sept. 1924 the International Pan-American Committee, consisting of men interested in developing closer Pan-American relations, proposed that Columbus Day, Oct. 12, should be observed annually as Pan-American Day, and the suggestion met with the approval of President Coolidge. The seventh Pan-American Sanitary Conference was held at Havana, Cuba, Nov. 5–15 1924, and the third Pan-American Scientific Congress met at Lima, Peru, in Dec. 1924.

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PAN-AMERICAN UNION (*see* 20.671).—At the second Pan-American Conference, held at Mexico City, Oct. 1901–Jan. 1902, the International Bureau of American Republics was organised under a governing board of the diplomatic representatives of the American republics at Washington with the Secretary of State of the United States as chairman. At the fourth Pan-American Conference, held at Buenos Aires, July 12–Aug. 30 1910, it was decided that this International Bureau should be henceforth called the Pan-American Union. The same year the Pan-American Union building in Washington, D.C., erected through a gift of $750,000 from Andrew Carnegie and other funds provided by the various republics, was dedicated and has since been maintained as the headquarters of the Union. At the fifth Pan-American Conference, held at Santiago, March 26–May 13 1923, the membership of the governing board of the Union was enlarged; and it was agreed that in future any American republic not having an accredited representative at Washington may nominate a special representative on the board.

The board is constituted of representatives of all the countries of America, except Canada and Guiana. Its purpose is to develop commerce, friendly intercourse, good understanding and the preservation of peace among the countries of America, and it is supported financially by quotas contributed by each country based upon their respective populations. It publishes a monthly bulletin embodying a record of Pan-American progress, and also special reports and pamphlets containing practical information on Pan-American subjects. Its library, the Columbus Memorial Library, contains 55,000 volumes and a large collection of maps, photographs, lantern slides and negatives. In addition to its other activities, the governing board acts as an *ad interim* executive committee in the intervals between the Pan-American Conferences (*q.v.*).

PANGALOS, THEODORE (1878–), Greek soldier and politician, was born in Salamis of Albanian origin, and in 1895 entered the Athenian Military Academy, whence he proceeded to complete his studies in Paris. During the World War he commanded a regiment in Macedonia, in 1917 he held a post in the Ministry of War, in 1918 commanded the first infantry division and in 1919 was chief of the General Staff during the campaign in Asia Minor. When the revolution of 1922 dethroned King Constantine for the second time, he was chairman of the commission of enquiry into the responsibilities for the Asiatic disaster, and was consequently concerned in the execution of the six Royalist Ministers. He subsequently became Minister of War in the revolutionary Govt., and commander-in-chief of the Army of the Hebros. At the elections of 1923 he entered the National Assembly as delegate from Salonika and chief of the Republican group. In the first Republican Cabinet of M. Papanastasiou in 1924 he was successively Minister of Law and Order (for the repression of brigandage) and War. On June 25 1925, by a bloodless *coup d'état*, he made himself Premier, then forced the Chamber to accept him, prorogued and subsequently dissolved it, took two Royalists into his Cabinet as a sign of "reconciliation," and on Jan. 3 1926 publicly proclaimed himself dictator; he had already been so in fact ever since he had thrown away the "parliamentary mantle" with which M. Papanastasiou had tried to cover the uniform of his former colleague. In April 1926 Gen. Pangalos was elected President of the Hellenic Republic in succession to Admiral Condouriotis.

PAN-GERMANISM.—Pan-Germanism is the name given to an imperialistic movement which, though it had long been gaining strength, received but little serious notice in Anglo-Saxon countries until the years immediately preceding the World War. Its importance may then have been exaggerated, yet there can be little doubt that it helped largely to popularise the belief that there had been at work in Germany forces bent upon ambitious schemes of territorial aggrandisement and political dominion.

Its Two Aspects.—There are, indeed, two aspects of Pan-Germanism—the purely national and defensive, and the outspokenly Chauvinistic and aggressive. The Pan-German is accustomed to describe his endeavours as merely designed to realise, under modern conditions, the ideas of men like Fichte, Arndt and other patriots who over a century ago looked to the time when the sundered German tribes would be gathered into one political fold. In the middle of the century the political economists Friedrich List and Wilhelm Roscher, both forward-looking in many ways, gave more purposive form to this vague notion of an all-embracing Germanic commonwealth. List dreamed of a German Empire extending from the Adriatic to the Black Sea, offering scope for German colonisation for centuries to come. He also predicted the eventual inclusion in that empire of Holland, holding that without control of the mouth of the Rhine Germany was "like a house whose front door is owned by a neighbour."

List's speculations would appear to have given encouragement and direction to the later more definite activities of the Pan-Germanist movement; for many of the imperialistic schemes which have been advanced by contemporary writers are only variations or augmentations—mostly the latter—of his ideas. List's influence can first be traced in the works of men like Paul A. de Lagarde, Gustav A. C. Frantz and Paul Dehn, who all wrote on the subject in the 'seventies or 'eighties of last century. Thus, in his *Deutsche Schriften*, Lagarde wrote:—

> We must create a Central Europe which will guarantee the peace of the entire continent from the moment when it shall have driven the Russians from the Black Sea and the Slavs from the South and shall have conquered large tracts to the east of our frontiers for

German colonisation. We cannot let loose *ex abrupto* the war which will create this Central Europe. All we can do is to accustom our people to the thought that this war must come.

Frantz, too, in his book *Die Weltpolitik*, advocated the formation under German direction of a powerful confederation of States comprising, besides Germany, Austria, Holland, Belgium, Flanders, Lorraine, Switzerland, Franche-Comté, Savoy, and, in the East, the Balkan principalities and Russian Poland.

The War Period

During the years preceding the World War these ideas affected Germany and were reinforced by influential political names. They had been kept alive by a host of writers of unequal merit, among the most influential being Ernst von Halle, Friedrich Lange and Ernst Hasse. The special aspect of the Pan-German question to which Hasse devoted his pen was "frontier policy," the title of his best-known book. One of his favourite schemes was the hedging of the empire on its landward frontiers by a military *glacis*, a day's march wide, to be settled by the families of ex-non-commissioned officers and other picked men who had had a military training. This real *Landwehr* was to be the *rocher de bronze* of which Frederick the Great spoke, a bulwark against which the attacks of Germany's enemies would hurl themselves in vain. He also advocated the incorporation in the German Confederation of Belgium, Luxemburg, Holland and certain French frontier districts, as well as of Bohemia and Moravia (to be taken from Austria) and parts of Western Russia. For, he wrote, "We want territory even if it be inhabited by foreign peoples, so that we may shape their future in accordance with our needs."

It was only in 1891 that the Pan-Germans resorted to systematic organisation and propagandism. The colonial movement was then in full flood, and the idea of imperial expansion had captured the national imagination in a high degree. Five years before a congress of patriotic organisations had been called for conference in Berlin by Dr. Karl Peters, who later acquired a sinister notoriety. A loose federation of these bodies was formed for the more successful advancement of national interests, particularly territorial expansion, and Peters was for a time accepted as its head.

A New League.—In 1891 this federation was reconstituted as the General German League (*Allgemeiner Deutscher Verband*) under pressure of the strong public feeling evoked by the conclusion of the Zanzibar Convention of the previous year, by which Germany ceded to Great Britain a large part of her East African empire in exchange for the island of Heligoland. A membership of 20,000 appears to have been obtained, but this number gradually fell off to 5,000, until in 1894 the movement was taken in hand by Prof. Ernst Hasse of Leipzig, the municipal statistician and a member of the Imperial Diet. Simultaneously the name Pan-German League (*Alldeutscher Verband*) was taken; the machinery of organisation was improved and expanded; an energetic agitation by means of meetings, leaflets and a weekly news sheet *Pan-German Leaves* (*Alldeutsche Blätter*) was begun; and both members and money again came in freely.

The new League sought to create a world-wide national union of all the Germans, adopting as its motto the saying of the Great Elector of Brandenburg, Frederick William, the founder of the German colonial movement and the creator of the German navy, "Remember that you are Germans." The propagandist manifesto in circulation before the War set forth: "We must strengthen our national sentiment and bring home to the mass of our people the fact that Germany's development did not end in 1871." The programme of action comprised the following measures:—

The quickening of the patriotic consciousness of Germans at home and the combating of all tendencies antagonistic to national development.

The solution of questions relating to the education and training of the young and the schools in the sense of Germanism.

The fostering and support of German national movements in all countries where our kinsmen have to struggle for the maintenance of Germanism; with the union of all Germans throughout the world. (At the same time Germans living abroad were warned against direct interference in the internal affairs of the countries of their adoption.)

The promotion of an energetic German "policy of interests" in Europe and across the seas, and especially the carrying forward of the colonial movement to practical objectives.

Had the Pan-Germans kept their endeavours within the limits of the party's programme much later reproach might have been saved them. Individual members of the League, however, were not slow to supplement its avowed aims by all sorts of immoderate schemes of aggression in Europe, Asia Minor and Africa. As time passed and the relations of the Great Powers became increasingly strained, the League itself developed into a powerful piece of political machinery. Berlin was the administrative seat, but the organisation covered the whole country, which for purposes of agitation was divided into *Gauen* or regions, while the formation of branches in foreign countries was studiously furthered. There was an executive committee of 300 members, drawn from all parts of the Empire; there were special committees for various territorial and other questions; and national congresses were held at intervals. The fact that a large number of its members sat in the Imperial Diet gave to the League an excellent forum for the propagation of its ideas, and in all the more critical episodes and controversies in foreign politics during two decades prior to the War it proved an unwearying exponent of a spirited imperialistic policy.

Yet influential though the Pan-Germanist movement was before the War, and inflammatory as was much of its influence on public opinion, injustice would be done by identifying the German nation as a whole with its more aggressive propagandism. In the main the movement appealed to and was embraced by the powerful nationalist and Chauvinist parties—in other words, by the military men and the political reactionaries—for though many intellectuals supported the League the soberer heads among them kept aloof, and the historian Mommsen even called the Pan-Germans "patriotic idiots."

Some Reflections.—It would be equally unfair to draw general conclusions from the many extravagances which were uttered and written in Germany during the years of war. The real significance of the Pan-German propagandism at that time lay in the new importance attached to the idea of a Central European Confederation under German influence, now revived by Dr. F. Naumann in his book *Mittel-Europa*, perhaps the ablest contribution from the German side to the literature of a "New Europe," the expansion of the old Berlin-to-Bagdad programme into a grandiose scheme of empire extending from Antwerp and the North Sea to Basra and the Persian Gulf, and the claim to a vast consolidated colonial empire stretching across tropical Africa, to be acquired at the expense of France, Belgium and particularly of Great Britain. These ambitious projects are not recalled in order to prove that the war aims of Germany were more immodest than those of some of her enemies, still less for the purpose of pointing the contrast between aspiration and achievement, but rather as showing how many years of intensive Pan-Germanic agitation had clearly familiarised the national mind with the idea of imperial expansion as one which might be better realised by force of arms than by the slow methods of peaceful penetration.

When criticised, the Pan-Germanist is ready with his answer. "Put yourself in our position," he says; and the challenge is one to be met. Viewing the question from the German standpoint it is not difficult to discover facts and tendencies in national and international politics that explain, and within limits may be said to have condoned, the anxiety and spirit of unrest which settled upon Germans when, in 1885 or thereabouts, they began to feel the pressure of the population question, the growing need for new markets and the stirring of ambitions which pointed outwards. It is significant that the movement made its greatest advance when Mr. Chamberlain, Colonial Secretary from 1895 to 1902, was uttering his clear and resounding call to the Commonwealths of the British Empire to coalesce and to raise their frontier barriers, commercially, to the outer world. In the past the British Empire had opened its door freely to Germans as immigrants and traders, but they might be perhaps,

less welcome than before. Even had it been otherwise, the Germans chafed against the inequality in the partition of the undeveloped territories of the earth which compelled their emigrants to seek homes under alien flags and thus to be eventually lost to the fatherland. Further, while many German politicians feared a future agglomeration of the Anglo-Saxon races, the whole nation was haunted by the two-fold menace of a restless Russia in the east and of a France in the west unreconciled to the loss of territory in 1871.

These and other facts, weighing on an emotional and politically immature people, probably gained for Pan-Germanist ideas a hearing and a sympathy which in different circumstances might have been refused to them. When all due allowances have been made, however, it is but the more justifiable to say that Pan-Germanism stands condemned by its excesses. The great mistake of the Pan-Germans in the past has been that they allowed a justifiable national pride and an eager and natural hankering for more elbow-room to degenerate into hostile designs against other nations which, owing to historical reasons, had preceded Germany in the colonisation of the empty spaces of the earth, and that they so often avowed these designs with astounding candour. Since the War the Pan-German League, refraining from aggressive agitation, has concentrated its attention upon the task of strengthening the national sentiment and spirit, hardly tried by adversity. The latest revision of its statutes (March 1925) is substantially directed towards the political rehabilitation of Germany as a Great Power and the removal of the territorial and economic penalties imposed by the Treaty of Versailles. Stress is laid upon the maintenance and strengthening of the national spirit, the cultivation of the German individuality, the need for a powerful defence force, the recovery of the lands of which Germany has been deprived and the union of German-Austria with the Reich.

Statistics.—On the eve of the War the number of regional groups of the League was about 200, and the aggregate membership was 17,000, a number considerably below the maximum attained in 1902. In 1917 the groups numbered 250, with little change in the total membership. No official figures have been published since the War, but both the number of groups and the membership are believed to have greatly decreased. The representation enjoyed by the League in the Diet has likewise declined, for while as many as 38 members were identified with it in 1902 the number of such members had fallen to 17 in 1917 and since the War it has been quite insignificant.

The Movement in Austria.—The most important development of the Pan-German movement since the War is the great stimulus which it has received in Austria. There an autonomous League was formed in 1919 with an independent organisation; and working from Graz it has carried on a vigorous agitation in all parts of the country, and has even succeeded in making its influence felt in the German districts which have passed from Austrian rule under the Treaty of St. Germain. While its programme has much in common with that of the parent League, it specially emphasises union with Germany as the hope of the future.

That great enthusiasm is being thrown into the agitation is shown by the fact that up to 1925 200 district branches of the League had been organised, representing an enrolled membership of some 14,000. These Austrian reunion endeavours practically revive the Great Germany movement of the middle of last century. It is not the least strange of the ironies of history that an idea which at that time reft in twain the old German Bund should serve to-day as a symbol of national unity.

BIBLIOGRAPHY.—The German literature of the Pan-German movement is very large and inevitably of very unequal value. Better known writers include, besides those already named, Alexander von Peez, Albert Ritter, General Friedrich von Bernhardi, the Anglo-German Houston S. Chamberlain, Baron L. von Vietinghoff, Count von Reventlow, Albrecht Wirth, H. Frobenius and Friedrich Lange. Noteworthy German works on the League itself are an official survey of Pan-Germanic endeavours entitled *Zwanzig Jahre alldeutscher Arbeit und Kämpfe* (1910); Martin Wenck's *Alldeutsche Taktik* (*Pan-German Tactics*) (1917); and Burchard's *Geschichte des Alldeutschen Verbands* (1920). Of a number of works in English there may be named Rowland G. Usher's *Pan-Germanism* (1913), and a translation of Charles Audler's *Pan-Germanism*, published in 1915.

(W. H. D.)

PAN-ISLAMISM.—This word was first employed in journalistic literature in the early 'eighties of the 19th century to describe the efforts made in the Moslem world to bring about some unity of action in opposition to the Christian powers of Europe. Invented to express what was believed to be a new order of circumstances, the word has led to much misunderstanding, since it has obscured the facts that Mahommedan political theory has always embodied a hostile attitude towards unbelievers unless they submitted to Mahommedan rule, and that the ideal of the unity of all believers has formed an integral part of the religious outlook of Islam since its very inception. The only new circumstance in the relations between the Christian Powers and the various Moslem populations was that the expansion of the Press in the East and improved methods of communication have in modern times enormously facilitated the rapid circulation of ideas.

The Unity of Islam.—Since the Armistice in 1918 it has been as difficult for the present generation of Moslems to effect any realisation of the ideal unity of Islam as for the Mahommedan world during the last thousand years. The Moslem empire held together under the rule of the early Caliphs for little more than one century only. Personal ambition, racial distinctions, sectarian divisions and geographical conditions broke it up into fragments, and although the ideal of the unity of all believers was never abandoned and indeed formed the theoretical basis of the political theory and of both the religious and the judicial organisation of the greater part of the Mahommedan world, it has generally been left to theologians and journalists to bring forward schemes for its realisation, while *de facto* rulers and practical statesmen have ignored all such visionary attempts to re-arrange the political conditions of contemporary society. Indeed, throughout the whole history of Islam, the infrequency of any serious attempts to realise political unity and the lack of response when any such attempts have been made are more noteworthy facts than any so-called pan-Islamic movements. The Sanusis, who excited so much anxiety among the French in the latter part of the 19th century, succeeded in arousing little more than local interest instead of starting the conflagration which was expected to be about to put the whole of North Africa in a blaze. Similarly, the struggles for independence on the part of the Berbers in the Rif have attracted to their assistance no volunteers from other parts of the Mahommedan world, and the Turkish republic (one of the few independent Mahommedan states now surviving) has on more than one occasion made it clear that it does not concern itself with the fate of Mahommedan populations in other countries, even as it does not welcome interference in its own internal affairs on the part of non-Turkish Mahommedans.

Attitude of Turkey.—This attitude of aloofness on the part of the Turkish Govt. has dealt a severe blow at pan-Islamism, for those who worked for the unity of Islam during the 19th century had looked on Turkey as the rallying point of their efforts, and since the Armistice, pan-Islamic feeling has taken the form chiefly of anxiety for the fate of Turkey. While the settlement of the terms of the treaty was so long delayed, there was ample time for an organised excitation of feeling on the matter. As the Caliph was Sultan of Turkey and the Caliphate (*q.v.*) was the visible symbol of Islamic unity and served as the easiest basis for a popular appeal, the defence of this institution and the advocacy of its claims were placed in the forefront.

India.—The Khilafat movement was started in India in Oct. 1919, and in the following Nov. a Khilafat conference was held in Delhi. Shaukat Ali became secretary of it in the following year, and he and his brother, Muhammad Ali, were henceforward prominently connected with the movement. The latter headed a deputation to the Prime Minister in London in March 1920 and maintained that Islam required temporal power for the defence of the faith, that for this purpose the Caliph must retain adequate territories, including the whole peninsula of

Arabia, which was defined to include Syria, Palestine and Mesopotamia, and that the guardianship of the Holy Places must remain in his hands. The deputation returned disappointed, and in July 1921, in the Khilafat conference at Karachi, Muhammad Ali declared that military service under the present British Govt. was religiously unlawful for all Moslems, and he was consequently condemned to two years' imprisonment for making a statement likely to cause soldiers to fail in their duty. One result of the excitement stirred up in India was that in Aug. 1921 rebellion broke out among the Moplahs, a section of Mahommedans in Malabar, who declared their intention of establishing a Khilafat Govt., and murdered or forcibly circumcised a large number of Hindus.

The declaration of a Republic in Turkey in Oct. 1923 and the consequent abolition of the Sultanate, hitherto a concomitant of the Caliphate, contravened one of the main contentions of the Indian Khilafat party, namely that the dignity of the Caliphate demanded that the holder of this office should possess adequate power for fulfilling all his functions. Indian opinion found expression in a letter sent by H.H. the Aga Khan and the Rt. Hon. Ameer Ali in Nov. 1923 to Ghazi Ismet Pasha, in which they urged that "any diminution in the prestige of the Caliph or the elimination of the Caliphate as a religious factor from the Turkish body politic would mean the disintegration of Islam and its practical disappearance as a moral force in the world." The relation of the Caliphate to pan-Islamic aspirations was emphasised by representing this institution as "the link which binds the followers of Islam as a vast congregation." When the Caliphate was in peril from outside attacks, Mussulman feeling all over the world was violently agitated, and the Moslems of India gave their sympathy and support to the Turkish nation in the belief that "in fighting for their independence they were also fighting for the preservation intact of the institution which symbolised Moslem solidarity." The publication of this letter gave much offence to the Turkish Govt., which was little inclined to pay consideration to Indian opinion, since the Turks regarded the Indians as impracticable idealists and resented their failure to render assistance during the World War.

The abolition of the Caliphate by the Turkish national assembly in March 1924 excited still greater indignation in India, but in answer to numerous protests Mustafa Kemal Pasha (*q.v.*) defended the action of the national assembly, maintaining that the Caliphate had been a source of internal dissension in Turkey, that the ideal of a united Moslem State under the Caliph had never been realised but, on the contrary, had been a constant source of strife and duplicity among Moslems, and that the interests of the various Mahommedan peoples demanded that they should now organise themselves into separate governments. In view of these altered circumstances the Indian Mahommedans, who had hitherto been urging the claims of the Sultan of Turkey, had to adopt a new programme, and accordingly the Central Khilafat committee, at its meeting in Bombay in May 1924, resolved to endeavour to promote friendly relations and to strengthen the bond of brotherhood between the different Moslem countries and exchange communications regarding a settlement of the Caliphate question in accordance with the Sacred Law of Islam; at the same time, efforts were to be made to free the Peninsula of Arabia (as defined above) from the control of European Powers.

Egypt.—Less excitement was felt in Egypt, but the action of the Turkish national assembly was condemned by the whole body of the 'ulama, and various proposals were discussed for the revival of the office of the Caliph. Finally it was resolved to invite representatives of all the Moslem communities in the world to meet in Cairo to elect a new Caliph; such a congress, first proposed for March 1925, was postponed until May 1926.

Java.—In Java the first pan-Islamic congress was organised in Nov. 1922, when a telegram was sent to Mustafa Kemal Pasha, and the Javanese attitude towards the Caliphate question was discussed. At a later meeting in Dec. 1924 it was resolved to send delegates to attend the proposed Caliphate congress in Cairo, and this resolution was reaffirmed in Aug. 1925.

Separatist Movements.—Such efforts for united action in the Mahommedan world are less significant than the separatist and national movements, which have filled a larger place and have been of more permanent influence in the political life of Mahommedan countries. The basis of such nationalist feeling in the case of the Turks was racial, as also in the Soviet Mahommedan republics, which were organised as Kirghiz, Tajik or Turkoman; similarly in Arabia, where hostility to Turkish domination was exacerbated by the primitive pride of race and love of independence. Internal dissensions in Arabia even implicated the Indian supporters of the Khilafat movement, though by theory they were working for the unity of all believers; they regarded the action of King Husain in throwing off his allegiance to the Sultan of Turkey as an act of treachery towards Islam, and the Khilafat committee, in Aug. 1924, expressed their sympathy with Ibn Sa'ud, the Wahhabi Sultan of Nejd, when he invaded the territories of the King of the Hejazs, and in 1925–6 sent more than one deputation to him with proposals for the future government of the Hejaz. In Egypt the nationalist movement was territorial, and Moslems and Copts combined to assert the independence of their country; also in India, where the Swarajist and non-co-operation movements united Hindus and Mussulmans. In Java, Bolshevik influence in 1923 converted the Sarekat Islam (founded in 1910) into the Sarekat Ra'yat (Union of the People), which, unlike the movement out of which it sprang, takes no account of religion.

Control of the Seas and of National Resources.—The earlier writers on pan-Islamism view this movement as a possible menace to Christian Europe. The obstacles in the way of any such united activity on the part of the Mahommedan peoples have recently been discussed from a novel point of view in the *American Geographical Review* (vol. 14, New York, 1924); it is there pointed out that European control of the seas makes it impossible for any powerful combination of Moslem peoples to be effective, and that in the parts of the world inhabited by a predominating Mahommedan population there is a lack of those mineral resources which are necessary for the conduct of modern warfare, *e.g.*, phosphates are only found in those parts of North Africa that are under French control, manganese only in Georgia, tin only in Malacca, and petrol only in Baku.

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PANKHURST, EMMELINE (1858–), British suffragist, was born July 14 1858, the daughter of Robert Goulden of Manchester. In 1879 she married Richard Marsden Pankhurst (d. 1898), a barrister who drafted the Women's Property Act (1882) and an advocate of Women's Suffrage. Early interested in politics, she, during a short residence in London, took part in the strike of the match girls at Bryant and May's factory in 1886 and helped to found the Women's Freedom League three years later. Returning to Manchester in 1893 she acted for four years as a poor law guardian, and was afterwards a registrar of births and deaths and a member of the school board and education committee. After having been successively a member of the Liberal and Independent Labour parties, she decided to abandon everything for the cause of Women's Suffrage, and in Oct. 1903 was chiefly instrumental in the foundations of the Women's Social and Political Union on a non-party basis. Having failed to induce the Liberal party to make votes for women a part of their programme she utilised her organisation to oppose their candidates, took headquarters in London, held public meetings and organised processions and deputations to the House of Commons. On May 16 1906 she spoke for her society at a joint deputation of suffrage societies which met Sir H. Campbell-Bannerman at the Foreign Office. But the Liberal party being divided on the question, their leaders refused facilities for the discussion of private bills, and the methods of the W.S.P.U. increased in violence.

In 1908 Mrs. Pankhurst was arrested and imprisoned in Holloway for inciting to a breach of the peace by the issue of a handbill urging her followers to rush the House of Commons, and sentenced to three months' imprisonment. Claiming to be treated as a political prisoner, she defied prison rules and suffered solitary confinement, but was released before the expiration of her sentence on grounds of health. Next year she was again arrested for a technical assault and was again imprisoned, and at the end of the year paid a first visit to the United States. In 1910 there was a short lull in the movement pending the consideration of a moderate measure framed by a non-party committee of the House, but as the Government refused assistance the agitation was again resumed. The census was boycotted in 1911, and on her return from a second American visit at the end of the year Mrs. Pankhurst and her daughter directed a window-breaking campaign. Mrs. Pankhurst was sentenced to 9 months' imprisonment for inciting to violence in March 1912, but was temporarily released in June after refusing to take food and resisting forcible feeding, under the so-called " Cat and Mouse " Act. On her return from another visit to America she was re-arrested at Plymouth but soon again released, when she went abroad to her daughter, Christabel, who, having evaded the police, was at Paris.

In 1913–4 arson and the destruction of property were added to the methods of the W.S.P.U., and after the burning of Mr. Lloyd George's house at Walton, Mrs. Pankhurst was sentenced at the Old Bailey for inciting to commit felony, to three years' penal servitude, despite the jury's recommendation to mercy. But she served but a small part of this sentence as she refused both food and drink and even medical attention. Meanwhile, although steps were taken to crush the organisation, it continued to flourish, and funds came both from England and America, whilst public opinion began to assert itself against forcible feeding. The outbreak of war brought militancy to an end, and both Mrs. Pankhurst and her elder daughter lent their organisation to the cause of recruiting and the increase of munitions. At the first election (1918), after the concession of the vote, the latter contested Smethwick as an independent candidate. Christabel Pankhurst (b. 1880) had been the director of the skilful strategy of the militant movement which she had induced her mother to adopt. Several other members of the family also took part in it. One of them, Sylvia (b. 1882), opposed the War, became a Communist, and was imprisoned in 1920 under the defence of the Realm Act.

See E. Pankhurst's, *My Own Story* (1914); S. Pankhurst, *The Suffragette* (1911); A. Kenney, *Memoirs of a Militant* (1924).

PANTALEONI, MAFFEO (1857–1924), Italian economist and politician, was born at Frascati in 1857. After studying in Germany, he returned to Rome and attended the law faculty of the university where he took his degree. He specialised in the study of economics, and after teaching at Venice, Bari and Geneva was, in 1902, appointed professor of political economy in the University of Rome, a post which he held until his death. In economics he was the founder of the new scientific tendency, but he always managed to weld theoretical principles with the elaboration of concrete facts. Pantaleoni was deputy for Macerata in the XI. Legislature, and at first showed some sympathy for Radicalism and even Socialism; but when the latter abandoned its struggles for the elevation of the working classes and evolved into a system of proletarian organisations for exploiting its political influence he became an uncompromising opponent of the movement. On the outbreak of the World War he was an ardent pro-Entente interventionist. After the Armistice he opposed Bolshevism, and was a warm supporter of the Fascist movement, being one of the first senators created by the Fascist Government. In 1923 Pantaleoni was appointed Italian delegate on the League of Nations committee for the restoration of Austria's finances, of which he was president. He died in Milan Oct. 29 1924.

Pantaleoni's works include: *Teoria della translazione dei tributi; Dell' ammontare probabile della ricchezza in Italia; Manuale di economia pura; Scritti varii di economia; Tra le incognite; Note in margine alla guerra, and Bolscevismo italiano.*

PAN-TURANIANISM.—The word *Turan*, from which the name of the Pan-Turanian movement is derived, is Persian. In the Persian epic it means the steppes and deserts of Central Asia, in contrast to the cultivated country of Iran or Persia. The people of Turan were the nomads who had constantly overrun Persia from the northeast. Since the beginning of the Christian era, these nomadic invaders from Turan have belonged linguistically to the peoples speaking the so-called agglutinative languages, in contrast to the languages of the Indo-European family. When modern European philologists wanted a common term to cover this agglutinative group they coined the word " Turanian " for the purpose.

Turanian researches were first taken up seriously by the Magyars of Hungary, and this for two reasons. The first reason was that the Magyar language belongs to the Ugro-Finnic branch of the agglutinative group, in contrast to most modern European languages, which are Indo-European. The second motive which influenced the Hungarians was not philological, but political. During the half-century before the World War, the Hungarian statesmen who largely controlled the foreign policy of the Austro-Hungarian monarchy were on the look-out for allies against the Pan-Slav movement which was being promoted by Russia, and seized on the fact that Turkish also was a Turanian language (though of a different branch from Hungarian), in order to commend to the Turks the idea of a Magyar-Turkish entente against the Slavs, a supposed linguistic kinship being assumed to imply a common racial origin. Thus the idea of Pan-Turanianism had an academic origin before it was exploited for political purposes, and it was first introduced to the Turks by a European nation, the Hungarians, who put it forward not in the Turks' interest, but primarily in their own.

Although the Magyar-Turkish entente eventually ripened into the military alliance between Turkey and the Central Powers during the World War, the Turks were never captivated by the concept of Pan-Turanian unity in the wider sense of a brotherhood between peoples speaking all branches of the Turanian family of languages. The Turks of the Ottoman Empire translated Pan-Turanianism into Pan-Turkism, that is, into the narrower idea of a brotherhood between all peoples speaking Turkish dialects, with an insistence upon the aboriginal Turkish element in their own Osmanli language and culture. These two sides of the Pan-Turanian movement as developed by the Ottoman Turks were equally important, and indeed were complementary to one another. The ancestors of the Ottoman Turks had travelled right across the Islamic world in order to reach their final home in Asia Minor and the Balkan Peninsula from their starting-point in Central Asia, and on their journey they had adopted the culture and religion of the Islamic world The Ottoman Turkish dialect was enriched and overlaid with borrowings from Arabic and Persian, and the Ottoman Turks felt vividly their solidarity with all other Moslems, of whatever race or language, while retaining little or no sense of kinship with other Turks as such, especially if those other Turks belonged to different sects of Islam, or to non-Islamic religious communities.

A specifically Turkish national movement among the Ottoman Turks only began after the revolution of 1908, in which the Committee of Union and Progress overthrew the Sultan 'Abdul-Hamid, and the leaders of the C.U.P. always tried to run Pan-Islamism and Pan-Turkism in double harness. It is only since the rise of a new Turkish national movement in 1919, under the stimulus of the Greek invasion of Anatolia, that the leaders of Turkey have consciously and completely abandoned the Islamic basis of the Turkish state, and have constructed a Turkish Republic on exclusively national foundations. Meanwhile, Mustafa Kemal Pasha and his party, that is, the very Turks who have brought Turkish nationalism to maturity, have thrown over the other side of the original movement, which insisted, not merely upon Turkifying the Ottoman state, but on re-creating the links between the Ottoman Turks and other Turkish peoples.

This latter movement, to which the name of Pan-Turanianism,

in the sense of Pan-Turkism, properly belongs, resembled the wider Pan-Turanianism of the Hungarians in having a predominantly political complexion. From the political point of view the essential fact about the present distribution of the Turkish-speaking peoples as a whole is that nearly two-thirds of them (reckoning by aggregate population) live under Russian government, while less than one-third live in Turkey itself. Thus, before the Russian revolution of 1917, when the Russian Empire was Turkey's principal enemy, the promotion of a Pan-Turanian movement among the Tsar's Turkish-speaking subjects seemed to Turkish statesmen of the Union and Progress party a powerful means of weakening and possibly breaking up the Russian Empire.

On the other hand, after the revolution of 1917, Russia suddenly changed from being Turkey's principal enemy to being her principal ally, and the new Turkish nationalists, in their life-and-death struggle with Greece and the principal Allied Powers, naturally abandoned a movement which would have made friendly co-operation between the new Turkish Republic and the new Russian Soviet Union impossible. Moreover, the Union of Socialist Soviet Republics, while losing vast territories which had belonged to the old Russian Empire on its European border, succeeded in establishing its sovereignty *de facto* over all former Russian territories in Asia, that is, over all former Russian territories containing Turkish-speaking populations. Thus the expected break-up of the Russian Empire did not take place as far as its Turkish-speaking subjects were concerned; and, for these several reasons, the Pan-Turanian movement, after obtaining a certain notoriety during the years 1914–7, has sunk into an obscurity from which it is unlikely to emerge, at any rate in its previous form.

It is to be noted, however, that the 15,000,000 or 16,000,000 Turks of the Union of Socialist Soviet Republics have been given a far-reaching political autonomy within the framework of the Union, which they never enjoyed under the Tsardom. Of the six republics constituting the Union two, namely the Turkmen and the Uzbeg Republic, are Turkish. Again, one of the three members of the Trans-Caucasian Republic (which itself is a member of the Union) is the Turkish Republic of Azerbaijan. Finally, within the Russian Socialist Federal Soviet Republic, which is the leading member of the Soviet Union, there are a number of autonomous Turkish units, such as the Tatar Republic, the Bashkir Republic, the Kirghiz Republic, the Karakalpak autonomous district, and several other less important territories like the Yakutsk Republic in the far northeast of Siberia. Thus in the constitution of the U.S.S.R. the germs of a new Pan-Turanian movement are latent. (See TURKEY.)

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PAPACY (*see* 20.689).—The year 1910 found Pius X. restoring the evangelical framework of the Church. After the break with France his tendency lay toward devotion, not politics. The visit of President Loubet to Rome led to the withdrawal of the French Embassy because, France being in diplomatic relations with the Papacy, President Loubet ranked technically as a Catholic Sovereign and broke the Papal Decree concerning official visits to the Italian King. A Protestant King under the same circumstances could be made welcome at the Vatican. The visit of President Roosevelt was a lost opportunity; friction was engineered by interested parties. The only Catholic Sovereign who visited Rome was the Prince of Monaco in the guise of a lecturer.

With the French and Portuguese Republics Pius waged open war. He declined all compromises with French law, while the persecution in Portugal evoked the Encyclical *Jamdudum in Lusitania*. Decrees as purely ecclesiastical as the *Ne Temere*, defining the conditions of Catholic matrimony, or that regulating the anti-Modernist oath, roused protest, principally in Germany. Both were directed against bad Catholics. For Protestants in good faith he maintained absolute toleration. The Pope sometimes seemed to see Modernism in an exaggerated light, for he pressed safeguarding measures upon dioceses innocent or ignorant of modern thought. Pius had decided that Modernism was Pantheism, and insisted on destruction before discussion; but by a letter to the Bishop of Limerick, he approved Newman's works; and under the cloak of Newman all modern thought, not demanding conclusions against tradition, finds honourable harbour. The Encyclical *Pascendi gregis* cut a few self-engineered Modernists from the Church, like Loisy and Tyrrell. Pius gave no quarter, and a great many loyal writers and thinkers were hermetically sealed in their own minds. It proved a sound caulking of the Ark, but original exegesis disappeared with the exception of scholars like the Dominican Lagrange, who was protected by his Order against the standards of Rigorism. The Encyclical *Editae saepe* on St. Charles Borromeo was thought to insult German history and the Princes of the Reformation and received modifications. The Modernists had attempted to rationalise a Creed whose value and distinction lay in opposing a Damascus-blind Faith to the earthly working of Reason. Pius minded less the Socialist tinge in the German Centre party than the Modernist colour in German professors. He disliked the Catholic Centre simply because it was political, but he made no decision between Cardinals Kopp and Fischer concerning Christian trade unions.

He did not approve a Catholic party in Italy under a Modernist and Socialist leader like Don Murri, against whom Catholic action was organised by lifting the *Non-expedit* of his predecessors whenever the Pope could help Conservatism to defeat Socialism. On one principle he supported the Italian Govt., which he protested against on another. By allowing Catholics to vote at times, he outvoted Divorce Law and drew personally closer to Italy. The insults offered him in Rome were due rather to a clique than to the people, who felt that he was Italian at heart. He blessed the Italian tricolor among the symbols of Catholic societies, but he protested bitterly against the statue of Giordano Bruno and the speech of the Mayor Nathan. He was not political except in his measures to bring the Italian Catholic party and the French Sillonists under episcopal control. Pius not only trimmed but discarded modern philosophy and politics. His reforms in discipline and devotion installed new disciplinary engines. The diplomatic web woven by Leo XIII. and the political entanglement bequeathed by Pius IX. were swept aside by an unrelenting desire to reform not only the universal machine and the text-books of the Church, but to regulate the writings and thought of individual Catholics. However expedient a council, the Pope proved more effective.

He founded the Biblical Institute based on the Bible, the whole Bible and nothing but the strictest interpretation of the Bible by the Church. Pius accepted and demanded belief in a verbal inspiration of Scripture, though by entrusting a revision of the Latin text to the Benedictines he admitted scribal error in the Vulgate. Degrees in Scripture were granted after serious and searching examination. Ineffective seminaries were suppressed and reluctant Bishops were deposed. Idle priests were banished from Rome. Rome herself received vigorous visitation after three-quarters of a century. Pius introduced a uniform Catechism into Italy and appointed a Commission to codify the canon law. He required a restoration of true Church music. He introduced frequent and juvenile Communion, thus quenching the embers of Jansenism. He by the *Sapienti consilio* reformed the Roman Curia. By the *Commissum nobis* he had abolished the veto of Austria or Spain in future conclaves, and buried future procedure in strict secrecy. He simplified the religious orders, establishing, for instance, the Franciscan Union. He upset the theory of Cardinalitial posts and demanded merit alone for the Sacred College. To the application for Red Hats he grimly replied that he was a tailor (*Sarto*), not a Hatter!

By the Decree *Divino afflatu* Pius reformed the Roman Breviary, so that the Psalter came more truly to be said weekly. The accumulation of Feasts was checked, and holidays of obligation were practically reduced to eight in the year, apart from Sundays. The Divine Office was lightened and the Breviary abbreviated, making it a way rather than a maze of devotion. He developed the Eucharistic Congress, sending Cardinal

Legates to various countries. He interested the Unites States by creating two American Cardinals. France he soothed by beatifying Joan of Arc and kissing the French Tricolor in the presence of 67 French Bishops. He was an evangelical Hildebrand and liable to the impulses and utterances of a saint.

To Britain Pius was propitious. He sent his *legatus a latere*, Vanutelli, to London for the Eucharistic Congress of 1908. He removed Britain from the care of Propaganda to the general law of the Church and created the new Archdioceses of Liverpool and Birmingham. He sent an Apostolic Delegate, Ceretti, to Australia and raised two Englishmen, Bourne and Gasquet, to the Sacred College. In 1913 he celebrated by the Encyclical *Magni faustique* the 16th centenary of the Peace of Constantine. Throughout 1914 he foresaw war and uttered warning of days "when class is rising against class and nation against nation." To his Secretary, Merry Del Val, he said prophetically: "We shall not pass the fourteen." The War overwhelmed him and he died the day the Germans entered Brussels. A legend was spread that his warning letter to the Austrian Emperor was withheld. The truth was that the Emperor asked for his blessing and the Pope replied that he blessed Peace—not War.

Election of Benedict XV.

The disorganisation of Europe did not prevent the Cardinals meeting. The policy of Pius X. was upheld by the group around Cardinal Serafini, while the moderate group round Cardinal Maffi coalesced with those who desired a diplomatic Pope, and elected Cardinal Della Chiesa, who took the name of Benedict XV. The election of Benedict was humanly unforeseen. He had been appointed to Bologna to suppress Modernism, but he was left for seven years without a Red Hat, to the perplexity of historians. After 100 days' Cardinalate he was Pope! His entire Pontificate was occupied with efforts to bring peace or to assuage the effects of the War. In Nov. 1914, in the Encyclical *Ad beatissimi*, he declared mystically that the days foretold by Christ, when nation should rise against nation, had actually come to pass.

The belligerents watched for hints of approval in spite of the philanthropic neutrality. Excluded from the Conference of The Hague in 1899, the Papacy was not in a position to pronounce upon the invasion of Belgium, though any proven atrocity to nun or child would have met stern condemnation. He made the Holy See a bureau of charity rather than a court of justice. It may be said that a courteous diplomatist and an erudite lawyer went in search of peace, exploring and extolling every avenue that lent the least hope during years of world despair. Benedict was impartial to the nations, but the nations were not impartial to him. He set himself in a halo of neutrality, but he referred to "our beloved people of Belgium," and appealed to the invaders not to devastate, and to the devastated not to aggravate their own plight. He denounced "every injustice by whatever side committed," which Gasparri amplified by specifically including the invasion of Belgium, and the Pope wrote Cardinal Mercier the words, "Your cause is our cause." At the same time he complained of the treatment of Catholics by the Russian Army in Galicia. Though the Holy See set great store on diplomatic action, that action tended to disappointment, whereas the strictly religious policy brought a growing prestige and success.

In 1914 Sir Edward Grey sent Sir Henry Howard, followed in 1916 by Count de Salis, to reopen English relations, which had officially lapsed since the reign of Queen Elizabeth. The Apostolic Delegate at Constantinople was able to arrange for the exchange of British prisoners and the care of British graves in the Dardanelles. At Constantinople Benedict received the tribute of a statue erected by all communities in recognition of his efforts to save nations from each other.

The Pope's war efforts may be set under:

(1) The exchange of prisoners unfit for further military service.
(2) Liberation and exchange of detained civilians.
(3) Hospital treatment for sick and wounded.
(4) Sunday rest for prisoners of war.

The Vatican acted, but not strenuously, when Bethmann Hollweg proposed a German peace at the end of 1916. Cardinal Gasparri urged Mr. Balfour not to give a flat refusal, for the sake of neutral opinion. If the Germans were called to state their terms, the terms might be moderate, and, if they were not, the moral advantage would lie with the Allies. The Pope told de Salis that the moment did not appear suitable for making suggestions to the belligerents.

At the beginning of his reign the political force of the Vatican was nearly nil. Without achieving spectacular success, Benedict spread conviction that his was a force with which it was advisable to be on terms of approach rather than of reproach, provided that distinction was made between internal ecclesiastical policy and the outside policy. Benedict's outside policy remained a tenacious demand for peace. He proposed a conference of belligerents on the basis of "eliminating unjust and impossible pretensions." When Italy entered the War, he blessed the Italian priests called to serve, while remaining in touch with the Austrian Government. With the narrowing of communications, the Pope complained that "complete and precise judgment on events" was impossible. In the dangers of Universal War the Holy See inclined to be indulgent, if not changeful. The unwritten alliance of the Italian and Papal Govts. was a sign of Benedict's times to be consummated by his successors.

With the entry of Italy a secret pact was made under Sonnino by which the Allies excluded the Pope from discussion of the Peace. This was published in 1917 by the Bolshevist Government. The German and Austrian representatives to the Vatican withdrew to Lugano, but Italy respected Papal communications with enemy countries in spite of the averted suspicion of pro-Austrianism. The disaster of Caporetto was met at the Vatican and the Quirinal by mutual forbearance and succour. The Pope declared that he looked to solve the Roman problem not by foreign arms but by the Italian sentiment of justice.

Still the Pope remained neutral, sharing with President Wilson the hope of a negotiated peace. The Vatican Council had been suspended before it could deal with practices of warfare. The Church therefore could only offer generalities without pronouncing on clear cases. After the sinking of the "Lusitania" the Pope protested against "methods of attack contrary to the laws of humanity both by land and sea." The transportation of Belgians and the bombing of undefended cities were condemned, but the Pope was unheard and increasingly criticised by both sides.

Benedict passed from exhortation to warning. It culminated in his supreme but unsuccessful bid for peace by the Note of Aug. 1917, when he asked with ironical despair, "Must the civilised world be reduced to a graveyard?" Austria was anxious for peace, but Germany offered no data. The Nuncio Pacelli sounded the German Govt. in June. Bethmann Hollweg had begun to show himself sympathetic even on Belgium and Alsace-Lorraine. In Aug. the Peace Note was distributed. By a curious irony, George V. was asked to give copies to the French and American Presidents and to the King of Italy. The Note caused no small stir, but it was ignored by the Allies and refused by Germany. The Pope claimed impartiality, pleaded for disarmament and arbitration, stigmatised the War as "useless massacre," since both sides recognised that "the honour of arms is safe." He proposed the evacuation of Belgium and invaded France and the return of the German Colonies. He added a plea for the small States. Ludendorff called him a French Pope and Clemenceau a German one.

The German Chancellor Michaelis was more hostile than the Allies, to whom he left the reproof in the declarations of Wilson and Lloyd George. Fundamentally there was no difference between the Pope and the Allies, except as between a negotiated and a dictated peace. The Note represented the measure of European exhaustion had not the United States entered the War. The Vatican, though represented unofficially at Washington, had no means of expecting either Wilson's declaration of war or peace. Benedict issued an Encyclical concerning the future, whereas the Pope's terms were a Protocol based on the past. Wilson's reply hushed the Pope, who, deeply

disappointed returned to the alleviation of the victims. His contrast will always lie with Wilson. For nearly three years they personified the greatest spiritual neutrality and the greatest temporal neutrality in the world. The Pope, more tenacious and consistent, was left alone in his plea for a just and durable peace to the profit of neither side. His consistence was twice impugned by interviewers and by the treason of Mgr. Gerlach, who helped the enemy of Italy actively while himself sheltered in the Vatican and was handed over to the Italians by Vatican officials at the Bronze Gates.

Benedict in 1915 warned the Rulers, saying, " Remember that nations do not die: humbled and oppressed, they chafe under the yoke. Why not from this moment weigh with serene minds the rights and lawful aspirations of the peoples?" It was two years before Wilson, converted, was chastising the Teutonic Powers with the same admonition. The Pope did not include the Temporal Power of the Holy See among unredeemed aspirations. He reduced an irreducible claim to Sovereignty to an appeal to help the Holy See out of a false position. Though Benedict was puzzled by Wilson's *volte-face*, he realised that it was Michaelis who brought his Peace Note to nought. The Erzberger revelations showed that the Pope was not met in Germany on the Belgian question with as much good will as was shown by the Allies. Though the peace declarations of Wilson and Lloyd George showed modelling on the Pope's Peace Note, the Pope after 1918 became restrained. With the collapse of the Central Powers he accepted " all legitimate changes in politics and territories."

Neutral in the War, the Pope was left neutral in the Peace. That Benedict had no share in the Treaty of Versailles proved a blessing to the Vatican and was consistent with the policy which maintained that the Pope would take no part in any peace dictated by Germany or the Allies. The Vatican sincerely believed that only by agreement was peace possible. At Versailles the Pope's unofficial representative, Ceretti, was supported by England in obtaining modifications in favour of Foreign Missions.

Of the Treaty of Versailles, the Pope showed implicit blame and justified suspicion as long as it failed of Christian bases. The Pope seemed almost, like Cato, to favour the vanquished because they were vanquished. The Germans, who had not been sympathetic to the Vatican during the War, looked to the Pope for help to avert the worst consequences of the Peace. By the Encyclical *Dei Munus* of 1920 the Pope called for European reconciliation rather as a Christian family than as a mere League of Nations. In the same year he celebrated the memory of St. Jerome by the Encyclical *Spiritus Paraclitus*. By 1921 he celebrated the seventh centenary of St. Francis in the *Sacra propediem* and the eighth of Dante by the *In praeclara summorum*. His utterances returned to the greatness of the Catholic past. Though a disappointed diplomatist, he never relaxed his impartial benevolence. His relations with Italy became so friendly that he relaxed the conditions laid down for the visits of Catholic Sovereigns to Rome, opening the way for visits from the Kings of Spain and Belgium. He received the ruling American President and the Prince of Wales. Like Leo XIII., whose pupil rather than whose equal he was, Benedict had been inclined to sacrifice Irish and Polish political aspirations to the importance of British and Russian friendship. After the Russian revolution he was quick to recognise the Polish Republic and to nominate a Polish cardinal. He would not declare himself during the War between the complaints of the Irish Bishops and the British Govt., but after the Peace he demanded an Irish settlement and beatified Oliver Plunkett.

Though France had prevented the Holy See obtaining direct access to the Chinese Govt. instead of using the French Minister, she found it no longer dignified to use the back stairs and sent her own Ambassador to the Vatican. When Benedict succeeded, there were two Embassies and twelve Legations. He left his successor with seven Embassies and eighteen Legations.

One stupendous intellectual achievement crowned his War-harassed reign, the issue of the new Codex of Canon Law, edited by order of Pius X. and promulgated by Benedict under Cardinal Gasparri's supervision by the Bull *Providentissima Mater* in 1917. The original Commission of five Cardinals appointed in 1904 had died and been succeeded by eight others, who achieved the gigantic work of codifying the Canon Law of centuries under 2,414 Canons, the most astounding legal *tour de force* ever accomplished.

Early in 1922 Benedict died suddenly. Until his archives are published his career cannot be appreciated historically, but upon his catafalque the Church, which he had served in agonising days, inscribed his *epitaphia* thus:

1. Vainly he tried by his counsels of a Christian peace to put out or restrain the fire lit by the greatest of wars. He succeeded by all means in making it less calamitous.

2. He made opportune prescriptions for the diffusion of the Catholic Faith. He excited the zeal of the better to help the heralds of the Gospel by prayer, by alms, by action.

3. The authority of the Apostolic See rising to the ascendant in public opinion, he brought almost all States to seek bonds of amity with the Church.

4. Admirably incarnating the charity of Jesus Christ, he clasped with paternal heat all the miseries of the people and comforted them by the effusion of his kindness.

Election of Pius XI.

The Cardinals elected Cardinal Ratti, Archbishop of Milan, as Pope, under the title of Pius XI. The secrecy of the Conclave was well kept, but it was obvious that neither the Rigorist school of Pius X. nor the diplomatic policy of Benedict would be carried on, though by continuing Cardinal Gasparri as Secretary of State the new Pope created a precedent. His first act was a *beau geste* toward Italy, for he gave the long withheld blessing of Orb and Urb to the saluting troops of the Italian Kingdom. From that moment the Roman Question could be described as in final solution. No Pope of modern times has been so universally hailed by a broken world or received such an international endorsement. His first regret was that the American Cardinals had arrived too late, and he extended the interval between a Pope's death and the Conclave to 15 days. His life had been passed in the Ambrosian and Vatican Libraries, with Alpine holidays. Interesting were such incidents as his Latin speech in Oxford at the celebrations of Roger Bacon, and his ascent of Monte Rosa. He has never been happier than when issuing Encyclicals on great scholars like St. Thomas Aquinas and St. Francis de Sales, whom he made patron of Catholic journalists. His Encyclical *Ubi Arcano Dei* was a signal for charitable rather than diplomatic action. The absence of Italy from the nations attached by bonds of friendship to the Holy See was lamented. The alliance of the Vatican and the Fascist Govt. has been indubitable, though the Pope has declared that Divine Providence has not yet indicated, nor human wisdom discovered, a substitute for the old Temporal Power. The new conception of the Papacy as one of the glories of the Italian Kingdom has been almost embarrassing to the Vatican, which has refused to condone outrages committed by Fascists.

Naturally, the conquered States flocked to the protection and internationalisation afforded by the Church. On the Ruhr question the Pope pointed out a possible equilibrium between charity to Germany and justice to France that France herself could not dispute. Such phenomena as German and French Embassies at the Vatican signified both the measure of German defeat and of French satisfaction. During 1925 the Pope celebrated a Holy Year of Jubilee, and by receiving nearly 200,000 pilgrims in Rome enabled many threads to be laid for the healing of the nations.

Pius XI. has remained on religious territory, making no effort to be included or consulted by the Powers except when ecclesiastical interests are at stake—the Holy Places, for instance. At first the Vatican welcomed the British Mandate in Palestine preferring a sympathetic non-Catholic power in the East to an anti-clerical protector like France. But the progress and priority of Zionism mortified Catholicism exceedingly, and the Holy See turned for assistance to the League of Nations. The Orient has been the scene of great activity by the Holy See. For centuries

the Czar and the Caliph had been inexorable enemies of the Vatican. With their disappearance the new Pope made instant advances. The Encyclical *Ecclesiam Dei* on the third centenary of St. Josaphat was an appeal to the Slavs. The cause of Oriental unity with the West became the Pope's prepossessing desire. Missions were dispatched to Russia. The Pope called Latin attention to the splendour of the Slavic rite, and to the Conference at Geneva expressed Russian sympathies. With some difficulty the Pope obtained from Lenin the release of an Archbishop from death. Nor was the Pope's protest against the spoliation of the Orthodox Church listened to. But the most striking ecclesiastical result of the War has been the opening of Oriental Europe to the Latin Church. The Papacy undoubtedly looks forward to a period of missionary activity in the East as great as that which followed the European convulsion of the 16th century. (*See* also ROMAN CATHOLIC CHURCH.)

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PAPER MAKING (*see* 20.727).—The production of paper increases *pari passu* with population: in the period under review (1910–26) the industry has grown and there has been marked progress in scientific-technical control of its operations.

The evidence of this development is the record in the form of periodical publications of the research work of chemists and engineers engaged in the industry, evoked and stimulated by the technical societies founded in all the leading countries of civilised activity. In Great Britain the Paper Makers' Association has constituted a technical section which publishes its "proceedings"; in France a school of instruction and research has been founded at Grenoble; in Germany the "Verein der Papier Techniker" has contributed important advances, and its technical publications have taken a leading position; in America the Government Forestry Department has carried out elaborate researches, especially in the study of fibrous raw materials; in Canada likewise the Forest Products Laboratories (Montreal) have worked in a systematic programme which has now resulted in the constitution of a department of the University devoted to cellulose, paper making and the related industries. Notwithstanding this activity in the investigation of the first principles of the Art, the period is not marked by any outstanding feature of scientific or technical novelty.

Beating Processes.—The beater and beating process are the most important factors of paper mill production. The old form and type of beating engine known as the Hollander not only survives, but is still found the most efficient machine for the preparation of fibrous raw material for important classes of paper in competition with the elaborated modifications which have resulted from the endeavours of engineers to improve a machine recognised to be wasteful of power.

The beating process is one of the most complex in manufacturing industry. The beater was first designed for the treatment of wastes from the textile and rope-twine spinning industries, and substitutes a continuous process for the medieval methods of reducing these wastes to "pulp" by stamping or wet-grinding. In treating rags, cuttings and twisted wastes the beater undoes the work of the spinner and weaver, opening out the component fibres for the further reduction, operated by the special mechanism of the beater roll, carrying its battery of knives or bars, running at high speed over a corresponding provision of bars in the bed plate of the circulating trough.

There is in this work a further complex of results or effects—(1) a cutting of the fibres, *i.e.*, reduction of length, (2) a splitting or shredding of the fibres in the length of their axis, to fragments, fibrillae of less diameter, (3) an effect known integrally as "hydration" by which the water is beaten into the fibre substance in such way as to facilitate its suspension in the carrying water, at the high dilution required for running on the wire of the paper machine. In modern paper making the beater preparation is applied to raw materials which are already in the form of ultimate component fibres—"half stuffs," as a result of previous chemical treatment of the actual raw or original material, *e.g.*, wood, straw, esparto grass. For measurement of the work of the beater, in the exact terms of "efficiency," this is already a simplification, and it becomes possible to equate the expression for consumption of power to certain of the above effects which can be measured.

Scientific Analysis.—This is the basis of the mathematical treatment of the subject up to the time of S. Smith's treatise. In this treatise, which embodies several original methods of experimental investigation, the author separates and separately measures (*a*) the cutting action from (*b*) the crushing action of the roll-bar bed-plate contacts. In regard to the effects of internal friction of the stuff or pulp surfaces, he formulates a "law" in new terms, viz., that resistance to displacement along a surface or plane of the pulp or wet stuff, is proportional to the surface dimensions and independent of pressure and speed of movement. Lastly he discusses the phenomenon which must be the immediate factor of the specific beating effects, that is the attachment of fibre to the beater bars rotating in the pulp mass and thereby brought into contact with the bars of the bed plate; as a contribution to this factor he especially treats the invisible phenomena of the beater bar cells or spaces between the bars, which are filled with the pulp mass and which is necessarily in a state of rapid rotation before and during the contact. This physical mechanical effect has certainly been overlooked in previous treatises, and the author is justified in claiming attention to it and in basing certain improvements of beater construction upon its recognition. For the attachment of the fibres in this sense the English Edition adopts the expression "fibrage" which is convenient and self-explanatory.

RAW MATERIALS

The addition of the wood pulps—cellulose (*q.v.*) as well as ground woods or "mechanical" pulps to the paper makers' supplies of raw fibrous materials, in the last century (1880–90) led to much unmethodical and indeed reckless treatment of the forest supplies of original material. Under methodical reafforestation (*see* FORESTRY) equilibrium has been reached in certain countries and a continuous supply of maturing timber guaranteed. But in view of the world's rapidly increasing consumption the question of a limit of supply is raised: and alternatively the question of supply of crop material in adequate massive quantity.

Cotton Residues.—In the cotton crop and the residues of lint and short fibres remaining attached to the seed after removal of the textile cotton, there is an immense potential supply of fibre, *e.g.*, on the United States production of seed alone, estimated at 300,000 tons. A de-linting machine invented by E. de Segundo has demonstrated its efficiency, and the "de-lint" is produced in Great Britain by the Cotton Products Co. in a condition of cellulose concentration or content as high as 70–80%. The matter appears to have passed into a phase of arrested development in encountering difficulties beyond the technical, which it is stated, have been surmounted, and it still offers the prospect of a most important and desirable addition to our supplies (see *Journal R. Soc. of Arts*, 67, 1919, pp. 184–202).

Flax Straw.—Another crop material largely unutilised is the flax straw or stem of the plant from which the seed (linseed) has been removed. This waste represents an enormous tonnage and loss of its 15–20% of fibre (Cellulose) of excellent paper-making quality. There have been several attempts to realise this potential industrial value, but with no further result than to fully demonstrate the practicability of a well organised scheme.

Bamboo.—Bamboo again, which is a massive growth and may be worked as a crop, has been the subject of much investigation which has resulted in industrial developments for the production of pulp. This matter also has reached a phase of arrested development.

Papyrus.—Perhaps the most massive of the vegetable growths of the world is the papyrus of the Nile and other African rivers. The fibro-vascular bundles of the relatively massive stems of the Papyrus break down under ordinary chemical treatment to a complex of fibres which have paper-making quality of the highest order. In several cases bulk quantities of this reed-material have been treated in English mills and worked up to papers of quite exceptional characteristics. These, however, represent merely attempts without industrial issue. Operations carried out in the Sudan (Sudd Fuel Co.) and in Zululand (Walmer Papyrus Co.) have ended in failure. In the latter case, the equipment of a factory for "half stuff" and "quarter stuff" production was carried out on modern design; but the venture failed for other than technical reasons.

The above represent potential supplies of sufficient magnitude to affect the world's markets in raw materials. The failure to develop them industrially illustrates the exacting character of the specification of qualities and conditions to be fulfilled for acceptance among the staple raw materials of this industry. The failure in these cases is in respect of conditions rather than qualities, and the matters may be regarded as open for more mature consideration and effective handling.

Processes.—The separation of cellulose from non-cellulose by treatment of fibrous vegetable material with alkaline lye, the general method (*a*) is a chemical process of great complexity. By contrast there are two methods of resolving these plant structures by chemical treatment with electronegative reagents, viz.: (*b*) sulphurous acid (*c*) elementary chlorine, which depend upon a simple quantitative reaction of synthesis with their lignone components, the main constituent of the non-cellulose admixtures, which convert these to derivatives freely soluble and easily removed.

(*a*) W. Raitt has devised methods of fractional treatment for removal of the non-cellulose components of raw materials which are described in his reports on "Bamboo and Indian Savannah Grasses," *Indian Forestry Records, 1912–3*, and invented a special digestor for the working of the processes (English Patent 16488–1915).

This leads to a notable simplification of the reactions with the alkalies employed and in consequence produces a cellulose pulp of much improved colour, and economy in the consumption of alkali.

(*b*) Sulphurous acid combined in the form of a bisulphite of lime, magnesia, soda, is the reagent employed in the industrial process for obtaining wood cellulose. The process has developed from its small beginnings in 1880 to the immense industry of the present time without a clear recognition of the actual chemistry of the process. Recent investigations have now established that the process depends upon direct synthetic reaction of sulphurous acid with the lignone components of the woods.

A sulphurous acid process carries resolution to a limit but the addition of ammonia in small quantity completes the resolution to cellulose and gives a by-product liquor free from the salts which, in the proportion of the present process, are a serious bar to the employment of the concentrated by-product in various industries. This by-product is one of the colossal wastes of the industrial world amounting to millions of tons per annum, and therefore it is obviously one of the most serious objectives of the chemist to convert this waste to value. See *J. Soc. Chem. Ind.*, 1924–5, papers by C. F. Cross and A. Engelstad (2) and by C. Doree and L. Hall (2).

(*c*) The process of isolating cellulose quantitatively by treatment of prepared vegetable tissue with chlorine gas was brought into prominence by Cross & Bevan in 1880–5, and since adopted as the standard laboratory method. A French chemist-engineer, De Vains, has invented and devised a comprehensive scheme with its several parts for realising this treatment as an industrial economic process. Factories have been established and are working on a large scale in France, Belgium, Canada and the Far East; results obtained especially with esparto and the cereal straws confirm the inventor's anticipations in regard to economy and certainly yield as might be expected a cellulose pulp of higher quality than by the relatively uncontrolled caustic alkali processes. The process is the subject of descriptive papers by J. Strachan in *The Paper Trade Review*, 1923–4.

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PAPINI, GIOVANNI (1881–), Italian author, was born in Florence Jan. 9 1881, and took to literature at an early age. He contributed to many reviews and founded two new ones, *Leonardo* (1902) and *Lacerba* (1913) and was also joint editor of *La Voce* in 1912, at a time when that journal gathered around it many of the most brilliant and original young Italian writers of the day. He was professedly an iconoclast, and in a volume entitled *Stroncature* (1917) he demolished many established reputations. Among his many works are several volumes of essays and criticism—*La paga del Sabato, L'uomo Carducci* (1918), *Il crepuscolo dei filosofi* (1906), and two novels *Un uomo finito* (1922) and *Parole e Sangue* (1921). His poetical output includes *Cento pagine di poesia* (1920), *Opera prima, Giorni di festa* (1920). Subsequently he surprised his readers by casting off his caustically sceptical and critical attitude and evolving into a mystic, with his *Storia di Cristo* (1921), a book which achieved immense success throughout Italy and abroad.

See E. Fabri, *Papini come scrittore* (1921) and R. Fondi, *Un Construttore: Papini* (1922).

PAPUA (*see* BRITISH NEW GUINEA, 19.489), a Territory of the Australian Commonwealth. The area, including surrounding islands, is 90,540 sq. miles. Papua occupies that part of New Guinea lying between the extreme limits of 5° and 12° S. and 141° and 155° East. The white population in 1924 numbered 1,276 and the estimated native population 275,000.

Production.—The physical features of Papua are favourable to agriculture. Rich soils at varying elevations, and heavy and evenly distributed rainfall, have ensured success in the cultivation of almost every tropical product. The system of land tenure is leasehold; no freehold is granted. The Government buys from the natives and leases to planters. The area held by the Crown in 1924 was 800,712 ac.; the area held under lease was 190,124 ac., as compared with 218,950 ac. in 1919 and 290,936 ac. in 1913. In 1913 there were 216 plantations, principally coconut, with a total area of 35,363 acres. In 1923 the plantations numbered 260, area 60,863 ac.; 46,798 ac. were under coconuts, 7,481 ac. under rubber, and 5,849 ac. under hemp, while other tropical products such as cotton, rice, coffee, tea, cacao, vanilla, tobacco and cinnamon were also grown. In 1924, 7,315 tons of copra and 304 tons of rubber were produced. It was estimated in 1917 that over £1,000,000 had been expended in plantations. An Act was passed early in 1926 by the Commonwealth Govt. granting bounties on the production of certain Papuan products, and at the same time a tariff preference was granted to these products imported into Australia. In Sept. 1925 the coastal provisions of the Australian Navigation Act, in so far as they were applicable to the Territory of Papua, were suspended.

Minerals.—Minerals have been found over a wide range of country, and include copper, gold, tin, lead, zinc and osmiridium. The yield of gold in 1923–4, valued at £6,702 was the lowest recorded since 1895; in 1921–2 the value was £68,726. In 1924 the first copper smelters were erected. The ore reserves were then estimated at 290,000 tons containing 13,300 tons of copper and 36,250 oz. of gold. The existence of petroleum has also been traced. Exploitation of the oil-fields by private individuals or companies was not permitted before 1923. Pearl-shell fishing is important: in 1923–4, £6,120 worth of pearl and trochus shell were exported, but returns are mostly credited to Queensland whose boundary comes within a few miles of the Papuan coast.

Native Labour.—The supply of native labour presents considerable difficulties. The population is scanty and the natives are peasant proprietors with land of their own sufficient to supply their simple wants. Under the Native Labour Ordinances the rights of both employer and employee are preserved. Service on the part of the native is voluntary and he must be justly treated and properly fed. Employers may recruit personally or obtain their natives through a licensed recruiter. The number engaged under contract of service during the year ended June 30 1924, was 7,578. Under the Native Taxes Ordinance, 1918, a tax not exceeding £1 may be imposed on natives. The proceeds of tax must be expended on education or on purposes directly benefiting the natives. The taxes collected in 1923–4 totalled £16,410. The revenue in 1923–4 amounted to £77,150, exclusive of the

Commonwealth Govt. grant of £50,000 per annum, and the expenditure £131,640.

Most of the plantations are close to the coast, and communication is by sea. There are some 240 m. of roads. Port Moresby is the seat of government and chief port. A three-weekly steamship service, subsidised by the Commonwealth Govt. for the carriage of mails, is in operation between Port Moresby, Samarai and Sydney. (*See* AUSTRALIA.)

PARACHUTES.—In 1924 parachutes were recognised as a part of the standard flying equipment for use with aeroplanes. The use of parachutes with large, dirigible airships is usually optional, the crews of such craft often preferring to run risks without them to the trouble of carrying them strapped to their bodies. The development of a parachute that could be used in aeroplanes was inevitable. As flying increased, so did accidents. When an aeroplane is disabled in the air through collision, fire or failure of the control cables, an aviator can seldom save himself except by parachute.

FIG. 1.—Airman wearing parachute. The right hand is upon the rip cord ring. By pulling this ring from its pocket and across the abdomen the pack is opened and the small pilot parachute leaps out by a spring and in turn pulls the main parachute out.

During the last days of the World War in 1918, German aviators jumped from their machines when the gas tanks were set on fire or the controls cut in combat, but after the War little was done to complete the use of parachutes until about the year 1921. At this time British and American aviators began working upon a parachute that could be carried conveniently by a pilot. It was obvious that the old style balloon parachutes were too cumbersome to carry in aeroplanes. In 1923 the U.S. Army Air Service developed a seat pack type parachute that was generally recognised the following year as standard and practically 100% efficient. More than 1,500 experimental jumps were made in achieving perfection.

The Standard Parachute.—The standard aeroplane parachute is folded into a compact pack about the size of an ordinary chair cushion, but about twice as thick. It is worn strapped upon the body with the pack in place beneath the buttock of the wearer and it becomes the cushion when the aviator takes his seat in an aeroplane. Thus, the regular cushion in aeroplane cockpits is generally omitted. The pack weighs approximately 18 pounds. It is made of carefully chosen untreated silk; the untreated silk is used because it does not become creased so easily as the finished material. When open, the parachute is 24 ft. in diameter. The shroud lines are made from high-grade thrown silk and consist of not less than 32 threads of 3-ply, each with a breaking strength of not less than 400 pounds. The main parachute is pulled from its case by a smaller "pilot chute," about 3 ft. in diameter, which operates by spring when the aviator pulls the "rip cord" that holds the pack closed. In jumping from aeroplanes, aviators do not pull the rip cord immediately, but wait two or three seconds until clear of the machine. The parachute descends at the rate of 16 to 20 ft. per sec., depending upon the weight of the wearer and density of the air. This is equivalent to jumping from a height of 7 ft. without a parachute. Each parachute is tested to withstand an operation of 200 lb., falling at the rate of 400 m. an hour.

The lowest height at which a parachute will open is probably not less than 150 ft., although a few forced jumps have been made at slightly lower altitudes. The lowest altitude considered safe is 250 ft., although the higher the jumper is, the better are his chances, because sometimes delayed openings occur. Jumps have been made from aeroplanes as high as 25,000 feet. An aviator usually pulls the rip cord and releases his parachute within a few seconds after leaving an aeroplane, but openings have been purposely delayed for experimental reasons while a jumper fell for about 1,500 feet. The first parachute jump ever made from an aeroplane was made by Captain Berry near St. Louis, Mo., U.S.A., in 1912. This jump was made with an old style balloon parachute, but, as stated previously, the old types of parachutes were too hazardous for aeroplane use and very few jumps were made from aeroplanes until the development of the standard aviators' parachute.

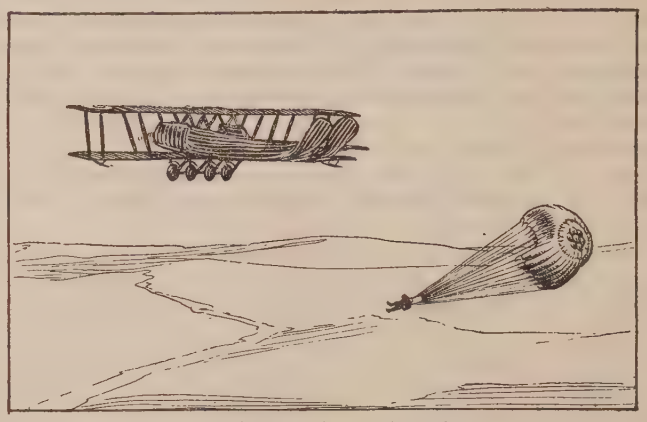

FIG. 2.—A normal parachute jump.

FIG. 3.—A normal parachute landing.

Parachute Flare.—A parachute flare contains illuminating chemicals attached to a small parachute, which, when ignited and dropped from an aircraft, will descend slowly and light up the country side for many miles. Parachute flares are used for military purposes to discover night movements of enemy troops by aerial observers; by aviators to locate landing fields at night and guide the approach to the earth and to take night photographs. (C. McD.)

PARAGUAY (*see* 20.756), a republic of South America and a member of the League of Nations. Its area is 161,000 sq. m., and in addition the disputed Chaco territory covers an area of about 100,000 square miles. The estimated population (1925) is 1,000,000, in addition to about 50,000 Guaraní and Chaco Indians.

Estimated population of Asunción, the capital, in 1925 was 101,790; Villarica 30,000; Concepción 25,000. Paraguay remained neutral during the European War, but after the United States declared war on Germany the government maintained a pro-Ally attitude and dismissed some of its German employees.

Political History.—Dr. Manuel Gondra, inaugurated as president in Jan. 1911, held office for a very brief period. A succession of revolutions caused him to be followed by four provisional presidents whose terms of office were of the briefest: Col. Albino Jura, Jan.–July 1911; Dr. Liberato M. Rojas, July 1911–Feb. 1912; Dr. Pedro Peña, Feb.–March 1912; Dr. Emiliano González Navero, March–Aug. 1912. Dr. Eduardo Schaerer, who assumed office on Aug. 15 1912, was the first president since 1870 to complete his term of office. He was succeeded in Aug. 1916 by Dr. Manuel Franco, under whose administration Paraguay's finances attained a sound position and the meat-packing industry reached a high point of development. Dr. Franco died on June 3 1919, and the remainder of his term was filled by Dr. José P. Montero until Aug. 1920, when Manuel Gondra was elected to a second term having been elected while minister to the United States. Gondra was forced to resign in Nov. 1921 under pressure of threatened revolts. The subsequent provisional presidency of Eusebio Ayala, which was disturbed by political and personal difficulties, terminated in July 1923, when Eligio Ayala was elected president, inaugurating the most prosperous administration in the history of Paraguay. The unsatisfactory character of the world market for Paraguay's produce in 1921 had precipitated an economic crisis. The government had defaulted in payments on the foreign debt, and an American financial adviser had been called in. Under Ayala's administration the fiscal year 1924 closed with a surplus in the treasury equivalent to $700,000, and in Sept. of that year an agreement, since scrupulously observed, was signed for the settlement of that part of the foreign debt held in London.

In 1913 direct diplomatic relations were resumed with the United States, after an interruption of eight years, and a United States minister was accredited specially to Paraguay. An extradition treaty with the United States was signed on July 30 1913.

Education.—Education is nominally compulsory in Paraguay, but at least 60% of the inhabitants are illiterate largely owing to lack of schools. An attempt at educational progress was made by President Franco in 1916–9. In 1919 there were 80,000 pupils enrolled on the school registers. In 1923 the total number of pupils attending the 1,204 government primary schools was 70,820; 2,089 pupils were attending the 31 private schools, and 800 the three national colleges at Asunción, Pilar and Villarica. The *Colegio Internacional*, a United States missionary institution and the largest educational establishment in Paraguay, was opened at Asunción in 1920.

Finance.—The budget estimates for the fiscal year 1923–4 provided for a revenue of 945,129 gold pesos and 104,488,950 paper pesos. Expenditure was estimated at 1,387,506 gold pesos and 113,534,896 paper pesos, the estimated deficit being 442,377 gold pesos and 9,045,946 paper pesos. Actual returns were, revenue 1,158,138 gold pesos and 142,346,867 paper pesos; actual expenditure was 1,232,224 gold pesos and 108,474,546 paper pesos. There was thus a deficit of 74,086 gold pesos and a surplus of 33,872,321 paper currency. The budget estimates approved for the financial year 1925–6 provided for a revenue of 1,250,330 gold pesos and 174,484,264 paper pesos. The estimated expenditure was 1,476,823 gold pesos and 164,766,277 paper pesos.

Production and Industry.—The cultivation of cotton is one of the growing industries of Paraguay, the quantity of ginned cotton for export having increased from 567 tons in 1922 to 2,653 tons in 1924. The expansion of cotton growing has stimulated the demand for agricultural implements. Yerba maté, or Paraguay tea, gathered in the virgin forests, is one of the chief articles of export, the quantity exported having increased from 6,908 tons in 1924 to 5,703 for the first six months of 1925. Under governmental encouragement the meat-packing and curing industry has arrived at a prosperous condition. Hides exported during the first six months of 1925 exceeded those exported for the whole year 1921. Sugar has declined, the production falling from 5,230 tons in 1920 to 2,400 tons in 1922. Tobacco reached its highest point of production in 1923 when 8,151 metric tons were exported. The chief exports in 1920 were timber and forest products $6,581,218; agricultural products $4,486,166; and animal products $2,905,610. The chief imports were textiles $3,485,714; machinery and hardware $3,408,392; groceries and kerosene $2,002,346. Total imports in 1923 were $8,314,084; in 1920 $12,724,949; and in 1910 $6,252,480. Total exports in 1923 were $12,097,409; in 1920 $14,510,400 and in 1910 $4,789,065. Imports in 1923 were chiefly from Argentina, $2,859,520, the United Kingdom, $1,899,609 and the United States $1,305,897. Exports in 1923 were, chiefly to Argentina, $9,139,326; the United States, $1,503,311; and Uruguay, $796,847.

Communications.—On Oct. 3 1913 direct rail communication was established between Asunción and Buenos Aires. This has done much to lessen the isolation of Paraguay. The Paraguay Central Railway Company has about 274 m. of track. The gauge of its main track, 232 m., was changed from 5½ ft. to 4 ft. 8½ in. in 1910 to conform to that of the Argentine railways. During the year 1923, 2,046 steam vessels of an aggregate tonnage of 221,488 tons entered the port of Asunción; during the same year 2,061 steam vessels of an aggregate tonnage of 226,020 tons were cleared from the port.

Banking.—On June 30 1925 a branch of the German Bank of South America (*Deutsch-Südamerikanische Bank, Aktiengesellschaft*) was opened at Asunción. A branch of the Bank of London and South America was opened early in 1920.

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PARASITOLOGY (*see* 20.770).—Parasitology deals with organisms which derive their nourishment from the bodies of other organisms with which they live in varying degrees of close association and in so doing prevent them from thriving as they otherwise would do. A parasite is thus definitely harmful to its host, because it directly destroys its tissues, absorbs its fluids or excretes substances which are injurious. A malarial parasite (*see* MALARIA) lives in a red blood corpuscle from which it abstracts its food. The cell is ultimately destroyed and toxic substances and granules of pigment are liberated from the parasite. These lead to secondary changes in tissues in which the parasite does not actually live, which are as dangerous to the host as the damage directly produced. Individuals infected with *Schistosoma haematobium* (*see* BILHARZIASIS) are only slightly affected by the worms themselves but suffer very serious damage as a result of the spined eggs which work their way through the tissues toward the bladder.

Sometimes organisms, though intimately associated with others, merely feed on waste products of the body, while at other times two live together for mutual benefit. In neither instance is this parasitism. In the one the associated organism is a commensal, while in the other the two are symbionts.

Parasites of Man.—Parasites belong either to the vegetable or animal kingdom and may parasitise either plants or animals, but here only the parasites of man which enter into the field of medical parasitology will be considered. The vegetable parasites of man belong to the fungi, bacteria and the allied spirochaetes. Ringworm and Madura foot are caused by parasitic fungi; enteric fever, tuberculosis, leprosy (*see* LEPROSY; VENEREAL DISEASES), pneumonia and diphtheria are due to parasitic bacteria, while syphilis, yaws and relapsing fever result from invasion of the body by spirochaetes. It is possible that the structures named Rickettsia, which occur in typhus and Rocky Mountain fever, are bacteria but at present the evidence on this point is inconclusive. In the animal kingdom the parasites of man are either unicellular Protozoa (*see* PROTOZOOLOGY) or multicellular Metazoa. To the latter belong the groups Cestoda, Trematoda, Nematoda and Arthropoda. There is also evidence that beyond the scope of the ordinary microscope there exist ultra-microscopic viruses or parasites which are responsible for disease. They are so minute that they pass through the pores of filters (*see* FILTER-PASSING MICROBES) which will not permit the passage of organisms which can be seen with the microscope. The virus of foot-and-mouth disease is of this type, while recent investigations indicate that similar organisms may be responsible for at least certain types of malignant growths. It is only possible to conjecture to which group these parasites belong.

Dependence on Hosts.—Parasites in general are absolutely dependent for their existence on their hosts. Except in specially

prepared artificial culture media which imitate the natural fluids in which they live, they are unable to survive in an active condition for more than a short time when separated from their hosts, though in many cases encapsuled resting stages are formed in which the parasites can live for long periods and are able to withstand adverse conditions such as desiccation and cold.

Mode of Transference.—If therefore any race of parasites is to survive, it or its offspring must find their way to new hosts. The transference takes place in one of two ways. Either the parasite passes directly from one host to another of the same kind (direct transmission) or it passes into an intermediate host of another kind from which it is transferred to one of the original kind. Sometimes a series of hosts is involved, as in the case of the trematode *Clonorchis sinensis* which lives in the bile ducts of man. The miracidium, hatching from the egg in water, enters a mollusc in which sporocysts and cercariae are produced. The cercariae infect carp, which lead to infection of human beings. Similarly the tape worm *Dibothriocephalus latus* requires two hosts apart from man, a copepod crustacean and a fish. The majority of tape worms which live in the human intestine require only one intermediate host.

In the case of the tape worm *Taenia solium* it is usually the pig and in *Taenia saginata* the ox. Such transmission is indirect, there being an alternation of hosts. With fungoid and bacterial parasites transmission is nearly always direct, a notable exception being *Bacillus pestis* of plague, which may have an alternative host in the flea, though direct transmission frequently occurs. If Rickettsia are bacterial organisms they constitute another exception, as they are transmitted by lice or ticks. Spirochaetal parasites are transmitted either directly from host to host, as in the case of syphilis, yaws and Weil's disease, or indirectly, as in yellow fever (*see* YELLOW FEVER) and relapsing fever. In the case of spirochaetes of relapsing fever a further modification occurs, for not only can the tick which feeds on an infected human transmit infection to other human beings, but it passes the infection to its own offspring, which are then able to cause the disease. This in many respects is comparable with the hereditary transmission of the spirochaete of syphilis from parent to child.

Protozoal parasites, again, are transmitted either directly through the ingestion of encysted forms, as in the transmission of the various parasitic amoebae and flagellates of the intestine and the coccidia, or indirectly, as in malaria, trypanosomiasis and probably kala azar (*see* KALA AZAR) and oriental sore. With the Metazoan parasites, the majority of the Cestoda and Trematoda depend on indirect transmission, though exceptionally, as in the case of the tape worm *Hymenolepis nana*, direct transmission by eggs from man to man is the rule. Both methods of transmission occur with the Nematoda. The intestinal forms pass directly from man to man by means of the eggs which escape from the intestine, while the various Filaridae, including the guinea worm, require the intervention of arthropod hosts to enable them to pass from man to man.

The round worm *Ascaris lumbricoides*, the thread worm *Enterobius vermicularis* and the whip worm *Trichuris trichurus* produce eggs which are directly ingested by another human being after they have undergone maturity outside the body in the development of an embryo within the egg shell. In the case of hookworms of the genera Ankylostoma (*see* HOOKWORM) and Necator, the eggs themselves are not ingested but the embryos which develop in the eggs after they escape from the body hatch in moist soil and enter the human body by penetrating the skin. Infection in the case of *Strongyloides stercoralis* takes place in a similar manner but the embryos usually hatch from the eggs before they leave the intestine.

Filaridae.—The Filaridae referred to above require to develop in either mosquitoes or flies of the genus Chrysops. The adult worms living in the tissues of human beings produce embryos which circulate in the blood, whence they are taken by the blood-sucking Diptera. In these flies they pass through a metamorphosis and eventually reach the proboscis. When the fly is feeding on a human being the embryos escape from the proboscis on to the skin and make their way into it by passing through the openings of the sebaceous glands. The guinea worm is transmitted in a similar manner, but in this case the intermediate host is a crustacean of the genus Cyclops. The embryos do not occur in the blood but escape from the female worm directly into water. They enter the bodies of the crustacea in which a metamorphosis occurs. The human being becomes infected through drinking water in which cyclops harbouring the parasites occur.

Arthropoda.—Parasitic arthropoda in many ways stand apart from other parasites. Many of them are purely ectoparasites which live outside the host. They vary in the degree of association. The ticks of the genus Ornithodorous, bedbugs of the genus Cimex, reduviid bugs of the genus Triatoma and allied forms, together with blood-sucking flies such as mosquitoes, sand-flies (*see* SAND-FLY FEVER) and tse-tse flies, visit their hosts only when blood is required. They can hardly be regarded as parasites. Fleas are more intimately associated with their hosts in that they spend at least some part of their life in the clothing and do not thrive if separated from them. Lice are still more dependent and quickly perish if removed from association with their host. The chigger flea *Sarcopsylla penetrans* at one stage of its existence is a true parasite. Males and females live apart from the host and only suck blood when this is needed. When they reach maturity fertilisation takes place and the female fixes itself to the skin by its proboscis and gradually works its way through the epidermis till it is lodged in a pocket. It becomes globular in form and produces a large number of eggs, which escape in the pus which discharges through the opening. The eggs reach the ground, where hatching of larvae, pupation and arrival at the adult stage take place.

The itch mite *Sarcoptes scabiei* has a similar life-history but the whole development takes place on the surface of the skin till the fertilised female produces the characteristic lesion by burrowing through the epidermis before laying eggs. Various diptera, the larvae of which develop usually in decomposing material, like the common blue bottle fly, may lay their eggs in wounds and give rise to a condition known as *myiasis*. The larvae hatch and feed on the breaking down tissues till pupation occurs, when they are discharged. These larvae are only secondarily parasitic. They feed on decomposing material whether in a wound or on the ground. But having commenced to feed on decomposing tissues *in situ* they aggravate the lesion and produce an extension of the necrotic area. Other flies, particularly the Oestridae, actually deposit their eggs on healthy skin, the larvae burrowing beneath the epidermis. When fully grown, the larvae pupate and fall to the ground. Certain Muscidae are truly parasitic in the larval stage. Thus *Cordylobia anthropophaga* lays its eggs on the skin. The larvae which hatch bore their way through the epidermis and attain maturity and pupate in the subcutaneous tissues. The fly *Dermatobia cyaniventris* is of interest in that the fly does not deposit its eggs directly on the skin but on the body of mosquitoes, from which the larvae migrate while the mosquito is sucking blood. The larvae of *Auchmeromyia luteola*, the Congo floor maggot, lives in cracks and crevices but sucks the blood of human beings at night, returning to its hiding place after a feed, like the common bedbug. The adult fly is not a blood feeder.

Reproduction of Parasites.—The above brief summary indicates the type of parasitism which occurs in connection with human disease. Transmission is either direct or indirect. When it is direct the stage of the parasite which is outside the body is either completely passive, as in encysted forms of Protozoa and the eggs of many helminths, or active, as in the case of larvae of hookworms and many bacteria. During the active stage reproduction may or may not occur. The larvae of hookworms do not reproduce, though those of *Strongyloides stercoralis* are capable of doing so outside the human intestine. Many parasitic bacteria like those of enteric and cholera (*see* CHOLERA) multiply in water or other situations. When transmission is indirect and two or more hosts are necessary for the completion of the life cycle the course of development may or may not be associated with reproduction. The embryos of filaridae merely undergo a metamorphosis but do not reproduce.

The number of parasites which are capable of infecting man from one mosquito, for instance, is at most the same as the number of embryos originally taken up by the mosquito when it fed on infected

blood. In other cases definite multiplication occurs. A pair of male and female gametocytes of a malarial parasite are able to give rise to hundreds of sporozoites in the salivary glands of an anopheline mosquito. The sporozoites, however, are unable to reproduce, so that when they have all been discharged the mosquito is no longer capable of transmitting the disease. A single miracidium of a Trematode, like *Schistosoma haematobium* or *Fasciolopsis buski*, can in the mollusc give rise to a large but limited number of cercariae, whereas a single egg of the tape worms *Taenia solium* and *Taenia saginata* will give rise to a single scolex in the pig and ox respectively.

In the case of *Trypanosoma gambiense* and *T. rhodesiense*, which give rise to sleeping sickness, the flagellates which invade the salivary glands of tse-tse flies are constantly reproducing, so that infectivity is maintained probably for the duration of life of the fly. Similarly in the case of *Triatoma megista*, the vector of *Trypanosoma cruzi* of South America, the infection of the hind gut, once acquired, is retained for the rest of life.

Thus, in the case of certain parasites, even when multiplication in the intermediate host occurs, the forms taken up by the vector can give rise only to a limited number of infective stages, while in others the number is limited only by the length of life of the host. Similarly, in the case of man himself, the behaviour of the parasite varies. The various bacteria which attack him reproduce indefinitely in his body, the only check being the development of protective substances which destroy many of the organisms. The same condition obtains in malaria, trypanosomiasis, spirochaetosis and many other diseases. Metazoan parasites, however, do not as a rule reproduce in the body of man. If only a single larva of a hookworm penetrates the skin only a single adult could be found in the intestine. If only one ascaris egg were eaten only one adult would be developed from it. A single cercaria of *Schistosoma haematobium* or other trematode will give rise to only a single adult, while a single scolex of a tape worm eaten in fish, pork or beef will give rise to but a single tape worm in the intestine.

In all these infections, if a large number of parasites is present a corresponding number of infective forms must have entered the body. It follows therefore that if active reproduction does not occur in the human body the persistence of infection depends on the length of life of the individual parasites. In certain instances this may extend to many years, as in the case of *Schistosoma haematobium*, but in all such cases, when the infection is not a heavy one and reinfection can be avoided, the ill effects may be slight and a cure occur owing to the death of the parasite. The only Metazoan parasite which can be said to reproduce in the human body is the tapeworm *Taenia echinococcus*. It differs from other tape worms of man in that man is not infected with the actual tape worm stage. This occurs in the intestine of the dog. The egg, which escapes in the faeces of the dog, is eaten by man. A large hydatid cyst is developed and in it a number of scolices is produced. Each scolex will give rise to a single tape worm in the dog.

Reservoir Hosts.—Another aspect of the parasitology of man which is of great importance is that of reservoir hosts. Certain parasites which attack human beings are capable of living in other hosts without disturbing them to any marked extent. The existence of such hosts in close association with man is a serious danger. The bacillus of plague lives in rats, human beings being constantly infected by fleas which have fed on these animals. Pigs harbour the ciliate *Balantidium coli*, and the majority of cases of balantidial dysentery in man are in those whose work it is to tend these animals. The wild game of Africa act as reservoirs of various trypanosomes and it is highly probable that tse-tse flies may infect themselves from these animals with *Trypanosoma rhodesiense* and later on hand the infection to human beings. Wild rats very commonly harbour the spirochaete of Weil's disease and it is extremely probable that they are responsible at least in part for maintaining a strain of organism which not infrequently infects human beings. Similarly these animals are reservoirs of the *Spirellum* of rat bite fever.

Development of Antibodies.—It might be expected that those parasites such as the bacteria, malarial parasites, trypanosomes and spirochaetes which reproduce rapidly in the human body would very soon be present in overwhelming numbers. In certain instances this actually happens when the strain of parasite is said to be a highly virulent one. Fortunately in the majority of instances such an unlimited development is checked by the development in the host of antibodies which are harmful to the parasite. The exact nature of these substances and the method of their production are questions for the immunologists (*see* IMMUNITY) to settle, but the degree of response on the part of the human host as regards the rate of production of antibodies varies considerably. In the case of relapsing fever antibodies are rapidly produced in sufficient quantity quickly to destroy all the organisms. Similarly in various bacterial diseases production of antibodies in many cases leads to rapid elimination of the parasites. In syphilis, tuberculosis and many other chronic infections antibody production may be sufficient to check reproduction to some extent but insufficient to kill all the organisms, which continue to multiply slowly and produce toxins which give rise to the characteristic symptoms of the diseases. As a general rule, antibody production is much more marked in bacterial diseases than in those caused by Protozoa and Metazoa. Methods of vaccination (*see* VACCINE THERAPY) have been devised for increasing the antibody production, while the introduction of antibodies, previously produced by vaccination of animals, into the human host after infection has occurred is a recognised method of treatment in such diseases as diphtheria, tetanus and possibly yellow fever.

Idiosyncrasy and Immunity.—An important feature of invasion of the body by parasites is the varying effect they have on different individuals. In one individual the parasites introduced multiply so rapidly that the host is quickly destroyed, while in another reproduction may take place so slowly that any slight derangement which occurs is overlooked. Sometimes, this is due to a variation in virulence of the parasite itself or, in other words, in its capacity for multiplication. In most instances, however, it undoubtedly depends on what is termed the susceptibility of the individual. Certain individuals are able to produce antibodies more rapidly than others, while some have them present before exposure to infection takes place. If they are present in a sufficient amount the parasites introduced are immediately destroyed. Such individuals are said to be naturally immune and they resemble in many respects those who are immune as a result of an actual infection from which recovery has occurred, or a vaccination which has led to the artificial production of antibodies.

Carriers.—Others, again, are only relatively immune, and though the parasites introduced establish themselves they give rise to few, if any, symptoms. Such infections very frequently pass unnoticed. They may rapidly come to an end or may persist for long periods (*see* EPIDEMIOLOGY; CEREBRO-SPINAL FEVER). In the latter case the individual is known as a carrier, for, though in him the parasite apparently does little harm, it may find its way into another individual who possesses no natural immunity and give rise to very serious or fatal infections. Such carriers are actually reservoirs of infections like the reservoir animals mentioned above. Carriers of this type occur with *Entamoeba histolytica*, the cause of amoebic dysentery (*see* DYSENTERY). Individuals have retained their infections for many years without having suffered from any of the symptoms which the amoeba may produce in others. On the other hand, when an infection takes place the parasite may reproduce rapidly and give rise to definite symptoms, which finally subside. The individual may no longer realise his infection, though parasites can still be demonstrated. He has passed into the carrier condition and is known as a convalescent carrier, to distinguish him from the contact carrier who has acquired the infection without having suffered in any recognisable way. Carriers of both kinds are of even greater danger to the community than actual sufferers from diseases, for they are often unrecognised and may be a constant source of infection to others. Outbreaks of enteric fever are repeatedly traced to carriers who quite unknowingly have been disseminating the parasites which cause the disease.

Importance in Therapeutics.—A complete understanding of the life histories of parasites, the response of the host to infections and finally the effect of drugs is of the utmost importance in the prevention and treatment of disease. If the life history of a parasite is completely known, an attack upon it may be made at any stage of its life history, but the measures can be more drastic in the case of stages which are outside the human body.

Malaria.—Since human beings never become infected with malaria parasites except from the bites of anopheline mosquitoes, malaria will be exterminated if all anopheline mosquitoes can be destroyed in a district, if individuals can avoid their bites, if the mosquitoes can be prevented from feeding on already infected persons, or if parasites can be eliminated from the bodies of infected individuals. Any one of these measures properly carried out will lead to the same result.

Guinea Worm.—Infection with guinea worm is acquired by swallowing the crustacean Cyclops into which the larvae which escape from the human host into water penetrate. The simple procedure of straining water through a fine mesh prevents the crustaceans being ingested. Eggs of the hookworm, if deposited in soil, hatch out larvae which penetrate the skin. The institu-

tion of latrines to avoid contamination of soil stops the larvae developing in dangerous ground, while the wearing of suitable coverings for the feet prevents the larvae from reaching the skin.

Bilharziasis.—The cercariae of species of Schistosoma, after they emerge from molluscs, survive in water for not more than 48 hours, so that water which has been kept for this length of time is not infective. The avoidance of known contaminated waters for washing and bathing purposes prevents infection.

Other Bacterial Diseases.—Many bacterial diseases, such as enteric fever and cholera (*see* CHOLERA), are contracted chiefly from water in which the organisms can survive and multiply. The drinking of boiled water alone and the avoidance of contamination of food or feeding utensils prevents infection. The extermination of rats, which act as reservoirs for the bacillus of plague, hinders the spread of the disease. The illustrations indicate the importance of the study of parasitology from the point of view of preventive medicine. When the complete life history of any parasite is known, an attack can be made upon it with confidence.

Treatment of Hosts.—As regards the response of the host to infection, a study of the causes which bring about the natural elimination of parasites from the human body has a direct bearing on treatment directed towards the production of active or passive artificial immunity and the period of isolation necessary for complete disinfection.

Finally, the effect of drugs on parasites is most important, both from the point of view of the individual infected and from that of the spread of infection to others. If by treatment parasites can be got rid of in any individual, he is cured of his infection and ceases to be a source of danger to other.

Specific Remedies.—An enormous amount of work has been done and is still in progress in connection with the search after specific remedies for each infection and the mechanism of action of such as have been discovered. This is one of the most difficult problems which confront the investigator, for both the effect of a drug on the parasite and the influence it may have on the host have to be taken into account (*see* PHARMACY; PHARMACOLOGY). Recent investigations show that in many cases the view that a drug introduced into the body of a host directly attacks the parasite is erroneous. In many, if not all, cases the actual substance introduced is not that which affects the parasite. The fluids and tissues of the host react upon it chemically so that some derivative is the actual toxic agent, or the drug itself stimulates the cells of the body to produce secondary substances which are injurious to the parasites. Such specific agents are quinine for malaria, emetin for amoebic dysentery, organic arsenic compounds for syphilis and relapsing fever, antimony salts for kala-azar and schistosomiasis. Though the administration of these drugs to infected persons rids them of their parasites, the exact mechanism of the action has not been elucidated. Many of these specific remedies have no action whatever on the parasites outside the body of the host.

Parasites as Therapeutic Agents.—The antagonism between one parasite and another is now being applied to the treatment of disease. In certain stages of infection with the spirochaete of syphilis the artificial infection of the host with the spirochaete of relapsing fever or the parasite of malaria, both of which can be easily eradicated by treatment, so alters the environment of the original parasites that they cease to multiply and are apparently destroyed. The view that the one parasite directly attacks the other is hardly tenable. More probably the superimposed infection changes the host in such a way that he ceases to be suitable for the continued development of the spirochaetes originally present.

Undiscovered Parasites.—In many cases in which there is evidence that disease is due to parasitic invasion of the body, the causative organism is known and much information regarding its life history has been obtained. In some instances, however, the parasite has still to be discovered. It has not yet been definitely decided whether the bacillus of Pfeiffer or a filterable virus is responsible for influenza (*see* INFLUENZA). The parasite which gives rise to the common cold is still unknown, while there is no precise information regarding any organism which can be held to be the cause of smallpox. Encephalitis lethargica, or sleepy sickness, and several other diseases are in a similar position, but the advances which are constantly being made in the methods of investigation will undoubtedly solve the many problems which surround these diseases, the etiology of which is still obscure.

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(C. M. W.*)

PARATYPHOID FEVER: *see* INFECTIOUS FEVERS.

PARAVANE.—The paravane was developed during the World War, in connection with the anti-submarine and anti-mine campaign, as a means of attacking submerged submarines for which purpose it was filled with an explosive charge and called an explosive paravane. Subsequently it was further developed as an anti-mine device, and when used for this purpose was called a protector paravane.

THE EXPLOSIVE PARAVANE

A considerable amount of auxiliary apparatus was required in connection with the explosive paravane, the whole installation being called the high speed submarine sweep. It enables a vessel to attack a submerged hostile submarine whose position is but approximately known. It consists essentially of two torpedo-shaped bodies called paravanes, which are towed one on each quarter of the attacking vessel. Each paravane contains an explosive charge, and runs at a definite and pre-arranged depth below the surface of the sea, whilst the speed of towing makes it move outwards a certain distance from the fore and aft line of the ship.

The paravanes are towed from steam winches by specially prepared armoured electric cables, led over fairleads in the stern of the attacking vessel. The towing wire takes up a curve of definite shape which is practically independent of the speed.

Methods of Detonating.—The charge may be detonated in one of three ways: (1) by impact; (2) by strain; (3) by hand.

When the towing wire fouls a submerged submarine it will slip over her smooth surface until eventually the submarine is struck by the paravane. The striking gear which is fitted to the nose of the paravane is moved inwards by the impact and thus a firing switch is actuated and detonates the charge.

An alternative device for detonating the charge is fitted in case the first does not operate. If, as might easily happen, the nose of the paravane does not strike the submarine, the wire will in consequence be held up or will be nipped over some part of the submarine's hull, when an excessive load comes upon the wire. Any load above a predetermined one trips a dynamometer switch which will again make the electrical contact requisite to detonate the charge.

The third method of detonating the charge is by a hand switch on the attacking vessel, and meets the case when it is desired to get rid of the paravane purposely, either to meet some sudden emergency necessitating full speed, or to blow up the paravane on some marked spot such as a patch of oil escaping from a supposed damaged submarine.

Spread of Sweep.—The maximum spread of the sweep is about 30 yd., *i.e.*, 60 yd. from paravane to paravane, and about 120 yd. of towing wire are then required for each paravane. Due to the design of the paravanes, this spread can be obtained independently of the depth at which the paravanes are being towed.

The "Q" type paravane herein described consists essentially of a torpedo-shaped body carrying a plane which gives the necessary thrust to get the maximum spread, and a rudder actuated by a hydrostatic valve to give the requisite depth of running independently of the amount of towing wire veered. In addition to the hydrostatic valve, the paravane carries within it a charge of T.N.T., depth-recording gear, firing switch, detonators, etc.

The advantages of this type of paravane are: (1) It can be towed at high speeds. (2) It leaves unaffected the manoeuvring powers of attacking vessels. (3) Being light it is easily handled. (4) It is not dangerous under shell fire when stowed on board.

Construction.—The paravane is divided into four parts, viz.: (1) head; (2) bonnet; (3) body; (4) tail.

The Head.—The head carries externally the tow anchorage, plane and striking device, and internally the gear for transmitting the effect of the impact to the striker-switch.

The Bonnet.—The bonnet is a steel dished plate carrying the striker-switch and depth-recording gear. The depth-recording gear registers on the attacking vessel the depth at which the paravane is running. The bonnet, carrying with it the striker-switch, lies wholly within the head, but the depth-recording gear, fastened to the after side of the bonnet, lies within the body of the paravane. Both the bonnet and body are made watertight.

The Body.—The body is made of steel plate $\frac{1}{16}$ in. in thickness, and is acetylene-welded to ensure watertightness. The body carries within it the charge of T.N.T., the primer tin and the detonating gear. The most complex part is the detonating gear, which derives

its complexity from the arrangements necessary to prevent the charge from detonating whilst the paravane is on board or in close proximity to the ship. As now arranged, the detonators are withdrawn from the primer tin, and the two safety shutters, being simultaneously dropped, form an effective fire screen between the two. This safety device is in operation whilst the paravane is on board or moving at a slow speed through the water. At a speed greater than about 10 knots, a water flap, which projects from the under side of the paravane, is forced aft by the water pressure upon it. This movement is transmitted by linkwork to a detonator carriage, which moves aft, forcing the safety shutters to one side and placing the detonators in position in the primer.

The Tail.—The tail consists of a bronze casting and carries the two rudders, the hydrostatic valve which actuates the rudders, and the horizontal and vertical fins. When the paravane is required to run at a certain depth, a compression corresponding to this depth is put upon the hydrostatic valve spring. This load due to this compression forces the rudders "down." The water pressure acting on the hydrostatic valve, however, tends to force the rudders "up." When the two balance, the rudders return to the amidships position and so keep the paravane on a course which undulates about the set depth. This apparatus was fitted in the Allied navies as well as to the British Navy. The official record of the results is as follows, as regards the British Navy alone:—

Submarines known sunk 5; probably sunk 1; probably severely damaged 4; and probably slightly damaged 11.

The Protector Paravane

The protector paravane installation is designed to protect ships of all classes from moored mines. On either side of the vessel, by means of a length of special wire, is towed the paravane, a torpedo-shaped buoyant body. These paravanes stand out at a considerable lateral distance from the fore and aft line of the ship, and remain at a definite depth below the surface of the water. The planes and fins with which the paravanes are fitted have therefore a considerable thrust at high speeds, and this load is transmitted to the ship through each towing wire. But the towing wires constitute, indeed, one of the protective elements of the installation.

Due to the position taken up by the paravanes, the wires lie in a wedge-shaped position on either side of the ship, and sweep through a broad path. If they foul the mooring wire of a mine, the mine is deflected away from the path of the vessel. Not only so, but the mooring wire will slip along the paravane wire until it reaches the paravane. There it is caught in a cutter fitted on the head of the paravane which severs the mine from its mooring. The buoyant mine springs to the surface, where it can be readily seen and destroyed. The location of the position at which each towing wire leaves the vessel is clearly very important. In practice the towing wire is attached to the vessel at a specially designed permanent fitting situated on or near the line of keel and as far forward as practicable.

Different Types.—When the towing wire fouls a mine mooring wire, a minimum outward thrust must be imparted to the mine and sinker in order to deflect them from the path of the vessel. It is computed that this thrust is over half a ton, and must be imparted independently of the type of paravane fitted if the protection is to be of any value. Difficulties arise on this account when dealing with vessels of widely different speeds. If a paravane be designed to give this thrust whilst moving at a moderate speed through the water, its total thrust when moving at a high speed would be very great, and an excessive load would be thrown upon the towing wire. Two different types of paravanes are therefore constructed, according to the maximum speed of the vessel to which they are to be fitted, viz., Type "B," for battleships and large vessels, whose speed is under 22 knots; and Type "C," for cruisers and vessels, whose speed is over 22, but does not exceed 28 knots (see fig. 1).

In each type of paravane the towing rope can withstand the load produced when the vessel travels at her maximum speed, whilst the paravane itself provides the minimum outward thrust at the lower speeds necessary to deflect the mine. Since the outward thrust produced by a paravane increases approximately as the square of the speed, the range of speed over which the paravane remains effective is reduced as the maximum speed for which the paravane is designed is increased. Broadly speaking, however, a suitable paravane will protect a vessel at all speeds from about one-third her maximum upwards. The effective speed of a paravane also depends upon the beam of the vessel to which it is attached—the throw-out necessary for a battleship is, for example, much greater than that for a mine-sweeper or other similar small vessel. Hence a "B" type paravane is effective for the latter class of vessel at a much lower speed than it would be in the case of a battleship.

Buoyancy.—At an early stage in the experimental design of the paravane, it was found that buoyant and non-buoyant paravanes were equally effective. The non-buoyant paravane has, however, been discarded for two reasons. Firstly, there would be a possibility of the paravane being damaged. When the ship slows down or stops in shallow water, the paravane would sink to the bottom. A rocky bottom would probably have a disastrous effect

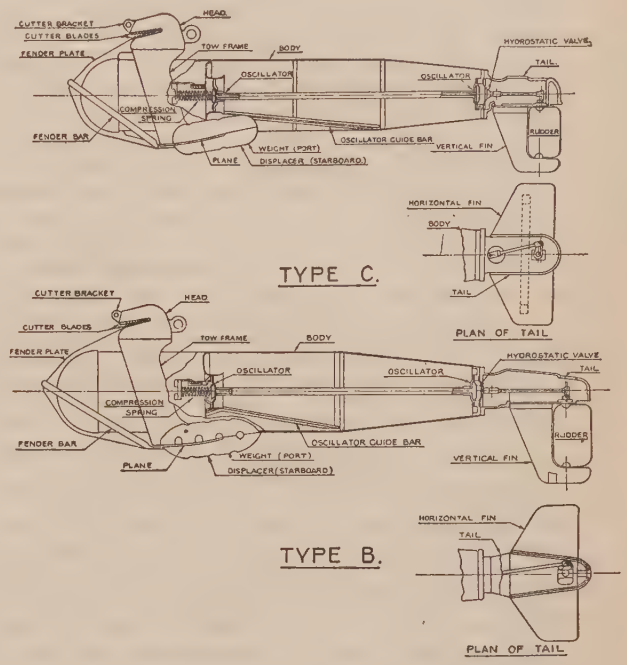

Fig. 1.—Diagrams illustrating the general arrangement of two types of paravane.

upon a paravane when the ship went ahead again. Secondly, the horizontal angle of tow would vary with the speed. The excess of the weight of the paravane over its buoyancy being constant and acting vertically downwards, would, when compounded with the varying outward thrust of the plane, give a resultant force whose direction varied constantly. Hence the angle from the vertical at which the paravane was towed could not remain at all speeds. The greater the excess of weight over buoyancy of the paravane, the greater would be the variation of this angle. This would cause the paravane to run deeper and deeper as the speed decreased. Although this is not a drawback from a protection standpoint, it is a considerable disadvantage from a navigation standpoint, seeing that the virtual draught of the ship increases as her speed is reduced. With a buoyant paravane, should the vessel be compelled to stop suddenly, the paravane, being buoyant, will float on the surface and support the towing wire. It will always sink to its set depth when the vessel is under way, as long as the speed is only a little above two knots.

Length of Towing Wire and Spread.—The protection afforded by the paravanes depends, amongst other things, upon the distance from the fore and aft line of the ship at which the paravanes are towed. This distance or spread in turn depends upon three things:—(1) the length of the towing wire; (2) the size of the paravane; (3) the size of the towing wire.

Depths of Tow Points and Paravanes.—The paravanes must be attached to the ship as far forward and as low down as practicable. If the point of attachment were above the level of the keel, a mine could pass under a towing wire and hit the ship. The point of attachment usually selected is the point of intersection of the fore perpendicular with the line of keel. This en-

tails the design on all warships of a permanent fitting or stem extension.

Further, the paravanes should not tow at any considerable depth below the keel line of the ship. If they did so, and the ship travelled from deep into shallow water, the paravanes might strike the bottom and be destroyed. As moored mines are usually laid in shallow water, the paravanes are arranged to run at little greater depth than the maximum draught of the vessel using them, and at approximately a constant depth, no matter how the vessel to which they are attached varies in speed. An essential feature of the paravane design is, therefore, a rudder actuated by a hydrostatic valve. This valve can be set to run at a definite depth before the paravane is thrown overboard. When a paravane is fitted with this gear, the depth at which it runs does not vary more than 4 ft. on either side of the set depth.

The paravane is usually set to run at a depth which is about 5 ft. in excess of the deepest draught of the vessel. The paravane towing wire and the tow point are thus practically in a horizontal plane in which also lies the keel of the vessel. Any mine within the sweep of the paravanes, which lies between the line of keel and the surface of the sea, must therefore be deflected by the towing wire. If a mine be moored so deeply that it passes under the towing wire, it cannot, under ordinary circumstances, strike the ship in calm water. The paravane attachment does not claim to be an absolute protection to a pitching vessel.

Oscillator.—The depth-keeping mechanism in the paravane is composed of two distinct portions, the hydrostatic valve and the mercury oscillator. The hydrostatic valve depends, for its action, on a change of depth above or below the normal depth. It therefore causes the paravane to follow a sinusoidal path through the water. At high speeds this motion becomes excessive and a device is required which will return the paravane to its correct position as soon as it is inclined to move from its set depth. This function is performed by the oscillator. It is the same in "B" and "C" paravanes, and is composed of a triple valve, comprising two mercury valves and one hydrostatic valve, and a compression spring.

The Cutter.—The cutter requires no setting, and can take the two parts of a mine mooring in rapid succession. The cutter supplied is very effective, and will sever a 1½ in. wire with a pull of about seven cwt. Further experiments show that this cutter will sever a ⅜ to ½ in. chain at a speed of 20 knots. Since it is impossible to moor any existing design of mine with such a large diameter chain, this cutter will be sufficiently effective for every size of mine mooring likely to be found in practice.

Its efficiency may be illustrated in another way. It cuts a mine mooring with no greater pull than that afforded by the mere weight of the mine sinker. It is therefore impossible for the mine and sinker to be towed by the cutter. As an example of the performance of these cutters, the results of tests made on three cutters selected at random are appended:—

	Cutting Pull (lb.)				
	A	B	C	D	Average
No. 1	854	780	797	636	767
No. 2	945	833	833	847	864
No. 3	670	749	721	693	708

These tests were made on an imitation German mine mooring rope. The loads were applied statically, starting at 300 lb. and rising by small increments.

Conditions under Helm.—It is desirable to consider not only the conditions when the vessel is steaming on a straight course, but also those when she is moving under helm. As already described, an effective paravane will deflect any mine from the path of a vessel which is on a straight course, but it is conceivable that, whilst a vessel is turning, a mine may be missed by the bow paravane and hit the ship near the stern. From this it is apparent that such a ship when under full helm sweeps out a pathway about 300 ft. wide.

In arranging that, as far as possible, the paravanes should sweep the sea clear of all mines which approach the outer side of a vessel swinging round under moderate and, if possible, manoeuvring helm, there are two cases to be considered. For relatively small ships, such as protected cruisers and all smaller vessels, one pair of paravanes gives practically complete immunity from moored mines as long as the ship is not in a heavy sea. With larger ships, however, the distance swept out by the vessel herself when turning under full helm may be so great that one pair of protector paravanes does not give adequate protection.

Horse-power Absorbed.—The following table gives the shaft horse-power absorbed at different speeds for the two types of paravanes when using the normal (56 yd.) length of wire. Of course, if the length of the wire be decreased, the resistance to motion and hence the shaft horse-power absorbed is reduced. On the other hand, if the length of wire be increased, the shaft horse-power absorbed is also increased.

	Type "B" Paravane				Type "C" Paravane			
Speed (knots)	16	18	20	22	18	22	26	28
H.P. absorbed	450	620	870	1,170	640	1,100	1,780	2,230

The above figures are deduced from actual tests on the measured mile, and represent the horse-power absorbed by the paravane system. The shaft horse-power absorbed on any particular ship may, however, differ slightly from the above figures on either side, seeing that the propellers will then be working under different conditions and will consequently have different efficiencies, but the above figures should be correct to within 5% for any particular vessel. The official record of the results obtained shows that British warship tonnage that, but for protector paravanes, would have been either sunk or seriously damaged, totalled 583,713 tons.

The Otter.—When the Admiralty decided to equip British merchant vessels with paravane protection, a simpler form of paravane called an "otter" was introduced. It is in all respects the same type of device as the protector paravane, excepting that the mercury oscillator is removed. The removal of the mercury oscillator renders the otter unstable above 14 knots. Since the average speed of a merchant vessel is 10–13 knots, the otter gave good service in practice.

CHRONOLOGY

Sept. 1914. Provisional scheme and design of explosive paravane submitted to British Admiralty by Lieut. C. D. Burney.

May 1915. High speed submarine sweep tested in H.M.S. "Mastiff" at Harwich and approved for supply to H.M. Navy.

March 1915. Provisional design of protector paravane submitted by Lieut. C. D. Burney.

Nov. 1915. First successful trial in H.M.S. "Melampus" of protector paravane.

Feb. 1916. Protector paravane successfully demonstrated to Grand Fleet, and approved for supply to H.M. Navy.

April 1917. First merchant vessel fitted with "otters." (When the Armistice was concluded, 3,000 merchant vessels had been fitted with otters.) (C. D. B.)

PARDO BAZÁN, EMILIA (1851–1921), Spanish author (*see* 20.800), died in Madrid May 12 1921.

PARENT, SIMON NAPOLEON (1855–1920), Canadian politician (*see* 20.801), died in Sept. 1920.

PARIS (*see* 20.804).—In modern times Paris has grown rapidly, and had, in 1921, a population of 2,906,472. In 1910 it counted nearly 90,000 houses while the built-over surface had increased to 2,775 hectares, the area of gardens, yards and unoccupied ground having somewhat diminished. The public transport services carried 994,000,000 passengers in 1912 as against 552,000,000 in 1901, while 29,000,000 passengers used the ceinture railways and the Auteuil line, and 100,000,000 passed through the Paris railway termini.

During this period Paris was not yet the industrial centre of France that it became after the War. In 1911 it produced one-sixth of the total production (excluding agricultural) of France. On Jan. 1 1911 Paris proper had only 14,075 factories, though there were many more in adjacent districts. Nevertheless, by 1914, Paris was among the leading producers of the metal, chemical, pottery, glass, hides and leather, food and timber industries. All great French commercial, banking and industrial businesses have their headquarters there, or at least maintain an office, and many foreign enterprises are represented. Paris represents an enormous concentration of wealth from every source, mainly localised in the west end and in contrast to the great areas of poverty in the east end and on the outskirts of the districts on the left bank of the Seine, and many places in the suburbs which

have grown up chaotically and in defiance of hygiene and of town-planning. By 1913 motors had superseded horse transport for practically every purpose in the public transport system.

In 1912 the Boulevard Jules-Ferry was opened, and in 1913 the Boulevard Raspail, which had been begun under Napoleon III. In 1913 also the reconstruction of the bridge of Notre-Dame was begun, to be finished during the War. The square of Parc-Royal was opened in 1913; the square Jules-Ferry in 1922 and Saint-Sévérin in 1923. The Palais de Justice was completed by the southeast wing 1911, the new Hôpital de la Pitié was opened, in 1917 a model lycée was built (the Lycée Jules Ferry in the rue de Douai), and the Cour des Comptes was opened.

The City During the World War

Immediately on outbreak of war the theatres were closed Aug. 3 (1914), cafés and restaurants were closed after 8 P.M. Aug. 4; women at once began to take the places of men in occupations such as public transport. Refugees poured in from the invaded districts; on the other hand many Parisians left the city, and the Govt. withdrew temporarily to Bordeaux. On Sept. 3 the Bourse was closed. The same day was placarded the proclamation of the new Governor of Paris, Gen. Galliéni, promising to defend the city to the last. After the victory of the Marne the danger passed. Theatres partially reopened at the end of Nov., the Bourse on Dec. 7; on Dec. 10 the Govt. returned. Paris gradually became an immense arsenal; the working-class population, including foreigners and women, rose to 61,000 in Jan. 1915, to 144,000 in April 1916, then to 300,000 in Nov. 1918. Factories like those of Renault and Citroën were characteristic of this war-time stimulus to industry. Taubes had flown over the city on Aug. 30 1914; in March 1915 Zeppelins appeared; they bombarded Paris Jan. 29 1916. Then came the first restriction—that on coal, begun in the winter of 1916–7. Queues for milk, chocolate, etc., became features of Paris streets. Ration cards were introduced with War bread, frozen meat, saccharine for sugar. In Jan. 1917 restaurant menus were cut down and in Feb. confectioners, pastry-cooks and tea-rooms were partially closed. In May meatless days were introduced. Prices began to rise. To keep them down, municipal butchers' shops were opened in May 1918.

Bombardments became more intense in 1918; during this year Gothas dropped bombs 14 times. On March 23 the long-distance gun, nicknamed "Big Bertha," began to play its part and on March 29, Good Friday, killed 88 persons in the church of S. Gervais and wounded 68. Long-distance guns bombarded Paris and its suburbs on 44 days, killing 256 persons and wounding 625. In consequence of the frequent air raids, street lighting was reduced at night to a minimum. Works of art were protected with sand-bags.

On Nov. 11, at 11 o'clock, salvos and carillons announced the Armistice. The crowd held joyful demonstrations along the great boulevards and on the Place de la Concorde, decorated with War trophies. A pendant to this occasion was July 14 1919, when the triumphal procession of victorious troops passed under the Arc de Triomphe de l'Étoile. But the economic consequences of the War continued. Bread cards were only abolished on June 1 1919, coal cards on Jan. 13 1921. The municipality had to fight the high cost of living; in Feb. 1919 it established a kitchen at Billancourt to supply cheap meals and on March 6 it opened the first Vilgrain stalls where foodstuffs were sold below market prices. During the period 1919–21 no less than 164 stalls were opened and for the same purpose restaurants for the masses of the people were opened in various parts of the city.

Paris After the War

Paris was greatly changed by the War. Many of the immigrants remained; war industries remained and were adapted to peace purposes. Thus a large new industrial population had to be housed. The old fortified enceinte was abolished in 1919, its area was set apart for cheap dwellings or barracks or, with certain limitations, for private building. The 250 metre-wide zone round it was reserved for parks and playgrounds, the obsolete forts of the first line of defence and the site of the second line of forts left open to provide reservoirs of air. On Aug. 1 1919 a competition was opened for a plan for the laying out and extension of Paris. In 1923 the Conseil Général de la Seine acquired the park of the ancient Château des Sceaux for recreation and building purposes; the Pelouse d'Avron for building sites; and a vast site near the Courneuve and Bourget where a new town will be built. Many of the new suburban houses are on the garden city model. A university "Cité" for students has been built near the Montsouris Park.

Overcrowding is worst in the suburbs and outskirts of Paris. The population of the central *arrondissements* has declined owing to offices replacing dwellings; the total population of Paris increased by only 18,362 between 1911 and 1921 (2,888,110 and 2,906,472, respectively), while that of *l'arrondissement* of Saint-Denis rose by 139,869 and of Sceaux by 99,418. The total population of the department, including Paris, was 4,567,690 in 1926, an increase of 224,344 since 1921. The growing suburbs are now connected with Paris. The population of the Seine included 300,000 foreigners in 1921, that of Paris, 170,000 in 1925. The intense shortage of houses has accentuated the need for a housing policy. The public office for cheap houses for Paris was created in Jan. 1914; for the Dept. of the Seine, July 1915. By March 31 1922, the city, the department, their offices and the Assistance Publique had built 2,731 dwellings, 935 more were nearly completed 5,110 under construction and 4,052 projected. Public surface transport in Paris was amalgamated in 1921. In 1924 1,070,000,000 passengers were carried by these vehicles; 575,000,000 on the Métropolitain and the Nord-Sud railways. The vastly increased traffic (which caused 60,000 accidents in Paris in 1920) necessitated many regulations. The gyratory system has been adopted at suitable points; that of one-way traffic for certain parallel streets. Mechanical signals allow momentary halts to enable foot-passengers to cross the streets, slow vehicular traffic is prohibited in certain streets at the rush hours. Fresh undertakings of the municipality are the completion of the Boulevard Haussmann, the reconstruction of the old bridge of la Tournelle and the transference of the Morgue to the outskirts of Paris; new undertakings of the Government of France are the grave of the Unknown Soldier and the exhibition of decorative arts of 1925.

The Port.—The port of Paris, which, independently of the Seine, includes the three canals of the Ourcq, Saint-Denis and Saint-Martin, which unite in the dock of la Villette, is being enlarged; three important ports are under construction at Bonneuil, Gennevilliers and Pantin; a port is to be established at Bobigny and connected with the future canal between Pantin and Saint-Denis; docks are also projected at several points in the old fortified enceinte, the deepening of the Seine is also proposed. A canal to unite the Marne from d'Annet to the Seine in the neighbourhood of Saint-Denis is intended to protect Paris from inundation.

A bureau for employment and labour statistics was created in 1915 for the department of the Seine, labour bureaux already in existence in the mayoral divisions of Paris were linked up with it in 1919. In 1924 the bureau found work for 308,000. The same department founded in 1918 the public bureau of social hygiene, whose principal object is to fight against tuberculosis; it has established dispensaries and controls sanatoriums; it has instituted fresh air schools and preventoriums; it also sends children to the country. The average figure of mortality from pulmonary tuberculosis in Paris, which from 1894 to 1898 was 3·62 per 1,000 inhabitants was reduced to 2·31 in 1920. Similar progress has been made in the provision of municipal baths, the bathing establishment of the Butte-aux-Cailles and the stadium at the Rue des Tourelles are new features for Paris.

Electric power has been centralised for Paris since 1914 by the Compagnie Parisienne de distribution d'électricité, which has rented the electric cable from the municipality and supplies the city from its stations at Saint-Ouen and Issy-les-Moulineaux. The number of customers, which on Jan. 1 1914 was 132,000, rose on Jan. 1 1924 to 379,000. With all this the municipal budget has not risen since the War, if account be taken of the depreciation of the franc; expenditure was 494,000,000 in 1911 and 1,550,000,000 in 1925. Meanwhile new fields are constantly opening for its activities with the general use of reinforced concrete, with the new architectural forms which it introduces, and the spread of mechanical devices. The new social city seems about to succeed the old princely city.

Bibliography.—*Le Livre foncier de 1911*, issued by the City of Paris (1911); *Ordonnance générale concernant la circulation*, issued by the Prefecture of Police (1925); H. Sellier, *La crise du logement et l'intervention publique en matière d'habitation populaire dans l'agglomération parisienne* (1921); *Vie Urbaine* (periodical since 1919); *Bulletin municipal (officiel) de la Ville de Paris*, appearing since 1911; E. Mareuse, "Chronique de l'année 1911" and subsequent years, in the *Bulletin de la Société de l'histoire de Paris et de l'Île de France;* Ministry of Commerce; *Évolution de la production d'après les renseignements fournis par les Chambres de Commerce, 1910, et les statistiques administratives, 1912* (1917), and *Rapport général sur l'industrie française* (1919). (M. Po).

PARIS, CONFERENCE OF.—The conference for framing the treaties which ended the War was held in Paris in 1919–20.

I. PRELIMINARIES

The Pre-Armistice Agreement.—Germany faced complete defeat and unconditional surrender when, one after the other, her allies Bulgaria, Turkey and Austria-Hungary broke under the strain of war in Sept. and Oct. 1918, and sought terms with the enemy. Germany saw her best chance in overtures to the President of the United States, whose speeches during months past had underlined the principles necessary to the restoration and preservation of world peace (*see* FOURTEEN POINTS). Accordingly on Oct. 4 the German Govt. despatched a note to Wilson through the Swiss Govt. requesting an armistice.

In reply, President Wilson laid down the stipulations that before negotiations for peace could be opened: (1) Germany must accept without qualification the principles of the Fourteen Points, leaving for discussion only the practical details of their application; (2) the German armies must be withdrawn from all territories of the Allies under the direction of the Allied military authorities so that there could be no question of the military supremacy of the armies of the Allies and of the United States in the field; (3) Germany must cease all illegal and inhuman practices and abandon unlimited submarine warfare, before an armistice could be granted; and (4) the German nation must free itself of the arbitrary Govt. which had conducted the War. The German authorities were reluctant to accept such terms for the cessation of hostilities. Gen. Ludendorff resigned rather than accede to those conditions, but the civil Govt., although it protested against the charges of illegal and inhuman practices, dispatched a note on Oct. 20 accepting the stipulations of President Wilson as preliminary to an armistice. With Germany committed to a programme, Wilson then presented the matter to the Allies. The President had already sent Col. Edward M. House to Paris as American representative on the Supreme War Council. He met with the Allied leaders, Lloyd George, Clemenceau and Orlando, to discuss, first, whether an armistice should be granted, and second, whether Germany's request that the Fourteen Points be used as the basis of peace should be accepted.

President Wilson has been much criticised on the ground that he was responsible for too early a peace, and that had it not been for him terms would have been dictated to Berlin. This is far from the truth. The Allied Council agreed to grant the Armistice on the recommendation of the military leaders; the Americans were in fact less eager than the French and the British for the cessation of hostilities. To be certain of Allied sentiment regarding the Armistice, House asked Marshal Foch directly whether or not from a purely military point of view he would prefer to have hostilities cease on the terms proposed. Foch replied that, since the terms demanded of Germany were practically the same as those that would be demanded at Berlin, he was opposed to the useless sacrifice of another life. "*On ne fait la guerre que pour ses résultats.*"

The Allied leaders were more doubtful as to whether President Wilson's Fourteen Points should be taken as the basis of the peace, as Germany asked. Clemenceau, Lloyd George, Hymans and Orlando each raised objections. They finally agreed, however, upon the strong insistence of Col. House, to accept the Fourteen Points with two reservations regarding the freedom of the seas and restoration of invaded territory. Acknowledging these reservations, Wilson on Nov. 5 communicated the reply of the Allies to the German Government. This note is of vital importance. "It constitutes the formal and written offer of the Allied and Associated States to conclude with Germany (*a*) an armistice convention and (*b*) a treaty of peace. This offer, it is conceived, was accepted by Germany by the act of sending representatives through military channels, to meet Marshal Foch for the purpose of arranging an armistice. By the acceptance of the offer a solemn Agreement was reached which served, both morally and legally, as the basis of the armistice convention and the treaty of peace."[1]

[1] Temperley, *A History of the Peace Conference of Paris*, I., 382.

The note of Nov. 5, in which Wilson stated that Marshal Foch would communicate the conditions of an armistice, contained the text of the memorandum of observations by the Allied Governments on the correspondence between President Wilson and Germany. In this memorandum those Governments "declare their willingness to make peace with the Govt. of Germany on the terms of peace laid down in the President's Address of Jan. 8 1918 (the Fourteen Points), and the principles of settlement enunciated in his subsequent Addresses," subject to two qualifications. These reserved complete liberty, as regards the "freedom of the seas," and interpreted "restoration of invaded territory" as meaning that "compensation will be made by Germany for all damage done to the civilian population of the Allies and their property by the aggression of Germany by land, by sea and from the air."

Both the Allied and Associated Powers and the Germans accepted this Pre-Armistice Agreement as the basis of the peace. The protests of the German delegation against the Versailles Treaty in May 1919 were based upon their allegation that the treaty was not in accord with the principles of the agreement. The Allied and Associated Powers, although they denied the validity of the allegation, explicitly acknowledged the validity of the basis: "The Allied and Associated Powers are in complete accord with the German delegation in their insistence that the basis for the negotiation of the treaty of peace is to be found in the correspondence which immediately preceded the signing of the Armistice of Nov. 11 1918."[2]

Organisation of Peace Conference.—The question whether the President of the United States should come in person to Europe and participate in the negotiations was one of the first importance. The statesmen of France and Great Britain had reason to fear for the satisfaction of their particular interests if the creator of the idealistic programme were there to apply his principles to practical details. Their misgivings, perhaps, were somewhat allayed by the assurance that the French Premier, Clemenceau, would preside over the Conference. They decided to welcome President Wilson and to take their chances with his point of view.

Representatives of the chief Allied and Associated Powers—France, Great Britain, Italy, Japan and the United States—held consultations in Dec., and the first plenary session of the Peace Conference did not take place until Jan. 18 1919. President Wilson did not reach Europe until Dec. 13 1918. The British Prime Minister, Lloyd George, was detained at home by the political uncertainties of a general election until after New Year. So important to any negotiations was the participation of these two heads of governments that nothing definite could be attempted until their arrival. In the meantime, the smaller Powers which had been overrun by the armies of Germany had time to reorganise their governments and to send plenipotentiaries to the Conference who could speak with responsibility.

The Peace Conference was called by the five principal Powers to assemble at Paris. Geneva had been suggested as a neutral meeting-place for victors and vanquished, but the opinion prevailed that the enemy should be excluded from the conference until summoned to hear the terms which must be accepted. Brussels also was suggested in appreciation of Belgium's heroic rôle in the War, but the honour was finally given to France. The War against the Central Powers had been directed from France; there sat the Supreme War Council of the Allies, and upon this the structure of the Peace Conference could most readily be erected.

Even while in the throes of war, and by no means certain of victory, the Allies had begun to study the problems of peace. Departments of the French Govt. had prepared plans. The British Foreign Office had established an organisation in 1917 to examine the issues for settlement. In the United States Col. Edward M. House at the request of President Wilson had organised "The Inquiry," a body of experts under the chairmanship of Dr. Sidney E. Mezes of the College of the City of New

[2] Reply of the Allied and Associated Powers to the Observations of the German Delegation on the Conditions of Peace.

York for gathering statistics and correlating necessary data. Other nations also had begun to prepare their cases against the Central Powers for presentation before the high tribunal of the forthcoming Peace Conference. In no case, however, had responsible heads of states made as yet the adjustments necessary between the facts of the past—economic, political and diplomatic—and the requirements for the international order of the future. Despite the fact that early in the War the leading Powers had realised the necessity of technical information and specialised knowledge, the Peace Conference was faced with the task of working crude materials into an intricate design for peace.

II. ORGANISATION OF THE CONFERENCE

The Council of Ten.—Upon the arrival of Lloyd George in Paris, a meeting of the Supreme War Council was held, Jan. 12 at the Quai d'Orsay. France was represented by Clemenceau and Pichon, Great Britain by Lloyd George and Balfour, Italy by Orlando and Sonnino, the United States by Wilson and Lansing. Though ostensibly an informal conversation among plenipotentiaries of the four leading Powers, the meeting was the occasion of the significant decision to add only the representatives of Japan to the Supreme Council and to exclude all others from the major decisions of the Peace Conference. Thus the Council of Ten sprang from the Supreme War Council. There also came to Paris the representatives of Belgium, Serbia, Rumania, Greece and the other States—32 in all—which had fought against the Central Powers or had broken off diplomatic relations with them. Obviously it was impossible for all to have equal part in determining the conditions of peace. To each, seats and a vote were allotted in the plenary sessions of the conference. Representatives of those states which had remained neutral during the War, and yet had interests to safeguard or to advance at the Peace Conference, were permitted to attend only those sessions which were arranged for discussion of their claims, whenever they were specially summoned by the five chief Powers. It had been the intention of the latter, at first to put on the same footing the new states which were rising from the ruins of the Central Powers. Before the first plenary session, Poland and Czechoslovakia were conceded representation in the conference; but Yugoslavia—including Serbia, Montenegro and the south Slav provinces of Austria-Hungary—was not officially recognised until the end of May, chiefly because of the opposition of Italy.

The Delegates.—Outstanding among the delegates from the smaller Powers were Hymans, Foreign Minister of Belgium; Paderewski, Premier of Poland, and his Foreign Minister Dmowski; and Bratianu, Premier of Rumania. For Serbia and the south Slavs came Pasitch, Vesnitch and Trumbitch. Veniselos came to speak for Greece. For Czechoslovakia came its Premier, Kramarsz, and the brilliant young Foreign Minister, Benéš. The new Kingdom of the Hedjaz was represented by the Emir Feisal, in striking Arab robes. These were but a few of the many dignitaries from every part of the world who soon crowded the hotels of Paris. It was easily recognised that all who came to represent their countries could not be included even in the plenary assembly of the conference. The number of plenipotentiaries for each state was, to be sure, merely a matter of sentiment, for no Power could have more than one vote.

But there was considerable dispute before the five principal Powers finally assigned places in the conference to each state in accordance with its military strength and its share in the War. Five seats were given to each of the five chief Powers; three apiece were assigned to Belgium, Serbia and Brazil; two each to Canada, Australia, South Africa, India, China, Czechoslovakia, Poland, Greece, the Hedjaz, Portugal, Rumania and Siam; one each to New Zealand, Bolivia, Cuba, Ecuador, Guatemala, Haiti, Honduras, Liberia, Nicaragua, Panama, Peru and Uruguay. Many delegates were thus left out, but the panel system was adopted so that all Powers could use their plenipotentiaries in rotation if they desired. Representatives of the British Dominions, for example, more than once shared in important decisions of the Supreme Council by reason of their membership in the panel of the British Empire. Other important work was found later for excess members of several delegations on commissions and subcommittees.

When the plenary assembly of the conference met for the first time on Jan. 18 it proved to be only a body of approval merely passing upon actions that had already been determined in the Supreme Council. Clemenceau was elected president of the conference. A secrétariat-général previously selected by the Supreme Council was appointed. A drafting committee was approved, on which had been placed only representatives of the five chief Powers. The smaller Powers endeavoured to protest against such rigid control by the Five. But at the second plenary session on Jan. 25 Clemenceau bluntly dismissed their objections with allusion to the 12,000,000 soldiers behind the authority of the five Powers. Having the greatest interests at stake, they were determined to keep political decisions well in their grasp. The smaller Powers could turn their energies into labour upon the technical commissions.

Administrative Work.—With this matter of authority arbitrarily arranged, the Peace Conference settled to the work of constructing a peace. Peace-making, however, was not to be its sole task. It was obliged also to assume executive duties of tremendous consequence. It must direct the Allied Armistice Commission at Spa. It must set up and control the Supreme Economic Council at Paris. It had to maintain its own authority over Poland, Germany, Hungary, Czechoslovakia and Rumania. The Supreme Council of the Conference administered the Armistice by instructions to Marshal Foch, who in turn forwarded them to the International Commission at Spa. The Allied members of the commission consequently had no authority to make any decision beyond their instructions. They did have full power to explain and to stress important points in the Allied interpretation of the Armistice and, by personal intercourse, to prevail upon the German representatives to accept the decisions of the Supreme Council at Paris. The matters that chiefly concerned the Armistice Commission were: the withdrawal of German forces from the territory of the Allies and their demobilisation, the repatriation of prisoners interned in Germany, surrender by Germany of the required amounts of arms, airplanes, mercantile and agricultural machinery, locomotives and railroad equipment, and the delivery of other commodities stipulated in the Armistice. There were accompanying financial and commercial questions to perplex the Allied representatives and to jeopardise the renewal of the Armistice until the conference had prepared terms for peace.

Supreme Economic Council.—At the instance of President Wilson on Feb. 8 the Supreme Council resolved to create a Supreme Economic Council of five members each from interested Powers. It was to advise the conference upon the temporary economic measures necessary pending the completion of negotiations for peace. During the War, several Inter-Allied organisations had grown up to deal with the problems of purchase, transportation and distribution of foodstuffs, nitrates, copper, petroleum and war materials of all sorts. In addition, there had been organised various programme committees, a Supreme Blockade Council, a Supreme Council of Supply and Relief, and the like (*see* CONTROL, INTER-ALLIED).

At its first meeting on Feb. 17 the Supreme Economic Council decided to co-ordinate the work of all these War boards and to direct them as sections of its own organisation. As a result, matters of food and relief were placed under Herbert Hoover of the United States as director-general; matters of finance, under Norman Davis of the United States; the problems of communications were ultimately assigned to Brig.-Gen. H. O. Maine of Great Britain; raw materials, to Loucheur of France; problems of blockade, to Vance McCormick of the United States; and shipping to Cooke of Great Britain.

The Supreme Economic Council endeavoured to supply devastated areas with materials necessary for reconstruction and to revive the economic activity of those countries which were victims of the War. It was especially concerned with the problem of relieving the famine-stricken areas of Eastern Europe—a

situation recognised as dangerous to political stability and likely to encourage the spread of Bolshevism. It arranged the Brussels Agreement by which Germany was provided with foodstuffs, to carry out that provision in the Armistice which pledged the Allies to revictual Germany in return for cash payments. It delegated to a sub-committee the special task of economic administration in the territories of Germany occupied by Allied armies. It carried on direct negotiations with the German Finance Commission, studied the economic effects of the Allied blockades of Bolshevist Russia and Hungary, and urged the Supreme Council of the conference to relax those blockades for the benefit of the peoples of other states near by. It relaxed the blockade against Germany and reorganised the transportation systems of Austria, Hungary and Poland.

In short, the Supreme Economic Council under the honorary chairmanship of Lord Robert Cecil, although established only as a temporary commission to administer economic affairs until the advent of peace, became one of the most important international bodies directing the reorganisation of Europe. After the Treaty of Versailles had been signed, it continued to act as agent for the Allies, to secure foodstuffs in America and to supply Austria with coal. The importance of some common economic body until the League of Nations should get under way was beyond question. The Supreme Council of the conference therefore decided to request that the Supreme Economic Council should continue at work, with some changes in its organisation. Political opposition interfered with the proper development of the Council into an International Economic Council, but before its last meeting at Rome, Nov. 21 1919, it had drawn up significant proposals for co-operative purchase and distribution of foodstuffs, coal and raw materials by the nations of Europe.

Hostilities on Eastern Fronts.—The authority of the Peace Conference was menaced seriously not only by the hostility of the enemy, Germany, but by the resistance of the ally, Rumania, and the new governments of Poland and Czechoslovakia. Early in Nov. 1918 hostilities had broken out between the Poles and the Ruthenians in East Galicia, where Polish proprietors constituted a landed minority, and Ruthenian peasants, closely related to the Ukrainians in Russia, were in a majority. During Feb. 1919 an Allied Mission intervened, but the Ukrainian commander refused to accept the proposed truce. In March the Supreme Council of the Peace Conference arranged another truce with the Ukrainian commander, and on April 2 set up an Inter-Allied Commission at Paris to arrange the terms of an armistice concerning Eastern Galicia. The Polish delegation rejected this armistice on the ground that Poland's safety required military occupation of East Galicia. In the end the Supreme Council sanctioned the Polish occupation. The ultimate status of Eastern Galicia was left for later decision.

To safeguard Poland on its western border, the Peace Conference imposed an obligation upon Germany that had not been stipulated in the Armistice. In Posen, where Germans constituted in large part the class of landed proprietors and Poles were the peasants, local conflicts developed during Dec. 1918 between garrisons and Polish volunteer forces. The Peace Conference finally in Jan. 1919 despatched an Inter-Allied Commission to stop these hostilities and served notice of that intention upon Germany through Marshal Foch. Germany protested, but practically accepted the provisional line of demarcation as laid down by the Allied Commission until the boundaries of Germany and Poland should be determined by treaty (*see* VERSAILLES, TREATY OF). Germany also objected strongly to the transport of Gen. Haller's Polish army from France to Poland via Danzig, on the ground that its presence would prejudice the ultimate disposition of Danzig. The conference forced Germany to admit the technical right of the Allies to use Danzig as such a port of entry to Poland, but allowed Germany to route Haller's army via railroad without touching Danzig. The Peace Conference was further annoyed by Germany's delay in withdrawing the forces under Gen. von der Goltz from the Baltic States where they were holding a line by agreement with Soviet Russia (*see* BREST-LITOVSK, TREATY OF).

Still more vexatious to the Peace Conference, perhaps, was the situation that developed in Hungary after the establishment of a Bolshevist régime under Béla Kun. The armistice of Nov. 3 1918 had been concluded between the Italian Supreme Command and the command of what was theoretically still the army of Austria-Hungary. But Poles, Czechs, Jugoslavs had already declared themselves independent. The German Austrians and the Magyars also had dissolved their old union. It was a real question, therefore, whether the terms of an armistice in behalf of a state no longer in existence bound the new Govt. of Hungary. On Nov. 13, accordingly, Franchet d'Esperey signed a military convention with the delegates of the Hungarian Government. On March 19 1919 the French officer heading the military mission in Budapest presented to the Karolyi Govt. a demand that all Hungarian forces be withdrawn behind a line corresponding to that fixed by the Rumanian Treaty of Aug. 13 1916. Karolyi seized the opportunity to distort the demand and to resign power to the Hungarian proletariat and Béla Kun.

On April 1 the Supreme Council of the conference dispatched Gen. Smuts to Budapest to find out whether Béla Kun's Govt. would recognise the validity of the military convention and would accept temporary military occupation by Allied troops of the zone between Hungary and Rumania as marked by the lines laid down by the Allied Powers. Béla Kun's Govt. agreed to withdraw its troops if Rumania would withdraw to a line further east than that temporarily fixed by the conference in Feb., and if Allied troops occupied the entire area in dispute. Smuts rejected this suggestion. Thereupon Hungarian troops moved out to meet Czechoslovakian and Rumanian forces that had already advanced into the disputed region. The Czechoslovaks had occupied important coal areas. Béla Kun decided to attack them first, breaking their liaison with the Rumanians and perhaps opening a way for Bolshevist forces to come over the Carpathian Mts. from Russia.

The Hungarian Army penetrated into Czechoslovakia before the Peace Conference intervened. On June 13 the conference summoned Rumania and Czechoslovakia to withdraw their troops behind the new frontiers which they were to be allotted. Béla Kun then ordered the Hungarian forces to withdraw from Czechoslovakia and, in turn, called upon the Peace Conference to make the Rumanians withdraw from Hungarian territory. But the Rumanian Govt. declined to do so until the Hungarian Army had been reduced to the six infantry and two cavalry divisions stipulated in the Armistice. On July 17 the Allied commander in southeastern Europe, Gen. Franchet d'Esperey, under orders from Paris, demanded that Béla Kun's Govt. retire in favour of one chosen by the Hungarian people. A wireless message from the Peace Conference on July 25 declared its willingness to negotiate with such a government.

In the meantime, Béla Kun thought to win favour with the Hungarian people by defying d'Esperey and by launching an attack upon the Rumanian forces. The Rumanian Army, however, resisted so successfully that by Aug. 8 it had rolled back the Hungarian Army and was in occupation not only of most of Hungarian territory east of the Danube but of Budapest itself. The Peace Conference meanwhile had sent a mission of Allied generals to carry out the agreements of the Armistice. Rumania resisted the direction of the Supreme Council, and issued an ultimatum demanding a third of available farm animals and machinery, half of the railroad equipment, large quantities of munitions and river shipping. The Peace Conference protested repeatedly against Rumanian actions and, securing the resignation of the Hungarian Govt. which had been established upon Rumanian approval, finally succeeded in getting Rumania to withdraw its troops and to accept those goods which it had exacted from Hungary as part of its share of reparations.

Still other matters to distract the Supreme Council of the Peace Conference from its major task of peace-making were the sharp controversies between Czechoslovakia and Poland over Teschen and between Austria and Yugoslavia over Klagenfurt. The situation in Russia caused much discussion during the first

days. Decision was reached on Jan. 22 that all the Russian factions should be summoned into consultation on the island of Prinkipo, in order to determine who was to be responsible for Russian interests at the Peace Conference. But nothing came of the effort. Neither the old Tsarist order, the revolutionary Govt. of Kerensky, nor the Bolshevist régime of Lenin were represented at the Peace Conference. Nor were the new Baltic States—Finland, Estonia, Latvia, Lithuania—which were breaking away from the old Russian Empire.

In view of such difficulties, it would seem remarkable that the statesmen at Paris ever reached common ground for any settlement. But, harassed as it was by executive duties, the Peace Conference went steadily forward with its peace programme.

Official Language.—Two preliminary questions of procedure for a time disturbed the plenipotentiaries at Paris. What was to be the official language of the conference? Should its proceedings be made public? It was decided that French and English texts, of equal authority, should be presented in the treaty with Germany which included the Covenant. Italian texts, along with English and French, were presented in the Austrian, Hungarian and Bulgarian treaties; and in all these the French version was declared to prevail in case of divergence. The languages of the enemy states were denied admission to the texts of the treaties. With regard to publicity for the actions of the conference, the decision was reached to withhold details of discussions as much as possible until definite understandings had been secured. The sessions of the Supreme Council, the commissions and committees must be in secret; for obviously, diverse interests could only be reconciled by compromise. It was better that the public concerned should not know the details of the bargaining, if there was to be future satisfaction with the settlement.

In addition to its burden of executive duties, the Supreme Council had to listen for hours to the special pleas of Rumanians, Greeks, Czechoslovaks, Arabs, Belgians, Syrians and Druses, Serbs and Croats, and Slovenes, Danes, Albanians, Armenians, Zionists. The Council soon realised that under such circumstances it could not make rapid progress toward an effective settlement unless other agents were put at work on the multitude of complex issues. The conference, therefore, was organised into commissions and sub-committees, over 50 in all, to study assigned problems, to hear expert testimony, to weigh opposing claims of interested parties, to debate rival policies, and to report to the Supreme Council, with which remained the final decision. Reference has been made above to the councils and missions employed for executive duties.

Special Commissions.—Among the special agents established to assist in making a peace were commissions on: (1) Responsibility for War and Guarantees, with Lansing of the United States as president, and sub-committees on criminal acts, responsibility for war, responsibility for violation of laws and customs of war; (2) Reparation for Damage, with Klotz of France presiding and sub-committees on estimation of damages, financial capacity of the enemy, and means of payment and reparation; (3) International Labour Legislation, with Gompers of the United States presiding (*see* INTERNATIONAL LABOUR); (4) International Control of Ports, Waterways and Railways, with Crespi of Italy as president and sub-committees on transit and control of routes of communication; (5) Financial Questions, with Montagu of Great Britain presiding, and sub-committees on financial problems preliminary to peace, on monetary questions, enemy debts and so on; (6) Economic Questions, with Clémentel of France as president and sub-committees on permanent commercial relations, tariffs and customs, navigation, industrial property and others; (7) Aeronautics, with Colonel Dhé of France as president; (8) Inter-Allied Naval and Military Affairs, under the presidency of Marshal Foch, which with other associated committees constructed the military and naval and air terms for presentation to the enemy; and (9) The Central Commission on Territorial Questions, over which Tardieu of France presided, to co-ordinate the work of the committees and commissions that had been assigned from time to time to the difficult tasks of examining the complex problems of Czechoslovakia, Poland, Rumania, Yugoslavia, Greece, Albania, Belgium, Denmark, the Saar Valley and Alsace-Lorraine.

As it proved, these territorial commissions could do little more than recommend that the Peace Conference accept and maintain the situation of each area practically as the War had left it. So deep were prejudices, hatreds and interests, that rebuilding of the states of Europe as the result of purely disinterested and scientific investigation was impossible. In all of these agencies of the Peace Conference the five Allied and Associated Powers kept for themselves either the entire membership or at least a majority over the representatives of the smaller Powers which were included.

III. COVENANT OF THE LEAGUE

First and most important of all was the commission on the League of Nations, chosen on Jan. 25 at the second plenary session of the conference upon the recommendation of the Supreme Council. The membership of this commission was drawn from the political leaders of 14 nations. Among them were Lord Robert Cecil and Gen. Smuts of the British Empire, Bourgeois of France, Orlando of Italy, Hymans of Belgium, Veniselos of Greece, Vesnich of Serbia, Wilson and House of the United States. The commission met on Feb. 3, and after daily sessions in the Hotel Crillon (held at hours that did not conflict with the meetings of the Council of Ten) presented to the plenary session of the conference on Feb. 14 the first draft of the Covenant. The usual procedure at the conference, of translating into French when English was used and into English when French was spoken, lengthened the sittings twofold and, while necessary, consumed much time. On the other hand, at the meetings of the commission to form the Covenant for the League of Nations, interpreters sitting by those who did not speak both languages, kept them informed in an undertone of the progress of the discussion. It was agreed by the commission to use as a basis for discussion the American plan for the Covenant prepared by Wilson and House, which had, by consent, been put into legal phraseology by Sir Cecil Hurst and David Hunter Miller, legal advisers respectively of the British and American delegations. There were several difficult problems to solve, one or two of them causing some rancour. Of these the question of political equality and that of having a league with an army at its command to enforce its decisions, advocated by the Japanese and French respectively, caused the most acrimonious debates. These finally were settled to the satisfaction of a large majority of the commission, although there was a small and resentful minority against the decisions reached.

The debate in the plenary session—the one important discussion in that body throughout the period of the conference—resulted in approval of the principle of the Covenant and brought forward various suggestions for amendment. President Wilson left on the following day for necessary executive duties in the United States. The Covenant as first drafted met stubborn resistance from the leaders of the Republican party in the United States. They argued that Article X., which committed each member of the league to respect and to preserve as against external aggression the territorial integrity and existing political independence of all other members, encroached upon the exclusive right to declare war which had been given to Congress by the Constitution of the United States. They declared that the league would destroy the Monroe Doctrine. They insisted that a state should be allowed, without sinister implication, to withdraw from the league if it saw fit. These, and many others, were objections raised in America.

The Covenant was revised by the commission and finally approved by the fifth plenary session of the conference on April 28, without change of a single word. It is to be doubted whether there were many sitting at that historic table who realised that with the acceptance of the Covenant a new phase of civilisation had begun and that the League of Nations was its keystone. The Covenant specifically provided for safeguarding the Monroe Doctrine against actions by the league; it contained a clause to permit any state to withdraw upon giving notice of its intention

two years in advance. A Japanese proposal for a clause in the Covenant declaring the equality of members of the league without respect to race or colour, was vetoed through the insistence of Premier Hughes of Australia. A French proposal to provide the league with a general military staff and with power to supervise disarmament also failed to win the approval of the commission. An American proposal to forbid discrimination in fiscal and economic regulations between one nation and another —a plan to eliminate *Zollvereins* and imperial preference—was likewise discarded. Finally, the chief objection to the Covenant raised in America was passed over. With the full support of President Wilson, Article X., so obnoxious to some Republicans in the United States, was retained in the Covenant.

IV. PROGRESS OF PEACE MAKING

Council of Four.—Four days after President Wilson left for the United States, Clemenceau was shot by a fanatic. Although not dangerously wounded, he was confined to his home. Col. House, who had been delegated to take Wilson's place, came to meet him there and, with the return of Lloyd George from England, the same group was reformed which had worked with celerity and success during the Armistice proceedings. Thus the Council of Four took form. The Japanese plenipotentiary, Marquis Saionji, might well have claimed the right to attend also, but he held to the Japanese policy of standing off when Japanese interests were not concerned, especially when the matters under discussion pertained purely to a European problem.

Upon Wilson's return to Paris, March 14, he replaced House in these informal conferences. The four heads of states abandoned the Council of Ten. It was reduced to the five foreign ministers. Whenever they desired, the Four assumed the authority of the Ten as the Supreme Council of the Peace Conference and drew apart to confer in private. The ministers of foreign affairs continued to sit as a Council of Five, although they were concerned chiefly with minor executive duties and other matters of routine. But, while the Four were still engrossed in negotiation with the recalcitrant German delegation, the Five went ahead with discussion of the terms to be given to Austria. The power of the Peace Conference, however, had been drawn into the hands of four men, and moreover, in the last resort, the Italian, Orlando, found that final decision belonged really to the Three—Clemenceau, Lloyd George and Wilson.

No one listened to the arguments of the Four except their interpreter, Capt. Paul Mantoux, and later their secretary, Sir Maurice Hankey, who rendered invaluable service by keeping the minutes of their discussions and by drafting the resolutions upon which they agreed. On occasion, experts were summoned to give data and technical advice; inter-Allied commissions were formed directly by the Four and ordered to report to them; but speeches, special pleas, formal audiences and other time-consuming devices were thrust aside.

National Claims.—When Wilson returned to Paris, March 14, the problem of meeting the claims of France, Italy, Belgium and Japan immediately became acute. The French asked for continued occupation by the Allies of the Rhineland and the bridgeheads of Cologne, Coblenz and Mainz. Unauthorised demands were made for the permanent separation from the Reich of German territory on the left bank of the Rhine. France asked further for complete sovereignty over the Saar Valley, as compensation for its own mines which had been deliberately ruined by the German forces. The French representatives pressed vehemently for "integral reparation," assessment of actual damages done by the enemy and exaction of the total amount in reparation. France supported Poland's claim to complete sovereignty over Danzig and the approaches to that city.

Although at one time (April 7) President Wilson threatened to break off negotiations over these questions and return to the United States without finishing the task of peace-making, compromises that he could accept were found one after another. The scheme for a republic on the Rhine was repudiated, but agreement was reached that the left bank of the Rhine, and a wide strip on the right bank, should be demilitarised and all fortifications razed, and that the Allies should maintain their joint military occupation for 15 years. It was to be continued if France, in the opinion of the Allies, was not then sufficiently secured against an unprovoked attack. The decision to prohibit union of Germany with Austria, described by Tardieu as one of Clemenceau's fundamentals, was taken in the second week of April, inserted in the first draft of the German Treaty in May and remained there in the definite text of June 28.

As for the French claim to the Saar Valley, the compromise was reached that France should have full ownership of the coal mines but that, on account of the 650,000 German inhabitants, government of the region should not be given to France but should be put under the control of the League for 15 years. At the end of that time, the inhabitants resident prior to this arrangement should vote for one of three settlements: the *status quo* under the League, union with France or return to Germany. In case they voted for return to Germany, France was to give back the mines and to receive compensation from Germany or the Reparations Commission which was to be created by the treaty with Germany.

Reparations.—The problem of reparation was not effectively solved by the Council of Four. Many English and American advisers, thinking of Germany's exhaustion, the danger of making the German people desperate and the mistaken policy of asking that a blank cheque be signed and handed over for the Allies to fill in, urged that Germany be cleared of charges for reparation by payment at once of whatever amount it could produce. The debate ramified into the uncertainties of Germany's capacity to pay and the largest sum for which Germany might be held liable. The French view prevailed. It was agreed that Germany should be held liable to pay to the last cent. The demands of the British and French that pensions should be included in the reparations bill were first opposed by Wilson, but he finally yielded (*see* REPARATIONS). The deadlock over Danzig was broken by Lloyd George who sought and found a way between Wilson's Thirteenth Point that Poland should have free and secure access to the sea, and British fears that a *Germania irredenta* with 2,000,000 inhabitants might be created. Danzig was to be a free city under the protection of the League of Nations, but Poland was to have access through Polish territory to the Baltic Sea and virtual control over Danzig's interests abroad. Within a week after President Wilson had threatened to leave the conference, these differences had been ironed out so well that the representatives of Germany were invited to appear at Versailles on April 25.

Crises over National Claims.—But another crisis suddenly appeared. The Italians threatened to withdraw from the conference unless their claims to Austro-Hungarian territories were met before the Germans signed the treaty. These claims were grounded upon promises given by France and Great Britain in the secret Treaty of London (April 26 1915). Orlando went further, however, to claim the city and port of Fiume which had not been allotted to Italy by the secret treaty. In this case he argued for the principle of self-determination, although he had opposed the application of that principle to the German population in the Tyrol south of the Brenner Pass. Wilson gave way to Orlando's contention to the extent of agreeing that Italy's northern frontier should be extended to the Brenner. But he resisted the Italian pretensions on the eastern shore of the Adriatic; for they were advanced at the expense of Yugoslavia and Albania. Fiume had a large Slav population and a purely Slav hinterland. It was the natural seaport of the Slav and Magyar regions to the east. Wilson rejected the suggestion that Fiume should be given to Italy in exchange for the Italian renunciation of claims upon Dalmatia under the Treaty of London. On April 23 Wilson publicly declared his reasons for opposing Italian claims. Orlando and his foreign minister, Sonnino, left Paris for Rome, but returned after the conference determined to proceed with the German treaty regardless. They reached Paris on May 7, a day too late for the sixth plenary session, which approved the draft of the treaty, and only a few hours before it was handed

to the Germans at Versailles. The Italians were back in the Conference, but the question of the Adriatic was not settled.

Meanwhile the claims of Belgium, Yugoslavia and Japan further complicated the situation for the Council of Four. Hymans appeared on April 29 to demand that, as Belgium had been first to suffer in the War, she should be first to receive compensation for war costs. She had been promised as much in the Armistice. He asked that Belgium be given a prior lien upon $500,000,000 of the first cash receipts from Germany and complete settlement of the Belgian account within 10 years. Eventually the American view prevailed, that Belgium's case was different from all others. Belgium was practically assured payment of her war costs by receiving a special issue of German bonds and priority on the half-billion cash receipts. Serbia immediately asked for $400,000,000, but the Council of Four dismissed that claim summarily.

The Japanese issue, however, could not be settled so easily as the Belgian or the Serbian claims. The Japanese representatives took exception to the suggestion that the German area in Shantung should be handed back directly to the Chinese. Japan claimed Shantung on several grounds. By the treaties with China in 1915, following the "Twenty-One Demands," Japan had gained rights in Shantung, even if the Chinese authorities had continued to insist that those rights had been exacted by superior force. Further, a secret agreement in 1917 with the European Allies against Germany had assured Japan that those Allies would offer no objection to Japanese claims in Shantung, although the United States had never been a party to the agreement. Wilson resisted the Japanese claims to Shantung, but finally accepted a compromise on April 30.

The Italian crisis was threatening to disrupt the conference, and an understanding with Japan was more than ever necessary. It was to the effect that the Japanese were to keep Kiaochow and its adjacent district, with rights also to exploit the mines and railways in the peninsula; but that Chinese sovereignty would be restored over the peninsula of Shantung "as soon as possible." The American President expressed faith in the oral promise of the Japanese that Japan would eventually evacuate Shantung in favour of China and retain there only commercial concessions. The Chinese representatives at the Peace Conference did not have such faith. They refused to sign the treaty with Germany. But they gained a place in the League of Nations for China by signing the subsequent treaty with Austria.

V. TREATY OF VERSAILLES

With these crises over national claims passed, the draft of the treaty with Germany was handed to its chief representative, Count Brockdorff-Rantzau, on May 7 1919 at the Trianon. Without rising from his chair, the German hurled sharp words at the representatives of the Allies for their dilatory methods. In the past six months, he declared, the blockade had caused the deaths of hundreds of thousands in Germany. "Think of that," he said, "when you speak of guilt and punishment." He and his countrymen would accept the liabilities to which they were committed by the Armistice under the terms of President Wilson. They were prepared to play their part in restoring Belgium and the devastated areas of France. But they and their nation did not hope for a just peace. "We know," he said, "the power of the hatred that we encounter here."

German Objections.—The Germans were given 15 days, and then an extension of time, in which to present their objections to the terms of the treaty. They complained that the Allied plan for reparations was too severe and claimed the right of appeal from the assessment of the Reparations Commission to some neutral arbitrator. They demanded a plebiscite in Alsace-Lorraine. In place of the Allied arrangement for the Saar Valley, they offered fixed annual supplies of coal to France until the French mines should be restored. Instead of giving up Danzig, Memel and West Poland, they offered to make Danzig, Memel and Königsberg free ports under German sovereignty. They demanded that Germany's claim to its colonies should be referred to arbitration. They asked for reciprocity with regard to commerce and goods in transit. They offered to negotiate concerning the League of Nations, provided Germany were admitted immediately, the members of the League were pledged against waging economic war and the Allied Powers also should abolish compulsory military service within two years and disarm themselves. They desired that the armies of occupation should leave German territory within six months after the signing of the treaty. They summed up their criticisms with the charge that the treaty as a whole was inconsistent with the terms of the Pre-Armistice Agreement. Such an imputation was angrily rejected by the Allies, but suggestions were made in the Supreme Council of the conference that the terms of the treaty should be softened.

Movement for Revision.—Lloyd George, backed by members of the British Ministry and representatives of the British Dominions, led the movement for revision. He protested against maintaining for a considerable period of time a large army of occupation. He now favoured a fixed indemnity in place of the plan for reparations. Mr. Lloyd George advocated plebiscites for Upper Silesia, Allenstein and Marienwerder to meet German objections and also urged some changes in the Polish frontier. He wished to grant early admission of Germany into the League. But the dangers of further delay were apparent. It was hardly possible at so late a date to rewrite the treaty. The movement for revision came to an end on June 13 with the only consequence that some concessions were made to Germany on minor points.

The Allies maintained their position with regard to reparations and the armies of occupation. They conceded some changes in the Polish frontier, to make it more consistent with ethnographic divisions. They agreed to a plebiscite in Upper Silesia. They withdrew the provision for making the Kiel Canal an international waterway. They intimated that they would open negotiations at once looking toward reduction of their own armaments. They promised to admit Germany into the League, if Germany complied with the terms of the treaty. They invited from Germany an offer (hedged round with many conditions), within four months of the signing of the treaty, of a lump sum to settle the whole bill for reparations. This suggestion was not accepted by Germany.

There was suspense as Count Brockdorff-Rantzau presented the final terms of the Allies to the German Govt. at Weimar. The Allied Armies of Occupation prepared for a general advance into Germany if the Germans should refuse to sign the treaty. The Scheidemann Ministry resigned on June 20, and the new Premier, Bauer, offered on the next day to sign the treaty without its articles requiring the surrender of War criminals and declaring Germany solely responsible for causing the War. The Allies refused. In this tense situation, the crews of the German battle-fleet scuttled their ships in Scapa Flow. But on June 22 Bauer obtained the permission of the Weimar National Assembly to sign without conditions, and the new German Minister of Foreign Affairs, Müller, with his colleague, Dr. Bell, at last on June 28 signed the treaty in the Salle des Glaces at Versailles.

Subsidiary Agreements.—Dependent upon the Treaty of Versailles, although apparently the result of separate negotiations among the interested Powers, were several other treaties and international agreements: (1) two defensive treaties, each signed by France, first with Great Britain, and next, with the United States. The two latter Powers bound themselves to come to the aid of France in case of an unprovoked aggression by Germany any time within the next 10 years. Great Britain made her ratification dependent on that of the United States. The latter refused to ratify, and so both treaties became nugatory; (2) a protocol defining certain ambiguities in the Treaty of Versailles; (3) an agreement among the United States, Belgium, the British Empire, France and Germany to define the nature of the military occupation of the Rhineland; (4) a treaty between Poland and the Allies to assure protection of life and liberty to all inhabitants of Poland without distinction as to birth, nationality, language, race or religion. Similar protection was later secured by the Allied Powers for minorities in Czechoslovakia, Rumania and Yugoslavia, provisions which were not applied to Italy (*see* MINORITIES; ST. GERMAIN, TREATY OF).

Ratification.—The Treaty of Versailles was ratified on July 9 by Germany, and by Oct. Great Britain, France, Italy and Japan also had ratified. The exchange of ratifications was delayed for two reasons. First, it was hoped that the Senate of the United States would ratify at least with reservations. Second, Germany must make amends for the destruction of its fleet in violation of the Armistice. On Nov. 19 1919 the American Senate failed to ratify; but on Jan. 10 1920 Germany finally signed a protocol to give compensation for scuttling the fleet. Then the exchange of ratifications was made at Paris between the European Allies and Germany, and on Jan. 16 1920 the League of Nations was formally inaugurated.

VI. OTHER TREATIES

After the Germans had signed the Treaty of Versailles on June 28 1919 the Peace Conference turned to the problems of Austria, Hungary, Bulgaria and Turkey, over which many of its commissions had been labouring for months. Chiefs of state began to resume their political tasks. Foreign ministers one by one left for home. Power to act in behalf of the respective states, however, was delegated to lesser dignitaries. The organisation of the conference remained intact to complete negotiations with the former allies of Germany. Austria was presented with terms drawn on lines similar to those granted to Germany. Her representatives signed at Saint Germain-en-Laye on Sept. 10 1919 (*see* SAINT GERMAIN, TREATY OF). And in Jan. 1920, Hungary, freed from its Communist régime and from Rumanian control, was accorded terms varying from the Austrian hardly more than in minor details. The Hungarians signed on June 4 1920 (*see* TRIANON, TREATY OF THE).

For Bulgaria, a delegation headed by Teodoroff, the Prime Minister, arrived in Paris on July 26 1919 but did not receive the draft of the treaty until Sept. 19. The Bulgarians delayed their reply more than a month to frame objections; but other than the promise for speedy admission into the League, they got no concessions from the Peace Conference. Further remonstrance from the Bulgarians led Clemenceau to give them 10 days to accept or to reject. By this time Teodoroff had lost power in Bulgaria, and Stambuliisky, head of the Agrarian party, had taken control of the Bulgarian Government. On Nov. 27 1919, at Neuilly-sur-Seine, Stambuliisky signed the treaty as the sole representative of Bulgaria (*see* NEUILLY, TREATY OF).

Following the establishment of the League of Nations on Jan. 16 1920 the Peace Conference came to an end. Several issues of first importance remained for disposal, among them the problem of the Adriatic and the settlement with Turkey. The plenipotentiaries left these matters, however, to the Conference of Ambassadors or to negotiation among the interested states. (*See* AMBASSADORS, CONFERENCE OF.) Italy continued to press her claims to Fiume and strategic points on the eastern shore of the Adriatic. Great Britain and France, though recognising their obligations under the secret Treaty of London, endeavoured to satisfy Italy with a compromise short of those obligations so as to gain the approval of the American Government. But Wilson persisted in opposition for the sake of the interests of Yugoslavia and Albania. The upshot of the controversy was that Italy secured the island of Sasseno outside the port of Valona, the port remaining in Albanian hands, and at a later date reached an agreement with Yugoslavia. Albania maintained her independence and on Dec. 17 1920 gained admission to the League of Nations.

The Turkish Settlement.—The Turkish question had been discussed at Paris in May and June 1919 and a Turkish deputation had visited the conference, but the drafting of the treaty was not taken seriously in hand until the London Conference of Feb. 1920. The delay was due in part to the hope that the United States would join in signing the treaty, but there were also great difficulties involved in the assignment of mandates over the national minorities in the Turkish Empire. Wilson's Twelfth Point had stipulated that these territories should receive "unmolested opportunity of autonomous development." An article in the Treaty of Versailles indicated that some of them at least would be recognised as independent states, under such mandatories as they chose to accept.

But there had been understandings among the Allies that ran counter to the principle of self-determination. In May 1916 France and Great Britain had made the Sykes-Picot agreement with regard to their respective spheres of influence in Turkey. The French sphere was to include Cilicia, southern Armenia and Syria. The British area was to include Haifa and Mesopotamia. Palestine was to be international territory. Greece claimed the whole of Turkish Thrace, the Aegean Is. and Smyrna, which Greek forces occupied in May 1919, with the approval of the Supreme Council of the Peace Conference. Italy claimed the Dodecanese, which it had held since the war with Turkey in 1912, and a sphere of influence on the adjacent mainland. Both France and the Hedjaz desired the Arab districts of Syria. The disposition of Constantinople also was uncertain.

On Feb. 16 1920 the London Conference of the Allies announced that Constantinople would remain the capital of Turkey; but a month later the Allies informed Turkey that this concession depended upon its good behaviour. Constantinople had been occupied by Allied troops under the command of Sir G. F. Milne before the end of 1918. On April 25, at the Conference of San Remo, mandates were given to France for Syria, Cilicia and the Lebanon; to Great Britain for Palestine and Mesopotamia, but the mandate over Armenia was declined both by the League of Nations and by the United States. Finally, on May 11 1920 the draft of a treaty similar in many respects to the Treaty of Versailles was handed to the Turkish representatives at Sèvres. It was signed on Aug. 10 1920. (*See* SÈVRES, TREATY OF.) Thus the task of constructing terms of peace for the last of the enemies of the Allied and Associated Powers was brought to an end. Real peace, however, had not yet come to the world.

VII. SUMMARY CRITIQUE OF THE CONFERENCE

The Peace Conference should have sat immediately after the conclusion of the Armistice, and should have made a preliminary peace to be followed later by a permanent peace. The belligerent nations had been so shattered by the War that the need for bringing about a resumption of normal conditions as soon as possible was imperative. The Armistice was signed Nov. 11 and, if the Peace Conference had convened by Nov. 20, a preliminary peace might have been signed by Christmas 1918. There was no necessity for the preliminary peace to cover more than three general conditions relating to the final settlement: the terms relating to military and naval affairs, the sum to be exacted for reparations and the delineation of German boundaries. The army and navy terms need not have been essentially different from those contained in the Armistice Agreement. The delineation of territorial concessions might have been given broadly as not exceeding certain lines, and the sum to be fixed for reparations likewise should have been flexible, both a maximum and minimum sum being stated. Much of the distress and many of the disasters which have overtaken Europe since 1918 might have been avoided by an early preliminary peace. There need have been nothing controversial in it and the Senate of the United States would have ratified it and, having ratified it, would probably have committed itself to the permanent treaty which might have been written at leisure.

President Wilson's Position.—It will always be a question of historical interest whether it was wise for President Wilson to go to Paris and venture himself into the controversies certain to arise. Some contend that without his influence the liberal part of the peace would not have been written, nor would the League of Nations have come into being. There are those who believe he should have remained the "God on the Mountain" at Washington and allowed others to negotiate for the American war aims, he having at all times a veto power and being beyond the reach of those who tried to use his influence in behalf of their own particular measures. That is in the realm of speculation, and no one may say with certitude which contention is right or which is wrong.

Clemenceau and Lloyd George at first did not look with favour upon his sitting in the conference. The reason they gave was that he was the head of a State and, if he participated in the conference, the kings of England, Italy and Belgium and the President of France might claim similar privileges. President Wilson was impressed by the argument when presented to him after he reached Paris, and indicated a willingness to be guided by it. One day, soon after the President's arrival, Clemenceau shifted his position and not only consented to his sitting in the conference, but even expressed a hope that he would do so. He undertook to guarantee that Lloyd George would also change his position and welcome the President as a colleague. It may be that after investigation they found that the sovereigns mentioned and President Poincaré would not press their claims to be present, or it may be that they concluded that if President Wilson entered the debating arena of the conference with them, he would descend from his high position and become as common clay. Or, Clemenceau, alarmed by the attitude of Lloyd George after the Armistice, may have felt he needed support from a strong and disinterested source to carry through what he had in mind for the safety and rehabilitation of France.

The delay in the meeting of the conference was less the fault of President Wilson than that of his principal colleagues. President Wilson might have come to Europe immediately after the Armistice was concluded, for his excuse that he had to remain in Washington for the purpose of delivering his message to Congress fails to carry conviction. He easily might have written the message and sent it to Congress, as was customary before he became President. But even if he had come immediately to Europe, it is to be doubted whether he could have hastened the date for the convening of the conference. Col. House urged an early convocation of the warring states and, had this come about, President Wilson would have responded and been present. As it was, when he did arrive on Dec. 14 1918, he found no one of his colleagues ready to begin. His visits to England and to Italy were made not to meet his personal desire to make them then but to fill in the time between his arrival and the earliest date he could obtain consent for the parleys to begin. Therefore, no more blame rightfully could be attached to him for this delay than for delaying, as was later charged, the conclusions of the conference by his insistence that the League of Nations' Covenant should be a part of the Versailles Treaty. The commission for the making of the Covenant worked mainly at night and at odd hours, and was the first committee to finish its duties and report to the conference, and it takes a large measure of imagination to bring so unjust a criticism against the President.

Subjects for Discussion.—When the conference first got down to work there was much confusion as to method and also as to the precedence to be given the subjects to be discussed. There should have been a well-defined programme laid out in advance so as to form a basis for discussion, as was done when the Covenant was formed. The lack of this caused the conference to waste time, and it resulted in the setting up of the ineffective Council of Ten which was, indeed, a council of 30 or 40 when the secretaries, experts and representatives of states interested were included in the meetings. The time of the council was largely taken up in listening to those who came to Paris to plead for certain boundaries affecting their countries. There were few on the council able to follow their arguments, and much time was wasted to no purpose. If the council had reached its own conclusions under advice of its experts, and then called in those interested to explain why such conclusions should not become part of the treaty, progress might have been made. After wasting many weeks in this futile endeavour to get at the facts and having failed, the Council of Four was substituted for the Council of Ten. Decisions then came rapidly. It was unfortunate that no one of the so-called Big Four possessed much organising ability; otherwise even greater progress might have been made.

Reparations and Security.—The question of reparations was the one great stumbling block of the conference, and the disagreements that arose in connection with it were the most potent cause of the delay in the making of the treaty. There was common agreement that Germany should pay to the full extent of her capacity, but there was a wide difference of opinion as to what her capacity was. The heads of the British and French delegations demanded of Germany the entire cost of the War on land and sea. The American Commission deemed this impossible, and sought to have a sum named which Germany might reasonably be expected to pay. After weeks and months of fruitless discussion, President Wilson finally agreed to a compromise which amounted to Germany's signing a blank cheque to be filled in later. He consented to this because it was thought that the Reparations Commission which the treaty provided, would, of necessity, name a sum which could be met. No one then considered the possibility of the United States Senate refusing to ratify the treaty, and thereby bringing about the disastrous deadlock which has so seriously impeded Europe's economic recovery.

The question of French security ran through the discussions at Paris and finally was met by compromise. President Wilson and Lloyd George agreed on behalf of the United States and Great Britain respectively to come to the assistance of France in the event of an unwarranted invasion by Germany. The terms of the treaty were somewhat indefinite, but they were the best that Clemenceau, after long negotiation, was able to secure. Wilson and Lloyd George were adamant in refusing all proposals regarding the left bank of the Rhine as a permanent line. Clemenceau has been criticised for believing that the United States Senate would accept such a treaty, as indeed have all the Allied leaders for believing that the Senate would accept membership in the League of Nations.

As a matter of fact, if the Versailles Treaty had been accepted, the Franco-American Security Treaty also would have, in all probability, gone through; and the Versailles Treaty would have been ratified by the Senate provided President Wilson had been willing to accept the Lodge reservations. The Versailles Treaty failed by six votes of getting the necessary two-thirds; twenty-odd Democrats who were ardently for the treaty voted against it, because of the reservations. As with the League of Nations, the importance of the French Security Treaty was not realised at Paris in the making of the peace. It has been the crux of nearly all the troubles which have beset Europe since the Armistice was signed on Nov. 11 1918. If the French had been assured of protection, their attitude toward Germany, toward reparations and toward disarmament undoubtedly would have been more in keeping with the public opinion of the world. (*See* SECURITY.)

It is only in retrospect that historic events are seen at their just value. Those who are making history oftentimes exaggerate the importance of some things and underestimate the importance of others. At Paris undue stress was laid on questions of enemy disarmament and reparations—both matters of temporary interest and susceptible of quick solution. Within a few decades they pass from view; but questions like the League of Nations and the security of France reach to the heart of peace and war, and are vital if Western civilisation is to live. It has taken Europe seven long years to realise this. If it had been seen at Paris, untold hardships might have been averted. The heavy losses incurred by the Allies during the War blurred, in a way, their sense of proportion. They could not realise that the costs of victory were so great that it was impossible to make the conventional treaty of peace, awarding to themselves damages and territories which might measurably recompense them for the sacrifices made. It was a time to forget rancour and to strive to make another such holocaust improbable and remote. If such a treaty had been framed at Versailles, the years following the War indicate that it would have been more satisfactory and profitable than the one actually made.

The so-called Secret Treaties were mischievous elements in making decisions, particularly regarding the Italian frontier. Great Britain and France entered the conference with their hands tied by promises made to Italy in order to induce her to enter the War on the side of the Allies. The United States was

free to act as seemed best, but even so the task proved beyond her capabilities. Few, if any, disinterested observers believed that the Tyrol as far north as the Brenner should have been wrenched from Austria under the pretext of making safe Italy's northern boundaries.[1] Italy's claim to Trieste and to some islands of the Adriatic was much clearer. The fight between Wilson on the one hand and Orlando and Sonnino on the other produced the most acute crisis of the conference. The Yugoslavs were ill-advised in not meeting the concessions the Italians were ready to make. They were counting on Wilson's coercing Orlando and Sonnino, but they failed to reckon on what might happen if the Peace Conference adjourned without a settlement being reached. The breaking-point came when Wilson gave out his statement of April 23 1919. This infuriated the Italians and they left Paris with the threat never to return. Wilson bore the brunt of the criticism which this rift in the conference caused, but he was by no means solely responsible. He was encouraged to do what he did do by members of both the French and British delegations.

Shantung.—At this moment feeling regarding Shantung ran high. No direct threat was made by the Japanese delegates, but it was in the air that if the conference refused their request they too would withdraw. They did not ask to keep Shantung, but merely that it should be returned to China through them. Here again Wilson bore the brunt of the fight, and the taunts of the liberals throughout the world were levelled at him. Even his associate commissioners from the United States, with the exception of Col. Edward M. House, protested against his acceding to the Japanese request. However, he and House had personal assurance from Baron Makino and Viscount Chinda that the province would be returned. They were men of the highest character and integrity, and their word, which has since been fully kept, was accepted without question, much to the chagrin of the Chinese commissioners.

The Chinese were advised by House to accept the decision in good faith and to compliment the Japanese upon their willingness to place the matter on such a high moral plane, thus marking a new era in international obligations. But they refused this advice. The bitterness of their defeat made them resentful and they gave notice that they would not sign the treaty; and they did not. The Belgians also were dissatisfied at this period of the conference. Suggestions of withdrawal were made and, with Italy gone, for the moment at least, it would have been fatal to the conference if Japan had left because her pledged word to restore Shantung to China was not accepted. It was a critical period of the conference, and the subsequent action of Japan has shown the wisdom of meeting her request.

The Saar Valley.—The demand of the French for the Saar Valley came rather late in the proceedings and was at first offered timidly. They tried to present an historical claim to it, but finally based their arguments upon the justice of their case. The Germans had wantonly wrecked the coal-mines of north-eastern France and, it was said at the time, had rendered them useless for a long period of years. The extent of the damage has since been proved not to be so great as was first estimated, but it was sufficient to warrant a modified yielding to the French claim. The difficulty was to arrange it in a way not to do violence to the almost wholly German population of the territory occupied. That it has worked out so well is due to the sagacity of the French in placing in charge engineers and officers who speak German fluently. Another helping factor was the superior value of the franc over the mark during the first trying period of occupation. For a time the German workmen in the Saar mines received on this account a much greater compensation for the same work than their fellow-miners in other parts of Germany.

Self-Determination.—During the War, when President Wilson announced his theory of self-determination, it stirred the dormant hopes of many peoples and did much to break the discipline in the Central Powers behind the lines. This declaration of our War aims brought to Paris many and diverse delegations from Europe, Asia and Africa. They were the most picturesque as well as the most ill-informed and unreasoning of all those who gathered around the historic centre where the peace was made. This noble sentiment, carried to its logical conclusion, would have wrecked the governmental machinery of the world. The conference has received unjustified blame for dividing up the Austrian Empire, but it must be remembered that the empire had already fallen apart before the Peace Conference met. The questions which came before the conference involved the boundaries of states in process of formation, and not the creation of such states themselves. Had the conference undertaken to curb the demand for national independence, its authority to do so would have been denied and another war would have begun—a war springing from the bowels of the old one and even more fierce and bitter. What was done had, of necessity, to be done. There was no other way. No such human upheaval as occurred during the years 1914–8 could be composed in exact justice to all—and that it was not done in this instance is no matter of surprise.

The Polish Frontiers.—The delineation of the frontiers of the new Poland was a task fraught with the gravest dangers, both for the moment and for the future. The reason for this was that her still great and powerful neighbour, Germany, was forced to yield a considerable part of her territory in order that there should be a national Poland and, further, that she should be given an outlet to the sea. Germany has never been reconciled either to Silesian boundaries or to the corridor to Danzig. She gave up the rich provinces of Alsace and Lorraine with scarcely a murmur, for when the tide of war went against her she realised that one of the penalties of defeat would be the restoration of territory taken from France in 1871. But the losses on her eastern frontier came as a shock, and cut deep into her national pride and consciousness. It may be that in time, and with wise and considerate treatment on the part of Poland, an adjustment of their differences may be reached. It is not an insoluble problem, but it is one that calls for patience and a high order of statesmanship. With better trade relations between the two countries and with Germany in the League of Nations, there may come a feeling of mutual dependence; and a yielding here and there by each may accomplish the miracle.

The rectification of the Belgian-Prussian frontier was a matter less serious, but the gain to Belgium is so slight that some day Belgium may feel it to be good policy to return to Germany the Prussian part of Moresnet as well as Eupen and Malmédy. While this district has some forests of value, there are less than 75,000 people involved, and their voluntary return to Germany would be a *beau geste* which would yield a far greater return in goodwill.

Mandates.—The acceptance of the principle of mandates was one of the most far-reaching decisions of the conference. It was a new venture in the government of backward peoples, and one destined to play a large part in the affairs of many nations. It gave an excuse and a method for taking over the German colonies by the several countries interested. The German colonial empire, built up painstakingly and at great cost, vanished overnight. It was one of the hardest blows which her national pride received, and one which she resents with passionate fervour. So strong is this feeling in the Germany of to-day that even some of the French are seriously considering the advisability of giving Germany a mandate over a part of the lost territory. The British protested during the War that they desired no new territory, but the insistence of South Africa, Australia and New Zealand made it impossible not to heed their demands. All of these countries resented the implied threat which the retention by Germany of her colonies might prove to be. Japan and France were equally determined, with the result that the vast colonial estate, which lay chiefly in Africa, was divided between the claimants according to their geographical situation.

[1] This is true with regard to the northern part of the region, South Tyrol, but many disinterested observers believed that the remaining and larger part, the Trentino, emphatically Italian, should be transferred to Italy.—Ed. *E.B.*

The policy of control based on mandates is a new departure in international polity; it involves the recognition that all nations have economic and other interests in backward regions. Until now, backward countries generally have been controlled or exploited by some Power for its own selfish purposes, and the good that has come from such control or exploitation has been merely incident thereto, and where a single control has not existed, backward communities have been a constant source of friction between the more civilised states, because of a desire to obtain control of their resources; this friction has oftentimes resulted in war.

Until the Paris Conference there had been no attempt to reach a general understanding or fixed policy between the more powerful civilised nations regarding the control or betterment of such states or territories. However, the system hitherto practised was admittedly so bad that when the conference came to the disposition of the late German colonies, there was general agreement that a more enlightened policy should be inaugurated. In furtherance of this desire Article 22 was incorporated in the Covenant of the League of Nations, and subsequently a commission was appointed to sit in London during the summer of 1919 for the purpose of preparing the terms of the mandates. Upon this commission were Lord Milner, who had as his adviser Lord Robert Cecil; M. Simon, French Minister for the Colonies; Viscount Chinda of Japan; Signor Marconi for Italy; and Col. House for the United States, with Mr. George Louis Beer as adviser (*see* MANDATES).

The acceptance by the members of the League of Nations of this new principle, in the difficult matter of the control of backward countries, was a long step forward. A mandatory Power was to accept trusteeship, not for the benefit of itself but for the benefit of the natives, and, incidentally, to permit other countries to share in the development of the state over which it exercised the mandate. The fact that hereafter each Power holding such a mandate will be under close observation will have a tendency to promote the best administration possible. The report which must be given each year to the Council of the League will in itself stimulate rivalry, and the Power giving the best account of its stewardship will be the one to hold the highest place in the esteem of the world.

BIBLIOGRAPHY.—The standard history of the Peace Conference is *A History of the Peace Conference in Paris*, 6 vol., ed. H. W. V. Temperley (1920–4). It is written chiefly by British experts, many of whom took part in the conference, but its point of view is objective. The texts of the treaties are to be found in the *Treaty Series* of the British Foreign Office, published by H.M. Stationery Office (1920). There is a special volume, *The Treaty of Peace between the Allied and Associated Powers and Germany (with amendments) and other Treaty Engagements Signed at Versailles June 28 1919, together with the Reply of the Allied and Associated Powers to the Observations of the German Delegation on the Conditions of Peace* (1925). *Comments by the German Delegation on the Conditions of Peace* and the *Reply of the Allied and Associated Powers* are published by the American Association for International Conciliation (1919) and the covering letter in the *American Journal of International Law* (July 1919). See also Deutscher Geschichtskalender, *Vom Waffenstillstand zum Frieden von Versailles*, pp. 565 *seq.* (Leipzig, 1918).

Important confidential documents are contained in R. S. Baker, *Woodrow Wilson and World Settlement* (1922). Important memoirs have been written by participants in the Peace Conference, especially André Tardieu, *The Truth about the Treaty* (1921); B. M. Baruch, *The Making of the Reparation and Economic Sections of the Treaty* (1920); Robert Lansing, *The Peace Negotiations* (1921); see also J. M. Keynes, *The Economic Consequences of the Peace* (1920); E. M. House and C. Seymour, *What Really Happened at Paris* (1921), a series of essays written by American delegates. (E. M. Ho.)

VIII. LATER CONFERENCES IN PARIS

After the conclusion of the important conference already described, three meetings of Allied statesmen were held in Paris to consider matters arising out of the execution of the Treaty of Versailles.

Jan. 24–30 1921.—A meeting to consider proposals put forward by Allied experts as a result of a meeting between them and German experts at Brussels from Dec. 16–22 1920, in continuation of the Conference of Spa (*see* SPA, CONFERENCE OF). The Allied statesmen adopted the experts' proposal for two German annuities, one fixed and the other on a sliding scale, but they proposed to saddle Germany with a far heavier burden than the experts had considered reasonable. The Allied Govts.' proposals as formulated by their representatives at Paris were rejected by Germany.

Aug. 8–13 1921.—A meeting of the Supreme Council of the Allied Powers to take action upon the results of the plebiscite in Upper Silesia (*see* SILESIA, UPPER). After failing to agree upon a line of partition between Germany and Poland, the representatives of the principal Allied Powers decided unanimously to refer the question to the Council of the League of Nations, under Article 13 of the Covenant. The Council accepted the task, and eventually made a recommendation which was adopted by the Conference of Ambassadors (*see* AMBASSADORS, CONFERENCE OF). This was the first case in which action arising out of a peace treaty, which fell within the province of the Ambassadors' Conference and of the Supreme Council as their principals, was transferred to the League of Nations by common consent. At this conference the Allied statesmen also considered the Greco-Turkish War in Anatolia, the Russian famine and several questions relating to Germany. In particular it decided that the additional occupation of territory carried out during the preceding March should continue, but that the economic sanctions taken simultaneously should be removed (*see* LONDON, CONFERENCE OF, Feb. 21–March 14 1921).

Jan. 2–4 1923.—A meeting between Allied statesmen to consider the terms on which Germany might be granted a reparations moratorium—terms on which agreement had already proved impossible at the London conferences of Aug. and Dec. 1922 (*see* LONDON, CONFERENCE OF). Since the adjournment of the latter of these conferences the situation had been rendered much more critical by the momentous decision which the reparation commission had taken on Dec. 26 1922, when a majority of the commission, consisting of the French, Belgian and Italian delegates, with the British delegate in a minority of one, had formally declared Germany in default in respect of deliveries of timber. Backed by this decision, M. Poincaré repeated with greater vigour the proposals which he had made on the two occasions aforementioned. In return for the remission of the French war debt to Great Britain, he would only be willing to cancel an equivalent amount of German "C" bonds, and in return for granting a moratorium to Germany there must be a military occupation of the Ruhr and a seizure of "productive pledges" in the form of coal deliveries, the seizure of the coal-tax hitherto payable by the industry to the German Govt. and the requisitioning of timber and other raw and manufactured products in the occupied territory.

On the other hand, the British Govt. proposed that Germany should be given an absolute moratorium for four years (except for certain deliveries in kind which were to be credited against future payments), on condition that Germany should stabilise the mark on lines suggested in the majority report of a commission of international experts which the German Govt. had called in during the preceding autumn; and secondly, that Germany should accept financial control by a foreign finance council, of which the German Minister of Finance was to be chairman, *ex officio*, and which was virtually to supersede the reparation commission. In regard to inter-Allied debts, the British Govt. made specific proposals which would have given substantial relief to France in exchange for a remission of German indebtedness to France, which would have been equally substantial.

The gulf between these two sets of proposals was so great that there was no chance of an accommodation, and the conference broke up on Jan. 4 after the French and British Govts. had "agreed to disagree." A week later, on Jan. 11 1923, the French and Belgian armies invaded the Ruhr (*see* REPARATIONS).

(A. J. T.)

PARIS, UNIVERSITY OF (*see* 27.751).—The University of Paris has prospered greatly under the constitution given to it in 1896 by the forceful genius of Louis Liard, and in all its faculties and departments receives an increasing number of foreign students

A university quarter has been created in addition to the numerous separate buildings in various parts of Paris, with the Palais de la Sorbonne as the main centre, where are housed the faculties of science and letters, the university library and the national school of charters. For other purposes an excellent site has been made available by the wise generosity of the city of Paris, on which, with the funds given by Émile Deutsch de la Meurthe, further provision is made for the accommodation of French students resident in Paris. The demolition of the fortifications has thus afforded the university the space it needed so much.

Other notable benefactions to the university have been made by the Marquise Aremati Visconti, M. Blumenthal, MM. Solvay et Cie, Dr. Kaprak of Bombay, Baron Mitsui and other Japanese notables, the Republic of Czechoslovakia, MM. Otto Kahn, Masson and Lavisse. L'Institut du Radium et Fondation Curie has received precious gifts from the Rothschilds, from public funds, from the Franco-Anglo-American League against cancer, and from Lazard Frères and La Filiale Canadienne de la Fondation Curie. Bequests of a valuable nature have been made to the faculties of medicine, science, letters and pharmacy; while with the purpose of aiding and stimulating scientific research—for public ends and for the welfare of individuals—many important developments have been effected in which the University of Paris, true to its ancient tradition, has taken a leading part.

Collège de France (*see* 27.769).—The great reputation of this foundation has been maintained worthily—even enhanced—since 1910 by periodical revision and reorganisation in order to meet the specialised needs of advanced students of both sexes in the higher branches of scholarship and science, and by the institution of new chairs from time to time. The newer chairs are those in human geography, public assistance, economics of Algeria, co-operative studies, colonial history and colonial protistology and pathology, some of which owe their existence to public sources and others to private benefactors such as Albert Kahn.

PARKER, ALTON BROOKS (1852–1926), American lawyer, was born at Cortland, N.Y., May 14 1852. He studied at the local academy and normal school, taught for a short time, read law and graduated from the Albany Law School in 1873. Admitted to the bar he began to practise at Kingston, N.Y., and in 1877 was elected surrogate of Ulster co., being re-elected in 1883. He resigned in 1885 on being appointed by the governor justice of the N.Y. Supreme Court to fill a vacancy, and the following year was regularly elected. He was a delegate to the Democratic National Convention in 1884 and in 1885 declined President Cleveland's offer of the first assistant postmaster-generalship. He was appointed a member of the second division of the N.Y. Court of Appeals in 1889 and a member of the general term in 1893. In 1898 he was elected Chief Justice of the N.Y. Court of Appeals. In 1904 he resigned on being nominated by the Democrats for president, but he was defeated by Theodore Roosevelt, the electoral vote being 336 for Roosevelt to 140 for Parker, the popular vote 7,623,486 for Roosevelt to 5,077,971 for Parker. He then resumed the practice of law in New York City. He was a delegate-at-large from New York to the National Democratic Convention in 1912. In 1913 he was counsel for the managers of the impeachment of Governor Sulzer of New York. He died in New York City May 10 1926.

PARKER, HORATIO WILLIAM (1863–1919), American composer and musician, was born at Auburndale, Mass., Sept. 15 1863. He studied music first in Boston, but later attended the Royal Conservatoire at Munich. On his return to America in 1885, he became professor of music in the Cathedral School of St. Paul, Garden City, Long Island. From 1888 to 1893 he was organist of Trinity Church, New York City, and from 1893 to 1901 organist of Trinity Church, Boston. In 1894 he was appointed professor of the theory of music at Yale. His oratorio *Hora Novissima* was widely performed in America. It was also given in England in 1899 at Chester and at the "Three Choirs" festival at Worcester, the latter an honour never before paid an American composer. His opera *Mona* won the Metropolitan Opera Company's $10,000 prize in 1911 and in 1914 his opera *Fairyland* gained a prize of the same amount offered by the National Federation of Women's Clubs. His cantata *Morven and the Grail* was written in 1915 for the centenary celebration of the Handel and Haydn Society of Boston. His other works include the cantatas, *King Trojan* and *The Kobolds*, the oratorios, *St. Christopher* and *A Wanderer's Psalm*, besides numerous sacred and secular pieces. He died at Cedarhurst, Long Island, Dec. 18 1919.

PARKIN, SIR GEORGE ROBERT (1846–1922), British educationist (*see* 20.831), published in 1912 *The Rhodes Scholarships*, an account of his works as organising representative of the Rhodes Trust (*see* 23.257). He was knighted in 1920 and died in London June 25 1922.

PARRY, SIR CHARLES HUBERT HASTINGS (1848–1918), British composer (*see* 20.865), retired from his professorship at Oxford in 1908. He died at Rustington, Sussex, Oct. 7 1918, and was buried in St. Paul's Cathedral, London.

PARSONS, SIR CHARLES ALGERNON (1854–), British engineer, was born in London June 13 1854, the fourth son of the 3rd Earl of Rosse. Educated privately and at St. John's College, Cambridge, he entered the Armstrong Works at Elswick in 1877. In 1884, having served for a year on the experimental staff of Messrs. Kitson, of Leeds, he entered into partnership with Messrs. Clarke, Chapman and Co., of Gateshead. On the dissolution of the partnership in 1889, Parsons, whose invention of the Parsons steam turbine was bringing him into considerable prominence, established his own works at Heaton, Newcastle-upon-Tyne, for the manufacture of steam turbines, dynamos and other electrical apparatus (*see* 25.845). Besides the chairmanship of C. A. Parsons and Co., he occupied important positions on the directorate of various electrical supply and engineering companies. He was made F.R.S. in 1898, was awarded the Royal Society's Rumford medal in 1902, was president of the Institute of Marine Engineers 1905–6 and of the British Association 1919–20. In 1911 Parsons was created K.C.B. In 1884 he married Katherine, daughter of William Bethell.

PARSONS, WILLIAM BARCLAY (1859–), American engineer, was born in New York City April 15 1859. He graduated from Columbia University (A.B., 1879; C.E., 1882). At first he entered the service of the Erie Railroad, but resigned to take up general practice in New York City in 1885 as consulting engineer. He became deputy chief engineer in 1891 to the Rapid Transit Commission of New York City and was chief engineer of the commission 1894–1904. As such he designed and supervised the construction of the first part of the subway system there. He has been connected professionally with railway construction in various parts of the world, especially China. He was a member of the Isthmian Canal Commission, 1904; advisory engineer to the Royal Commission on London Traffic, 1904; a member of the board of consulting engineers of the Panama Canal, 1905; and chairman of the Chicago Transit Commission, 1916. He served during the Spanish-American War as chief of the engineers, National Guard of New York, and in the World War was Major and later Colonel of the 11th U.S. Engineers attached to the B.E.F. and A.E.F. in France.

His publications include *Turnouts* (1885); *Track* (1886); *Rapid Transit in Foreign Cities* (1895); *An American Engineer in China* (1900); *The American Engineers in France* (1920); *Robert Fulton and the Submarine* (1923).

PARSONS, WILLIAM EDWARD (1872–), American architect and city planner, was born at Akron, O., June 19 1872. He graduated at Yale University in 1895 and Columbia University in 1898, where he was awarded the McKim fellowship in 1899, attending the École des Beaux Arts, Paris, and studying under Laloux. He entered the office of J. C. Howard, architect, New York City, in 1901, and was appointed consulting architect to the U.S. Govt. in the Philippines, 1905. He designed many public and other buildings in the Philippines, including the Manila Hotel, Philippine General Hospital, the University Hall, the Manila Club and the Manila Normal School. He also developed and directed the execution of a number of city plans,

including those for Manila, Baguio and Sebu, and instituted the conservation of the old fortifications of the city of Manila as public parks. He resigned in 1914 and returned to the United States, opening practice in Chicago in 1919 with E. H. Bennett as partner. The firm was retained to prepare plans for municipal improvements and town-planning in many parts of the United States, including Chicago, Buffalo, St. Paul, Pasadena and San Juan, Porto Rico.

PASCAL, JEAN LOUIS (1837–1920), French architect, was born in Paris June 4 1837, and at the age of 16 became a pupil of Gilbert. Later, when in the studio of Questel, he entered the École des Beaux-Arts, and amongst other distinctions gained the *Grand Prix de Rome* in 1866. On his return to Paris in 1870, after his four years at the Villa Medici, he was appointed inspector of works at the Louvre and the Tuilleries. In 1872 he became patron of his *atelier*, and thereafter was appointed assessor in public competitions, and subsequently received many distinctions. Amongst these was his election to the council of the Beaux-Arts and president of the jury, and to membership of the Institut de France, and finally he became *commandeur de la Légion d'Honneur*. In his long career the private, as apart from official, work of Pascal was of a very diversified nature, and covered a wide area of ground, domestic and civil, and particularly a long series of artistic memorial monuments such as those commemorating Col. d'Argy at Rome, Henri Regnault at the École des Beaux-Arts and President Carnot at Bordeaux.

Among Pascal's buildings are the Château du Doux, Corrèze, that for the Faculté de Médecine, Bordeaux—a design with much dignity and calm—the painter Perrault's house and studio, Paris, and several villas and châteaux in the provinces—at Pau, Beaulieu, Avignon and elsewhere. He lived long enough to see, at the close of his busy career of over 50 years, the completion of the Bibliothèque Nationale, Paris, a fine building characteristic of his learning and ingenuity. With M. Gaudet, he is responsible for the splendid edition of Blondel's *Architecture Française*, published under the auspices of the French Government. The celebrated *atelier* of which he was for so many years the patron was responsible in his time for the training of many architects to be found later on in every country in Europe, in the United States and in Canada. Among them were Sir John Burnet, Thomas Hastings of New York, Signor Beltrani of Milan and Henri Nénot of Paris. In 1914 he was awarded the gold medal of the Royal Institute of British Architects, but his great age and state of health prevented his receiving this in person. He died in Paris in 1920.

PASCOLI, GIOVANNI (1855–1912), Italian poet, was born at San Mauro di Romagna Dec. 31 1855. After studying at the college of the Scolopi fathers at Urbino, he won a scholarship which enabled him to enter the University of Bologna. There he obtained his degree in literature and was afterwards appointed secondary school teacher successively in Bologna, Massa and Leghorn. He soon began to acquire a reputation as a poet, and in 1891 published his first volume of verse, *Myricae*. After he had won the prize for Latin verse at Amsterdam, he was appointed to the chair of Latin and Greek grammar at the University of Bologna, whence he was transferred first to Messina and then to Pisa as professor of Latin literature; finally he was recalled to Bologna to succeed the poet Carducci as professor of Italian literature, an appointment which he held until his death. He published several other volumes of poetry, *Primi poemetti* (1912), *Nuovi poemetti, Canti di Castelvecchio, Poemi conviviali, Poemi del Risorgimento, Canzoni di Re Enzio* (1908) and *Carmina* (in Latin). Pascoli was a mystic, given to meditation and solitude, and his poetic output faithfully reflects the characteristics of his melancholy and extremely sensitive temperament. He died at Bologna April 6 1912.

See A. Galletti, *La poesia e l'arte di G. Pascoli* (1918); J. J. Hartman, *De Joanne Pascoli poeta Latino* (1920); F. Morabito; *Il Misticismo di Giovanni Pascoli* (1920); A. Valentin, *I Pascoli, Les thèmes de son inspiration* (1925).

PAŠIĆ, NICHOLAS (1846–), Serbian statesman, was the son of a merchant at Zaječar, close to the Bulgarian frontier. He studied engineering first at Belgrade and then, with the help of a State bursary, at the University of Zürich, where he and other young Serbs came under the influence of the Russian revolutionary Bakunin. Where they differed so profoundly from him was in their insistence upon nationality and national liberation as an essential preliminary to all social progress. Pašić was one of a small group of remarkable men who surrounded Svetozar Marković, and on the latter's early death in 1875 became one of the chief exponents of his views, which were of capital importance for the political development of Serbia. He became a deputy in 1878, and was in 1881 one of the founders of the Radical party. Its ambitious programme of constitutional and administrative reform, freedom of the Press and of assembly, and in foreign affairs national unity and a Balkan alliance, brought the party into acute conflict with the reactionary régime of King Milan.

A popular rising which broke out in the Timok district in 1883 led to the arrest of most of the Radical leaders and fresh repressive measures. Pašić fled across the Danube and was condemned to death *in absentia*, remaining in exile till after King Milan's abdication in 1889. On his return he became president of the Skupština and on two occasions mayor of Belgrade. He was Premier for the first time from Feb. 1891 to Aug. 1892, and as Foreign Minister accompanied the young King Alexander on his first visit to the Tsar. As a strong Russophile he was made Serbian Minister in St. Petersburg (Leningrad), but resigned as a mark of protest against the illegal return of King Milan to Serbia in 1894. The Radicals were now in keen opposition, and when an attempt was made on the ex-king's life in 1899 the Government rid itself of their leaders by trumped-up charges of engineering the crime, and imposed savage sentences of forced labour. Pašić, thanks to Russian remonstrances, only received five years and was then amnestied on condition of leaving the country. He only returned after Milan's final withdrawal.

After the fall of the Obrenović dynasty in 1903 the Radical party became dominant, and Pašić was Foreign Minister in 1904 and Premier in 1906 and again from 1908–10. He shared in Milovanović's negotiations for a Balkan League and on his premature death in 1912 became the dominant figure in the Radical party, resuming the Premiership on the very eve of war with Turkey. He remained in office throughout the two Balkan wars, and contributed materially towards the alliance with Greece and the rapprochement with Rumania. While his foreign policy was essentially Russophile, he, on two occasions, in 1912–3 made overtures to Vienna, which Berchtold contemptuously rejected. Discontent inside his own party had led to an important secession, and in the spring of 1914 he was engaged in an acute struggle against the Opposition and had to promise a revision of the constitution.

Parliament had already been dissolved and the electoral campaign started when the murder of the Archduke at Sarajevo brought the already strained relations with Austria-Hungary to a head. But so absorbed was Pašić in internal politics that he was absent from Belgrade when the fateful ultimatum was presented, and even then was preparing to visit Veniselos at Salonica when an urgent message recalled him. Party discord was silenced by the national danger, the elections were postponed and the already dissolved Parliament reassembled at Niš. In Nov. a coalition Cabinet was formed, but Pašić remained Premier, and when in 1917 the Opposition again seceded, he once more formed a purely Radical Government.

In foreign policy he had always relied implicitly on the support of Conservative Russia, and the revolution of March 1917 and the fall of Tsardom weakened his position both at home and abroad. He thus saw himself forced to recede from the strictly Pan-serb and Orthodox attitude which he had taken up, and to negotiate, upon equal terms, with the Yugoslav committee under Dr. Trumbić, the so-called " Declaration of Corfu " (July 1917), which laid down the broad lines of the future unified Yugoslav State. But his relations with the Committee became increasingly strained, and he stubbornly denied to them any status in the allied camp and refused to admit them to a coalition Cabinet.

This attitude was the main reason why the Entente governments withheld from the Yugoslavs that recognition which they accorded in Aug. 1918 to the much less favourably situated Czechoslovaks. The result was that Austria-Hungary collapsed before any agreement had been reached among the Allies on the Yugoslav problem, and that Italy, abandoning the compromise reached at the Roman Congress of Oppressed Nationalities in the previous April, reasserted her full territorial claims under the secret Treaty of London. Despite this dangerous situation Pašić maintained his obstructive tactics not merely towards the Yugoslav committee but also towards the new provisional Government which had been formed in Zagreb and which had at once nominated Trumbić as its spokesman in Paris. Finally, a certain compromise was reached, and while Protić became the first Premier of Yugoslavia, Pašić was made first delegate to the Peace Conference, with Trumbić and Vesnić as his colleagues.

During the first two years of the new State he remained under a partial eclipse, but on his return to Serbia soon reasserted his ascendancy over the Radical party and strengthened its machinery and discipline, as against the loosely knit Democratic party. The first general elections held after the World War (Nov. 1920) gave no party a majority and rendered complicated bargaining inevitable. This situation gave such a superb tactician as Pašić the chance for which he had known how to wait. In Jan. 1921 he again became Premier, and thanks partly to his skilful bargaining with the minor groups and partly to the foolish abstention of the Croat Peasant party, he was able to manoeuvre the new Centralist constitution through Parliament (June 28 1921), and as reprisals for the attempted murder of the Prince Regent and Pašić and for the successful murder of Drašković a month later, to suppress altogether the Communist party. In the following winter he was able to manoeuvre his Democratic allies out of the Government and to form a purely Radical Cabinet. At the elections of March 1923 he failed to secure a majority, but was again saved from an untenable position by the refusal of Radić and his party to enter Parliament and join the rest of the Opposition in overthrowing Pašić. The blunders of his enemies, even more than his own remarkable skill and endurance, rendered him almost indispensable, and though from July to Oct. 1924 he had to give place to a coalition Cabinet under Davidović, he returned to power stronger than ever.

In Feb. 1925 he again dissolved Parliament, threw Radić and his colleagues into prison, and by the adoption of extremely drastic electoral measures secured a small working majority. On this Radić made a complete surrender of his republican, federalist and anti-militarist principles, acknowledged the dynasty and the "Vidovdan" constitution, allowed his deputies to take their seats in Parliament and accept portfolios, and finally, in Oct. 1925, himself entered the Cabinet as Minister of Education. Thus Pašić's tactics of violence successfully overcame the long Croat resistance which had so gravely retarded the consolidation of Yugoslavia and produced for the time an irresistible union of the two strongest parties in the country.

(R. W. S.-W.)

PASTRNEK, FRANTIŠEK (1853–), Czech philologist, studied in Vienna, where he qualified in 1888 as a lecturer on Slavonic philology by his work entitled *Beiträge zur Lautlehre der Slovakischen Sprache in Ungarn*. From 1895 onwards he was a professor of the same subject at the Charles University in Prague. He published many articles and reviews in native and foreign periodicals dealing with Slavonic philology. Among his works may be mentioned *The Slavonic Apostles Cyril and Methodius* (1902). He compiled a bibliographical survey of Slavonic philology between 1876 and 1891. He also made a study of various Slavonic dialects (*cf. Zur Charakteristik der mahrischen Dialekte*, Archiv. fur slav. Phil. XX. 1898).

PATERSON, N.J., U.S.A. (*see* 20.912), increased its population to 135,875 in 1920, of whom 45,242 were foreign-born, and to 141,695 in 1925 (census bureau estimate). The output of its factories was valued at $69,263,000 in 1909; $216,659,000 in 1919; and in 1923, recovering from a drop of 25% in 1921, at $194,857,975, two-thirds being contributed by silk manufactures ($112,100,378) and the dyeing and finishing of silk and other textiles ($20,386,475). Paterson dyes 75% of the silk that comes into the United States and makes 20% of the country's output of broad-silk, in plant units ranging from 10 to 750 looms.

By 1925 Paterson had made substantial progress on a programme for modernising its public school plant. A high school for girls, to be opened in Feb. 1926, was built on a seven acre tract in the heart of the city. By joint action on the part of Paterson and other cities in the Passaic river valley, a trunk sewer was constructed, at a cost of $22,000,000, to carry the sewage of the valley out to Robin's Reef in New York Bay (opened 1924). In 1925 a museum was established in connection with the public library; and a series of lecture courses, called the Paterson collegiate centre, was inaugurated by the chamber of commerce in co-operation with New York University. Work on the elimination of grade crossings on the Erie Railroad was begun in 1924. A city plan commission and a zoning commission were in operation, and in 1926 Paterson was co-operating with other municipalities in a project for securing its own water supply.

PATHOLOGY.—The study of pathology began about 100 years ago and it was in the last 30 years of the 19th century that its importance began to be recognised by definite and separate academic provision for its prosecution. At first it consisted mainly of the investigation of the changes found in the human body after death and their correlation with the signs of disease which had been observed during life.

The large progress made along these lines soon led to its expansion in a variety of directions until pathology came to include almost anything which had to do with disease, and its field included aetiology, pathogenesis, morbid anatomy, microscopic histology, parasitology, functional changes, chemical alterations, and indeed any topic, except diagnosis and treatment, which was open to fairly accurate study. The contemporary progress of medicine and surgery showed also that laboratory methods for the investigation of sick persons afforded valuable aids in diagnosis, this large subject of "clinical pathology" is properly recognised as belonging to clinical medicine rather than to pathology.

This very diverse assemblage of studies forms together a consistent whole, which necessarily suffers by sub-division, but the increase of knowledge in some directions has been so great that it is no longer practicable to treat the various sections as a single discipline, and bacteriology, immunology, protozoology, pathological chemistry and other branches have been progressively separated as specialised topics each with its own devotees, literature and academic staff. It remains here to consider what progress has been made since 1910 in the residuum which still remains under the heading "pathology." Advance here has been relatively small; apart from a tendency to assimilate pathology to the other biological sciences and a considerable increase in the attention paid to functional as distinct from anatomical changes, no ideas or methods of primary importance have emerged to cause any great change in general outlook, and workers have mostly been engaged on the elaboration and consolidation of the position represented by the article in the 11th edition (*see* 20.913). Pathology in its restricted sense may be taken to mean the study of the reactions of living organisms to injury—the investigation, that is, of what the body does in response to abnormal conditions and circumstances imposed upon it.

Nature of Injury.—The injury may be of very various kinds: mechanical trauma, injury by poisonous substances (many of the most important of which are produced by parasites), defective supply of food (*e.g.*, by living at high altitudes or by errors of diet), electricity, radiation energy and other factors which are still indefinite. The injury may immediately cause gross alterations in structure, and it is known that the physical injury of a cell often entails radical changes in the biological and chemical characters of its protoplasm which depend in some way on its architecture as a whole. Or the injury may be anatomically perceptible though unaccompanied by any large structural changes. Or it may, like electric shocks, cause no visible change and yet lead to a complete and permanent cessation of the activities

which constitute what we know as life. Or, finally, it may cause no anatomical changes recognisable by present methods and be put in evidence only by greater or smaller alterations in function.

The obvious anatomical changes in injured tissues with which the early students of pathology mostly concerned themselves are not as a rule the direct and immediate consequence of the injury. They result partly from alterations which take place in cells after death by the process known as *autolysis* and partly from the activity of the uninjured and healthy cells in the neighbourhood and elsewhere in the body which constitutes the response or *reaction*.

Autolysis.—This is the mechanism by which dead tissues tend to be automatically removed. The normal body consists of life-cells and certain products of live cells (such as bone) which are not wholly dead in that they are in functional relation to living tissues. Any dead cells constitute therefore abnormal or foreign elements and it is required to remove them if restoration of the normal structure is to be achieved. When cells die, ferments are set free which act on the substance of the cell much in the same way as the digestive juices act on food in the alimentary canal. The solids are liquefied and so readily absorbed into the circulating blood, carried away to other parts of the body and if necessary, excreted. Autolysis is naturally signalised by substantial structural changes recognisable naked-eyed or by the microscope. The translucency, colour and consistency of the part are altered, and it is on the recognition of these secondary changes that morbid anatomists depend. Under the microscope the nuclear membrane and chromatin, the protoplasm and the cell wall become more and more disorganised until nothing remains except amorphous débris.

The *reaction* by the uninjured parts of the body is the means by which the effect of the injurious agent is diminished and the normal constitution of the injured part restored as far as may be possible. It may be local or general. Many of the symptoms and signs of disease are due to it rather than to the injury which is the beginning of the disease.

Cellular Processes.—In the higher animals, cells which are mechanically injured or which have suffered gross structural change seem as a rule to be incapable of recovery: nerve cells may have their long processes cut off and be able to repair the damage, but such facility is quite exceptional. It is more frequent in lower forms of life but here, too, in unicellular animals such as bacteria any substantial injury is usually irrecoverable and is made good not by the restoration of the individual but by a compensatory increase of the other members of the community of which the injured cell formed a part. Similarly in man, when a part is injured, the whole of the body is available and may be used in co-operation to bring the part, and with it the whole, back to normality. This reaction, whatever its real nature, has the appearance of being purposive in the sense that it is adapted to achieve a definite end.

Pathological changes indeed illustrate exquisitely two great biological truths. The first is that it is characteristic of all live organisms to resist any alterations in their structure and composition and, if these are varied by circumstances which are beyond control, to proceed actively to correct the deviation and so return to the normal state. The second is that all the parts of which the organism is composed work together and in relationship to one another for the common good. A growing realisation of these principles has been one of the most productive changes in recent pathological thought. It carries the corollary that the anatomical changes, which are generally the first objects of study, must be regarded as representing phases of processes rather than definitive states. The mode of thought which has collected into museums specimens of morbid anatomy and classified them as if they were species of animals should be replaced by one which regards a hypertrophied heart, a cirrhotic liver, or a sclerosed kidney, not as a " typical " example of a state, but as an illustration of one stage in a process by which the body has responded to a stimulus of injury.

Mechanism of Reaction.—The general nature of the reaction being purposive and restorative, it is likely that the particulars of the mechanism by which it is brought about will vary widely, since the constants of live organisms are the ends which are achieved rather than the means by which they are reached. Such is the case as will be seen from some illustrative examples.

The human economy is adjusted to live in air at a pressure of about 760 mm. of mercury containing 21 % of oxygen: a compromise of the conflict between having a blood of a tolerable viscosity for the heart to pump round the body and one which will carry an adequate amount of oxygen from the lungs to the tissues has been found at a concentration of about 5,000,000 red corpuscles per cu. mm.; and the respiratory centre is adjusted to respond to a pressure of carbon dioxide which corresponds to about 40 mm. of mercury in the alveolar air. If man goes to an altitude of 15,000 ft. above sea level, where the barometric pressure is only some 440 mm. of mercury and the oxygen pressure correspondingly reduced, he is at once in difficulties in respect of the supply of oxygen, especially if the need for it is increased by activity. No clear injury is inflicted on the tissues of the body which can be recognised by anatomical changes, but the shortage of oxygen causes plain symptoms and initiates a response the effect of which is to correct the deficiency wholly or in part. This is done by altering the sensitivity of the respiratory centre so that it responds to a lower pressure of carbon dioxide and so increasing the amount of air breathed, by changing the composition of the blood so that the haemoglobin will take up more than the normal amount of oxygen at a given oxygen pressure and by stimulating the bone marrow to grow and produce more red corpuscles so that the concentration of haemoglobin in the blood and hence its oxygen-carrying power are increased. The connecting links between the deficiency of oxygen and this complex reaction (*i.e.*, the immediate stimuli to which the reactions are responses) are not known. The result is that man can soon live comfortably under conditions so different from those to which he is accustomed that they would cause serious harm if not compensated.

Simple wounds.—A simple incised *wound* of the skin and superficial tissues made by a knife which is chemically and bacteriologically clean inflicts an uncomplicated mechanical injury on a limited number of cells in the epidermis and dermis. This is followed after a few hours by a familiar reaction: the injured part feels full and uncomfortable and is swollen, red and painful. These are the outward signs of an inflammatory reaction, which consists intimately in a dilatation of the blood vessels, an increased flow of blood to the neighbourhood and an alteration in the walls of the capillary vessels which enables liquid plasma and leucocytes to pass through from the blood to the tissue spaces. The cells killed by the injury undergo autolysis and in the course of a few days they are replaced by fresh cells derived from the adjacent epithelial cells of the skin and from the connective tissue of the dermis, as is appropriate.

The result in the end is that the wound is healed and the part restored to normal. It is impossible to suppose that this reaction is started by the absence of the cells which were originally destroyed: the actual stimulus is no doubt provided by the soluble products of their autolysis, which can be shown outside the body to have a stimulating action on cell-growth and by suitable experiments to alter the permeability of capillary vessels. The process is self-regulated and the inflammatory reaction is accessory to the restorative growth. By increasing the local circulation it raises the temperature of the part and so promotes all cellular activities; it provides plasma, which helps to wash away the soluble remains of the dead cells, and leucocytes, which eat the more resistant remnants of the cells; the discomfort which attends the hyperaemia and swelling is of value in securing rest to the injured part and freedom from further mechanical disturbance, conditions which help cell-growth and healing. The process is also automatically regulated quantitatively for the amount of autolysate, *i.e.*, the amount of stimulus, depends on the extent of the original injury. Its effect varies with the responsivity of different tissues and, allowing for that, is determined by its concentration. If this is very high, which occurs in the ordinary way only with exceptionally massive destruction of tissue, it injures and kills cells and is responsible for the fatal condition known as secondary shock which may follow extensive injuries. Lower concentrations stimulate growth, as often happens with cellular poisons. And if the products of autolysis are present only in concentrations below the threshold value for stimulation, they have no action on the tissues. Hence in the example under consideration the response is limited to the immediate neighbourhood of the injury and the growth of cells takes place where it is needed and not in all the parts of the body to which traces of autolysate are carried in the blood. The local reaction to a bullet or a piece of glass buried in the tissues illustrates the same regulative reaction. The response consists in a growth of the connective tissue next to the foreign body without any obvious destruction of cells, due to the irritants nowhere reaching an actually poisonous concentration owing to their small solubility in the tissue fluids.

Abscesses.—The history of an *abscess* illustrates a similar kind of injury stimulus and response, complicated by the fact that the infliction of the injury is itself a process rather than an event. Abscesses can be produced experimentally by unorganised irritants, but in the natural course they are caused by bacteria which are capable of

multiplication and produce poisonous substances which are effective agents in killing and injuring cells, and as stimuli have, in a general way and apart from special actions, the same effect as the products of autolysis. At first the organisms are present only in small numbers and do relatively little damage, but as they increase in numbers the amount and concentration of their poisons increase in parallel until a substantial piece of tissue is destroyed. This undergoes autolysis and the stimulus of the autolysate is added to that of the bacterial toxins.

Hence in a developed abscess three zones may be distinguished. In the centre, where the stimuli are at their highest concentration, there is an area filled with a more or less fluid mass (*pus*) composed of leucocytes and plasma from the inflamed blood vessels in the neighbourhood, the causative bacteria and the dead cells of the part and their disorganised remains. Different tissues are killed at different concentrations; highly differentiated cells such as those of the liver, kidney and other specialised organs generally succumb easily, while the white fibrous connective tissue which forms a skeleton framework of the whole body is particularly resistant. There may therefore be an area of differential destruction at some place in the falling gradient of concentration resulting from diffusion from the central point. Surrounding the pus is a zone where the concentration of stimuli is not enough to kill cells but is adequate to stimulate them to grow; hence we find all round the pus an area of active inflammation and a wall of growing connective tissue which acts as a filter in preventing the bacteria and their poisons spreading through the body unhindered. Beyond this zone the tissues seem generally to be unaltered on superficial examination, and for the most part this is so.

That specially sensitive cells may, however, be injured is shown by the fever and feeling of illness which an abscess may cause and by the functional impairment of the secretory cells of the kidney and stomach and other delicate tissues. We also find evidence of the reception of stimuli in distant parts of the body in the growth of leucocytes in the bone-marrow. Any good-sized abscess contains in its pus more leucocytes than are present at any one time in the circulating blood, from which it follows that the formation of an abscess leads to the production of fresh leucocytes and that the cells which develop into leucocytes must be exceptionally responsive to the small amounts of stimulating substances which reach them. This deduction is confirmed by direct examination of the bone-marrow where leucocytopoiesis is found going on actively, often with a vigour which results in there being an obvious excess of these cells in the circulating blood. The purposive and reparative nature of this reaction needs no further elaboration beyond indicating that the passage of plasma out of the inflamed vessels brings antibodies (*see* IMMUNITY) to bear on the bacteria to which the leucocytes are also directly inimical and that the general, as contrasted with the local, rise of temperature promotes the multiplication of leucocytes at places distant from the abscess itself. The reaction does not always succeed: the bacteria may generate such a concentration of poisons throughout the body as is fatal to essential organs such as the brain and heart. On the other hand, an abscess may cure itself by destroying so much tissue that the pus finds an exit to the surface of the body and the absorption of poisons ceases because it becomes mechanically easier for them to pass outwards with the stream of plasma than inwards—a process of natural cure imitated and anticipated by surgical interference. The same result is gained if the bacteria die out or are killed off.

Hypertrophy.—If one kidney is removed from a young animal, the other kidney will grow in the course of a few months to twice its normal size. Similarly, if an error of development leads to one kidney being absent from the beginning, the other will be as big as two normal kidneys. In this instance the injury inflicted on the kidney is the presentation of more work to do than it was designed to discharge, and an analogous increase of both kidneys can be brought about by increasing their work by giving excess of water or of nitrogenous food. Muscle and many of the other tissues of the body show the same intimate relation between quantity of substance and quantity of function and will increase their bulk in response to greater functional requirements.

The intermediary mechanism of this *hypertrophy* has not been identified, but the similarity between the products of activity and those of autolysis is suggestive and it may well be that the normal sizes of organs which accompany normal amounts of work are determined by the soluble substances which are set free in active katabolism. So, too, if functional activity is reduced, the bulk of corresponding tissue becomes smaller. An unused muscle soon wastes, and in consonance with the quietude of old age most of the important organs shrink. If the arm is cut off at the elbow, the muscles which normally move the lower arm wither, the bones to which they are attached grow smaller, and the nerve cells in the spinal cord which actuate them may disappear.

Two points need further mention: (1) The removal of one kidney has no detectable ill-effect on an animal or man; one kidney is evidently enough to do the ordinary excretory work which is required. But the kidneys and other organs are designed to discharge, and are capable of discharging, much more than the ordinary amount of function; a muscle can at any moment do more than its average work and indeed more than it has ever been called upon to do before. The possession of this *reserve force* is an obvious teleological necessity for survival, and so precise is the response to an increase of average work that it is maintained in hypertrophied as well as in normal organs. (2) If the increase of work is too large, hypertrophy does not occur, *i.e.*, the stimulus to hypertrophy is an amount of extra function within the range of the reserve force of the organ. This is a well recognised principle in the training of voluntary muscles for athletic or aesthetic purposes.

All these circumstances of the response to work seem to be best explained on the hypothesis that an organ is made up of a number of units, each of which requires a restorative period of rest after each of the periods of activity which are necessary for its maintenance. To fulfil the ordinary amount of function only a proportion of units is active at any one time; as their activity proceeds they become, in accordance with the general law, progressively less excitable by the stimulus which rouses their activity and eventually cease to respond. Their function is then taken over by another set of units which, after a period of rest, are more responsive. In this way a larger number of units is kept in working order than is usually required. The maximum possible work is the amount which can be achieved by all the units working simultaneously: this is the limit of the reserve force, and if it is habitually reached no units have time for the necessary rest and restoration, the organ is worn out and cannot make hypertrophic growth.

These reparative responses are not the inevitable result of the application of the appropriate stimulus: the reaction may not occur if it is unnecessary or undesirable. If the portal vein bringing blood to the left half of the liver is tied, the left lobe progressively atrophies and the right lobe hypertrophies so that at any time the total quantity of liver substance remains about normal. But if the right lobe is injured by tying its bile duct, it does not hypertrophy and the left lobe does not atrophy, though it receives blood only through the hepatic artery. The atrophy is conditioned by the total functional requirements of the body for liver tissue and does not necessarily follow the reduction in blood supply. If rabbit's blood is injected into the circulation of a normal rabbit, the excess of liquid is got rid of in a few hours, and the excess of red corpuscles in ten days or so and the normal position is regained. If such a transfusion is repeated, the excess red cells are destroyed in two or three days and the animal can be brought by practice to a habit of disposing of them promptly. If such a trained animal is bled and then transfused with an equal quantity of blood from another rabbit, no destruction of the injected blood occurs. The difference is that the extra blood is not wanted by the normal animal while the bled animal has need of it to carry oxygen: in the former it is destroyed, in the latter it is kept and used.

Response.—Of the circumstances which facilitate response, age and experience are the most important: their influences will often be antagonistic. The inherent capacity of a tissue to grow and discharge any of its functions steadily diminishes as the organism of which it forms a part grows older. But its available ability to do anything is influenced by whether and how often it has done it before, individually and racially. Experience in such exercises as reproducing blood which has been lost by haemorrhage or making the substances which neutralise bacterial poisons gives the same advantage as it does in the more complicated reactions of behaviour. In general, the most effective preparation for successful resistance to a large injury is the previous reception of small injuries of the same kind.

Reactions to stimuli may fail in whole or in part because the stimulus is too large and kills the whole organism or because the tissues are old or already diseased. In some instances it is the nature of the tissue which mostly determines the imperfection of the result. Blocking of one of the smaller blood vessels of the heart kills the muscle which the vessel normally supplies. The dead muscle autolyses and is removed, and its place is taken by fibrous tissue instead of by cardiac muscle, which is inherently incapable of the necessary multiplication of cells. The repair is for the time effective but it is unsatisfactory, for fibrous tissue is less elastic than muscle and is liable to tear. The nerve cells of the central nervous system never grow to repair an injury: if some of them are destroyed they cannot be replaced, and the best that can be achieved is a certain amount of functional restoration by the rearrangement and adaptation of the parts which remain. In other cases, the nature of the injury and the mode of its infliction determine the result. The common sclerosis of the kidney begins by the destruction of a proportion of the glomerulotubal units of which the organ is composed by some poison circulating in the blood. The dead tissue is cleared away and, since kidney cells cannot adequately regenerate, the gap is healed by the growth of the connective tissue. Later, which is characteristic of the disease, further destruction takes place and so on from time to time, each loss of secreting tissue being followed by fibrous tissue repair. The other units, as might be expected, hypertrophy, and up to a point function is adequately maintained, partly by the local reaction and

partly by a general rise of arterial blood pressure backed by a hypertrophied heart which tends to compensate the diminution of vasomotor mobility and control resulting from the anatomical changes. But if successive injuries continue, the limits of the possible hypertrophy of the remaining healthy tissue are exceeded and its growth is impeded by the firm fibrous tissue which comes to constitute a large part of the organ. Hence, in the end, function fails, as it finally must if repeated injuries are inflicted on tissues which cannot be vicariously replaced and are capable only of compensatory hypertrophy (*i.e.*, most specialised tissues) and not of indefinite regeneration (*e.g.*, connective tissue, blood corpuscles).

These examples are sufficient to illustrate the kind of topics which form the subject-matter of pathological study and the way in which they can at the moment be fruitfully approached. The reaction to injury (using the word in a wide sense) is a process which is initiated by some definite stimulus arising within or outside the body and generally promoted and extended by secondary stimuli which are produced by the body in the early stages of the response. The injury and the response may be local or general; general injuries may provoke local reactions, and local injuries may elicit responses in which many organs take part. The organism in this, as in other respects, has to be regarded as a coherent and essentially indivisible whole, and one must recognise the limitations of the point of view, fruitful enough in the past, from which a live animal appears as an assemblage of relatively independent cells or organs. The character of the response is such that it tends to correct in one way or another the anatomical defect or the functional derangement which is caused by the injury. Whatever the mechanism by which the result is attained, the reaction is purposive in appearance if not in intention, and its purpose is survival.

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PATIALA, SIR BHUPINDAR SINGH, MAHARAJA OF (1891–), head of the Sikh community in India, was born Oct. 12 1891, the son of Maharaja Sir Rajendra Singh, who died in Nov. 1900. He was carefully trained, and on receiving full ruling powers at the close of 1910 maintained and greatly developed the progressive policy of the council of regency, applying himself with great assiduity to the moral and material welfare of his people. In the World War the contribution of Patiala to the Indian Army, including Imperial service troops, was increased from about 4,000 men to 28,000, and as the recognised head of the Sikh race the Maharaja exercised an enormous influence in promoting recruitment from other parts of the Punjab. His subjects saw active service in nearly all the theatres of war, and won 125 battle distinctions. He also took part in the Afghan War (1919). He took a prominent part in promoting the inauguration of the chamber of princes in 1921 and represented the princes at the League of Nations Assembly at Geneva in 1925.

PATON, JOHN BROWN (1830–1911), British Nonconformist divine (*see* 20.930), died at Nottingham Jan 26 1911.

PATON, JOHN LEWIS ALEXANDER (1863–), British educationalist, was born in Sheffield on Aug. 13 1863, the son of the Rev. J. B. Paton, D.D., afterwards principal of Nottingham Congregational Institute. Educated at Nottingham High School and Shrewsbury School, where he was head boy, he went to St. John's College, Cambridge, where he was bracketed first in the classical tripos (Part I.) and became a fellow of his college. He studied also at Halle. After a year as a master at the Leys School, Cambridge, and 10 years at Rugby, he was appointed headmaster of University College School, London, in 1898. In Sept. 1903 he was appointed high master of Manchester Grammar School and held the post till July 1924. On his retirement a fund was raised in his name to commemorate his services to the town and district, as well as to the school. Paton was a member of the consultative committee of the Board of Education from 1907 to 1915, was lecturer on education in Victoria University and president of the Teachers' Guild (1907) and of the Modern Languages Association (1911). He was a zealous advocate of the social and religious, as well as the literary sides of education.

He published in 1914 a *Life of J. B. Paton*, and his educational works include *Chapters on the Aims and Practice of Teaching* (1896); *The Public Schools from Within* (1906); *The Higher Education of Boys in England* (1906); *Cambridge Essays on Education* (1917); *Vocation* (1919); as well as a special report for the Board of Education on *The Teaching of Classics in Prussian Elementary Schools* (1907).

PÄTS, KONSTANTIN (1874–), Estonian politician, was born in the Pärner district. After completing his studies in the faculty of law at Dorpat University, he became in 1901 editor of the *Teatajă* (Newsheet), the first daily paper in the Estonian language. This journal maintained radical principles and gave much prominence to economic questions. Päts then devoted his energies to organising the Estonian citizens and secured municipal administration for Estonia from the Russians, being himself appointed assistant to the Mayor of Revel. During the revolution of 1905, when the Russian authorities gave way to panic, Päts was the real ruler of the town. He brought about a compromise with the Social Democrats and thus succeeded in protecting Revel from plunder and excess. When the Russian punitive expeditions arrived he was sentenced to death by the military court, but the sentence was later commuted by the ordinary courts to imprisonment for one year.

While the Russianising wave was passing through his country during the World War Päts effected a compromise in 1915 with the Estonian nobility in connection with a reorganisation of the mediaeval system of local autonomy, which was cancelled, however, by the Russian authorities. After the revolution of 1917 Päts became head of the national administration, and on the declaration of independence of Estonia on Feb. 24 1918 he formed the first temporary Government. Owing to resistance to the plans for the formation of a Baltic Duchy he was imprisoned by the German Occupation authorities, but on the collapse of German rule he returned to the head of the temporary Government. He then began the political organisation of the peasant movement and fostered the steady growth of the Agrarian party. Päts became President of the Riijikogu and Prime Minister in 1920–2 and again in 1923.

PATTERSON, JOSEPH MEDILL (1879–), American publisher and editor, was born in Chicago, Ill., Jan. 6 1879. He graduated from Yale University in 1901 and joined the staff of the Chicago *Tribune*. He was elected a member of the Illinois House of Representatives in 1903, and acted as Commissioner of Public Works, Chicago, 1905–6. In 1914 he became associated with his cousin, Robert Rutherford McCormick (*q.v.*), as co-editor and publisher of the Chicago *Tribune*, which, under their direction, rose to be one of the most influential and successful papers in the United States. He acted as war correspondent in Belgium and France, 1914–5; served with the U.S. Field Artillery in Texas, 1916; and also with the A.E.F. in France, taking part in the second battle of the Marne, St. Mihiel and the Argonne. Enlisting as a private he rose to the rank of captain in the 149th F.A., 42nd Division. He was the author of *A Little Brother of the Rich* (1908); *Rebellion* (1911) and *Note Book of a Neutral* (1915).

PATTI, ADELINA JUAÑA MARIA (1843-1919), British singer (*see* 20.937), died at Craig-y-Nos Castle, S. Wales, Sept. 27 1919.

PAUL, SAINT: *see* CHRISTIANITY.

PAUL-BONCOUR, JOSEPH (1873–), French politician, was born at St. Aignan, Aug. 4 1873. After a brilliant university career, he joined the Paris Bar. His book *Le fédéralisme économique*, published in 1900, showed him an ardent advocate of the trade union movement, and in 1906 he was elected to the Chamber as an independent Socialist, a follower of Painlevé, by his native district of Loire-et-Cher. In 1911 M. Paul-Boncour was appointed Labour Minister in the Radical Monis-Bertaux Cabinet and in this capacity was successful in applying the new Old Age Pension Law. In the elections of May 1914, however, he was defeated by a narrow margin of 35 votes. On the outbreak of the World War he became a commander on the Lorraine front. Meanwhile, he had definitely joined the Socialist party, thus fulfilling a promise made to Jaurès, a few months before the latter's tragic end. He was returned to the Chamber at the Nov. 1919 election and at once joined forces with Léon Blum in the struggle against the national Bloc. He was again returned

in 1924, this time as deputy for Jaurês' former constituency of the Tarn. He was also one of the French delegates to the fifth and sixth assemblies of the League of Nations, 1924 and 1925, and acquired great prestige at Geneva. He became the recognised leader of the right wing of the French Socialist party.

PAUPERISM: *see* POOR LAW.

PAVLOV, IVAN PETROVICH (1849–), Russian physiologist, was born Sept. 14 (old style) 1849 in the district of Ryazan in Russia, son of the village priest. He studied science at the University and then medicine at the military medical academy of St. Petersburg (Leningrad). He graduated as a doctor in 1883, and in 1884 was appointed *privat-dozent* in physiology, but he went for two years to Germany to work under Ludwig and Heidenheim. In 1890 Pavlov was appointed director of the physiological department of the institute of experimental medicine at St. Petersburg and in 1897 professor at the medical academy. In 1907 he was elected member of the Russian academy of sciences. He is famous for his leading work on the problems of digestion, *The Work of the Digestive Glands* (Eng. tr., 1902) (for which he was awarded in 1904 the Nobel Prize) and for research on cerebral activity and the theory of reflexes. His first achievements were on the physiology of blood circulation. He devised special methods of treating animals, which enabled him to make observations under normal conditions of the organism. His first papers appeared in 1878–9. From 1892–7 a series of papers on the physiology of digestion was published in the *Archives des Sciences Biologiques*. In 1897 a collected account was published in German and French, *Die Arbeit der Verdauungdrüsen*. Most of his and his pupils' researches are published in Russian. In 1907 Pavlov was elected a foreign member of the Royal Society and in 1915 he was awarded the Copley medal. See M. Dontchef-Dezeuze, *L'Image et les Réflexes Conditionnels dans les travaux de Pavlov* (1914).

PAVLOVA, ANNA (1885–), Russian dancer, was born in St. Petersburg (Leningrad) Jan. 31 1885. At the age of 10 she entered the Imperial Ballet School, attached to the Marianski Theatre, St. Petersburg, and subsequently became prima ballerina of this theatre. She later appeared at the Imperial Opera House in St. Petersburg, and in 1910 made her first visit to England. Assisted by Michael Mordkin she appeared with conspicuous success at the Palace Theatre, London, in "Le Cygne," "Les Papillons" and "Valse Caprice." In the same year she appeared in Paris with Diaghilev's Russian ballet in "Les Sylphides," "Pavillon d'Armide" and "La Nuit Egyptienne"; and also in New York in the ballet "Coppelia." Later, after making regular appearances in London for some years at the Palace Theatre, she toured in the United States. In the autumn of 1923, 1924 and 1925 she appeared with her own company at the Covent Garden Opera House, London, in "Dionysus," "Don Quixote," "Amarilla," "The Fairy Doll" and other ballets. During her career Mme. Pavlova toured all over the world, and her performances were invariably assured of an especially appreciative and enthusiastic reception in London and New York.

PEACE CONFERENCE: *see* PARIS, CONFERENCE OF.

PEARCE, CHARLES SPRAGUE (1851–1914), American painter (*see* 21.24), died in Paris, France, May 18 1914.

PEARL, RAYMOND (1879–), American biologist, was born at Farmington, N.H., June 3 1879. He graduated from Dartmouth College (A.B., 1899) and the University of Michigan (Ph.D., 1902), afterwards proceeding to the University of Leipzig, the Naples zoological station and University College, London. After being instructor in zoology at the University of Michigan and the University of Pennsylvania (1902–7), he was appointed biologist and head of the department of biology at the Maine Agricultural Experimental Station in 1907. He became professor of biometry and vital statistics in the school of hygiene and public health, Johns Hopkins University, in 1918, and professor of biology in the medical school there in 1923. In 1925 he was appointed director of the Institute of Biological Research, a new division of Johns Hopkins University. He became known through his biological researches on variation in organisms, and his studies in heredity. He was a member of the executive committee, chairman of the agricultural committee and member of the executive board of the National Research Council, 1916–9, being also chief of the statistical division of the U.S. Food Administration, 1917–9. (*See* DEATH.)

Pearl wrote, among other works, *Variation and Differentiation in Ceratophyllum* (with O. M. Pepper and F. J. Hagle, 1907); *Variation and Correlation in the Crayfish* (with A. B. Clawson, 1907); *Diseases of Poultry: Their Etiology, Diagnosis, Treatment and Prevention* (with F. M. Surface and M. R. Curtis, 1915); *Modes of Research in Genetics* (1915); *The Nation's Food* (1920); *The Biology of Death* (1922); *Introduction to Medical Biometry and Statistics* (1923); *Studies in Human Biology* (1924); and *The Biology of Population Growth* (1925).

PEARSE, PATRICK HENRY (1879–1916), Irish leader, was born in Dublin Nov. 10 1879. Educated at the Christian Brothers Schools and the Royal University of Ireland, he became editor of the *Claidheamh Soluis*, the weekly organ of the Gaelic League. He was secretary to the publication committee of the League and an energetic member of its executive. After touring Belgium to study bilingual methods, he published several *Fiana*, tales from Irish manuscripts. Pearse's chief interest was education and he approved Mr. Birrell's Irish Education Bill (*see* 14.788), as it gave the Irish control over their own education. He founded a school at Cullenswood, Dublin, moving it in 1910 to the Hermitage, Rathfarnham, where he continued to run it until his death. After a tour in America, Pearse joined the Irish Volunteer Movement and was commander-in-chief of the Irish forces in the rebellion of 1916. On April 30 1916 he sent out an order to his troops to surrender. He himself was arrested and executed on May 3 1916.

PEARSON, SIR CYRIL ARTHUR (1866–1921), British newspaper proprietor, was born at Wookey, near Wells, Feb. 24 1866, and was educated at Winchester. He early founded the business of C. Arthur Pearson, Ltd., newspaper proprietors and publishers; and after making large profits with *Pearson's Weekly* and other periodicals he founded in 1900 *The Daily Express*, a halfpenny rival to *The Daily Mail*. In 1904 he purchased *The Standard* with *The Evening Standard* (*see* 19.560). Under his control *The Standard* reverted to the policy of colonial preference which it had advocated nearly 50 years previously. He was a strong supporter of Mr. Chamberlain's tariff reform movement, and was vice-president of the Tariff Reform League and vice-chairman of the Tariff Commission of 1903. In 1905 he amalgamated *The Evening Standard* with *The St. James's Gazette* which he had bought a few months previously. In 1910 increasing—later complete—failure of sight obliged him to retire from the active direction of newspapers. Henceforth he devoted himself and his fortune with whole-hearted industry to efforts to ameliorate the condition of the blind. During the World War he established at his house, St. Dunstan's, in Regent's Park, London, a hospital for blinded soldiers, and became chairman of the Blinded Soldiers' and Sailors' Care Committee (1914). He also became president of the National Institution for the Blind. He was created a baronet in 1916 and G.B.E. in 1917. Sir Arthur died in London Dec. 9 1921.

PEARSON, KARL (1857–), British mathematician, was born in London and educated at University College School and at King's College, Cambridge. He was called to the bar in 1882, and afterwards devoted himself to the science of eugenics, becoming a leading authority on the subject. He was subsequently appointed Galton professor of eugenics at London University and director of the Francis Galton laboratory for national eugenics. He was awarded the Darwin Medal of the Royal Society, of which he was elected fellow in 1896, for his numerous contributions to the mathematical theory of evolution and heredity. Professor Pearson was the editor of *Biometrika* from 1902–24, and his other publications include *The Ethics of Freethought* (1887, 1901); *The Chances of Death, and other Studies in Evolution* (1897); *Grammar of Science* (1899, 1900, 1911); *National Life from the Standpoint of Science* (1901); *Tables for Statisticians* (1914); *The Life, Letters and Labours of Francis Galton* (1925).

PEARY, ROBERT EDWIN (1856–1920), American Arctic explorer (*see* 21.30) died in Washington, D.C., Feb. 20 1920. On account of his discovery of the North Pole (1909) he was promoted rear-admiral in 1911 and received by special Act the thanks of Congress. The same year he was U.S. delegate to the International Polar Commission in Rome. During his later years he was much interested in aerial navigation. He was the author of *The North Pole* (1910) and *Secrets of Polar Travel* (1917).

PEAT (*see* 21.31), the fibrous substance formed chiefly of the remains of bog mosses growing in swampy places, has long been used for fuel, firelighters, fertilisers and litter for animals and in the production of gas, charcoal and various by-products. In the present century its use in making bandages, wadding, spinning-fibres, paper, cardboard, millboard, non-conducting coverings, building blocks, finger plates and other moulded articles has formed the subject-matter of numerous patents. More than half the water of fresh peat is so closely associated with its organic constituents that it is practically impossible to reduce by pressure the water content to an amount, *e.g.*, 25%, desirable for most commercial purposes.

Methods of Treatment.—Ekenberg's wet-carbonising process has been improved in details. In this process, a mixture of peat and water circulates through an arrangement of highly heated tubes; by this treatment the cell structures of the peat are broken down and the liberated water is then removed by pressure. In Messrs. Testrup, Rigby and Söderlund's process (British patent specification No. 17610 of 1911), apparatus for wet-carbonising and briquetting peat is worked in association with a generator plant adapted for the recovery of ammonia. The process may be worked so that, by using some of the peat briquettes in the generator, the heat requirements of the process are met and ammonia and a surplus of gas and briquettes are obtained. In the process of Dr. Perkin and the Bettisfield Trust Co. Ltd. (British specification No. 288993), the peat is macerated and transferred to a digester, which delivers it into a large cooling chamber in which the pressure on the peat is reduced suddenly; the peat is then pressed, cooled and briquetted. The briquettes are hard, contain about 18% of water and are said to yield a high quality charcoal. Other processes for facilitating the removal of water from peat, by pressure, are the repeated cutting and mixing of the peat until it is a pasty mass, like mustard (Herman de Meijer); grinding to a very fine state in ball or tube mills (Nielsen); treating with slaked lime and removing the released water by means of centrifugal machines or presses (Sirocco Engineering Co., Belfast); and mixing with about one-third of dried peat (Brune-Horst process), coke dust and other substances.

Many successful processes for treating peat on a large scale are modifications of the old air-drying process. At the Alfred Peat Bog, Ontario, the excavated peat is transferred to the drying ground, cut into blocks and exposed to the air by mechanical means and stored under cover. The peat at the Wiesmoor Peat Station, Germany, is macerated before being spread on the drying ground. Near Vislanda, Sweden, where the Ekelund system has been used, the peat is spread on the drying ground by an arrangement of travelling screens; the peat blocks obtained are crushed, dried and pulverised to obtain a very dry peat powder for use in locomotives. At Juurkopi in Finland and Schwanberg in Oldenburg the peat is cut into and washed into storage pits by jets of high-pressure water. This process is useful in working bogs containing trunks of trees.

It has been proposed to obtain charcoal, oils, wax, ammonium sulphate and acetic acid by low temperature carbonisation of peat. Dry peat has been used in gas generators at Portadown, Ireland. The Fuel Research Board also has obtained good results by using peat in Glover-West vertical retorts. The Power-Gas Corporation Ltd., making use of Mond generators at Orentano in Italy, in Westphalia, at Osnabrück in Hanover and near Moscow, has employed " wet peat " (60 to 70% water) for obtaining gas, charcoal and by-products. (*See* also FUEL PROBLEMS.) (T. E. L.)

PEEL, ARTHUR WELLESLEY PEEL, 1ST VISCOUNT (1829–1912), British statesman (*see* 21.39), died at Sandy, Beds., Oct. 24 1912.

He was succeeded by his son William Robert Wellesley Peel (b. 1867) who, in 1916, was chairman of the committee on the detention of neutral vessels. In 1919 he was appointed Under-Secretary for War, in 1921 became Chancellor of the Duchy of Lancaster, and from 1922–4 was Secretary of State for India. When Mr. Baldwin formed his second Government in Nov. 1924 he was made First Commissioner of Works.

PEKING (*see* 21.61), the capital of the Chinese republic, with a population estimated at 1,181,400 in 1923, has been much improved since the revolution of 1911. The duties of the municipality are carried out by the Ministry of the Interior, which aims at making Peking a model city. A Chinese self-government association was formed in 1921, to agitate for the foundation of a municipal council. The chief streets have been metalled and lighted; water, sewage and electric light systems installed; new roads made and tramways laid; and a municipal fire brigade, a central hospital, a model prison and a Government industrial museum (with a factory for native handicrafts) opened. There are a number of foreign banks, and the Chinese banks have made great progress in recent years; the Peking Bankers' Association, founded in 1919, opened a fine building in 1920. A wireless telephone system to Tientsin was started in 1922. The reorganised police have recently been replaced by the military.

The Kalgan railway had reached Paotow in 1923, but the road-bed was not completed. Railway traffic conditions have been improved by the location of the termini of the lines to Mukden and Hankow at the reconstructed Chien Men, the great south gateway of the Tartar city. A circular line to link up the stations, which has involved the destruction of the curtains of most of the gateways, has been built; the wall of the Imperial City has been pierced in a number of places, and broad thoroughfares driven through the Forbidden City. The deposed Manchu Emperor keeps his court in a small part of it, less than half a mile square. The three palaces have been repaired, and the Temple of Heaven is open to the public; roads have been made in the lovely park, barracks built and a library and museum of Imperial treasures opened. The national university was reorganised in 1917, and women students have been admitted since 1920. The Yenching University, in temporary premises in Peking, has acquired 175 ac. of land to the east of the city, and buildings were being erected as rapidly as possible in 1925. A medical school was opened at the Peking Union Medical College in 1919. Most of the recent institutions, the Government offices and many banks and commercial businesses are housed in buildings of Western style; these, however, are chiefly conspicuous in the vicinity of the legations, and the general features of Peking are little changed. The number of resident foreigners has increased considerably, and, although the city has not been opened to foreign trade, many business houses have been established with the tacit consent of the Chinese authorities.

The authority of the Peking Govt., though recognised by the Powers, did not in 1925 in reality extend outside the capital, and many anti-foreign disturbances, including a strike of the Chinese servants at the British legation, occurred. A tariff conference on the question of the revision of tariffs met in the city in the autumn of 1925, but was at a deadlock early in 1926, when the Peking Govt. was in desperate straits for lack of funds, trade was stagnant, and the city menaced by opposing armies and by threatened attacks by the Canton Govt. (*see* CHINA).

PELLETAN, CHARLES CAMILLE (1846–1915), French politician and journalist (*see* 21.69), died June 4 1915.

PELLOUX, LUIGI (1839–1924), Italian general and politician (*see* 21.71), died in Rome Oct. 26 1924.

PENCK, ALBRECHT (1858–), German geographer, was born at Reudnitz, near Leipzig, Sept. 25 1858. He studied at the University of Leipzig and afterwards taught in Munich. He was a professor in the University of Vienna from 1885 to 1906 when he went in the same capacity to Berlin. His chief work in that city was the extension of the marine museum and the geographical institute of the university, of which he became director.

Penck travelled extensively in various countries for the purpose of study and collected much valuable scientific material. His researches were particularly devoted to climatic phenomena of ancient and modern times. He made special studies in connection with the Ice Age and the formation of glaciers in the Tertiary and Diluvial periods, and also some outstanding contributions to scientific knowledge in the sphere of hydrography. Before the World War he acted for a time as professor at Columbia University, New York City. In the field of practical geography Penck did valuable work in promoting the production of a map of the earth on a scale of 1: 1,000,000 (*see* MAP).

His publications include *Die Vergletscherung der deutschen Alpen* (1882); *Die Donau* (1891); *Morphologie der Erdoberfläche*, 2 vol. (1894); *Die Alpen im Eiszeitalter*, with E. Brückner, 3 vol. (1901–9). He also edited the *Geographische Abhandlungen*, the *Bibliothek geographische Handbücher* and the *Bibliothek Länderkundlicher*.

PENLEY, WILLIAM SYDNEY (1852–1912), British actor (*see* 21.99), died at St. Leonards-on-Sea Nov. 11 1912.

PENNSYLVANIA (*see* 21.105), a state of the United States of America. The population in 1920 was 8,720,017, an increase of 1,054,906 over 1910. The rate of increase, 13·8%, was considerably lower than that of the preceding decade, 21·6%. The estimated population in 1925 was 9,317,647. In 1920 the population of the cities of over 50,000 inhabitants was:—

Philadelphia	1,823,779	Pittsburgh	588,343
Scranton	137,783	Reading	107,784
Erie	93,372	Harrisburg	75,917
Wilkes-Barre	73,833	Allentown	73,502
Johnstown	67,327	Altoona	60,331
Chester	58,030	Lancaster	53,150
Bethlehem	50,358		

Agriculture.—The production of chief crops (in thousands of bushels) is shown in the following table:—

	1923	1919	1909
Wheat	24,381	23,454	21,564
Maize	58,912	61,450	41,494
Oats	33,793	29,183	28,173
Buckwheat	4,449	4,756	4,797
Rye	3,583	3,208	3,497

The production of potatoes in 1923 was 23,406,045 bu.; of apples, 11,735,320 bu.; of peaches, 1,953,700 bu.; of pears, 636,515 bushels.

Mineral Production.—The production of coal in recent years (in thousands of net tons of 2,000 lb.) was as follows:—

	1924[1]	1923	Average 1916–20	Average 1911–5
Anthracite	90,214	93,339	92,741	79,233
Bituminous	123,530	171,880	168,532	157,229

[1] Estimated.

The production of coke (in net tons of 2,000 lb.) was 25,625,000 in 1923; 13,992,000 in 1922; 23,638,000 in 1920; 25,632,000 in 1915.

Manufactures.—In 1914 Pennsylvania became the foremost State in the value of silk production, displacing New Jersey. Her 1914 production was valued at more than one-third of the national total, and the State had more than two-fifths of all the employees in the industry. In hosiery manufacture Pennsylvania in the same year produced 39·7% of the national quantity and 41·2% of the national value. The iron and steel and kindred industries in the period 1909–23 more than doubled the value of their output, that of steel works and rolling-mills rising from $500,344,000 in 1909 to $1,292,222,273 in 1923, while the output of blast furnaces increased in value from $168,578,000 in 1909 to $377,227,181 in 1923. In the manufacture of tin plate, Pennsylvania in 1914 had 13 establishments with 2,368 employees and an output valued at $36,795,990. In 1919, with eight establishments only, the number of employees had increased to 12,311 and the value of the product was $115,642,300. In 1923, in all manufacturing industries combined there were in the State 19,055 establishments, with an average number of wage-earners of 1,995,066 and a total output valued at $7,438,609,142.

The following table shows the figures for the more important industries in 1923, as compared with 1921:—

	Years	Establishments	Wages	Value of products
Steel Works and rolling-mills	1923	186	$272,189,711	$1,292,222,273
	1921	190	146,957,133	645,759,871
Blast furnaces	1923	53	20,468,325	377,227,181
	1921	42	11,766,246	164,558,350
Foundry and machine shops (general)	1923	1,017	94,135,554	344,064,225
	1921	1,092	62,121,550	238,197,741
Silk manufactures	1923	455	45,396,927	286,073,270
	1921	470	42,733,610	224,195,519
Steam railroad repair shops	1923	170	111,678,064	245,098,336
	1921	156	90,507,445	193,711,154
Knit goods	1923	610	46,003,198	221,183,510
	1921	614	35,368,629	177,149,526
Electrical Machinery, apparatus and supplies	1923	159	47,275,071	201,117,706
	1921	116	24,741,162	116,577,178
Printing and publishing, newspapers and periodicals	1923	685	21,194,352	142,113,747
	1921	697	17,790,771	121,004,569
Cigars and Cigarettes	1923	672	26,035,626	119,665,073
	1921	775	23,128,934	119,264,188
Worsted goods	1923	103	18,664,705	116,959,148
	1921	101	16,444,526	85,231,872
Cars, steam railway, not built in railway repair shops	1923	14	20,008,875	115,589,913
	1921	12	11,438,931	69,163,002
Clothing, men's (outer garments only)	1923	524	19,039,109	100,829,552
	1921	535	15,488,576	78,422,296

Education.—Two progressive steps a decade apart mark the development of the public schools. The first was the adoption of the school code of May 18 1911; the second, the enactment of what is known as the Finegan programme (named after the State superintendent of public instruction) by the legislature of 1921. The school code of 1911 was virtually a codification of all the laws governing the public school system and a general unification, with many new features, of administration measures. Its important sections provided for independent control of taxation and borrowing by school boards, with minimum and maximum tax rates varying according to the size of the school district; reduction of the number of members in school boards so as to simplify official business; establishment of a state board of education; establishment of a state school fund, and general provisions for the better selection of text-books and for the development of higher education.

The measures of 1921 (the Finegan programme) raised the standard of qualification of teachers and county superintendents; established a uniform salary schedule for teachers; increased the State aid to schools; made appropriations for normal schools so that they might be supported without tuition fees; centralised the State school administrative system by the creation of a State council of education; standardised the elementary courses in public and private schools; and required that teaching be in the English language and from texts in English.

The following table shows the number of pupils and teachers employed in the years ending July 1920–3:—

Year	Number of pupils enrolled in public schools	Number of teachers
1919–20	1,592,591	44,862
1920–1	1,624,915	45,485
1921–2	1,709,477	48,000
1922–3	1,840,766	49,843

The total expenditure, state and local, for education increased from $52,544,036 in the school year 1913–4 to $175,000,000 in

1923–4. In 1924 the State appropriation for education reached $21,000,000, the largest in the history of the State, being an increase of $6,000,000 over that of the preceding year.

Finance.—The revenues of the State more than doubled from 1909 to the end of 1920. The receipts in 1909 were $28,945,210; in 1920 $62,071,293. This does not include $11,800,000 derived in 1920 from the sale of State road bonds, a fund kept separate from the regular state moneys. The Treasury disbursements in the fiscal year 1920 were $74,960,112, $18,000,000 higher than 1919, the increase being due to road construction. For the year ending May 31 1924 the receipts were $103,123,948 and the expenditure during the same period rose to $97,157,571. On June 30 1924 the total number of commercial and savings banks was 1,650, with total resources or liabilities of $5,526,654,000; capital, surplus and undivided profits of $924,673,000; and deposits of $3,924,883,000.. Of these banks, the national banks numbered 864, with total resources or liabilities of $2,756,792,000; capital, surplus and undivided profits of $411,427,000 and deposits of $1,826,986,000.

History.—The first two constitutional amendments of the period 1910–25, adopted in 1911 and 1913 respectively, had to do with the courts—the amendment of 1911 increasing the number in Philadelphia Co. and merging those in Allegheny Co.; the amendment of 1913 altering the judicial and municipal terms to conform with an amendment of 1909, which changed the date of the elections from Feb. to November. Another amendment of 1913 enabled municipalities, except Philadelphia, to embark upon the construction or acquisition of waterworks, subways, etc., even though their cost brought the indebtedness above the limit allowed; it also permitted arrangements whereby the interest and sinking-fund charges were paid from the principal until the properties should have been completed and in operation for one year. A limit of 10% of the assessed valuation of taxable property in a municipality was fixed for such indebtedness, three-fifths of the electors of the municipality having first to give their assent to the increase.

On Nov. 2 1915 the people voted on four proposed amendments and adopted three of them. The first and most important prepared the way for workmen's compensation. The second enabled Philadelphia to increase its borrowing capacity under conditions similar to those set forth in the amendment of 1913. The third enabled the general assembly to enact laws providing a system of registering, transferring, insuring and guaranteeing land titles by the State or the counties. Amendments passed by the legislature in 1915 and 1917 were approved by the voters in 1918, one enabling the State to issue bonds to the amount of $50,000,000 for the improvement of highways, and the other enlarging Philadelphia's borrowing capacity by removing the previous restrictions which confined its increased indebtedness to the construction or acquisition of waterworks, subways, etc. An amendment approved at the general election in 1920 enabled the assembly to levy "graded or progressive taxes." The result of these numerous amendments was manifest in the session of 1919, when a bill was passed authorising the Governor to appoint a commission to study the constitution with a view to general revision or to amendment by sections.

The number of boards, commissions, etc., functioning under the State Government was greatly increased between 1919 and 1925. The Legislature in 1911 created a Bureau of professional Education under the State department of public instruction, its purpose being to regulate the education of physicians, dentists and pharmacists. A Bureau of medical education and licensure, under the department of public instruction, was also created by Act of 1911 to examine into conditions in the medical schools and conduct the examination of students applying for State licences. Another important change of 1911 was the reorganisation by legislative enactment of the State highway dept. and the undertaking of an extensive system of highways to be built and maintained entirely from State funds.

In 1913 the Department of Labour and Industry was created, with power to enforce the "laws relating to the safety, health, and prosperity of employees and the industries." A workmen's compensation board was set up, the State was divided into districts, and the administration of compensation was carried on through referees and members of the board. A state workmen's insurance board was created the same year for the purpose of administering the insurance fund provided in the Workmen's Compensation Act. The Legislature, in 1913, also did away with the old State railway commission, substituting a public service commission with much greater powers.

The year 1915 saw the reorganisation of the department of agriculture with the creation of a commission on agriculture to appoint all officers and employees of the department and prepare the budgets of the department and the state livestock sanitary board. Other new boards of that year were the one on vocational training under the department of public instruction; the board of censors on all motion pictures; the prison labour commission, to supervise the manufacturing industries of inmates of penal institutions; and the veterinary medical examining board. The bureau of municipalities under the Department of Labour and Industry was a development of 1917, intended to classify and make available statistics and other information tending to improve the government of municipalities. In the same year five new boards were created; the State military board, which has the power to grant pensions not exceeding $12 per month to widows or minor children of national guardsmen killed on active duty; the board of pharmacy; the board of optometrical education, examination of licensure; the board of commissioners on uniform state laws and the public school employees' retirement board.

The Legislature of 1917 also created a commission on public safety and defence, for which was appropriated $2,000,000. It functioned during the two years of American participation in the World War, but was succeeded in 1919 by the commission on public welfare, which received an appropriation of $500,000 to carry on the work of reconstruction and of collecting records of the State's part in the World War. In 1919 a bureau of statistics and information was created under the State department of internal affairs, the bureau of municipalities was transferred from the department of labour and industry to the department of internal affairs, and a bureau of rehabilitation was created under the department of labour and industry.

The year 1919 witnessed the adoption of two Federal amendments; the prohibition amendment of Feb. 25 and the Woman Suffrage amendment on June 24. The Legislature in 1921 created a welfare department, which assumed the duties of the former board of public charities, the lunacy committee, the prison labour board and connected activities. In 1923 a new administrative code was enacted, providing for the consolidation of the existing administrative agencies of the State into 12 departments, viz.: State and finance, justice, public instruction, military affairs, agriculture, forests and waters, labour and industry, health, highways, welfare property and supplies, and commerce.

Governors of the state between 1911 and 1925 were John K. Tener (Rep.), 1911–5; Martin G. Brumbaugh (Rep.), 1915–9; William K. Sproul (Rep.), 1919–23; Gifford Pinchot (Rep.), 1923–.

(A. E. McK.)

PENNSYLVANIA, UNIVERSITY OF (*see* 21.114).—The period from 1910 to 1926 marked some of the greatest developments of this university in 185 years. The standards of admission to all schools were raised, and the number of students was definitely limited in most of the schools. The law, medical and graduate schools now require academic degrees for admission, and the dental school at least two years of academic training. In 1925 the engineering schools adopted a new system of admission, requiring two years of academic training; and subsequently required two years of intensive study in engineering subjects for the technical degree. Admission to all other undergraduate schools has been restricted almost entirely to applicants who have graduated from the upper half of a standard four-year approved high school, and no students are admitted on condition. The courses in veterinary medicine and dentistry have been increased to four years.

New Developments.—During this period the following schools and departments have been added to the university. In 1910

the Henry Phipps Institute was transferred to the university. In 1912 the original college department was divided into the Towne scientific school, the Wharton school of finance and commerce and the college; and the dental school was merged with the Thomas W. Evans Museum and Dental Institute. In 1914 a school of education was founded and schoolmen's week established. In 1916 the medico-chirurgical college and hospital were merged with the university. In 1917 the department of military science was established. In 1918 the Philadelphia Polyclinic and College for Graduates in Medicine were merged with the university. In 1919 the graduate school of medicine was founded. In 1920 the laboratory of hygiene was organised as a school of hygiene and public health; and the school of fine arts, including architecture and music, was established. In 1921 a department of dental hygiene was instituted, and in 1923 the Moore School of Electrical Engineering. Dr. Josiah H. Penniman was acting provost from 1921 to 1923, when the position of president was created and Dr. Penniman became both president and provost, which positions he was occupying in 1926.

For the sessions of 1925–6 there were in the University of Pennsylvania 17,509 students; of these, 4,215 were women. The students were distributed as follows: college, including arts and science, biology and college courses for teachers, 2,815; summer school, 2,230; Towne scientific school, including mechanical, civil and chemical engineering, 166; Moore school of electrical and engineering, 93; fine arts, including schools of architecture, music, 442; Wharton school, 2,677; various extension schools, 4,597; school of education, 1,508; graduate school, 1,393; school of medicine, 472; hygiene, 2; graduate medicine, 130; law school, 342; dental school, 542; dental hygiene, 42; veterinary school, 58.

During 1910–25 many new buildings were added to the campus, among them several dormitory houses, including one for women students; a new surgical pavilion and other additions to the hospital groups; the Duhring Stack and the Henry C. Lea wing were added to the library, and several wings to the university museum; Bennett Hall; the school of education and the graduate school; zoological building; the Evans dental institute; and a university stadium seating eighty thousand persons. Ground was also broken for a new gymnasium, an anatomical laboratory building, Irvine Hall, auditorium building, etc. The university plant, with these new structures, will consist of 110 ac. and approximately 75 buildings.

The treasurer's report of June 30 1924 shows the total assets of the university to be about $33,000,000, including grounds, buildings and endowment. The buildings, grounds and university plant are valued at about $18,000,000. Not included in these figures are several plants affiliated with the university such as the Evans Dental Institute, the Wistar Institute of Anatomy, etc., the values of which are more than $3,000,000. There are also 130 fraternities, of which 93 operate houses, and of these 60 own property valued at more than $3,000,000. The total annual receipts in 1925 were approximately $4,000,000. The sum of $1,803,560 was spent on educational salaries and $919,477 on other salaries. On May 1 1925 there was organised the "University of Pennsylvania Fund," the object of which is to secure at least $45,650,000 before the 200th anniversary of the university in 1940; more than $5,500,000 had been subscribed by 1926. (E. F. Sm.)

PENSIONS.—In most civilised countries a considerable portion of the working population can look forward to pensions in their old age, while Great Britain and her Dominions, the United States and other countries provide pensions for those who were disabled during the World War. Pensions are also given to officers and men who have served in the army, navy or air force. Further, Germany, Great Britain and other countries have state schemes for providing old-age pensions, and in addition many business firms have pension schemes.

I. GREAT BRITAIN

Great Britain has an elaborate national scheme which provides pensions for all who attain the age of 70, and also for widows, blind persons and certain others who are under that age. These form part of the national system of social insurance and are described in this work in that connection (*see* Insurance, Social). Pensions are given to civil servants, these being calculated at so much for each year of service up to a maximum of half the salary. In addition, a lump sum, equal to a year or more of salary, is paid on retirement. Municipal authorities, banks and many business firms have pension schemes for their employees. These vary very much in character, but most of them are contributory, the employee paying a certain percentage, perhaps 2½%, of his annual salary and the firm contributing a like amount. Great Britain has also civil list pensions, as they are called. The Government provides £1,200 each year, which is spent in giving pensions to literary men and their dependants, and others whose circumstances are impaired.

War Pensions.—The World War made necessary a vast expenditure on pensions, and in Great Britain a large organisation was set up to control this. The Ministry of Pensions came into existence in Dec. 1916, but it did not take over the administration for pensions for long service, which still remain under the War Office, the Admiralty or the Air Ministry. Its headquarters are at 2 Sanctuary Buildings, 18 Great Smith Street, Westminster, London, S.W. 1, and under it are five regional districts. Much of the work is done through local committees. The amount of work carried on by the Ministry just after the conclusion of the War was so enormous that at one time it employed 32,000 persons. As, however, claims were settled and the pensioners began to die off, the amount was reduced. In 1924–5 its expenditure, mainly on pensions, was £66,947,000.

Pension Rates.—Pensions are granted to all those who have been disabled, wholly or partially in the War, and to their dependants; also to the dependants of those who were killed. A disablement pension is usually first granted on a temporary basis for 12 months, afterwards being made final when the disablement is sufficiently stable. Such pensions are reckoned on a percentage basis—a total disablement being taken as 100%. The lowest figure entitling to a pension for disablement is 20%. Thus, if a disablement is assessed at 50%, the man would receive 50% of the full rate of pension and his wife and children, if eligible, 50% of the allowances. Disablement assessed at less than 20% is compensated for by a gratuity or an allowance for a stated number of weeks. A grant of this kind, however, must not exceed a maximum of £200.

The rates of pensions in force in 1926 are as follows: For 100% disablement a private receives 40s. a week and his wife 10s. 7/6 is paid for the first child and 6/3 for each other child. A widow over 40 receives 26s. 8d. and a widow under 40 20s. a week. From the beginning of the War to March 31 1925 the total number of pensions paid to officers and their relatives was as follows:—

Officers	59,787
Widows	11,616
Children	12,844
Other dependants	8,028
Nurses	2,415

The number of pensions paid to non-commissioned officers and men and their relatives to the same date was as follows:—

Men	1,269,706
Children	1,015,271
Widows	248,367
Children of widows	399,349
Other dependants	410,988

On March 31 1925 the number of persons in receipt of pensions was as follows:—

Officers	25,500
Widows of officers	9,100
Children of officers	8,500
Dependants of officers	6,400
Nurses	1,100
Men	472,000
Widows of men	148,000
Dependants of men	346,000
Motherless children	18,000

The estimated cost of pensions and their administration during the financial year 1925–6 was £63,504,900. (A. W. H.*)

II. THE UNITED STATES

Pensions Prior to the World War.—During the period 1910–26 various amendments and additions to the U.S. War pension laws were made by Congress, including provision in 1915 for a double pension in case of death or disability resulting from an aviation accident. The most recent amendment was contained in an Act, approved May 5 1926, increasing the pensions of those who have lost limbs or been totally disabled or become totally blind in the military or naval service of the United States.

The following table shows the number of pensioners on the roll and the total disbursements for pensions during the period 1910–25:—

Fiscal year	Soldiers on roll	Widows on roll	Total disbursements for pensions
1910 .	602,180	318,903	$159,974,056.08
1926 .	285,110	299,363	213,295,314.00
1921 .	267,713	290,955	258,715,842.54
1922 .	256,828	282,965	253,807,583.37
1923 .	253,605	278,700	263,012,500.00
1924 .	248,049	270,194	229,994,777.00
1925 .	244,657	260,382	217,150,602.00

A detailed specification of the pensioners on the roll, June 30 1925 was as follows: Civil War—soldiers, 126,566; widows, etc., 241,193; nurses, 60; War with Spain—soldiers, 101,702; widows, etc., 18,363; nurses, 169; Regular Army—soldiers, 12,399; widows, etc., 3,762; Indian Wars—soldiers, 3,924; widows, 3,034; War with Mexico—soldiers, 17; widows, 1,257; World War—soldiers, 49; widows, etc., 21; War of 1812—widows, 21.

World War Compensation.—The first provision for pensions arising out of casualties of the World War was made by Act of Congress, Oct. 6 1917, which provided for compensation for death or disability arising from personal injury suffered or disease contracted of all persons in service, including women in the army and navy nursing corps in line of duty in the War. The death compensation varied with the relationship of the recipient and the number of dependants. Compensation for disability depended upon its seriousness and duration. The Act also provided that in addition an injured person should be furnished such medical and hospital service and medical supplies and appliances as should be reasonably necessary and, in cases of permanent disability, courses of rehabilitation, re-education and vocational training. Provision was also made for allowances to families and dependants of all enlisted men and insurance at peace-time rates to any person, man or woman, in active military or naval service. The administration of the various parts of the Act was committed to three organisations: the Bureau of War Risk Insurance, the United States Public Health Service and the Federal Board for Vocational Education. By Act of Congress, Aug. 9 1921, all the World War Veteran's relief activities were consolidated in the United States Veteran's Bureau, and this resulted in great economy in administration and a correspondingly greater efficiency. By Act of Congress, June 7 1924, the "World War Veterans Act, 1924," a consolidation and revision of the previous legislation was accomplished, and under this statute with minor amendments, the U.S. provision for World War pensions or "compensation," insurance and other forms of assistance to World War Veterans and their dependants has been administered.

Up to June 30 1925 1,001,931 compensation claims had been filed, 490,258 of which were allowed, 497,103 disallowed and 14,570 were pending. At that date compensation payments were being made on 277,035 claims and the total disbursements for death and disability compensation had amounted to $730,107,737.29.

PENSIONS, MINISTRY OF.—This department of the British Govt. was set up by Act of Parliament in Dec. 1916, to deal with pensions arising out of services during the World War. The Act transferred to a minister, responsible to Parliament, the powers and duties of the Admiralty, the War Office and the Chelsea Commissioners, "in respect of the payment of pensions and grants to officers and men, to their widows, children and dependents and to persons in the nursing services of the naval and military forces." The administration of pensions for services in the army, navy and air force was left with the departments responsible for the general administration. The work of the ministry grew enormously during the War period, and just afterwards. In 1921 it had a staff of 26,000 persons, and at the end of 1920 it was paying pensions to over 1,800,000 men, women and children, the total number of persons benefiting being estimated at nearly 3,500,000. The medical work of the ministry was on a correspondingly large scale. It had many hospitals and a large staff of medical men, who at one time examined over 20,000 cases each week. The supply and repair of artificial limbs was an important branch of the work.

After the War the work of the ministry was decentralised and in 1919 and 1920 11 regions were established, although the number was afterwards reduced to seven. These seven are London, Birmingham, Manchester, Bristol, Newcastle-upon-Tyne, Edinburgh and Cardiff. Each is governed by a director, assisted by a commissioner of medical services and others, who carry on—(1) Medical examinations; (2) Awards of pensions; (3) Control of hospitals; (4) Supervision of local pension committees. The headquarters of the ministry are at 2, Sanctuary Buildings, Great Smith Street, London, S.W.1. and in 1923–4 it disbursed in salaries and expenses over £73,000,000.

PÉREZ GALDÓS, BENITO (1845–1920), Spanish novelist (*see* 21.139), died at Madrid Jan. 4 1920.

PERIODICALS (*see* 21.151).—This article deals with the new reviews which have appeared since 1912 treating of language, literature, politics, art, fiction and topic subjects. For the most part only those periodicals which are still being issued are recorded and the year of their first appearance is given.

Naturally the economic strain of the World War caused the collapse of many publications which might have survived in more prosperous times. Even apart from wars the appearance and speedy disappearance of new reviews is a common event of the publishing world, and has been no less common in the last dozen years. An example of a periodical which was killed by the War is *Blast* (1914). *To-day*, a literary review, ran from 1917 to 1923, *Life and Letters* appeared in 1923 and 1924 only, while the *Anglo-French Review*, which began in 1919, had an equally short career.

I. THE BRITISH EMPIRE

The Appeal to Popular Tastes.—The period is remarkable for the growth of new periodicals appealing to the popular taste rather than for its more solid and learned reviews. To give lists at all approaching completeness of this class of publication would be impossible within the space allotted to this article. A few examples will be given taken from such subjects as the cinema, wireless, motoring, dancing, popular fiction, domestic economy, etc. Among periodicals concerned with the cinema stage are the *Ciné-Musician* (1925); *Cinema Pie* (1919); *Cine-shows* (1919); *Cinema Chat* (1919–20), continued as *Home News* (1920). Reviews treating of the recent developments of wireless telegraphy are *The Radio Review* (1919); *The Broadcaster and Wireless Retailer* (1922); *The Wireless Magazine* (1925); *The Wireless Constructor* (1924); *Brighter Wireless* (1925). In the automobile world in addition to a large number of trade and advertising journals there are many reviews intended for the amateur, such as the *Autocycle* (1913) and the *Motor Owner* (1919). The popularity of dancing is responsible for *Dancing Life* (1921); *Danceland* (1922); *Dancing Annual* (1923) among others.

Fiction and Domestic Economy.—The magazines devoted entirely to popular fiction are possibly more numerous than those of any other class. Among them are *The Premier Magazine* (1914); *Home Mirror* (1919) *Short Stories* (1920); *Gaiety* (1921); *Choice Story Magazine* (1923), *True Love-Story Magazine* (1924); *Merry Magazine* (1924); *Standard Stories* (1925). The contrast between the gay appearance of these periodicals and the sobriety of the fiction magazines of the 19th century is striking. These

magazines are to a great extent taking the place of the earlier monthly miscellanies, the family magazines. The popular periodical of the 19th century was largely devoted to fiction, but also contained a certain amount of instructive matter; its tone was eminently serious. The present-day popular journal, on the other hand, is devoted entirely to light fiction, has frankly no other object than that of amusement, nor is there any attempt to convey moral instruction under the guise of fiction. The change may be in part accounted for by the existence of a wider reading public, embracing less educated classes.

Equally striking is the change which has taken place in the form of the periodicals concerned with domestic economy and the life of women, of which the best examples are *Good Housekeeping* (1922) and *Woman* (1924) and *Woman's Pictorial*. These journals have been influenced by the American woman's magazine *Vogue*, which appears to circulate throughout the English-speaking world. They have a distinctly artistic standard and are not content with the mere fashion-plate. They are remarkable also for the advantage which they take of modern developments in colour printing. The increased attention paid to advertising has enabled these and similar magazines to be more lavish in the manner of their production, while the advertisers or advertising agents have themselves devoted especial care to matters of typography and the lay-out of the printed matter. This is reflected also in magazines intended for children, a class of periodical which has much increased its numbers. The *Merry-Go-Round* (Oxford, 1923) is the best example of a well printed children's magazine. Others are *Toby and Wonderful Playthings* (1921), *My Magazine* (1914), which developed from *The Children's Encyclopaedia*, and *The Children's Companion* (1923).

Literature.—Turning to the more serious periodicals we find that the general review, a publication dealing with politics, literature and the arts, etc., is less frequent than the more specialised review. The majority of the new journals are definitely political, literary or artistic. Dealing with English literature and language we have *The Review of English Studies* (1925) and *The London Mercury* (1919), of which the first treats mainly of earlier English literature, while the second is chiefly devoted to contemporary literary criticisms. *The Poetry Review* (1909) is concerned with the criticism of poetry and also contains original verse. Of literary reviews which publish original fiction and verse there are *The Adelphi* (1923); *The Bermondsey Book* (1923); *The Calendar of Modern Letters* (1925); *The New Criterion* (1926), originally founded as *The Criterion* (1922); *The New Coterie* (1925). One well-known literary review, the *Athenaeum* (1828), has joined forces since 1921 with the *Nation* (1890), and thus become one of those literary weeklies which must be classed as newspapers. Of this class there has been one new journal of note, *The New Statesman* (1913), which appears to have become well-established. On the whole the weekly review of politics and literature is losing ground between the more specialised monthlies and quarterlies on the one hand and the Sunday newspapers on the other hand. Such papers as *The Observer* (1791), and *The Sunday Times* (1904), besides being definitely newspapers, are to all intents and purposes general weekly reviews.

Politics.—Of periodicals which are mainly political there are *The New Europe* (1916–20); *The Round Table*, a quarterly review of the politics of the British Commonwealth (1910); *The Conservative Review* (1925); *The Labour Monthly* (1921); *The Polish Review* (1917), and *Twentieth-century Russia and Anglo-Russian Review* (1915), both discontinued; *The Balkan Review*, now *Eastern Europe* (1919); *The Anglo-Italian Review* (1918), now discontinued; *Africa and Orient Review* (1920); *The Commonweal*, a monthly magazine of enlightenment and progress (1925). Here may be recorded *The League of Nations Official Journal* (1922). Of periodicals devoted to the arts there are *Apollo*, a journal of the arts (1925); *The Arts Gazette* (1919); *Artwork* (1924), *Colour* (1914), an art journal which is remarkable for its reproduction in colour.

Theology, Education, etc.—Theological journals are *Theology*, a monthly journal of historic Christianity (1920); *The Venturer*, a monthly journal of Christian thought (1915; new series, 1919–21) and *The Pilgrim*, a review of Christian politics and religion (1920). Educational journals are *Education for the New Era*, continued as *The New Era* (1920); *The Torchbearer*, a review of education (Birmingham, 1924). Other specialised reviews are *The Cambridge Historical Journal* (1923) and the *Psychic Research Quarterly* (1920), now *Psyche* (1921).

Typography.—Throughout the period here considered there has been a continued advance in the standard of typography and book production in periodical literature, as well as in the book proper. Several reviews devote space to purely typographical criticism, while in their form many of them show a great improvement on their predecessors of the last century. Most countries have their periodicals devoted to the study of typography, some of which are mentioned below. In England *The Imprint* (1913) survived less than one year. It was followed in 1923 by *The Fleuron*, a journal of a very high standard devoted entirely to the art of printing. Several advertising journals connected with the trades of printing and publishing are noteworthy for their form, *e.g.*, *The Linotype Record*, *The Monotype Recorder*, magazines issued by typefounding companies, and the *The Bookmark* (1925), and *Now and Then*, a periodical of books, periodicals issued by the publishing houses of Dent and Jonathan Cape respectively.

University Publications.—Almost all these journals are published in London, where the book trade tends to be centred more and more. In England almost the only exceptions are a few periodicals issued in connection with, if not by, the universities. Such are for example two reviews dealing with modern languages, *The French Quarterly* (Manchester, 1919) and *The Bulletin of Spanish Studies* (Liverpool, 1923).

Scotland.—In Scotland there are two new general, mainly literary, reviews, *The Northern Review* (Edinburgh, 1924) and *The Scots Magazine* (Glasgow, 1924).

Ireland.—In Ireland, since the formation of the Free State, there has been considerable activity in periodical publications. Already, in 1912, we had *Studies*, an Irish quarterly review of letters, philosophy and the sciences. We now have *The Dublin Magazine* (1923), a general non-political periodical. A popular magazine entitled *Banba* lasted for two years only, 1921 and 1922. *An Branar*, also, a journal written in Irish, which began in 1919, has been discontinued.

Overseas Dominions and India.—In this section there is but little new work to record. Canada has a number of popular magazines which show the influence of the United States. *The Canadian Forum*, a monthly journal of literature and public affairs (Toronto, 1920) is the chief review of a more ambitious class. *Art in Australia*, a quarterly magazine, published at Sydney, appears to have come to an end in 1923. South Africa has two new reviews, *The Cape*, an independent review of South African Life and politics (Cape Town, 1915), and *The South African Quarterly* (Johannesberg, 1919); *The Eastern Illustrated Review*, a quarterly (1918) and *The Malayan Chronicle* (1923) are both published at Singapore. At Calcutta is published *Rupam*, an illustrated quarterly journal of oriental art (1920). Of other Indian journals issued in English *The Hindu Review* (Calcutta, 1913–4) and *The New Review* (Bombay, 1917–9) both had a short existence.

II. OTHER COUNTRIES

United States.—The number of periodicals published to-day in the United States is certainly much larger than in any other country, and especially in the class of popular magazines. All that has been written above about these journals in England applies with much greater force to the United States; indeed in the style and scope of these magazines England is mainly an imitator. If the art of advertising has changed the appearance of journals in this country, its effect has been still more pronounced in America. No lists need here be given. Almost equally numerous are the technical and scientific periodicals, which cannot be dealt with here.

Of new reviews in our restricted sense there are two of particular importance, *The American Mercury* (New York, 1924), a

monthly review, mainly literary, and *Foreign Affairs* (New York, 1922), a political journal. Other literary reviews are *The Modern Review* (Boston, 1922), a quarterly; *The Unpopular Review* (1914) now discontinued; *Poetry*, a magazine of verse (Chicago, 1912), containing besides original verse some criticism; a journal entitled *1924*, which began in July of that year. Another political journal concerned with European affairs is *The Adriatic Review* (Boston, 1918). Art magazines are *The Print Connoisseur* (New York, 1920), a quarterly, and *Art in America* (New York, 1918). Of journals concerned with philology, *The Romantic Review* (New York, 1910), a quarterly and the *International Journal of American Linguistics* (New York, 1917), devoted to the study of the language of the American Indians, are of importance. Other specialised reviews are the *Hispanic American Historical Review* (Baltimore, 1918–22); the *Anglican Theological Review* (New York, 1918); *The Psychoanalytical Review* (New York, 1914); the *American Journal of Physical Anthropology* (Washington, 1918). Naturally the great majority of specialised journals are issued by learned societies and are therefore outside our scope; it should be remembered, however, that such publications are extremely numerous in the United States, a country which is showing a Teutonic industry in research, with the advantage of more abundant financial support.

Finally it follows from the fact that a second revival of printing has taken place in America, that a host of journals connected with the printing trade have been issued, including one first class review concerned with typographical history, *Ars Typographica*, which took on a new and enlarged form with its second volume in 1925.

France.—The position of Paris as the literary centre of France and perhaps the most important literary centre in the world is reflected in the publication of new periodicals. Of reviews devoted to literary criticism and history we have the *Chronique des lettres françaises* (1923); *La Connaissance*, revue des lettres (1920); *Les Nouvelles littéraires* (1922); *Les Feuilles libres* (1918); *Revue de littérature comparé* (1920); *Etudes italiennes* (1919); and *La Nouvelle Revue française* (1919). Of more general reviews, dealing with political affairs as well as literary, we have *Europe* (1923); *L'Esprit nouveau*, revue internationale illustrée (1920); *Les Lettres* (1919); *La Minerve française* (1919); *Le Navire d'Argent* (1925); *La Revue belge* (1918); *La Revue anglo-americaine* (1923); *La Revue du siècle* (1925); *La Revue européenne* (1923); *La Revue universelle* (1920); *Transatlantic Review* (1924). Reviews dealing mainly with serious fiction are *Commerce* (1924); *Demain* (1924); and *Action*. Cahiers, individualistes de philosophie et d'art (1920). The chief new political reviews are *Annuaire du monde musulman* (1923); *Le Monde libre* (1919); *La Nation Tchèque* (1915); *La Voix de l'Arménie* (1918). Of periodicals dealing with the arts, there are *Arethuse*, revue d'art et d'archéologie (1923); *Beaux Arts* (1923); *L'Art vivant*, revue bi-mensuelle des amateurs et des artistes (1925); *Revue des arts asiatiques* (1924); *Revue d'art oriental* (1920); *L'Acropole*, revue du monde hellenique (1925), a classical journal. Historical reviews are *Archives de la grande guerre* (1919) and the *Revue des Etudes Napoléoniennes* (1912). Finally we record two periodicals which treat especially of book production and typography, *Byblis*, miroir des arts du livre et de l'estampe (1921) and *Le Livre et l'Estampe* (1923). All these are issued at Paris. The *Revue du Lyonnais* (Lyons, 1921), is an important review published in the provinces.

Germany.—For the large number of periodicals, mainly illustrated and popular, issued in Germany during the World War, the reader is referred to the bibliographies of War literature. The majority of the serious and important German reviews have survived the War and the critical years following. As to the new publications they appear to have suffered, if not in number, at any rate in form, many of those here recorded being but slender publications. New general reviews, mainly literary, are *Die Hilfe* (Berlin, 1914); *Freie Deutsche Bühne* (1919), now *Das blaue Heft* (Berlin, 1921); *Die neue Schaubühne* (Dresden, 1919); *Die neue Bücherschau* (Munich, 1919); *Der Piperbote* (Munich, 1924); *Europäische Revue* (Leipzig, 1925); *Neue deutsche Beiträge* (Munich, 1922); *Deutsche Vierteljahrschrift für Literaturwissenschaft* (Halle, 1923); *Der neue Merkur* (Munich, 1917); *Vers und Prosa* (Berlin, 1924). More political are *Der Jude* (Berlin, 1916); *Neue Ukraine* (Berlin, 1923, published in Russian); *Ost. Europa*, zeitschrift für Gesamtfragen des europäischen Ostens (Königsberg, 1925). Reviews of art are *Das Kunstblatt* (Potsdam, 1917); *Faust* (Berlin, 1921); *Kunst und Antiquariat*, Zeitschrift für Kunst und Bücherfreunde (Munich, 1925). Two reviews deal with oriental art, *Ostasiatische Zeitschrift* (Berlin, 1912) and *Artibus Asiae* (Dresden, 1925). Treating of classical antiquity there are *Gnomon* (Berlin, 1925) and *Die Antike* (1925). More specialised periodicals are the *Zeitschrift für slavische Philologie* (Leipzig, 1924); *Zeitschrift für Individualpsychologie* (Munich, 1914); *Volk und Rasse* (Munich, 1926), an ethnological journal. Even before 1912 Germany had a number of reviews devoted to the history of printing and typography; to these have been added *Monatshefte für Bücherfreunde und Graphiksammler* (Leipzig, 1925); and *Die Bücherstube* (Munich, 1920).

Italy.—The new Italian reviews are *Bilychnis*, rivista di studi religiosi (Rome, 1913); *Nuovi Studi medievali* (Bologna, 1923); *Rivista Indo-Greco-Italica di filologia, lingua, antichità* (Naples, 1917); *Archivum Romanicum*, nuova rivista di filologia romanza (1917), and *Il Nuovo Giornal Dantesco* (1917), both published at Florence; *Dedalo*, rassegua d'arta (1920); *Il Convegno*, a literary review started since the War; *Aegyptus* (1920), an archaeological journal; *Musica d'oggi* (1922), all published at Milan. This growth of periodical literature in the chief industrial town of Italy is significant.

Spain.—The most important of the few new reviews of note is *Hermes* (1917), a literary periodical published at Bilbao. Madrid has had two new literary reviews, *Cervantes* (1916) continued as *Cervantes, Revista hispano-americana* (1918–20, but no longer published), and the *Revista de Occidente* (1923).

Belgium.—*Congo* (1920) is a political review, *La Revue belge* (1924), a general political and literary magazine. There is also *Buzavtion*, revue internationale des études byzantines (1924), and a bibliographical curiosity of the War, *La libre Belgique* (1915), secretly produced during the German occupation. All these are published at Brussels.

Holland.—*De Kronik* (Hague, 1914); *De Stem* (Arnheim, 1920), an annual; *Het Getij* (Amsterdam, 1915); *Kakatoe* (Amsterdam, 1915) and the *Haagsche Maanblad* (Hague, 1924), are mainly literary reviews. *Maanblad voor beeldende Kunsten* (Amsterdam, 1924), is an art journal. *Het Boek* (1912), formerly the *Tijdschrift voor Boekwezen*, now published at the Hague, is practically a new periodical, and is one of the chief continental journals concerned with the history of printing. *English Studies* (Amsterdam, 1919) is also worthy of mention.

Scandinavian Countries.—*Det nya Sverige* (Stockholm, 1918), *Den Nye Literatur* (Copenhagen, 1919), and *Edda, Nordisk tidsskrift för literaturforskning* (Oslo, 1914), are all literary reviews. *Holberg Aarbog* (Copenhagen and Oslo, 1920), is an annual concerned with the dramatist Holberg. The *Nordisk Tidskrift för Bok-och Biblioteks-väsen* (Stockholm, 1914), is an important review devoted to typographical matters.

Switzerland.—*La Revue de Genève* (1920) is a general, political and literary journal.

BIBLIOGRAPHY.—The value of indexes as a guide to the mass of important material which is often to be found only in the pages of periodicals has long been recognised. Well-established periodicals meet this want by issuing their own indexes and by reviewing whatever has appeared on their subject in other periodicals. A good review on any particular subject is itself the best guide to the current literature of the subject. In addition to this, two classes of publications embrace the bibliography of reviews: first, lists of periodicals and secondly subject-indexes. Of lists in 1925 appeared *The World List of Scientific Periodicals*, which records more than 20,000 current scientific and technical journals. A second volume is to follow, which will be a guide to the libraries containing these journals. *The Times* has published the *Tercentenary Handlist of English and Welsh Newspapers, Magazines and Reviews, 1620–1920*. The fourth edition of Severance's *Guide to the Current Periodicals and Serials of the U.S.A. and Canada* appeared in 1920. *Willing's Press Guide*, *The Writers' and Artists' Year-Book*, the *Literary Year Book* and other similar

annuals contain lists of periodicals written in English. *The American Newspaper Annual* is a comprehensive work for the United States. France has an *Annuaire des journaux, revues et publications périodiques*. Germany has produced two comprehensive subject indexes, the *Bibliographie der deutschen Zeitschriften-Literatur* and the *Bibliographie der Fremdsprachigen Zeitschriften-Literatur*, the second of which appears to have come to an end in 1915. *The Athenaeum Subject-Index*, now *The Subject Index to Periodicals*, published by the London Library Association is the most important index produced in England. The *Readers' Guide to Periodical Literature*, now *The International Index*, is an American publication. Faxon's *Annual Magazine Subject-Index*, a subject-index to a selected list of American and English periodicals, is issued at Boston. In the *New Guide to Reference Books*, published by the "American Library Association" (Chicago, 1923), there is a valuable chapter on the bibliography of periodicals. Finally in Italy the "Biblioteca della Camera dei Deputati" has issued a *Catalogo metodico degli scritti contenuti nelle publicazioni periodiche italiane e straniere*, a useful index for certain subjects, but extending only to 1914. (*See* also NEWSPAPERS.) (A. F. J.)

PERISCOPE, an optical instrument used in land warfare and in submarine navigation to enable an observer to see his surroundings while remaining under cover or submerged. It invariably includes among its optical elements two mirrors or reflecting prisms to change the direction in which the light travels, the first to divert it down the interior of a tube which normally forms the frame of the instrument, and the second to guide it into a direction convenient for observation. In addition there is usually a more or less complex telescopic system, and in some types devices are added for taking ranges, for measuring the speeds with which objects are moving, or for searching the whole sky, to which may be added means for varying the magnifying power of the telescope. Some of these devices are necessarily complex.

The simplest type of periscope, consisting of a tube and two mirrors at its ends placed parallel to one another and at an angle of 45° with the axis of the tube, is not of recent origin, but the great developments which have been made in modern times are due to requirements for submarine navigation. These developments secure a large angular field of view when the tube is of considerable length and yet of restricted diameter and give an enlarged image. As in other military instruments, clear vision through the periscope even under adverse conditions is of great importance, and the beam of light brought to the observer's eye must therefore be of a diameter large enough to fill his pupil when it is somewhat widely opened. These various conditions tend to be opposed to one another, so that the design of each instrument represents a compromise which may vary over a considerable range as more or less importance is attached to one or other of these requirements.

A typical submarine periscope consists externally of a tube about 30 ft. long and 6 in. in diameter except for a length of from two to three feet at the top, where the diameter may be reduced to two inches or even less. At the lower end a length of several feet of the full diameter is required for passing through the long stuffing box where the instrument enters the hull of the submarine. A diameter of about six inches is needed to resist the bending movements caused by the resistance of the water as the submarine advances; an increase in the diameter adds to the resistance offered by the periscope to the boat's progress. The narrowing at the top is introduced to make the part which projects above the surface of the water less conspicuous. The optical effects of this constricted portion are so pronounced that the dimensions assigned to this part determine the design of the instrument. It is debatable whether the tendency has not been to attach too much importance to this reduction in the diameter of the tube.

If an observer looks through a series of tubes of the same diameter but of different lengths, placing his eye close to the end of the tube, his field of view will be smaller with a long tube than with a short one. The factor governing the extent of the field of vision is obviously the proximity of his eye to the front end of the tube. Thus in a periscope the only way of increasing the field of view is to locate the eye virtually near the top of the tube by inserting therein a system of lenses which, in addition to satisfying other conditions, will form an image of the observer's eye in the required position. These further conditions ensure the transmission to the real eye of all the light (assuming for the moment that all losses of light on refraction through the lenses of the instrument may be neglected) that reaches the virtual eye position: roughly, they involve the insertion in the tube of a lens at intervals proportional to the distance of the virtual eye from the open end of the tube. Thus if the field of view is to be doubled the number of lenses needed in a tube of given length and diameter must be doubled. Consider now two tubes, the length and diameter of one being twice that of the other. If they are both used to accommodate optical systems giving the same field of view, the distance of the virtual eye position from the open end will be twice as great with the large tube as with the smaller, and this will be secured with the same number of lenses in each instrument. But another factor enters which modifies this result: if the smaller instrument gives all the illumination necessary, *i.e.*, fills the observer's pupil with light, the larger instrument will fill with light a pupil of twice this diameter. The transmission down the large tube of beams of this width will be useless, and since diameter of beam and angular field are reciprocally proportional, the angular field may be doubled in the large tube for a fixed number of lenses without reducing the illumination below that obtained with the smaller tube.

Another way of stating this result is that for a given angular field and a given diameter of emergent beam the number of lenses required is proportional to the length of the tube and inversely proportional to the square of its diameter. As an illustration, the number of lenses required to transmit a given beam down a tube three feet long and two inches in diameter will transmit the same beam down a tube 27 feet long if the diameter is increased to six inches.

The chief objection to an increase in the number of lenses in an instrument is the reduction in the brightness and clearness of the image it involves. The brightness suffers because the amount of light transmitted through the instrument is decreased owing to reflection, absorption and scattering; the clearness is diminished because, of the transmitted light, a decreasing proportion is concerned with the formation of the real image, the rest forming spurious images or appearing as mere fog. When these additional lenses belong to a narrow part of the instrument, their powers, being inversely proportional to the interval between successive lenses—that is, proportional to the inverse square of the diameter of the tube—are high, and their effects in introducing irremovable aberrations, such as chromatic aberration and curvature of field, are correspondingly great. From the optical point of view that narrowness in the tube, even for a short length, is very detrimental to the production of a good instrument.

The optical system in a periscope is intended to give a view roughly similar to that obtained by direct vision, and is thus telescopic; that is to say, it has an infinitely great focal length, and exhibits objects with a constant angular magnification. Objects viewed through a tube present an illusive appearance of being less than their natural size, and to compensate for this it is usual to provide an angular magnification of one and a half times as the equivalent of a naked eye view. With this magnification an angular field of about 40° is ordinarily attained, with an emergent beam of diameter 4 or 5 millimetres.

The use of a simple telescope in addition to the top and bottom reflectors would not allow such a field of view to be attained in a periscope of normal length. The typical method of developing more complex telescopes to meet the conditions consists in adding one telescope to another, the combination being itself of course necessarily telescopic. If two telescopes of the astronomical type are combined, pointing—in the astronomical sense—in the same direction, a large magnifying power results and the illumination is feeble. If, however, they are pointed in opposite directions, with their objectives facing one another, the resulting magnifying power will be the ratio of the magnifying powers of the component telescopes, and therefore may be kept down to the low value desired, while at the same time the leading lenses, which constitute the eyepiece of the first telescope, will be of the small diameter needed for the leading portion of the system. A

system of this kind will yield satisfactory images near the axis whatever the separation of the two objectives may be; but in the outer parts of the field, owing to the obliquity of the corresponding beams between these lenses, the brightness of the image is reduced as the separation is increased. The brightness accepted in the outer parts of the field is considerably less than that at the centre, but it may not be reduced beyond the point at which the change—which is gradual from the centre outwards—becomes obvious to the observer. There is thus a limit to the length attainable by the use of two telescopes, but the addition of more telescopes gives correspondingly greater lengths.

In many periscopes a higher power than one and a half, nearly always six, can be introduced instantly in place of the lower power without any change in the focus or displacement of the centre of the field of view. In order to avoid loss of light or reduction of the field as seen by the observer (the " apparent " field), the change of power must be effected at the top of the instrument, that is in the narrow portion of the tube. This requirement of course adds to the difficulties inseparable from a narrow tube. Of the many different means of changing the power employed by different makers only one will be illustrated.

When it is required to search the complete sky, the top reflector must consist of a prism, or alternatively of two prisms

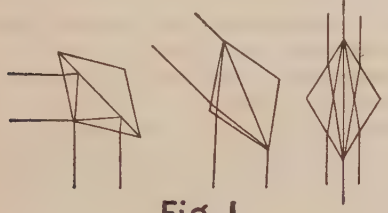

Fig. 1.

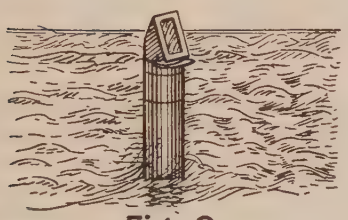

Fig. 3.

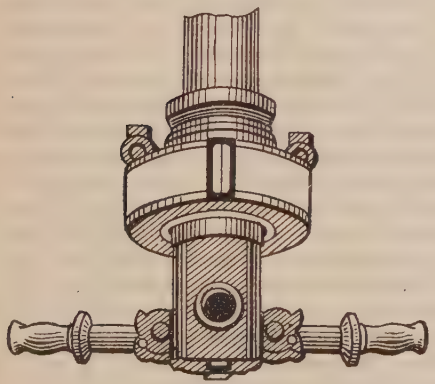

Fig. 4

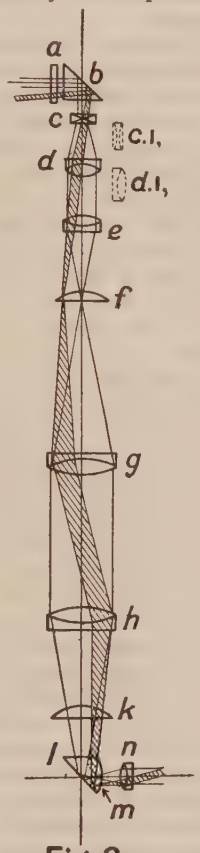

Fig. 2.

FIG. 1.—Diagram showing how light from different altitudes is directed down the periscope tube. FIG. 2.—General principle of type of submarine periscope (see text). FIG. 3.—Upper end of sky-searching type. FIG. 4.—Lower end of same.

placed with their reflecting bases close together and parallel to one another. The way in which light from different altitudes is directed down the tube is evident from fig. 1.

PRINCIPLES OF CONSTRUCTION

The accompanying series of illustrations (figs. 2 to 4) show the general principles of construction, together with the appearance of the two ends, in one of the many patterns of submarine periscope that are made by Messrs. Barr and Stroud. Fig. 2 shows diagrammatically the arrangement of the optical parts in a bifocal periscope giving a field of view of 40° with a power of 1½ and a field of 10° with a power of 6.[1] The system will be considered first as a high power instrument. Light enters through the plane parallel plate *a*, which is sealed into the tube, making a watertight joint; immediately afterwards it is reflected downwards by the prism *b*, and is then refracted in turn by the lenses *e*, *f* and *g*, which constitute an inverted astronomical telescope. Of these lenses *e* corresponds to the eye lens, *f* to the field lens of the eyepiece and *g* to the object glass. This telescope is followed by a second, comprising four lenses, *h*, *k*, *m* and *n*: *h* is the objective, *k* a collector lens, which may be moved along the axis of the tube for focusing and the remaining pair *m* and *n* together constitute the eyepiece of the periscope. The lower reflector is the prism *l*, to which the lens *m* of the eyepiece is cemented.

The first telescope produces an angular magnification measured by the ratio of the focal lengths of *e* and *g*. Since the instrument is used with the eyepiece and object in the reverse of the usual order, the image formed appears to be diminished instead of magnified, and, of course, is inverted. The second telescope magnifies this diminished image in a ratio depending on the relation of the focal length of the pair of lenses *h* and *k* to that of the eyepiece *m* and *n*. By a proper selection of these focal lengths it is evident that a power of six can be obtained without imposing any inconvenient restrictions on any of the lenses. Moreover, the inverted image formed by the first telescope is reinverted by the second, so that objects viewed through the periscope present their natural appearance. To obtain a power of one and a half with a correspondingly augmented field, Messrs. Barr and Stroud introduce a Galilean telescope in front of the system just described. Since such a telescope gives an upright image, no inversion results from the introduction of the additional lenses, and no change in the position of the real image plane of distant objects occurs if these lenses are in correct telescopic adjustment. Since a diminished angular magnification is to be obtained, the eye lens—that is, the negative lens *c* of the Galilean telescope—precedes the objective *d*. When the high power is in use the lenses *c* and *d* are swung to one side, as at c_1 and d_1, against the side of the tube. Fig. 2 shows the paths of two beams through the low power system, that along the axis having the full cross section admitted by the lenses *g* and *h* and the other from a point at the edge of the field showing by its smaller cross section the diminution in illumination which takes place.

Fig. 3 shows the upper end of a Barr and Stroud periscope of the sky-searching type. The window is inclined to the axis of the tube to give the large angular field required. Within the window may be seen the prism by the rotation of which about a horizontal axis the direction of sight may be varied from the zenith to below the horizon according to the principle illustrated in fig. 1. The lower end of the periscope is illustrated in fig. 4. The handles are used to rotate the instrument about its axis, and so enable the line of sight to be directed to any part of the horizon as required. The bearing of any object to which the periscope is directed may be read on the scale seen in the upper part of this figure. When the instrument is not in use the handles may be folded into a vertical position out of the way. The eyepiece, surrounded by a rubber eye-guard, is seen between and slightly above the handles. In focus with the image of external objects are seen the graduations of vertical and horizontal scales. These correspond to suitable angular intervals by means of which the apparent sizes of objects may be obtained with fair accuracy, and from this an estimate of distance, for example, may be derived. Inset in the top of the field of view, so as to be visible without taking the eye from the eyepiece, is a view of a portion of the bearings scale, which is projected into the field of view by means of a small prismatic telescope.

[1] This page is much too short to enable a drawing to scale to be printed thereon.

In addition to reading the bearing it is important that the observer should be able to bring any object into the centre of the field of view without removing his eye from the eyepiece. This involves control over the angle of elevation of the line of sight, ability to adjust the focus and possibly the power of introducing coloured screens before the eye. In this periscope the top prism may be adjusted for elevation as required by rotating one of the handles about its axis, and the focusing adjustment and the light filters are controlled by means of the two milled heads seen projecting from the bottom of the periscope in fig. 4. The change of power is effected by rotating the second handle. All these controls are placed conveniently for the observer. The coloured glasses are placed within the tube and lie close to the eye lens.

In ordinary use the low power telescope is employed, and a change is only made to the high power when it is desired to observe an object that has been sighted more minutely than is possible with the low power. By using the low power, which embraces an angular area sixteen times as great as the high power, large regions can be observed much more rapidly than with the high power with its smaller field of view. Means are provided, but not illustrated, for raising and lowering the periscope rapidly. The recognised method of use is to break the surface for a series of rapid observations rather than keep the top above water, since the continuous trail made at the surface as the submarine travels under the water betrays her presence to an enemy.

Special provision has to be made for desiccating the air in the interior of the periscope from time to time. As material for the tubes bronze has been used on account of its non-magnetic character—a most important requirement; also nickel steel, which is only slightly magnetic. The latter material is somewhat corrodible by sea-water. Very slight action of this kind is serious, since it causes the tube to work shiftily in its watertight gland. Messrs. Barr and Stroud use immadium bronze, which they find preferable in all respects to the earlier materials.

The principles of construction of periscopes for use on land are the same as those described for naval instruments. The conditions to be satisfied are in general less stringent than in submarine periscopes, and in the absence of important special features it is unnecessary to give illustrations of these instruments. See the article "Periscope" in *Dictionary of Applied Physics*, vol. 4. (T. Sm.)

PERKIN, WILLIAM HENRY (1860–), British chemist (*see* 21.173), was in 1912 appointed Waynflete professor of chemistry at Oxford. His numerous investigations on the constitution of the terpenes and of various alkaloids and natural colouring matters, which are described in a very brilliant and numerous series of papers in the *Transactions of the Chemical Society*, were carried out with great skill and originality. These investigations formed the scientific basis of the great synthetic dye industry, in the development of which Germany played the leading part.

PERMANENT COURT OF INTERNATIONAL JUSTICE.—The Permanent Court of International Justice was created by an international agreement concluded at Geneva, Dec. 16 1920, and consisting of a statute for the establishment of the Court and a protocol of signature by which 48 States declared their acceptance of the statute and of the jurisdiction of the Court. At the close of 1925 this protocol had been ratified by 37 of the 48 signatories, including all the principal Powers, except Germany, Russia and the United States of America. On Jan. 28 1926 the Senate of the United States, upon the formal initiative of the President, advised and consented that the United States adhere to the protocol of Dec. 16 1920, with certain reservations designed to put the United States upon an equal footing in respect of the Court with the several members of the League of Nations. Germany applied in 1926 for membership in the League of Nations, and, if admitted, it is reasonable to assume will adhere to the Court protocol.

I. CONSTITUTION AND JURISDICTION

Judges.—The Court consists of 11 judges and four deputy judges, who are elected for terms of nine years and may be re-elected. The seat of the Court is at The Hague. It holds regular annual sessions, and, unless otherwise provided by rules of the Court, the regular session begins on June 15 of each year and continues as long as may be deemed necessary to finish the cases on the list. It elects its own president and vice-president, appoints its own registrar and makes its own rules regulating procedure. The president and registrar are required to reside at the seat of the Court. If at any time the full number of 11 judges cannot be present, the deputy judges are called upon to make up the number; nine judges being necessary to make a quorum. The statute requires that the members of the Court shall be a body of independent judges elected regardless of their nationality from amongst persons of high moral character who possess the qualifications required in their respective countries for appointment to the highest judicial offices or are jurisconsults of recognised competence in international law.

Not more than one national of any State at one time may be member of the Court. The members receive regular salaries and are not permitted to exercise any political or administrative function, or to act as agent, counsel or advocate in any case of an international nature. Every member is required, before taking up his duties, to make a solemn declaration in open court that he will exercise his powers impartially and conscientiously.

Litigants.—Only States or members of the League of Nations can be parties to cases before the Court. The rights of a private person, therefore, can be brought before the Court only by the Government of the State or quasi-state of which he is a citizen. The Court is open unconditionally to the members of the League of Nations and also to the states mentioned in the annexe to the League Covenant, and it is open to other States upon condition of their accepting the jurisdiction of the Court and undertaking to carry out in good faith its decisions and not to resort to war against a State complying therewith. The jurisdiction of the Court comprises all cases which the parties refer to it and all matters specially provided for in treaties and conventions in force.

There was much discussion whether this jurisdiction should be made generally compulsory, so that whenever one party to any international controversy wished to bring the case into court, the other party would be bound to submit to the jurisdiction. Many States being unwilling to subject themselves to so comprehensive an obligation, the question was disposed of by including in the protocol and statute an optional clause, which the several States were at liberty to sign or refrain from signing, and under which the States signing recognised as compulsory, in relation to each other, the jurisdiction of the Court in legal disputes concerning (*a*) the interpretation of a treaty, (*b*) any question of international law, (*c*) the existence of any fact which, if established, would constitute a breach of an international obligation (*d*) the nature or extent of the reparation to be made for the breach of an international obligation. At the close of the year 1925 this optional clause had been signed by 23 States. France was the only Great Power included in this list. Since the Court began its work, its jurisdiction under the head of "matters specially provided for in treaties and conventions" has been enlarged by many new treaties and conventions providing that disputes between the parties shall be submitted to the Court.

Procedure and Practice.—The statute requires the Court to apply in its decisions (1) international conventions, whether general or particular, establishing rules expressly recognised by the contesting States; (2) international custom as evidence of a general practice accepted as law; (3) the general principles of law recognised by civilised nations; (4) judicial decisions and the teaching of the most highly qualified publicists of the various nations, not as binding, but as subsidiary means for the determination of rules of law.

The official languages of the Court are French and English. The hearings are public. Every decision is by a majority of the judges present at the hearing. The judgments are required to state the reasons on which the decisions are based. They are delivered in open court, and are printed and published in a regu-

lar series of reports. They are final and without appeal, but a judgment is binding only between the parties and in the particular case. Dissenting judges are entitled to deliver separate opinions.

Special chambers of five judges each are appointed by the Court for three years to hear and determine labour cases arising under Pt. XIII. of the Treaty of Versailles and cases relating to transit and communications under Pt. XII. of the Treaty of Versailles. In such cases the judges are assisted by technical assessors. With a view to the speedy dispatch of business, the Court forms annually a chamber of three judges, who, at the request of the contesting parties, may hear and determine cases by summary procedure.

Special pains are taken in the statute to ensure that in each case there shall be in the Court some judge familiar with the laws, customs and peculiarities of each country which is a party to the controversy, and if in any case there is no member of the Court coming from the country which is a party litigant, that party may name an additional judge to sit in the Court in that case. For this purpose several parties in the same interest are reckoned as one party only.

Advisory Opinions.—The Court has provided by rules for giving an advisory opinion upon written request from the Assembly or the Council of the League of Nations containing an exact statement of the question accompanied by all documents likely to throw light upon it. When such a request is received, the registrar is required to give notice to the members of the Court, to the members of the League of Nations, to the States mentioned in the annexe to the Covenant and to any international organisations which are likely to be able to furnish information on the question. Opinions are given only after hearing all parties concerned and after deliberation by the full Court; and the requests and opinions are printed and published in a special collection of reports.

II. ELECTION OF JUDGES

The judges and deputy judges of the Court are elected by separate concurrent votes of the Council and the Assembly of the League of Nations, a majority vote of the members of each of those bodies being necessary to an election. The voting is confined to a list of eligible candidates nominated by the members of the old Permanent Court of Arbitration at The Hague established by the Hague Conferences of 1899 and 1907. That Court of Arbitration was made up by each Power signatory to the Hague Convention for the Pacific Settlement of International Disputes selecting not more than four persons who were required to be "of known competency in questions of international law, of the highest moral reputation and disposed to accept the duties of arbitrators." The persons thus selected were inscribed as members of the Court of Arbitration in a list which was sent to all the contracting Powers.

When a controversy was to be brought before the Court of Arbitration, five persons were to be selected from this list by the parties to constitute the tribunal to hear and determine the case. The list of members of the Court of Arbitration accordingly really constitutes a panel from which in each case the arbitral tribunal is selected, and this panel is composed of as many little national groups as there were States signing the Hague Convention and making appointments under it. Under the statute of 1920 creating the Permanent Court of International Justice, when a judge of the new court is to be elected, each of these national groups in the old court is called upon to nominate not more than four candidates, not more than two being of their own nationality. All the nominations thus made are entered in a single list to which the votes of the Council and the Assembly for the new judges are confined.

The experience of many years has shown that the character of the men appointed to the old Court of Arbitration was such as to withdraw them to a great degree from the most disturbing influences of local politics and to make them specially familiar with the persons who would be fitted for judges of the new court, and the statute conferring the power of nomination upon them contains an express provision that "before making these nominations, each national group is recommended to consult its highest court of justice, its legal faculties and schools of law, and its national academies and national sections of international academies devoted to the study of law." The statute creating the new court also lays down for the guidance of the Assembly and Council in casting their votes the following rule: "At every election the electors shall bear in mind that not only should all the persons appointed as members of the Court possess the qualifications required, but the whole body also should represent the main forms of civilisation and the principal legal systems of the world."

If after three meetings there remains a vacancy for which no candidate shall have obtained an absolute majority of votes both in the Assembly and in the Council, then a joint conference committee is provided for, which shall endeavour to agree and report upon a candidate, and the conference committee may, by unanimous agreement, go out of the list of nominations for a candidate. If the conference fails, then the judges of the Court already elected may proceed to fill the vacancy by selection from amongst the candidates voted upon in the Assembly or in the Council.

III. ORGANISATION AND WORKING

The first election of judges to constitute the Court was held at Geneva Sept. 14–6 1921. The list of eligible candidates proposed by the members of the old Court of Arbitration included 89 names, and from this list 11 judges and three deputy judges were elected by concurrent ballots of the Council and Assembly, and a fourth deputy judge was chosen upon the report of a conference committee accepted by both bodies. The judges elected were respectively citizens of France, Great Britain, Spain, Denmark, the Netherlands, Switzerland, Italy, Japan, Brazil, Cuba and the United States of America. The deputy judges were citizens of Norway, Rumania, the Serb-Croat-Slovene State and China. The members elected met at The Hague on Jan. 30 1922, and proceeded to organise the Court by electing Judge Loder (Holland) as President and Judge Weiss (France) as Vice-President, appointing Mr. Ake Hammarskjold (Norway) as registrar, and adopting rules regulating the constitution and working of the Court and procedure before it.

The first session for the transaction of judicial business opened on June 15 1922. The regular sessions provided for were held henceforward and during the years 1922–5 there were nine extraordinary sessions. During the same period the Court heard, considered and gave decisions in six contested international cases and upon 12 requests for advisory opinions. Most of the questions passed upon were novel, difficult and important, and many of them presented differences of opinion which required an authoritative decision if the establishment of peace and order in Europe on a reasonable working basis was to proceed after the extensive re-arrangements caused by the Treaty of Versailles. The 18 judgments and opinions rendered were accepted as final. The existence of the Court is manifestly beginning to affect international discussion of disputes and to be recognised as affording a means of escape from those international deadlocks which have seemed insoluble because neither party felt willing to humiliate itself by surrendering its position.

IV. EVOLUTION OF THE COURT

The Permanent Court of International Justice is not a product of any one mind or group or negotiation. It is a growth of many years during which a multitude of men familiar with international affairs have collaborated in an effort to adapt to the conditions of international controversy the idea of justice under which in civilised communities judicial decision has superseded private war. Many projects designed to accomplish this result were devised and published by individuals from the 16th down to the close of the 19th century without much apparent effect. In the meantime, however, provisions for arbitration became more frequent in international treaties and the practice of

settling international disputes by arbitration increased. Nineteen international arbitrations are registered during the first half of the 19th century and 117 during the second half. The Hague Conference of 1899 greatly facilitated the practice of international arbitration by providing a general system with well considered forms of procedure, an established secretariat and an available list of suitable arbitrators.

Justiciable and Non-justiciable Questions.—The next step in development was a realisation of the distinction between the arbitration of controversies between nations and the judicial decision of justiciable questions. Arbitrators selected *ad hoc* by the parties for the decision of a controversy proved quite likely to negotiate a settlement. Men of the highest character in such a position had a tendency to act under a sense of diplomatic obligation, according to which the legal rights of the parties were merely elements in determining what it would be wise to do. By the time the Second Hague Conference of 1907 met, a considerable opinion had arisen that for the decision of international questions of legal right it was necessary to create a permanent tribunal composed of judges who were judicial officers and nothing else, and who would devote their entire time to the trial and decision of international causes by judicial methods and under a sense of judicial responsibility, and who were so selected that the different systems of law and procedure should be fairly represented.

After very full discussion, the Conference of 1907 declared itself in favour of this view. It adopted a draft project for such a court which, however, remained incomplete because it proved impossible to reach an agreement on the mode of selecting the permanent judges. The numerous smaller Powers were insistent upon their rights of equal and independent sovereignty and upon an equal voice in the selection of judges as a logical incident to that sovereignty. The Great Powers were unwilling to agree to a court in the constitution of which they would have practically no voice commensurate with their populations and interests, as against the overwhelming majority of smaller States. Throughout the Conference and during the seven years that elapsed between 1907 and the outbreak of the World War, there were constant but unavailing negotiations for an agreement upon some mode of electing the judges.

At the close of the War, the Fourteenth Article of the Covenant of the League of Nations required the newly created Council of the League to resume this effort and to formulate and submit to the members of the League for adoption plans for the establishment of a Permanent Court of International Justice. In pursuance of that instruction, 12 international lawyers, resident in as many different countries, were invited by the Council to act as a committee to prepare plans for the establishment of the proposed court. Upon this invitation such a committee met at The Hague on June 16 1920, consisting of members from Great Britain, France, Spain, Belgium, Holland Norway, Italy, Japan, Brazil and the United States. After long discussion, this committee, on July 24 1920, reported a plan containing the arrangements for the election of judges above described. With some amendments in the Council and Assembly, particularly regarding jurisdiction, that plan was incorporated in the statute of Dec. 16 1920.

Many of the provisions embodied in the statute creating this Court had their origins during these long years of discussion in the necessity of reconciling the opinions of a great number of nations differing in their circumstances, in their modes of thought and feeling and in their conceptions of what would contribute to international justice. The statute probably does not conform to what would be produced in any single country, but it probably does include substantially all the useful provisions upon which the members of the community of nations were willing to agree in the year 1920.

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PERNAMBUCO: *see* RECIFE.

PERNERSTORFER, ENGELBERT (1850–1918), Austrian politician, was born in Vienna April 27 1850. Acquainted since childhood with Viktor Adler, Pernerstorfer studied and sympathised with the young Austrian labour movement since his earliest days as a teacher. In 1870, together with Adler, Friedjung, the historian, and others, he formed a league for the study of social movements. His first political activities were, however, linked with Schönerer's extreme German Nationalist movement. He was one of the authors of the German Nationalist *Linzer Programm* (1880), but he left this party and entered Parliament in 1889 as an independent. As deputy he enjoyed the right of free speech and began to act as the mouthpiece of the Social Democrat party, to which he was of the greatest service. He joined the party in 1896, and sat for it in Parliament from 1901 until his death, in latter days being president of its parliamentary fraction and vice-president of the House (1909, 1911). Pernerstorfer was rather an advanced liberal, who adopted Socialism from love of humanity and hatred of absolutism and clericalism. His own principal interests were literary and educational. His fearless and generous personality did much for the poorer classes of his fellow men in days when they were practically political and social outcasts. He died in Vienna Jan. 6 1918.

PERRY, BLISS (1860–), American author, was born at Williamstown, Mass., Nov. 25 1860. He graduated from Williams College in 1881 (A.M., 1883), continuing his studies at the universities of Berlin and Strasbourg. He was professor of English at Williams College, 1886–93, and professor of oratory and aesthetic criticism at Princeton University, 1893–1900. In 1907 he became professor of English literature at Harvard University, and was Harvard lecturer at the University of Paris, 1909–10. He was the editor of *The Atlantic Monthly* 1899–1909.

Among his published works are *The Broughton House* (1890); *The Powers at Play* (1899); *A Study of Prose Fiction* (1902); *The Amateur Spirit* (1904); *Walt Whitman* (1906); *Carlyle* (1913); *The American Spirit in Literature* (1915); *A Study of Poetry* (1920); *Life and Letters of Henry Lee Higginson* (1921), and *The Praise of Folly* (1923).

PERSHING, JOHN JOSEPH (1860–), American soldier, was born near Laclede, Mo., Sept. 13 1860. He studied at the Kirksville (Mo.) Normal School; graduated from the U.S. Military Academy in 1886; was commissioned second-lieutenant and assigned to the 6th Cavalry in a campaign against the Apaches in Arizona. In 1890, during an uprising of the Sioux, he served in Dakota, in charge of the Indian scouts. In 1891 he was appointed military instructor at the University of Nebraska, remaining there four years. He entered the law school and received the degree of LL.B. in 1893. In 1897 he was appointed instructor in tactics at the U.S. Military Academy. He served in Cuba through the Santiago campaign (1898), was appointed ordnance officer with the rank of major of volunteers, and in June 1899, assistant adjutant-general. He organised the Bureau of Insular Affairs in the War Department, of which he was head for several months. In Nov. 1899 he was sent to the Philippines as adjutant-general of the department of Mindanao, and in 1901 was made captain in the regular army and later conducted a campaign against the Moros, which he completed with success in 1903. He then returned to the States and was appointed a member of the General Staff. In 1905 he went to Japan as military attaché to the U.S. embassy, and during the Russo-Japanese War spent several months as military observer with the Japanese Army in Manchuria. As a reward for his success in the Philippines, President Roosevelt in 1906 appointed him brigadier-general from the grade of captain, passing him over 862 senior officers. Afterwards he returned to the Philippines as commander of the department of Mindanao and governor of the Moro Province.

In 1913 Pershing was placed in command of the 8th Brigade at San Francisco, which was soon after sent to the Mexican border. In March 1916 he commanded the punitive expedition into Mexico against Francisco Villa, and the same year was made major-general. After the death of Maj.-Gen. Funston in 1917 he succeeded him as commander on the Mexican border. On America's entrance into the World War he was chosen to command the American Expeditionary Force in Europe. With his staff he reached England June 9 1917 and four days later landed in France. In Oct. 1917 he was made general. From the start Gen. Pershing insisted upon the integrity of the American Army being preserved. He was convinced that the presence of an independent American Army would be a serious blow to German morale. As commander-in-chief of the A.E.F. he urged the American attack at the Marne salient in 1918, and planned American operations at St. Mihiel and in the Meuse-Argonne. His management of the A.E.F. is clearly described in his succinct *Final Report* (less than 100 pages), issued by the Government Printing Office, Washington, Dec. 1919. His nomination by President Wilson to the permanent rank of general, a grade held previously by only four Americans—Washington, Grant, Sherman and Sheridan, was confirmed unanimously by the U.S. Senate Sept. 1 1919. In 1921 he was appointed chief-of-staff. He was given the G.C.B. by King George V. He was head of the U.S. deputation which attended the celebration in Peru on Dec. 9 1924 of the centenary of the battle of Ayacucho, visiting also Chile, Argentina, Brazil and Venezuela. Appointed by President Coolidge as the U.S. representative and *ex-officio* head of the commission to supervise the plebiscite under the Tacna-Arica Arbitration Award, he went to Arica in July 1925 to take up his duties, but, owing to his health becoming impaired, had to resign. He returned to the United States in Feb. 1926. (*See* TACNA-ARICA.)

PERSIA (IRAN) (*see* 21.187), an Asiatic State under a shah. Its area is about 628,000 sq. m. and the population is estimated at 10,000,000.

I. POLITICAL CHANGES

1909–14.—The autumn of 1909 was a turning point in Persian history. The despotic Mahommed 'Ali had abdicated in favour of his young son Sultan Ahmed, thus ending the struggle against absolutism. Great Britain and Russia were sympathetic, the latter power not only appointing a minister with liberal ideas, but withdrawing her troops from Kazvin and Tabriz. The field was clear, and Persia seemed to have every chance of setting her house in order. But, a year later, the situation again changed, and Nasir el Mulk, who had been elected Regent, reached Tehran at a critical time. The ex-Shah, who had settled at Odessa, crossed Russia with the connivance of Russian officials, and landed near Asterabad with a band of adherents and a quantity of munitions. The Turkoman rallied to him and marched on Tehran, where at first they caused a panic, but were defeated mainly owing to the able handling of a machine gun by a European instructor. The Salar ed Dauleh, brother of the ex-Shah, who had advanced on the capital from Kermanshah with a force of tribesmen, was also defeated. Finally, the ex-Shah retired to Russia because Great Britain refused to consider the question of his return to the throne, which was favoured by Russia.

In March 1912 Russia committed a singularly disgraceful and foolish act at the shrine of the Imâm Riza, the chief centre of pilgrimage in Persia. The Russian consul-general took advantage of minor local disturbances to call in a large Russian force. An *agent provocateur* collected large crowds at the shrine to listen to his incendiary speeches. The Russians then bombarded the shrine. Many innocent men and women were killed or wounded; the sacred tomb-chamber in which lie the remains of Persia's saint was repeatedly struck by shell-fire; the treasury, containing the gifts of countless pilgrims, was removed, and when restored was not intact. The outrage excited intense indignation and was the chief cause of Persia's hatred against Russia. To cope with the general anarchy, the Persian Govt. engaged a staff of Swedish officers, who began, in the face of great difficulties, to raise a force of gendarmerie. Their first recruits were largely loafers, but they gradually made progress, especially in the capital and in Shiraz. During the World War the force was incorporated with and superseded by the South Persia Rifles raised by Sir Percy Sykes. Events in Persia during the war period, 1914–8, form the subject of a separate article (*see* PERSIA, CAMPAIGNS IN).

Events of 1919 and 1920.—When news of the Armistice reached Tehran, the Persian Govt. hastened to congratulate the victors. In 1919 a Persian delegation reached Paris to lay extravagant claims for territorial expansion before the Peace Conference, but was refused a hearing on the ground that Persia, not having taken the side of the Entente in the War, could not be represented at the conference.

Shortly afterwards, negotiations were conducted between Great Britain and Persia for a convention, which was signed in Aug. 1919. By its terms, Great Britain agreed to help Persia with a loan, with financial advisers and with military officers. It was honestly intended to benefit Persia, but the convention was considered to threaten her independence, and was opposed by the Nationalist party, which was supported by certain allied legations. As a result, when the convention came before the Majlis, it was denounced, and the British incurred much unjust odium, which did little credit to Persia.

In May 1920 the Bolshevist fleet from Baku bombarded Enzeli and occupied Resht, where a Provisional Govt. was formed under Kuchik Khan. At Tehran there was a panic, and the British were blamed for not protecting Persia. The Persian Cossack Division recaptured Resht some months later, but was finally defeated by the Bolshevists, and took refuge inside the British lines. The corrupt and inefficient Russian officers were dismissed, and were temporarily replaced by British instructors.

Rise of Riza Khan and Expulsion of the Qajar Dynasty.—In the winter of 1920–1 a *coup d'état* was organised by a Persian journalist; the Cossack Division marched on Tehran and seized the Government without opposition in Feb. 1921. Their leader was a senior officer, Riza Khan, who had risen from the ranks and was of humble origin. He became commander-in-chief and also Minister of War, and from this date practically ruled Persia. He used the money that reached the treasury primarily for the regular payment of his troops, who realised that their interests were being looked after as never before. He also restored order with the result that Persia became safer than for many years past. For a while Riza Khan contented himself with being the virtual head of the Government but, in the autumn of 1923, he became Prime Minister and drove the *fainéant* Shah out of the country. In the spring of 1924, following the precedent established by Mustafa Kemal in neighbouring Turkey, he attempted to establish a republic with himself as President. This scheme failed, mainly owing to the opposition of the *mullas*, who had noted with deep concern that the establishment of a republic in Turkey was followed by the abolition of the Caliphate. Riza Khan's position was only temporarily shaken by this failure and, in the autumn of 1925, he was able to dethrone the Shah and was elected to the vacant throne by a practically unanimous vote of the Majlis.

Thus fell the Qajar dynasty which had ruled Persia for nearly a century and a half. Since the death of Nasir ud Din in 1896, their rule had been hopelessly corrupt and inefficient. It seemed possible that under Shah Riza Pahlevi, Persia might regain her prosperity and strength. He had organised a well-trained force of all arms, 40,000 strong, with which he defeated and reduced to submission the nomad tribes who, of late years, had been virtually independent of the Government. He then set about disarming the entire population, a step calculated to help materially towards the restoration of order and prosperity.

It might be thought that the hostility of the Qajar Princes would be too strong for the new Shah, but this did not prove the case. Sultan Ahmad had alienated the sympathy of his

relations, many of whom have believed that the bloodless revolution that had taken place was more likely to guarantee them the possession of their wealth than the steady drift towards a break-up that characterised the old order. The chief danger facing the new Shah was that of Bolshevik propaganda, and this was the more grave in that the improved situation depended on the single life of its author. He was also faced with troubles due to the scarcity of bread and the interference with military at elections, which events led, June 1926, to the resignation of the prime minister.

II. ECONOMIC CONDITIONS

Communications.—Persia is cut off from the rest of the world by her rugged mountains and lack of modern communications. A metalled road was constructed during the War by the British from railhead at Khanaqin to Kermanshah and Hamadan, where it joined a Russian built road running to Kazvin and the Caspian. Again, the British opened up routes from Bushire to Shiraz and Isfahan; and from Duzdap, on the border of Persian Baluchistan, to Meshed. These latter roads are not metalled and would not stand heavy traffic. Other routes available for wheeled traffic were opened by the British in Southern Persia, but Persia remains deplorably deficient in roads. Under her American advisers, an effort is being made to grapple with this problem, although the available amount of money is very small. The new Shah is deeply interested in developing a route from Mohammerah *via* Ahwaz, Khurramabad and Sultanabad to Tehran. This all-Persian route runs through fertile districts and it seems probable that it will be selected as the alignment of the first Persian railway. The main road in 1926 was that running from Baghdad to Tehran, and it was being developed by the Eastern Transport Company, which had established a weekly service of cars and lorries from Khanaqin to Tehran, in connection with their service from London to Baghdad *via* Beirut. Thanks to this service, passengers reach Tehran in three days from Baghdad and machinery only takes one month from London, instead of five or six under the old conditions.

With the exception of the almost derelict line from Julfa there are no railways in Persia, whose communications are actually deteriorating relatively to progress in neighbouring countries. Indeed, until a railway programme is carried out, Persia will remain a mediaeval land. Persians hope to finance railway construction by extra taxes on tea and sugar, but the sums raised would not be sufficient for the purpose. Railways would not pay in Persia and will have to be subsidised by the Government.

The Persian Army is developing an air service of its own, which has helped materially in the restoration of internal order. The country is particularly suitable for transit by air and the important British commercial air service that is being organised between Baghdad and Karachi will follow down the shores of the Persian Gulf. A German company has been granted the privilege of establishing an air service in Persia.

Persia is well served by telegraphs. The Indo-European trunk lines run from Julfa to Tabriz, Tehran and Kashan. At this town, one line runs due south to Bushire and thence by cable to Jask and by land line to Karachi, while a second line runs through Yezd and Kerman and across Baluchistan to Karachi. Other lines also exist. Wireless installations are being constructed in the vicinity of Tehran and it is intended to erect smaller installations at other centres. Telephones are installed in the chief towns.

Agriculture.—Persia is essentially an agricultural country. The main crops are wheat, barley, millet, cotton, opium, lucerne and tobacco. Sesame and other oil seeds grow everywhere, as do onions and turnips. Rice and maize are chiefly produced in the Caspian provinces. Potatoes, beans, peas, cabbages, tomatoes, cucumbers, spinach, lettuces and radishes are the chief vegetables, but many of them, potatoes for example, are only grown near the larger towns. Persia is rich in fruit, which grows to considerable perfection in spite of the lack of scientific cultivation. Apples, pears, quinces, apricots, plums, peaches, nectarines, cherries and mulberries grow everywhere in great abundance. Figs, pomegranates, almonds and pistachio nuts grow better in the warmer districts, while the date-palm, orange and lime are, generally speaking, confined to the *garmsir* or "hot country." The grapes and melons of Persia are famous. The barren mountains produce an edible thistle, rhubarb and a large mushroom. The delicious manna exudes from a species of tamarisk, while valuable gums are tapped from stunted trees. Tea planting was started some years ago in the Caspian provinces and is making some progress, while the silk industry is capable of considerable development. Generally speaking, agriculture has been utterly neglected, and although it may be difficult to increase the supply of irrigation water on the plateau, the value and output of the crops could be considerably increased by the application of modern methods.

Finance.—With the help of her American advisers, Persia is now producing honest budgets. For the year 1923–4 the revenue was £5,128,000, Customs representing 33%, direct taxation 16% and oil royalties 10 per cent. The expenditure was £5,700,000, of which 40% was taken by the War Ministry. For the year 1924–5 the incomplete accounts show that this deficit had been practically wiped out. After the War the Bolshevist Government cancelled all debts due by Persia and all Russian concessions. These debts had been larger than the sums owed to the British Government and to the Imperial Bank of Persia, which amount to about £2,600,000. This small debt, to some extent, represents advances which are repaid during the year. Persia has kept faith with her creditors, thereby strengthening her financial position against the day when she will need to float a large loan for the reconstruction of the country.

The Imperial Bank of Persia, a British institution, is the state bank, receiving revenues and remitting Government funds without charge. It also accommodates the Treasury with advances and in many other ways. It possesses the monopoly of issuing notes and pays the Government 6% of its profits. The Imperial Ottoman Bank has several branches in Persia, and banking is also carried on in a small way by Persian *sarrafs*. The standard coin is the silver kran, the conversion rate used in this article being krs. 45 to £1. Gold is also minted, but has no fixed prices and fluctuates considerably in value. It is especially high at the Persian New Year (March 21), at which season gold coins are given as presents.

Trade.—Persian imports for 1923–4, aggregating krans 694,251,000, consist of manufactured products 54%, and food and drink 33 per cent. Exports valued at krans 768,392,000 include raw or semi-manufactured materials 72%, and manufactured articles 17 per cent. The above figures prove the undeveloped state of Persia, dependent on foreign countries for her manufactured articles, a large proportion of which are textiles, tea and sugar. Of her exports, mineral oil constitutes one-half, followed by opium, carpets, cotton and wool. Before the War, the trade of Russia reached 60% of the total trade, as against 21% for the British Empire. To-day the position is reversed, Great Britain's share being 57% and that of Russia 18 per cent.

Anglo-Persian Oil Company.—Persia possesses considerable mineral wealth but, owing to lack of railways, water, fuel and technical skill, it remains undeveloped. The notable exception is the British oil concession which includes all Persia except the five northern provinces. The royalties derived from the company constitute 10% of the revenue, and mineral oil forms one-half of the exports. Moreover, the company spends over £2,000,000 in Persia and trains some 40,000 Persians to habits of industry. Opium is grown in almost every province and comprises about one-fourth of the export trade. The Persian Government is prepared to limit the export, but the question bristles with difficulties. The League of Nations is sending a Commission to inquire into the whole question, but it is unlikely that they will be able to recommend the substitution of other crops owing to the absence of railways. To conclude, there is great need for modern means of transport and for education of

every sort, without which Persia must inevitably remain a poor and undeveloped country.

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PERSIA, CAMPAIGNS IN.—For many years before the World War Germany had been making strenuous efforts to increase her influence and interests in Persia. At Tehran a college was opened, staffed by German professors and subsidised by the Persian Government. In the Persian Gulf the firm of Wonckhaus began to deal in mother-of-pearl at Lingeh in 1896; in 1897 a German vice-consulate was opened at Bushire. In 1900 Germany attempted to purchase a site for the terminus of the Baghdad railway at Al Kuwait, but Sheik Mubarak had previously concluded a secret treaty with Great Britain agreeing, in return for protection, not to sell or lease any of his territory without her consent.

Other German efforts, made in collusion with Turkey, members of Mubarak's family and the Wahabis, failed; but Turkey established and held posts on Mubarak's territory in Hor 'Abdullah, an inlet running from behind Bubiyan Island to within 30 m. of Basra. In 1902 the firm of Wonckhaus attempted to gain control of the pearl fisheries around Hulul, then of the red oxide deposits of Abu Musa and finally of a piece of land along the river bank at Mohammerah. These attempts were foiled by Sir Percy Cox, the British Resident. In 1906 the Hamburg-Amerika Co. started a service to the Persian Gulf. At the outbreak of war Great Britain was engaged in negotiations with Germany which would have given that Power a strong position at Basra, the destined terminus of the Baghdad railway; and had acknowledged Turkey's suzerainty over Al Kuwait.

I. THE MENACE TO INDIA

In July 1914 the regency terminated with the coronation of the young Shah, who had hardly taken up his duties when hostilities commenced. His Majesty summoned the Majlis, and duly proclaimed the neutrality of Persia. The position was, however, a difficult one. The grandees were, in many cases, only anxious to receive money from one or both sides; the masses hated the Russians and mistrusted the British for being the friends of their enemies. There was sympathy in some quarters for the Turks, and "let the Christians devour one another" was frequently heard. But Persia was powerless. Her military forces included the Cossack brigade 8,000 strong, the Swedish gendarmerie 7,000 strong and the useless Persian Army.

German Policy in Persia.—At first sight it would seem unlikely that remote Persia should become a war theatre, but there is no doubt that Germany had prepared her plans for attacking the Indian Empire across Persia, using the Turkish Army as her instrument. Before Turkey declared war, the Government of India took the precaution of despatching a brigade of Indian troops to the Bahrein Islands. After the outbreak of hostilities this force, increased to a division, defeated the Turks at Sahil, and occupied Basra on Nov. 21, thus effectually protecting the oil refineries of the Anglo-Persian Oil Co. To protect the pipe-line, 150 m. long, running through Ahwaz to the oilfields at Maidān-i-Naftūn, which the tribesmen had breached and fired in several places, operations were undertaken, as a result of which Persian soil was cleared of a Turkish force that threatened Ahwaz; the local tribes then submitted to the Indian troops and the pipeline was repaired.

Germany hoped to embarrass Russia, and still more, Great Britain, by forcing Persia and Afghanistan into the War on her own side and creating disturbances in India and on her frontiers. If Persia would come in, the claim that Islam was on the side of the Central Powers might have brought in Afghanistan. Germany was able to divert forces to Persia at a small cost; for India was weakly held, and the "Emden" was causing some uneasiness. A Turkish force marching across Persia to Afghanistan could have forced its Amir to join an invasion of India. Agents well furnished with arms and money were sent to enlist levies and march across Central and Southern Persia, murdering or expelling the British. These groups formed supports to missions destined for Afghanistan and Baluchistan, which bore official letters to the Amir and Indian princes and carried on an anti-Christian propaganda in the name of the "Hajji Wilhelm."

The chief German agent was Wassmuss, formerly consul at Bushire, who organised an anti-British confederacy at Tangistan, Dashti and Dashtistan, bought over the Swedish officers of the gendarmerie at Shiraz and secured control of their force. The British vice-consul was murdered, the consul and entire colony arrested and taken to the coast, Quawam el Mulk, the chief of the Arab tribes, who was acting Governor-General, was driven out, and Wassmuss reigned supreme in Fars. In Kermanshah, Turks and Germans expelled the British in April 1915; at Isfahan the Germans were equally successful, and later at Yezd and Kerman. At the end of 1915 seven out of the 17 branches of the Imperial Bank of Persia (a British company) were in enemy hands, and the British colonies had been expelled from Central and Southern Persia, except the Gulf ports. In the north the position was different. The Russians landed troops at Enzeli, which marched on Tehran. This action drove the enemy ministers to quit the capital. They tried, in vain, to induce the Shah to accompany them. They used the force they had collected, mainly composed of escaped prisoners-of-war, for somewhat aimless raiding, but it was easily dispersed by the Russians who moved south and occupied Kashan.

One of the dangers to be guarded against was that of German missions to Afghanistan and Baluchistan. Efforts were made to intercept such parties, but it took time to make the necessary arrangements, and it was not until 1916 that the Eastern Persian cordon was in working order with the Russians patrolling the frontier as far south as Kain, from which centre the British, with some regular troops and a number of locally raised levies, were responsible to the borders of Baluchistan. Persia being a land of vast distances, it is not surprising that a German mission was able, by means of very long marches, to reach Herat in safety. It was received with every honour, but displayed extraordinary lack of tact by openly decrying everything of Afghan manufacture, the arms manufactured at the arsenal at the capital, for instance, being criticised contemptuously. At Kabul too, the same behaviour brought the mission into trouble. The Amir, who had received it courteously, played for time by summoning a council representative of all the tribes and by lengthy meetings with the mission and his own advisers. The Germans gradually realised that, without a Turkish force, their efforts were wasted. They were finally dismissed, the Amir pointing out that he could hardly break with the British until a large, well-equipped army reached Kabul from the west. The mission broke up into small parties, most of which successfully evaded the cordon.

In 1916 the ebb and flow of the struggle were very marked. At first the Turks, shortly after the retreat of the British from Ctesiphon, occupied Kermanshah and pushed forward towards Hamadan. The Russians in their turn, justly elated at their astounding feat of arms at Erzerum, advanced and drove the enemy off the plateau, while a second force swept the hostile Bakhtiaris out of Isfahan and brought back the British and Russian communities. The capture of Kut again transformed the military situation and, in the summer, the Turks, 16,000 strong with 54 guns, gradually drove back the Russians who could only oppose them with 12,000 men and 19 guns. Kermanshah was evacuated and then Hamadan, the retreat continuing as far as the Sultan Bulaq range which covered Kazvin and threatened a force marching on Tehran. This situation remained unchanged until December.

The South Persia Rifles.—In 1916 it was decided, in consultation with the Persian Govt., to organise a force of Persian troops to restore order in Southern Persia and take the place of the Swedish gendarmerie. This force was to be 11,000

strong, and the Cossack brigade was to be raised to a similar strength. Brig.-Gen. Sir Percy Sykes, who had spent many years in Southern Persia, was appointed to undertake this task, and landed at Bandar 'Abbas in March, with three other British officers and a few Indian instructors. The state of affairs was most unfavourable as, apart from the defeat of Qawam, the British agent and his escort were assassinated at Lingeh, and two British officers were assassinated in Makran about the same time, both murders being due to German instigation; and finally this terrible month of April saw the grave disaster of Kut al Imara. Many experienced officials expected a wave of fanaticism to sweep across Persia and there was certainly cause for deep anxiety, especially in Makran, but British coolness undoubtedly saved the situation. Recruiting operations at Bandar 'Abbas were started immediately after landing and, in spite of a strong anti-British party, men were rapidly enlisted, and, before the end of a month, the Persian flag was hoisted with ceremony over a camp. The force, handled with much tact and patience by its British and Indian instructors, never looked back, and was soon able to protect Bandar 'Abbas and an important section of the caravan route from the raiding tribesmen.

Qawam was aided by the British with money and munitions, and an exaggerated report of the means placed at his disposal led to the rebel Arab headmen kissing his feet. With their aid he defeated the Swedish gendarmerie, and was marching in triumph to Shiraz when he was killed by a fall from his horse. His son, a man of 28, was, however, able to restore Persian authority in Fars.

The success of Qawam and the landing of the mission at Bandar 'Abbas made the position of the German parties at Kermān decidedly insecure. The governor-general became hostile to them, and they decided to retire westwards to Fars, the route farther north being dangerous owing to the Russian advance southwards. They fled in two parties, and after suffering some losses from attacks on the road, they were all captured by Qawam and imprisoned at Shiraz. The little band consisted of 60 Germans and Austrians, a dozen Turks and a few Afghans.

A small force of Indian troops, consisting of a section of mountain guns, a squadron of cavalry and 500 rifles, was sent to Bandar 'Abbas, and Sir Percy Sykes marched inland a distance of 280 m. to Kerman, where he was received with much cordiality. The various pro-German elements who had created a state of insecurity fled, the bank and telegraph offices were reopened, and the normal state of affairs was quickly re-established. The column then marched to Yezd, where the British colony had just returned. News being received of the Turkish advance and of a probable attack on Isfahan, the column made a forced march to that city where it joined the extreme left of the Russian Army, represented by 600 Cossacks. The Turks, hearing of the arrival of the British at Isfahan, stopped at a village some six miles distant, and then retired. When it became evident that the danger had passed, the column marched south to Shiraz, which it reached in Nov., thereby completing a march of 1,000 m. through the heart of Persia.

At Shiraz the question of the gendarmerie had to be settled. The Persian Govt. had not actually given its consent to its being incorporated in the South Persia Rifles, but it was unable to pay or equip the force. Spread over the route for a distance of 200 m. from the borders of Fars in the north, to Kazerun in the south, and numbering some 3,000 men, the problem which confronted Sir Percy Sykes was one of extreme difficulty. He had no staff to administer or train such large numbers, and he was aware that it was this force which had seized the British consul only a year previously and that many of the officers were pro-German in sentiment. But he also realised that, if the gendarmerie broke up into well-armed bands of robbers and devastated the country, few supplies would reach Shiraz. He consequently decided to take over the entire body, and the force gradually developed and helped to restore order in South Persia. (*See* WORLD WAR; WORLD WAR: BIBLIOGRAPHY.)

II. THE BRITISH IN PERSIA

During the winter, however, the positions in Mesopotamia entirely changed. Instead of weak, ill-equipped columns, severely handicapped by unfavourable climate conditions, failing before Kut al Imara, there was the pleasant picture of overwhelming forces under the inspiring leadership of Gen. Sir Stanley Maude recapturing Kut in Feb. 1917 and following this up by the signal success of the capture of Baghdad. The position of the Turks in Persia became more and more difficult as the British advanced. On the day Baghdad was occupied they evacuated Kermanshah and, pursued by the Russians, reached the Persian frontier at Qasr-i-Shirin on March 31, worn out and hungry but not wholly demoralised. But during the succeeding winter, the Russian Army disintegrated. Its collapse opened up to the enemy a completed line of northern advance across the Caucasus and the Caspian Sea to 'Ashqabad, Merv (the junction for Kushk, within striking distance of Herat), Bukhara, Samarqand and Tashkent, the administrative centre of Russian Turkistan. Over 100,000 German and Austrian prisoners were in Central Asia and if through communication had been established, it would have been easy to reorganise these veterans and march on Kabul, with an invitation to the Afghans to share in the plunder of India. In Sept. 1917 Georgia and Armenia decided to claim their independence, and a third state came into being under the title of the republic of Azerbaijan, with Baku as its capital. In connection with the efforts made to ward off the danger to India involved in the Russian collapse, British troops entered Western Persia.

The Dunsterville Mission.—It was out of the question to dispatch large bodies of troops to support the Georgians or Armenians, as Baghdad was 800 m. distant from Baku. The authorities therefore, decided to dispatch a military mission to reorganise the sound elements of the country into a force that would prevent the Turks and their German masters from reaching Baku. It was hoped that these small States would fight for their homes, but the Armenians absolutely failed to do this. Maj.-Gen. L. C. Dunsterville was appointed to command this mission, and, in Feb. 1918, he started off from Baghdad with a party of officers in 40 cars to cross northwest Persia. Enzeli was his objective, and he hoped from that port to be able to proceed to Baku and Tiflis. He reached Enzeli only to find that the port and its shipping were in the hands of hostile Bolsheviks, while the neighbourhood was dominated by Mirza Kuchik Khan, an ambitious brigand who had recruited some 4,000 followers, nicknamed *Jangalis* or " Forest Dwellers," to the cry of " Persia for the Persians," and who robbed his countrymen if they refused to join him. Dunsterville quickly realised the situation, and, before his opponents had concerted their plans and had overcome their fear of the armoured motor-car, the mission had retired to Kazvin and Hamadan, which latter city became its headquarters.

During this period, Dunsterville was brought into close relations with the Russian generals Baratov and Bicherakov. The former had commanded the Russian troops in Northern Persia and was now helplessly watching their disintegration. The latter, on the contrary, had kept his command of 1,200 men practically intact. By March the last of Baratov's men had left, but Dunsterville had been able to keep Bicherakov's command at his side. Without its aid, the Jangalis, elated by the retirement of the mission, which was magnified into a great victory over a British army, would have been able to march on the capital. There they would probably have introduced a reign of anarchy and have forced Persia into the War on the side of the Central Powers, with whom Kuchik Khan had close relations; he also had German, Austrian and Turkish instructors well supplied with machine-guns. When the Jangalis marched on Kazvin, Bicherakov forestalled them, and drove them back to the forests with heavy losses. He then embarked at Enzeli. Dunsterville, who had received reinforcements consisting of a regiment of cavalry, a battery and two regiments of infantry, followed behind Bicherakov and took over the road. The Jangalis, under their European officers, attacked a detachment

at Resht, but suffered heavy losses, and Kuchik Khan made terms and became a contractor for supplies. About this time the Bolshevik Govt. at Baku was overthrown and replaced by the Central-Caspian dictatorship, which asked for British assistance. Dunsterville took his force to Baku, held it for some weeks against overwhelming Turkish numbers, denying the use of the oil wells to the enemy, whom he also kept away from the Caspian Sea, and finally evacuated the town and returned to Enzeli, thus ending a very gallant episode of the War.

Investment of Shiraz by the Kashgais.—In the spring of 1918 the Persian Govt., in reply to a British note, denounced the South Persia Rifles as a foreign force and a threat to Persian independence and integrity. It also expressed the hope that the British Govt. would withdraw its troops and allow Persia to commence her cherished reforms.

The Cabinet was under the impression that Germany was winning the World War or such a curt note would never have been penned. This reply was published all over Southern Persia; and the results were speedily shown in serious desertions from the South Persia Rifles and culminated in the formation of a confederacy under the Kashgai chief, Solat-u-Daulah, to annihilate the British in Southern Persia. He had at his disposal 4,500 Kashgais and 1,500 Kazerunis and this number was reinforced by contingents from Dashti, Dashtistan and elsewhere, and reached about 8,000 fighting men. The tribesmen were well armed with Mausers, had plenty of ammunition, and fought both bravely and cunningly. The British force at Shiraz was 2,200 strong, one-third being recruits. The South Persia Rifles slightly outnumbered the Indian troops and, owing to propaganda and the proclaimed hostility of the Persian Govt., were a danger to the British. The detachments in the outposts mutinied and surrendered or deserted. Qawam had collected 2,000 Arabs in and about Shiraz, who were ready to attack the beaten side. On May 24 the column marched out 1,600 strong and defeated the Kashgais in the hilly country to the west of the city. About 10 days later the enemy returned in still larger numbers, and the Kazerunis occupied the garden quarter, which almost touched the fortified perimeter constructed by the British outside Shiraz. The inhabitants of Shiraz were incited against the British by the *mullas*, some of whom preached *jihad* or Holy War.

Sir Percy Sykes learned that the Kashgais were preparing to unite with the townspeople in a combined attack on June 17, and he determined to forestall them. Accordingly, on June 16, the column sallied out and again inflicted considerable losses on the enemy. On the following day, Shiraz rose, its inhabitants attacking everyone suspected of being friendly to the British. But the Kashgais did not come to the support of the townspeople, who were overawed by the seizure at midnight of various key-positions by the British. The tide then turned. The governor-general appointed a new *Ilkhani* or " paramount chief " in place of Solat, whose followers began to break away, influenced by the heavy losses they had suffered. Qawam declared in favour of the new Ilkhani, and his example was followed by a brother of Solat and by perhaps one-quarter of the tribe. The column marched out again, and Solat fled a broken man, pursued by Qawam, the new Ilkhani, and most of the Kashgai tribe. The expedition is described by L. C. Dunsterville, *The Adventures of Dunsterforce*, 1920. (P. M. S.)

PERSIAN GULF (*see* 19.974).—This term is, strictly speaking, restricted to the land-locked sea which extends from the mouth of the Shatt al 'Arab 460 m. to the mountainous promontory of Ras Musandam, but for the purpose of this article it will be considered to include the Gulf of Oman to which it is joined by the Strait of Ormuz, 29 m. wide. The Gulf itself has an average width of 120 miles. It is tidal, spring tides rising about 9 ft.; with the exception of the Shatt al 'Arab almost all the streams that flow into it are so salt as to be undrinkable. Good harbours are scarce, with the exception of Al Kuwait and Muscat, anchorage being mostly shallow and exposed.

Political History.—Up to 1913 the Turks exercised suzerain rights in the maritime tracts of Al Hasa and Hofuf and claimed it in Qatar and Al Kuwait. The Sultan of Nejd, 'Abd el 'Aziz ibn Sa'ud, ejected them from the first-named districts; the World War put an end to their claims elsewhere in the Gulf. The Trucial chiefs of the Arabian coast hold sway from Ras Musan dam to Qatar. From east to west their headquarters run as follows:—Ras al Khaima, Umm Qaiwain, 'Ajman, Sharja, Dibai, Abu Dhabi, Qatar. The Sheikh of Bahrein exercises no authority on the mainland.

The friendly attitude of Ibn Sa'ud towards Great Britain on the outbreak of the War resulted in the conclusion of a treaty with him dated Dec. 28 1915, in which he was recognised as independent ruler of Nejd and Al Hasa, and given a limited dynastic guarantee, with a promise of support in case of foreign aggression. Great Britain assumed control of his foreign relations outside Arabia. He on his part undertook not to alienate any territory to a foreign power, except with the consent of the British Government.

British Interests.—The peculiar interests, strategic, political and commercial, of Great Britain in the Persian Gulf have never been denied. The considered policy of the British Govt. was embodied in 1903 in Lord Lansdowne's declaration in the House of Lords:—

> We should regard the establishment of a naval base or of a fortified port in the Persian Gulf by any other Power as a very grave menace to British interests, and we should certainly resist it by all the means at our disposal.

This declaration was formally reaffirmed in 1907 by Sir E. Grey in a dispatch to the British Ambassador at St. Petersburg, which further stated that:—

> H.M.'s Government will continue to direct all their efforts to the observance of the *status quo* in the Gulf, and the maintenance of British trade; in doing so, they have no desire to exclude the legitimate trade of any other Power.

These declarations were never challenged, and the policy indicated has been steadfastly followed by successive governments.

Arms Traffic.—The arms traffic was rife in 1911, in spite of a naval blockade of the Makran coast by Great Britain in 1910–11. In 1912 the Sultan of Muscat issued a proclamation requiring all arms imported into Muscat to be placed in a special warehouse. This killed the trade at Muscat and, by 1913, it had virtually ceased to exist.

Slave Trade.—In 1833 the status of slavery was abolished throughout the British Empire. Great Britain, in defiance of her commercial interests and her popularity with the Moslem populations of the Gulf, set herself to suppress the trade in these waters, an arduous task involving great sacrifice of life and money. By 1920 the last remaining traces of the traffic by sea had virtually disappeared, but domestic slavery as an institution is likely to continue in Muscat and in Central Arabia; it is important to distinguish domestic slavery, which is an institution recognised by Koranic law, which imposes many obligations and restrictions on the owners of slaves, from the commercialised slavery which disgraced Christendom in the 18th and the early days of the 19th century.

Trade.—The Persian Gulf serves as a means of communication for two land masses, *viz.*, Persia and Arabia. In both, the population is small and poor, so that the commerce of the region is of comparatively small aggregate value. The principal port is Bushire on the Persian side; the others, in order of importance, are Mohammerah, Bahrein (Manama), Bandar 'Abbas, Al Kuwait, Muscat and Lingeh.

Since the standard of living of all the peoples round the Gulf is low, their requirements are few; cotton piece goods, tea, sugar and foodstuffs are the principal imports. The total value of goods imported into the Persian Gulf in 1924 was about £8,500,000 sterling—including piece goods to the value of £2,000,000, sugar £1,500,000, rice £750,000, tea and coffee £500,000. Of imports, over 50% are from India and 25% from the United Kingdom, but a large proportion of India's share consists of goods in transit from Europe and the United Kingdom.

The exports for 1924 were estimated at £12,500,000 sterling, including the Anglo-Persian Oil Company's exports valued at £8,000,000, opium £1,250,000, pearls £500,000 (probably greatly undervalued), carpets £250,000, dates £250,000. Of exports (including petroleum products) the United Kingdom in 1924 took about 50%, India 18%, Russia 8% (mostly opium).

Communications.—The only steamship line (1926) running regular services to the Gulf ports is the British India Steam Navigation Co., Ltd. The next line of importance is run by Messrs. F. C. Strick and Co. Ltd., who maintain a direct service with the United Kingdom to the Persian Gulf. There is of course constant communication between various ports by native craft. When once merchandise has

arrived at any port, the further transport to the hinterland is effected by pack animals.

The following table shows the amount of shipping entering the Shatt al 'Arab during the three years:—

	Gross registered tonnage	No. of steamers
1922–3	2,581,855	530
1923–4	2,776,052	636
1924–5	3,197,046	601

of which about 75% were tank steamers proceeding to Abādān for oil, of which some 4,000,000 tons were exported in 1924–5.

The bar of the Shatt al 'Arab is being dredged by the 'Iraq Govt., and it is intended to maintain a minimum depth of 27 ft. at high water, along a dredged channel 12 m. in length. Lights and buoys are maintained at certain ports and on certain islands in the Persian Gulf by the British Govt., the cost being met (since Oct. 1925) by a levy on all ships crossing the bar of the Shatt al 'Arab.

Currency.—On the Persian side the unit of currency is the *kran* (roughly equal to 6d.); the rupee is also current. On the Arabian side the rupee is in general use; inland the Maria Teresa dollar (roughly equal to 2s. 6d.) is in use.

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PERTAB SINGH, Sir (1844–1922), Indian soldier and statesman (*see* 21.259), relinquished his position as Maharaja of Idar in 1911 in favour of his adopted son Daolat Singh, in order to resume the regency of Jodhpur which he had previously held on the death of his brother in 1895, but this time for his grand-nephew Summair Singh, then 13 years of age. When the World War broke out Sir Pertab, in the words of Lord Hardinge the Viceroy, "would not be denied his right to serve the King-Emperor in spite of his 70 years." He came to France for service in the field with his young ward, then only 16, and commanded the famous Jodhpur Lancers. In the later stages of the War he served with them in Egypt and Palestine. Sir Summair Singh died in 1918, two years after receiving ruling powers, and Sir Pertab again became regent, assisted by a council. He died on Sept. 4 1922, after nearly 60 years of close association with the administration of Jodhpur.

PERTH, Australia (*see* 21.259), the capital of Western Australia, had a population of 154,873 in 1921 within a 10-mile radius, which included the port of Fremantle and 129,339 in the city proper. Perth is linked to Brisbane by the railway opened in 1917 from Port Augusta to Kalgoorlie. The tramways were transferred to the Government in 1913 and are now worked in connection with the railways. A comprehensive scheme for supplying water to the metropolitan area was undertaken in 1922. The University of Western Australia was inaugurated in 1913 and a branch of the mint was established here in 1916.

PERTH, Scotland (*see* 21.260), with an area of 2,653 ac., had a population of 33,208 in 1921, showing a small decrease on the figures for 1911. The city has been in the Perth and Kinross division for parliamentary purposes since 1918. In 1910 the west tower of the cathedral, which had been left unfinished owing to the insecure state of the foundations, was taken down. A city hall in King Edward street was finished in 1911, and a replica of the old market cross, destroyed in 1765, was unveiled in the open space opposite the hall in 1913, as a memorial to King Edward VII. New buildings for the Perth Royal Infirmary were opened on the slope of a hill to the west of the city in 1914. The Perth Academy and Sharp's Institute were combined in 1915. The museum of the Perth Literary and Antiquarian Society has been handed over to the municipality and reorganised. Kinnoull Hill, a landmark overlooking Perth, was presented by Lord Dewar in 1924. The restoration of the church of St. John the Baptist was undertaken as a War Memorial.

PERU (*see* 21.264), a republic in South America, and a member of the League of Nations. The estimated area was 532,000 sq. m. in 1925. No census has been taken, but the population in 1925 was estimated at 4,750,000, consisting of Indians 52%; Mestizos, 30%; Asiatics, negro-Indians, etc., 10%; pure negroes of African origin, 6%; and whites (Caucasian), 2%. The chief towns and their population (1925 estimate) are: Lima and suburbs 225,000; Arequipa, 55,000; Callão, the principal port, 60,000; Cuzco, 35,000; Trujillo, 25,000; Iquitos and Ayacucho, 20,000 each; and Chiclayo, 30,000.

I. POLITICAL HISTORY

The presidential term of Don Augusto B. Leguia y Salcedo, 1908–12, was notable for many internal reforms and improvements, including the planning of the Ucayali Railway and the settlement of old boundary disputes with Bolivia and Brazil. A policy of naval reform and commercial development was interrupted by the collapse of the rubber market, which caused a financial stringency. At the expiration of his term of office in 1912, Leguia was succeeded by Don Guillermo Billinghurst, the grandson of an English officer. The Conservative party did not, however, approve Señor Billinghurst's parliamentary reform policy, and a military *coup d'état* led by Col. Oscar Benavides resulted in his removal from office and deportation in Feb. 1914. Benavides remained in the presidency until July 1915. Each of these presidential terms was revolutionary in character and there was general political uneasiness, accentuated by acute diplomatic controversies with Ecuador and Bolivia.

The War Period.—The outbreak of the World War found Peru passing through a period of economic and financial difficulty, which continued until the end of 1915, when the demand for Peruvian cotton, sugar, copper and other products at war prices greatly relieved the situation. Dr. José Pardo entered upon his second presidential term in July 1915. Public opinion was divided as to the attitude to be adopted by Peru towards the War. A section of the Conservative aristocracy was at first inclined to favour the Central Empires, partly because of a dislike of President Wilson's utterances, but mostly because of financial and sentimental ties with Germany. On the other hand the majority of the intelligentsia strongly favoured France and her allies, and this element finally caused the severance of diplomatic relations with Germany in 1917, soon after the declaration of war by the United States. The years 1916, 1917 and 1918 were remarkable in that, whereas trade and industry enjoyed the greatest boom known since the foundation of the Republic, the national finances did not improve to a corresponding degree—largely owing to the need for a thorough overhauling of the administration, which the complexities of local politics prevented the President from effecting. On several occasions minor crises occurred, the most notable being in 1918 when members of the military garrison of Ancon revolted and caused a good deal of damage, which included the cutting of the railway, before they made their escape to the interior.

Post-War Developments.—Early in 1919 Señor Augusto B. Leguia returned from England and announced his intention of again standing for the Presidency. On May 18 the election took place without disorder, but before the results could be declared a *coup d'état* on July 4, unaccompanied by violence, placed Leguia in the chief executive office. The new President issued a manifesto declaring that an attempt to deprive him of a victory at the polls had compelled him to seize the direction of affairs and he proposed to introduce constitutional reforms which would render personal and autocratic government impossible. On July 10 a decree was issued authorising the formation of a Constituent Assembly for the purpose of altering the existing constitution. This body formally opened on Sept. 24 and passed a law giving legal sanction to all the Acts and Degrees of the Provisional Government. Señor Leguia was inaugurated as constitutional president on Oct. 12 1919; and by the end of the year the constitutional reforms he had proposed were referred to a plebiscite, and accepted almost in their entirety. The chief reforms proposed were:—

1. An increase of the presidential term from four to five years, and the re-election of an entirely new Congress for the same period, instead of for two years as hitherto;
2. A Council of State, consisting of six members to act in an advisory capacity to the President to be provided for;
3. The reorganisation and decentralisation of provincial government, and the formation of three regional legislatures;
4. Income tax, hitherto unknown, to be introduced;
5. Government officials debarred from drawing salary from more than one post at the same time; and
6. Labour disputes to be settled by compulsory arbitration.

Some of these reforms did not immediately materialise; others were introduced before the end of 1919. At the beginning of Dec. the Assembly authorised the dissolution of all municipal bodies, and the appointment, by the executive, of new ones. On Dec. 26 a law was passed empowering the Government to confiscate the property of persons attempting a revolution. The general prosperity of the country helped the opening period of Leguia's administration, and, although the masses were fervently in his favour, his opponents were of opinion that his proposals for legislative reform and agricultural, commercial and industrial developments, were much too ambitious to be immediately successful. In 1920 the new constitution drawn up in 1919 was published, and throughout the year the President's reformist efforts were continued with unabated zeal.

The years 1920 and 1921 (up to the month of August) showed a continuance of his original policy, often interrupted by acrimonious discussions in Congress and by spasmodic attempts at obstructionism here and there by the President's political enemies. On Aug. 5 an insurrectionary movement described to be for the purpose of " constitutional restoration " was initiated by a Captain Cervantes in the Department of Loreto. This movement spread to the departments of San Martin and Amazonas; and although the government sent small bodies of troops, isolated risings on a small scale continued among the Indian population and in the south. The rising was not finally suppressed till late in 1921. During this ineffective revolt the Peruvian and Brazilian Governments exchanged notes in regard to a request by Peru that navigation should be stopped between Manaos in Brazil and Iquitos in Peru, following upon the closure of this port by a decree of Aug. 10.

The years 1921, 1922 and 1923 were marked by an acute financial and economic crisis caused by a collapse of the abnormal prosperity induced by the World War, to be followed by a slow and gradual process of readjustment that was well on the way to completion by 1924. In that year the Government, although still hampered by lack of funds, had succeeded in effecting many improvements in administration. Don Augusto B. Leguia was again elected to the presidency in 1924, this time unopposed by the votes of the Democratic, Democratic Reform and Constitutional parties, for the period 1924–9, during which he proposed to continue his reforms. In May 1924 preparations were made for the election of a new Congress, and the Cabinet was reconstituted with Dr. Alexandrino Maguina as President of the Council. From then onwards till the end of the year governmental and public attention was directed towards preparations for the celebration of the Centenary of Ayacucho in Dec., to commemorate the final struggle against Spain which culminated in the independence of Peru and the Spanish-speaking republics of South America. For this event special missions and embassies representing 39 nations were sent to Lima, amongst whom were Gen. Pershing representing the United States and President Saavedra representing Bolivia.

The year 1925 was free from political disturbances, and during it President Leguia worked to bring to completion his far-reaching proposals for the reform of administration in Peru. The difficulties in his path were great and progress was slow, for, because of his virtual dictatorship, he had alienated the sympathies of many of the ruling class, which had hitherto regarded the privilege of government as reserved to its own members. The commercial community and the mass of the people largely approved of his methods, for many solid achievements stand to the credit of his régime: yellow fever has been stamped out, sanitation schemes have been initiated, construction and road-making have progressed, order has been, on the whole, successfully maintained, and the national finances, if not fully restored to equilibrium, have been greatly improved.

During the period 1910–25 the boundary dispute with Chile regarding the provinces of Tacna-Arica has at times, especially during the period 1922–5, overshadowed all other questions of home and foreign policy (*see* TACNA-ARICA).

Defence.—Military service is compulsory but not universally enforced, and consists of two years in the active army, five years in the first reserve, five in the second, and 20 years in the national guard. The peace establishment is 8,000 officers and men forming 13 regiments of infantry, seven of cavalry, and four of mountain artillery, together with units of coast defence and field artillery. There is a military school, a staff school, an engineering school and a military aviation school. Gendarmerie and police, including civil guards, have a personnel of 8,000. The army is modelled on that of the French Army and a French Military Mission was employed by the Government for instructional purposes. The navy in 1925 consisted of two light cruisers, one auxiliary cruiser, one destroyer, two submarines, and a river flotilla on the Amazon of six small units. There is a school for naval aviation. A North American naval mission has trained the personnel since 1920 and advised the Minister of Marine on technical subjects. The personnel of the navy was 179 officers and 1,500 ratings in 1925.

Education.—Primary education is compulsory, and free in the Government schools; secondary education is given in high schools at a moderate charge. In 1925 there were over 2,000 primary schools with 200,000 pupils. Each departmental capital has a high school supported by the Government with some 5,000 pupils. There are four universities—San Marcos at Lima; Arequipa, Cuzco, and Trujillo; there is also a school of mining and civil engineering.

II. FINANCIAL AND ECONOMIC HISTORY

Finance.—The unit of currency is the Peruvian pound (£p.) equal at par to the £ sterling. Exchange from 1910 to 1916 was steady, but from 1916 onwards (owing to excess of exports over imports) the £p. was at a premium over the £ sterling, rising to 28½% in 1918 and to 30% in 1919. During the first half of 1920 it averaged 20%, declining to a discount of 14½% in 1921 but rising again to 16¼% premium in Jan. 1923, with slight variations up to Dec. 1925. Note issues amounted to £p.7,000,000 approximately, fully covered by gold. Public debt in 1923 amounted to £p.11,401,391 of which £p.4,371,049 was external. This was slightly increased in 1924 and 1925. The budget for 1914 was: revenue £p.3,547,836 and expenditure £p.3,109,836. For 1925 it was estimated to balance at £p.8,364,068. The principal sources of revenue are customs taxes on imports and exports, and taxes on miscellaneous articles.

Production.—Agricultural products in order of importance are:—sugar, cotton, wool, hides and skins. Other products are: castor oil, rice, hides, wheat, coffee, barley, lumber, potatoes, coca, cocaine and sisal hemp. Before the cultivation of plantation rubber after 1910, wild rubber, collected in the Peruvian Oriente, was one of the chief exports, but by 1925 the industry had practically ceased to exist; most of the interests formerly engaged in this industry are now devoted to cotton. With the exception of the Andean region, nearly the whole of Peru, and especially the valleys of the coastal region, is fertile. Considerable attention has been paid by the Government to irrigation. Before 1914 Peru imported wheat; in 1925 over 100,000 hectares were in cultivation, with an estimated production of about 75,000 metric tons. The area under sugar-cane approximates 1,000 square miles. Salaverry and Trujillo are the chief centres of the sugar industry, the annual production of sugar approaching 350,000 tons. Some 500 sq. m. are under cotton, mainly in the southern coastal areas: the annual production approximates 30,000 tons. Rice is extensively grown, some 30,000 tons being produced annually. Coffee is grown in the central areas: the cultivation of coca is extending. Coca is grown in the Cuzco, Ayacucho, and Huanuco districts; over 3,000 lb. of cocaine is exported

annually. Stockraising is of growing importance but is hampered by lack of sufficient labour; the alpaca, the llama and the vicuña are prized for their coats; but since 1920 a law has prohibited trade in articles made from vicuña wool. Mineral production is valued at over £10,000,000 annually, the chief minerals being petroleum, copper, silver and gold. The production of petroleum is increasing (*see* PETROLEUM). The coal output exceeds 300,000 tons per annum.

Industry.—Cotton spinning and the manufacture of sugar with its by-products are the chief industries. Apart from these two, Peruvian manufacturing activities are only of local importance, although there is much scope for development. The chief cotton-weaving factories are at Lima, Ica, Arequipa and Cuzco. There are altogether about 1,500 looms producing up to 25,000,000 yards of material annually, with an invested capital of over £p.500,000. Other manufacturing industries are: fuel, Panama hats, paper, woollen goods, fertilisers from guano, coca and by-products, and cotton by-products.

Trade.—After a decrease in trading caused by the outbreak of the World War, the European demand for Peruvian products brought a period of prosperity to the country, which continued with interruptions during 1920, 1921 and 1922 to 1925. In 1921 the Government organised a Trade Exhibition which was held in Lima.

The following tables give the value of the trade in £p. and the direction of trade during certain years:—

Year	Imports £p.	Exports £p.
1913	6,088,776	9,137,780
1920	18,358,224	35,304,155
1924	18,029,418	25,111,377
1925[1]	12,680,000	15,184,000

[1] First nine months.

Trade with Foreign Countries

Year	Great Britain		U.S.A.		Germany	
	Exp. %	Imp. %	Exp. %	Imp. %	Exp. %	Imp. %
1913	37·2	26·3	33·2	29·8	6·7	17·3
1919	31·4	13·5	46·6	62·0	1·8	0·001
1924[1]	45·0	17·0	33·0	45·0	3·0	5·0

[1] Estimate.

Communications.—In 1914 there were 1,825 m. of railways, which had increased to approximately 2,030 by 1925. One-third of the railways of Peru are narrow gauge. The Peruvian Corporation, with registered offices in London and largely owned by foreign interests, controls over 80% of the railways, including the Central, one of the world's great achievements in railway engineering. This line of 248 m. runs from Lima to Oroya through the Andes, reaches a height of 15,665 ft. above sea level and serves important agricultural and mining districts. The Cerro de Pasco Railway is a branch extension of the Central, reaches a height of 14,300 ft. above sea level, and has a branch serving the coal-mining district of Goyllarisquica.

Roads are of little importance—although some 5,000 m. exist they are mainly tracks, only about 375 m. being suitable for motor traffic in 1925, but a further 300 km. were under construction or being planned. In 1916 the Government put forward an elaborate scheme of road construction which was yet uncompleted in 1925. Civil aviation was still in its infancy in 1925, although a school had been established at Lima and tentative efforts had been made in 1920 and 1921 for the establishment of air services along the coast. There are some 7,000 m. of navigable rivers, of which the chief is the Amazon with the Peruvian port Iquitos about 2,000 m. from the Brazilian port of Para, and visited by vessels of 2,000 tons. By an agreement made in 1921 the Marconi Wireless Telegraph Company took over the administration of the telegraphic and postal services. In 1925 there were 10,000 km. of telegraphs with about 350 offices. There were 664 post offices in 1911 and over 800 in 1925. The Peruvian Mercantile Marine consisted in 1925 of 12 steamers, 16 sailing ships and 80 small craft, representing 23,000 tons aggregate; the Compañía Peruana de Vapores, of which the Government owns one-half of the capital, is the only national steamship line.

Banking.—The principal bank is the Banco del Perú y Londres, which has its head office in Lima and has branches in the chief towns. In 1922 the Banco de Reserva del Perú, a central reserve bank, commenced operations and was granted the sole right to issue notes. A law passed in 1923 enacts that a branch of a foreign bank must have in Peru a capital of £p.200,000 and must have its obligations guaranteed. Deposits in banks in 1925 were estimated at over £p.12,000,000. The Government claims 6% of interest accruing on all current accounts.

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PÉTAIN, HENRI PHILIPPE BENONI OMER JOSEPH (1856–), French soldier, was born May 24 1856 at Cauchy la Tour (Pas de Calais). He was commissioned from St. Cyr 1878, passed in due course through the École de Guerre, filled various staff appointments, including that of instructor at the École de Guerre, and was promoted colonel in 1910. At the outbreak of the World War he was commanding an infantry regiment, but he was immediately given a brigade and then a division, and acquitted himself so well during the opening weeks of the struggle that he was advanced to the command of the XXXIII. Army Corps in Artois on Oct. 25 1914. He greatly distinguished himself on the occasion of the French offensive near Arras in May 1915, where his corps completely broke through the German position, though exploitation proved to be impossible for want of reserves.

On June 21 1915 he was given command of the II. Army, which under his orders carried out on Sept. 25 1915 the great attack in Champagne. After this action Gen. Pétain wrote a remarkable *Rapport sur les opérations de la IIe. armée en Champagne et enseignements à en tirer.* This contained the principles of a new tactical doctrine, and was published in the *Archives de la Grande Guerre*, No. 10, pp. 5–30.

After the battle of Champagne, the staff of the II. Army was withdrawn from the front, and was thus available at the moment when the Germans were attacking Verdun on Feb. 21 1916. It was then that the task of stopping the advance of the Crown Prince was entrusted to Pétain. On Feb. 24 he was summoned by telegram to general headquarters at Chantilly. From thence he proceeded immediately to his new headquarters, arriving there on the evening of the 25th. His chauffeur missed his way in the snow and Pétain himself was seized with pneumonia. No one knew this, however, but his doctor, and ill as he was he directed the battle during the first few days.

His first task was to organise the battle zone. He fixed a line of defence from Bras to Douaumont: this line had to be held at all costs, and under cover of it he divided up the ground to be held in sections which were duly laid out and equipped. It was largely owing to the system and energy of Pétain that Verdun was saved. On May 1 1916 he was given the command of the centre army group, of which the IV. Army, on the left, took part in the great offensive of April 16 1917. At the War Council held on April 6 at Compiègne, Pétain, while admitting that there was an opportunity for an offensive, had asked that it might be limited to definite objectives; but after the check on April 16 he was strongly opposed to its being continued. On April 28 he was appointed chief of the general staff at the Ministry of War in Paris; and on May 15 he replaced Gen. Nivelle as Commander-in-Chief of the armies in the field.

The French Army at that time was faced with a grave crisis, not excluding mutinies. Pétain did his utmost to remove the special causes of discontent, such as the irregularity of leave, and the inequality between units in their tours of duty in the trenches.

He also saw to it that soldiers on leave were not exposed to dangerous influences or neglect, and he renewed the confidence between the combatants and their leaders. He visited personally every division and questioned the officers. By means of reforms rather than measures of repression, he succeeded from the month of June onwards in having the army completely in hand. He saw clearly that, in view of the wastage in man-power caused by three years of devastating war, an offensive project on a great scale, such as his predecessor had adventured, was impossible for the time being. He therefore decided to exercise patience. In *directive* No. 1 he informed the army group and army commanders that they must limit themselves provisionally to preparing attacks with only limited objectives with the object of wearing out the enemy reserves. In *directive* No. 2, which was issued in the second fortnight of June, he reconstructed the training of the troops. In *directive* No. 3, at the beginning of July, he laid down the method of distribution in depth.

The keynote of the limited operations outlined by his *directive* No. 1 was to be thoroughness of organisation and the high proportion of fire-power, so as to give the maximum result with the minimum risk. Such were the characteristics of the action of the I. Army in Flanders, July 15–31; the II. Army before Verdun, Aug. 13–25; and of the VI. Army at Malmaison, Oct. 17–26.

Late in 1917 it became apparent that owing to the defection of Russia a formidable German offensive would be launched in the spring of 1918 on the Western Front. With this in view, Pétain studied the possibilities of surprise by placing reserves within reach of the threatened points. On Feb. 22 1918 he and Sir Douglas Haig agreed to give each other mutual assistance. Each commander-in-chief undertook in the event of the other being attacked to relieve a sector of his front in order to free a certain number of his divisions. This agreement was drawn up in document No. 5476.

On March 21 when the Germans had just attacked Gen. Gough's Army with great violence, Pétain hurried forward the V. Corps which was in reserve behind his left wing. On the 22nd Haig having requested the intervention of the French Army, Pétain pushed forward the extreme left or 125th Div. of the VI. Army towards the field of battle, where it arrived during the night March 22–3. Other French units were speedily added in order to assist the British, and these formed successively the III. Army and then the I.

Meanwhile, on March 26 at Doullens, Gen. Foch had been entrusted with the mission of co-ordinating the efforts of the Allied armies. Pétain therefore had only to carry out on the lines of the *directives* issued by Foch those operations which had been assigned to the French armies. He withstood the German attacks of May 27, June 9 and July 15, and as a tactical counter to the enemy's offensives, he planned in a note of June 24 new tactics of elastic defence under which the second line trench system became the main position of resistance.

It was now the moment to pass to the counter-offensive. On June 27 Foch had asked Pétain to draw up a *directive* for an offensive. This was the *directive* No. 5, July 1. The operation itself as originally planned was to consist of a move by Gen. Mangin's Army on Soissons. On June 14 Foch had ordered preparations to be made for an offensive against this town. On June 16 Pétain issued the same order to Gen. Fayolle, the commander of the army group. On June 20 Mangin, who was entrusted with its execution, drew up the plan of action, which consisted of preliminary operations which were to be followed by the occupation of the heights in front of the town. This plan was approved on June 27 and the first phase was carried out between June 28 and July 3. The preliminary successes led Mangin to think that the action could be further developed. On July 7 Pétain and Foch discussed this point; and next day Pétain sent Fayolle a letter in which he expressed approval of Mangin's plans. But on July 9 Foch conceived the idea of an action on a larger scale in which two other armies should take part. With this end in view Pétain on July 12 issued to the army group commanders instructions which were approved by Foch on July 13. On July 14 Foch went to see Pétain, and an agreement was reached between them as to the time when the offensive should be launched. This was planned for the 18th. From these details it will be realised how close was the collaboration between the different sections of the command.

Pétain, under similar conditions, prepared the great offensives of Aug. 8 and Sept. 25 1918 and he was also responsible for pushing the Germans back to the Ardennes. On Nov. 21 Pétain received at the hands of the President of the Republic at Metz the baton of *Maréchal de France;* he was also the recipient of many high honours from the Allied Governments. He subsequently held the position of vice-president of the *Conseil Supérieur de la Guerre;* and it was in this capacity that he went to Morocco in the summer of 1925 to supervise the arrival and employment of the reinforcements which were sent out to carry on the campaign against Abdel Krim. (H. Bi.*)

PETER I. (1844–1921), first King of the Serbs, Croats and Slovenes, was the eldest son of Alexander Karagjorgjević, who had been elected as Prince of Serbia on the expulsion of the Obrenović dynasty in 1842, and was therefore grandson of Kara George, the first leader of Serbian independence. His father lost his throne in 1858 and withdrew to Austria, where Peter grew to manhood. Accused of complicity in the plot against Prince Michael Obrenović (1868), Prince Alexander transferred himself with his family to Switzerland, and Peter made Geneva his headquarters for many years.

In 1870 he joined the French Army as a volunteer and served with distinction in the campaign against Germany. In 1876 he joined the Bosnian insurgents against Turkey and fought under the assumed name of Peter Mrkonjić, leaving behind him a legend which had its influence on the young revolutionaries of a later generation. In 1882 he, the exiled Pretender, and not the newly proclaimed King of Serbia, was invited to attend the coronation of Tsar Alexander III., who resented Milan's dependence upon Vienna: and it was very largely due to the Tsar's personal influence that in 1883 Peter married Zorka, daughter of Prince Nicholas of Montenegro. For a time he lived at Cetinje and his children were born there, but after his wife's death in 1890 he again lived in Geneva.

In 1903 shortly after the murder of King Alexander and Queen Draga by a military gang, Peter was unanimously elected King of Serbia and though he was gravely embarrassed at home by the political interference of the regicides, and abroad by the odious circumstances to which he owed his accession, he set himself steadily to work for constitutional government, his tact, self-effacement and liberal outlook forming a marked contrast to the attitude of Serbia's previous rulers and contributing to the rapid political consolidation which followed the upheaval of 1903. In June 1914 ill-health forced him to entrust Crown Prince Alexander with the regency, and condemned him to a passive rôle during the World War. But the simplicity of his life, his stirring proclamations to his soldiers and the visits which he paid to the trenches in a half crippled condition, did much to encourage Serbian resistance; and he shared the privations of the great retreat across Albania, lying in a litter which was sometimes carried by soldiers, sometimes propped in a bullock cart. After the War and his election as "King of the Serbs, Croats and Slovenes," he lived mainly in retirement at Topola and died on Aug. 16 1921. (R. W. S.-W.)

PETERS, KARL (1856–1918), German traveller (*see* 21.300), in Feb. 1918 published an autobiography, and died at Woltorf, Hanover, on Sept. 10 of the same year.

PETROGRAD or LENINGRAD, Russia (*see* 24.38), the former capital of the Russian Empire is now the capital of the province of Leningrad. The Govt. was removed to Moscow on March 9 1918. The name was changed from St. Petersburg to Petrograd on Sept. 1 1914 and to Leningrad on April 22 1920. The city is in a far worse condition even than Moscow since the removal of the official bodies, and is only a shadow of its former self. The people are in a state of extreme poverty. The population, 1,429,000 in 1905, was officially given as 926,732 in 1921 and 1,067,328 in 1923, but another authority, in 1925, gave it as barely 500,000. The streets are grass grown,

owing to the small amount of traffic and full of holes; many of the houses are in ruins, and few shops or factories are open.

In Sept. 1924 there were disastrous floods, said to be the worst in the past century, when many bridges and quays were broken. The university, the custom house, the zoological gardens, one of the electrical stations and the central aqueduct were damaged. A number of books were destroyed in the library of the former Imperial Academy of Sciences, but many pictures and antiquities had been removed to museums in other cities, particularly from the Hermitage and Yusupov palaces. The palace of the Grand Duchess Xenia, which had been made into a naval museum, library and private dwellings, was destroyed by fire in 1924. In 1925 the roof collapsed over two halls of the Winter Palace. Institutes for the study of a number of branches of science have been established since the revolution, and in 1925 it was decided to erect an observatory on the dome of St. Isaacs Cathedral. It was stated early in 1926 that 364 churches, having been nationalised, were closed and dismantled of bells and other fittings; the procedure of the authorities being to fix a rental for the buildings beyond the means of the congregations.

Petrograd is the only Baltic harbour left to Russia, and is its chief port for imports, but much of the trade comes through Reval, Riga and Libau, which are strong competitors. The port is said by the Soviet authorities to have been re-equipped, and to have been up to pre-War standard in 1925, with a total length of quays of 21,000 feet. It is stated to possess the largest ice-breakers in the world for keeping a channel open when the port is closed by ice.

PETROLEUM (*see* 21.316).—Increased consumption and many new uses for petroleum products continuing to stimulate

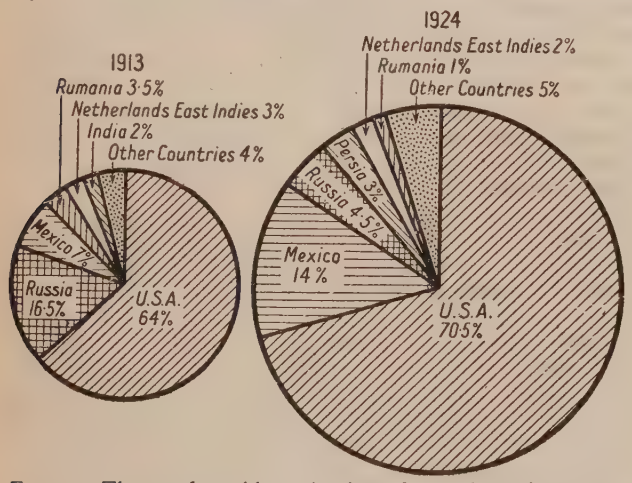

FIG. 1.—The total world production of petroleum in 1924 was about two and a half times that of 1913. These diagrams show the percentage of the total produced by each of the chief producing countries in 1913 and 1924.

the search for petroleum in the older producing countries and in new territories, often remote from civilisation, has been rewarded by important extensions and discoveries, with the result that between the years 1908 and 1924 the world's annual petroleum production nearly quadrupled. This development was largely due to the increased production in the United States.

I. THE PRODUCTION OF PETROLEUM

The following table from the U.S. Geological Survey gives the annual world's production from 1908 to 1924:—

Barrels of 42 U.S. Gal.

1908	285,552,746	1917	508,687,302
1909	298,616,405	1918	514,729,354
1910	327,937,629	1919	544,885,000
1911	344,174,355	1920	695,281,000
1912	352,446,598	1921	765,928,000
1913	383,547,399	1922	858,715,000
1914	403,745,652	1923	1,018,900,000
1915	427,740,129	1924[1]	1,005,915,000
1916	459,411,737		

[1] Estimated by *Oil & Gas Journal*, Tulsa, Okla.

Between 1908 and 1925 many prolific fields in the United States were developed, enabling that country to keep its pre-eminent position. Mexico, which rose from unimportance to second position during the period of the World War, retained that ranking among oil-producing countries during the post-War period, although total production declined. After 1908, Argentina, Colombia, Venezuela, Trinidad, Egypt and Persia developed production of commercial importance, Russia added the Maikop and Ural-Caspian fields, and Japan the Akita prefecture.

The production of the various countries in 1923 and 1924 is shown in the following table:—

Country	1923[1] Barrels	% of Total	1924[2] Barrels	% of Total
United States	732,407,000	71·9	717,000,000	71·2
Mexico	149,585,000	14·7	140,000,000	13·9
Russia	39,156,000	3·9	44,000,000	4·4
Persia	28,793,000	2·8	32,000,000	3·2
Dutch East Indies	19,868,000	1·9	15,000,000	1·5
Rumania	10,867,000	1·1	13,000,000	1·3
Venezuela	4,059,000	·4	8,200,000	·8
India	8,320,000	·8	7,500,000	·7
Peru	5,699,000	·6	6,500,000	·6
Poland (Galicia)	5,373,000	·5	6,000,000	·6
Sarawak	3,940,000	·4	4,500,000	·4
Argentina	3,400,000	·3	4,000,000	·4
Trinidad	3,051,000	·3	3,750,000	·4
Japan and Formosa	1,789,000	·2	1,500,000	·1
Egypt	1,054,000	·1	1,000,000	·1
Colombia	424,000		600,000	
France	403,000		500,000	
Germany	312,000		350,000	
Canada	170,000		175,000	
Czechoslovakia	74,000	·2	100,000	·2
Italy	34,000		30,000	
Algeria	9,000		9,000	
England	1,000		1,000	
Others	112,000		200,000	
	1,018,900,000		1,005,915,000	

[1] U.S. Geological Survey.
[2] Preliminary, *Oil & Gas Journal*.

NORTH AMERICA

United States.—Petroleum production in the United States in 1924 totalled 707,265,000 bar. (net preliminary estimate U.S. geological survey). The following table, from the survey, gives the production of the important divisions in 1908, 1923–4 in barrels of 42 U.S. gallons:—

District	1908	1923	1924
Appalachian	24,946,000	28,225,000	27,049,000
Lima-Indiana	10,032,000	2,404,000	2,288,000
Illinois and S.W. Indiana	33,686,000	9,500,000	8,732,000
Mid-Continent	48,834,000	348,460,000	368,729,000
Gulf Coast	15,772,000	33,271,000	27,642,000
Rocky Mountain	412,000[1]	47,653,000	42,761,000
California	44,855,000	262,876,000	230,064,000
	178,537,000	732,389,000	707,265,000

[1] Including "others."

The Appalachian area includes Kentucky, West Virginia, Pennsylvania, New York and eastern Ohio. Oil and gas sands occur throughout a long stratigraphic interval, including rocks ranging in age from Ordovician to Carboniferous. Petroleum from this area is a high-grade paraffin oil, the average gravity being about 45° Baumé (0·8000 sp. gr.). The Lima-Indiana field covers northwestern Ohio and northeastern Indiana, the oil being obtained from lenses or discontinuous layers in Trenton limestone. The average gravity is about 39° Baumé (0·8285 sp. gr.), although some of the oil is much heavier. The principal productive area in the Illinois field is in the southeastern part of the State, but there are also scattered pools in central and western Illinois. Most of the oil is obtained from beds of sandstone in the Pennsylvanian and Mississippian series of the Carboniferous system. In gravity the oils range from 27° to 37° Baumé (0·8917 to 0·8383 sp. gr.).

The greatest increases in production between 1908 and 1924 occurred in the mid-continent field, embracing Oklahoma, Kansas, northern, central, eastern and southwestern Texas, northern Louisiana and southern Arkansas. Pools are scattered throughout the area and new pools are constantly being discovered. Most of the oil is obtained from sandstone or other porous rocks of the Cretaceous and Tertiary systems. The average oil has a gravity of about 35° Baumé (0·8485 sp. gr.), ranging from the thick black oil of some of the Louisiana and Arkansas fields, of 21° Baumé (0·9272 sp. gr.) or under, to the high grade Cushing oil of above 55° Baumé (0·7568 sp. gr.). The Glenn pool discovery in Creek county, Okla., in 1907 led to a great petroleum development in that State, the pool reaching a maximum production of 125,000 bar. a day. In 1912 the Cushing pool, also in Creek county, was discovered; the maximum production reached was 320,000 bar. a day, sustained for a 60-day period in 1914, and resulting in the collapse of the oil markets. In 1914 the Augusta pool in Butler county, Kan., was opened up, and in 1915 the El Dorado pool, also in Butler county; with the Towanda extension, the latter pool made over 100,000 bar. for a few days in Sept. 1917.

Late in 1917 the discovery of oil in a well 3,450 ft. deep near Ranger, in central Texas, resulted in a most sensational development, covering the widest " boom " area in the history of petroleum in the United States up to that time. The Ranger boom is significant in two main respects: it began a long series of great " wildcat " enterprises, the testing out of great areas of unproven oil lands, the results of which were still felt throughout the next decade; and it was the beginning of the movement on the part of American oil operators to drill deeper and deeper for possible oil sands, which was responsible for great volumes of the new production that has been developed. The Ranger development opened up extension pools in Eastland county, Stephens county, and adjoining counties. In July 1918 a prolific well opened up the Burkburnett pool development in northern Texas. Another important development in the mid-continent field was the discovery in Sept. 1918 of oil in a shallow well near Homer, in northern Louisiana: a large gusher at greater depth was brought in in Aug. 1919.

One of the most important developments of the early part of 1921 was the discovery of oil in commercial quantity in southern Arkansas. The El Dorado pool in Union county resulted. The Mexia pool in Limestone county, Tex., was developed in 1921. The " flush " production pendulum swung back to Oklahoma later in 1921, and in 1922 important extensions and discoveries resulting from deeper drilling occurred, the output of the state being chiefly increased by such pools as the Burbank, Bristow, Hewitt, Lyons-Quinn and Tonkawa. But the greatest succession of flush pools reaching their peak in the mid-continent field in conjunction with similar pools in California was in 1923, when Burbank and Tonkawa in Oklahoma, the original Smackover development in Arkansas, and the Powell field in eastern Texas, all in the mid-continent area, attained high production levels. In 1924 Oklahoma's bonanza pools showed little loss in production, Burbank was extended, and a prolific deep sand development occurred in the Tonkawa field. The Smackover pool in Arkansas was extended and production greatly increased. The sensational and short-lived Wortham pool in eastern Texas came in Dec. 1924. Several smaller pools, which in combination resulted in considerable new production, also came in during 1924 in Oklahoma.

The Gulf-coast field first came into prominence in 1901, when the Spindletop pool in Jefferson county, Tex., was developed. This field includes southern Texas and southern Louisiana, and the petroleum is associated with masses of rock salt and gypsum in domes. The age of the oil-bearing strata ranges from Cretaceous to Quaternary. The field includes a great number of small scattered pools, some of which have developed wells of enormous productivity. The gravity of the oil ranges from 15° to 30° Baumé (0·9655 to 0·8750 sp. gr.). Among the more important pools are the Goose Creek, Hull, Humble, West Columbia and Damon Mound pools. The Rocky Mountain field, which embraces the areas of production in Colorado, Wyoming and Montana, as well as new producing and prospective territory in Utah, Arizona and New Mexico, was being tested by the oil driller in 1925 with good results; the greatest development was in the Salt Creek field of Natrona county, Wyoming.

The most sensational developments were in California, where oil production during the five years preceding 1922 had been running from 100,000,000 to 115,000,000 bar. annually. Before 1923 the principal producing districts were Kern river, McKittrick, Midway-Sunset, Lost Hills and Belridge in Kern county; the Coalinga field in Fresno county; the Lompoc and Santa Maria fields in Santa Barbara county; the Ventura and Newall fields in Ventura county; and the Los Angeles and Salt Lake and Whittier-Fullerton fields in Los Angeles county. The bulk of the production was heavy oil averaging about 21° Baumé (0·9272 sp. gr.). Important addition to production in the Midway-Sunset field was made in 1920–1 by the development of the Elk Hills district. But the most important discoveries were in 1920 of the Huntington Beach field, and in 1921 of the Santa Fé Springs and Long Beach fields, all in the Los Angeles basin. These fields reached their greatest production in 1923, and yielded high-grade, gasolene-bearing crude oil.

The production in barrels of the major pools in 1923–4 is shown in the following table, taken from " World Production of Petroleum in 1924 " by E. de Golyer, *Transactions of American Institute of Mining and Metallurgical Engineers*:—

Field	1923	1924
California:		
Huntington Beach	34,355,000	17,533,000
Long Beach	68,810,000	60,122,000
Santa Fé Springs	79,781,000	26,309,000
Total	182,946,000	103,964,000
Wyoming:		
Salt Creek	33,645,000	30,879,000
Oklahoma:		
Burbank	33,821,000	30,805,000
Tonkawa	27,033,000	22,413,000
Total	60,854,000	53,218,000
Arkansas:		
Smackover	35,041,000	42,000,000
Texas:		
Powell	32,243,000	33,374,000
Total	344,729,000	263,435,000

By the end of 1924 California's three great pools had declined in production or showed signs of considerable decline, but considerable production was added in the Los Angeles basin district by the Torrance, Dominiquez and Rosecrans pools, and early in 1925 by the Inglewood pool.

Alaska.—Oil has been found in several localities in Alaska, notably in the Katalla field: in the Kayak field, several miles inland from Cape Suckling; in the Cook Inlet field, between Itimma Peak and Iliamna Lake; and in the Cold Bay field, opposite Kodiak Islands. Wells were drilled in the early 'nineties in the Kayak, Cook Inlet, and Cold Bay regions, but oil was not found in commercial quantity. Desultory search for oil in Alaska has continued. In 1923 the Associated Oil Co. and the Standard Oil Co. (California) drilled wells in the Cold Bay field without any favourable results being reported.

Canada.—Canada's production has declined since 1908. The output in 1924 was estimated at 175,000 bar., compared with 528,000 bar. in 1908. Virtually all of Canada's petroleum is produced in Ontario, and occurs in sandstone and limestone of Silurian and Devonian age. A small production is obtained in New Brunswick and Alberta. In 1920 oil was discovered on the Mackenzie river, 150 m. south of the Arctic Circle in the Canadian North-west Territory. The well was located northwest of Fort Norman, and on Aug. 23 1920 it began to flow over the

top of the mast from a depth of 783 ft.; after an uninterrupted flow of 40 min. the well was capped. In 1922 the well was deepened to 951 ft., with the result that a flow of 60 to 70 bar. per day was secured; it was again deepened in 1923 and the flow was increased to about 100 bar. a day. Two other wells were drilled in 1923 with negative results. During the summer of 1924 another well, 150 ft. east of the discovery well, was started and carried down to 975 ft., with an oil showing at that depth, and the test is being continued. In the autumn of 1922 oil was struck at Wainwright, 120 m. southeast of Edmonton, in Alberta. This has stimulated drilling in the Wainwright-Irma district. In 1924 a well producing oil of 73° Baumé was brought in in the Turner Valley field, 45 m. southwest of Calgary. It blew itself in on Oct. 14 and is stated to have produced at the rate of 400 bar. daily, with production steadily increasing.

Mexico.—Mexico's petroleum development, sensational in its rapid growth, has been, when considered from the view-point of individual wells and leases, equally sensational in its rapid decline. Mexico still ranked second among the world's producing countries in 1925, but its "golden lane" of the so-called southern field or Tampico-Tuxpam region, which supplied the bulk of the oil in the years 1919 to 1922 inclusive, has virtually been exhausted except for "stripping" operations. However, the northern or Panuco fields have done much to offset these losses. An interesting feature of the change that has occurred in Mexican petroleum relates to the fact that in the southern area the oil is so-called "light" oil, ranging from 15° to 29° Baumé (0·9655 to 0·8805 sp. gr.), while in the northern area the oil is "heavy," ranging from 10° to 14° Baumé (1·000 to 0·9722 sp. gr.). Thus the losses in production have been in the more valuable light oil. Mexican production in 1924 is estimated at 140,000,000 bar., which compares with 149,585,000 bar. in 1923 and 182,266,000 bar. in 1922. The change in the volume of light and heavy oil from 1922 to 1924 is shown in the following table:—

Year	Light Barrels	Heavy Barrels	Total Barrels
1922	136,505,000	45,761,000	182,266,000
1923	61,043,000	88,542,000	149,585,000
1924	35,500,000	104,500,000	140,000,000

Although yielding oil as early as 1901, it was not until 1910 that production of Mexico became a commercial factor. In the latter part of that year the Juan Casiano No. 7 well was drilled south of the Dos Bocas well, the latter an uncontrolled gusher south of Tampico, struck July 4 1908, which went to salt water several months later. The Potrero del Llano No. 4 well came in Dec. 27 1910, with an estimated initial flow of 10,000 bar. daily, increasing to 160,000 bar. and establishing itself as the largest producer up to that time. Both the Casiano and del Llano wells were in the so-called southern field as distinguished from the northern or Panuco field, these two fields being part of the Tampico-Tuxpam region. This lies in the northern part of the State of Vera Cruz and the southern part of the State of Tamaulipas. Oil in the Tampico region occurs in the Oligocene, Eocene, and Cretaceous formations, and is found in numerous pools. Before striking the big wells mentioned a considerable production had been developed at Ebano, 40 m. west of Tampico, in the northern part of the Tampico-Tuxpam area and in the Tehuantepec area. The Tehuantepec-Tabasco area extends along the Gulf coast in southern Vera Cruz and the State of Tabasco. Its oil-bearing rocks are of the Pliocene and Pleistocene age, and it had not developed a large production up to 1925. Oil in the Tehuantepec field has a gravity of 32° Baumé (0·8642 specific gravity).

Central and South America

No petroleum production has been developed in Central America, but prospecting has been done and some drilling was under way in 1924–5. Test wells have been sunk on Columbus Island, off the east coast of Panama, and in the Estrella valley of Costa Rica. Exploration work has been done in Honduras and Guatemala.

Argentina.—Argentina's commercial production dates from 1908. Late in 1907 petroleum was found in a well being drilled for water by the government near Comodoro Rivadavia, Chubut province, on the coast of Patagonia. The government immediately reserved part of the oil-bearing land, and Argentina's petroleum development has thus been in large part in the hands of the government, although in recent years private companies have been active both on government lands and on privately held lands. Argentina's oil production is estimated at 4,000,000 bar. in 1924, compared with 3,400,000 bar. in 1923, and slightly over 1,000,000 bar. in 1919. Innumerable indications of oil, asphalt, rafaelite, etc., occur throughout the whole length of the country. Heavy oil is found seeping out near Punta Arenas on the Straits of Magellan, in the beds assigned to the Tertiary period, but no systematic prospecting operations have been carried out. The most southerly wells are drilled in the neighbourhood of Santa Cruz, but the results recorded are of a discouraging order. From Comodoro Rivadavia the oil belt extends northward through the territory of Neuquen and the provinces of Mendoza Salta and Jujuy, to the Bolivian border, a distance of about 1,500 m., the width being unknown. Broadly, the oil-bearing formations exploited belong to the Cretaceous at Comodoro Rivadavia, the Upper Jurassic in the province of Neuquen, the Triassic (Rhaetic) at Mendoza, and range from Upper Mesozoic to the Devonian in Jujuy and Salta. Most of the production since the beginning of operations in Argentina has come from the Comodoro Rivadavia field. The oil is heavy and of asphalt base, and ranges in gravity from 18·9 to 21·8° Baumé (0·940 to 0·922 sp. gr.). Argentina in recent years has seen great prospecting and development activity and has great potentialities.

Venezuela.—Active prospecting in Venezuela began in 1910, and during the next four or five years wells were drilled in several areas with varying success. A well in the Mene Grande field, on the east coast of Lake Maracaibo, Sucré district, drilled in 1913, established the occurrence of oil in paying quantity, and by 1915 the field had developed a considerable production, furnishing up to 1921 practically all the Venezuelan output. Drilling in the district of Colón, State of Zulia, commenced in 1914. Four wells credited as good producers in the Rio Oro and Rio Tarra sections had been completed by 1916 and were shut in. Two wells reported as proven in the Bolivar district, State of Zulia, were also capped. Operations in Venezuela in 1920–1 were active, particularly in the Lake Maracaibo district. During the period 1921–5 several important fields have been added to Venezuelan producing territory. In 1924 the estimated production was 8,200,000 bar., compared with 4,059,000 bar. in 1923. Commercial production in the Mene Grande field dates from 1917 and has steadily increased. The field is located about 75 m. southeast from the city of Maracaibo on the eastern side of Lake Maracaibo and about 12 m. from the shore. The oil is a heavy oil.

In the La Rosa field, located on the east side of the lake about 27 m. southeast of the city of Maracaibo, the first drilling was done in 1915, but after the completion of two small wells operations were virtually discontinued until 1922, when the La Rosa gusher, which produced over 1,000,000 bar. in nine days before it sanded up, was brought in. Competitive producing with many wells drilled in the lake adjacent to the shore has been a feature of the La Rosa development, which has recorded many large wells, practically all of which have experienced difficulties in sanding up and which, therefore, are being pinched down to reduce the pull on the sand. In 1925 La Rosa was the largest producing field in Venezuela. The oil is a heavy oil. Another field which has attained commercial production is El Mene, which is located in the northeastern semi-arid part of the Maracaibo basin and about 36 m. inland from the lake. The oil is a light oil, and the wells, which are comparatively shallow, are not of the large volume, gusher type. The La Paz and Concepción fields, about 15 m. apart, are located on the west side of the lake. Both fields have been proven and further drilling is in progress, while exploratory drilling throughout Venezuela is occurring.

Colombia.—Colombia is one of the recent arrivals in the oil-producing columns, and in 1924 was credited with an output of 600,000 bar., compared with 424,000 bar. in 1923. The principal development and the only one on a commercial scale is that of the Infantas field, on the De Mares concession, located on the Rio Colorado in Santander del Sur. The field is approximately 350 m. from the mouth of the Magdalena river. At the end of 1924 there were 17 producing wells in the field, some of them shut in. Preliminary work was started in 1925 for laying a pipe line from the field to the coast. Other test work with varying results has been carried on. Oil from the Infantas field is reported to test 26° to 31° Baumé (0·8974 to 0·8696 sp. gr.).

Peru.—Peru is the oldest oil-producing country in South America, first being credited with production in 1896. Its production has been steadily maintained, the principal fields being Negritos, Lobitoa and Zorritos. Another petroliferous district near Lake Titicaca has not developed any considerable production. Oil is found chiefly at the north (Pacific coastal district), and occurs in several horizons of soft sandstone and shale of early Tertiary age. The oil ranges from 32° to 48° Baumé (0·8642 to 0·7865 sp. gr.). Production has steadily increased, and in 1924 the output was credited at 7,500,000 bar., compared with 1,011,180 bar. in 1908. This does not represent maximum production, as much production was shut in during 1924 owing to the depression of the world's oil markets. The bulk of the

output comes from the Negritos field, which in 1924 produced approximately 6,500,000 barrels.

Prospecting in Other States.—Bolivia and Ecuador have been actively prospected, but oil in commercial quantity has not been developed. Chile has had several oil booms, particularly those based on the oil deposits of the province Punta Arenas, northwest of Tierra del Fuego, but without successful results. Prospecting has been undertaken in Brazil and Uruguay.

The West Indies

Trinidad.—The oil-fields of Trinidad are mainly in the southern part of the island, the oil being obtained from lenses of sandstone of Tertiary age. Trinidad first appeared as an oil producer in 1908, although in 1902 wells were known to exist north of the Pitch Lake at Guayaguayare, in the extreme southeast of the island. This district became prominent in 1908, when a well at 700 ft. spouted oil over the derrick, and a rapid development followed. Oil in the Pitch Lake district varies in density from 14° to 25° Baumé (0·9722 to 0·9032 sp. gr.). In the latter part of 1911 regular oil shipments from Brighton began. In that year several large gushers were brought in, but immediately clogged, owing to sand. In 1913 a well came in rated at 40,000 bar. daily, but sanded up, and in subsequent years other large producers have been reported, the initial production of which has soon fallen off on account of sand. Trinidad's production in 1924 totalled 3,750,000 bar., compared with 3,051,000 bar. in 1923.

Cuba.—An oil boom in Cuba in 1917 failed to yield any considerable production. The principal development was in a field near Havana. Prospecting and a little drilling work have been done in Santo Domingo and exploration work carried on in Barbados and in Haiti.

Europe

Russia.—While Russia, as a result of the World War and the revolution that followed, dropped in world rank as regards petroleum production, it remained the largest European producer. Oil is found in Tertiary clays and sands. Baku oils are of about 27° Baumé (0·8917 sp. gr.), while in the Suraghany district of Baku province the oil is as high as 48° Baumé (0·7865 sp. gr.). The relatively small area comprising the Baku field supplies the bulk of Russia's production. Other productive fields are the Grozny, Maikop, Ural-Caspian (Emba), and Cheleken fields. The Maikop field in the province of Kuban on the north flank of the Caucasus, northeast of the Black Sea, was discovered in 1910. Maikop oil is about 40° Baumé (0·8235 sp. gr.). The Ural-Caspian field, covering a large area in the Emba-Uralsk region round the north end of the Caspian Sea, first became a commercial factor in 1913. Emba oil is about 28° Baumé (0·8861 sp. gr.). For many years the island of Cheleken—off the Asiatic coast of the Caspian Sea near Krasnovodsk, was the scene of moderate operations, and from 1911 onwards large yields were obtained from wells sunk in the Ali Tepe district in the southwest. Cheleken oil is about 22° Baumé (0·9211 sp. gr.).

The Russian revolution disorganised the oil industry. Production was 72,801,110 bar. in 1916, but it had dropped to 25,429,600 bar. by 1920. In May 1921 the industry was nationalised and was then built up at a fairly steady rate to a production of about 44,000,000 barrels. Soviet officials reported that in the early part of 1925 production was attaining pre-War level.

Galicia (Poland).—Galician production showed a declining tendency after 1909, and during the World War the decline was aggravated, as the fields were battlegrounds. The largest output is obtained from Eocene beds. The chief producing areas are: in eastern Galicia, Boryslaw-Tustanowice, and Bitków; in western Galicia, Bobrka, Potok and the Gorlice district. The bulk of Galicia's production comes from the Boryslaw-Tustanowice district. Boryslaw oil is 32° to 34° Baumé (0·8642 to 0·8537 sp. gr.), and is the standard market grade for Galicia. Bitków oil is about 53° Baumé (0·7650 sp. gr.); Bobrka, about 31° Baumé (0·8696 sp. gr.), Potok, 34° to 45° Baumé (·08537 to 0·8000 sp. gr.). Production in 1924 was approximately 6,000,000 bar.; the peak of production was in 1909 with 14,932,799 barrels.

Rumania.—Like Galicia, a battleground during the World War, Rumania suffered in petroleum production. Most of the oil is obtained from Miocene and Pliocene beds, but part is from Eocene and Oligocene and possibly from Cretaceous beds. The principal fields are Buştenari, Campina, Moreni, Filipeşti, Băicoi, and Buzău. The oil is from 25° to 45° Baumé (0·9032 to 0·8000 sp. gr.). Production in 1924 was 13,000,000 bar. and had practically reached the maximum output prevailing before the World War.

Germany.—Oil is obtained largely at Hanover, where it occurs in domes associated with rock salt. The rocks are chiefly limestone and sandstone of upper Jurassic age. Oil at shallow depths is heavy, gravity from 17° to 19° Baumé (0·9524 to 0·9396 sp. gr.); at greater depths the oil is lighter. The production is very small.

France.—Production in Alsace occurs in sandstone of Eocene and Oligocene age and is comparatively small. The gravity ranges from 25° to 29° Baumé (0·9032 to 0·8805 sp. gr.).

Italy.—Italy's production, relatively small, is chiefly in the Emilia district of Lombardy, on the northeastern slope of the Apennines. Oil occurs in sandstones of Eocene and Miocene age, and ranges from 31° to 48° Baumé (0·8696 to 0·8187 sp. gr.).

Great Britain.—Apart from the shale-oil industry of Scotland and Wales, Great Britain joined the list of petroleum-producing countries in 1919, when the Hardstoft well was brought in in Derbyshire. This was one of 11 drilling locations, seven of which were in Derbyshire, two in north Staffordshire and two in the Midlothian district of Scotland. The Hardstoft well was started in Oct. 1918 and struck oil in May 1919, at 3,078 feet. At 3,100 ft. it produced 10 or 11 bar. daily. The well was still overflowing naturally at the end of 1920. Up to that time its production totalled 4,575 bar., or 590 tons, of which 2,909 bar., or 375 tons, were produced in 1920. After 1920 production declined. Other test wells have failed to develop a commercial production. Oil from the Hardstoft well tested 40° Baumé (0·8236 sp. gr.).

A considerable production of petroleum is derived from the Scottish shale-oil fields stretching from Dalmeny and Abercorn on the Firth of Forth southward to the district of Cobbinshaw and Tarbrax. The oil-shale industry in Scotland has been in commercial operation since 1850; in 1917, 3,116,529 long tons of oil were produced. There is a small oil-shale production in England and Wales.

Africa

Egypt.—Prospecting in Egypt resulted in the discovery of oil on the borders of the Red Sea and the development of small production in 1911. In 1913 several large wells were brought in in the Gemsah district on the west shore of the Red Sea, near the junction of the Red Sea and the Gulf of Suez. In Oct. 1914 oil was struck in the Hurghada district, south of Gemsa, and up to 1925 Egypt's production had been mainly confined to these districts. The oil occurs in sandstone and in cavernous, dolomitic limestone, associated with thick beds of gypsum of Miocene (Tertiary) age, accompanied in some places by thick beds of salt. The underlying Nubian (Cretaceous) sandstone also contains some oil. Egyptian oil is about 40° Baumé (0·8235 sp. gr.). Difficulties from salt-water flooding have been encountered in the fields, shortening the life of the large wells. Exploitation has been restricted to a comparatively small area, but exploratory work has been carried on in other areas. While Egypt's production almost doubled in 1918 as a result of increased activities that year, it fell off in 1919, and in 1920 showed a sharp decrease. Production in 1918 was 2,079,750 bar.; in 1919, 1,501,000; and in 1920, 1,042,000. From 1920–5 production failed to increase.

Other Areas.—Some oil has been obtained in the Shelif river area in the district of Oran, Algeria. Over 30 wells have been drilled in the Msila and Mejila districts, but during the World War operations were practically discontinued. Interest in Algeria revived after the War. The oil-bearing formation is probably Upper Miocene and its structure is complex. Prospecting has been active in Angola and Ashanti, in the Tertiary coastal plain formations, and tests have been drilled in Angola in the Alto Daude district near Loanda and at Ambrizette. Showings of oil were reported in test wells drilled in the Betsiriry valley, Madagascar, but no commercial production developed.

Asia

Persia.—Persia is looked on as a new petroleum-producing country of unusual importance. Development has been virtually confined to the Maidan-i-Naftun field in northern 'Arabistan, about 100 m. north of the head of the Persian Gulf, where the first wells were completed in 1908. In 1914, 10 wells were reported as being operated, and 20 more were shut down at the top of the sand. In the neighbouring Maidan-i-Naftek field one well had been drilled and capped and a second begun. One test well had started in the White Oil Springs district. The following year a total of 12 wells had been completed in the Maidan-i-Naftun field. The oil is rich in naphtha content. The entire Persian production up to 1925 was from flowing wells of the Maidan-i-Naftun and nearby pools, all controlled by the Anglo-Persian Oil Co., Ltd. In his report to the general meeting of the company in London on Nov. 25 1924, the chairman stated that production from the Persian fields was then at the rate of 4,500,000 tons (34,650,000 bar.) per year—the maximum quantity that they were then able to dispose of, and that much production was closed in. He further stated that the company's production could be brought up to 10,000,000 tons (77,000,000 bar.) per annum by opening all existing wells, and that it could be further augmented within a few months by drilling in wells that had been carried only to the cap rock. Well F7, in the Maidan-i-Naftun field, maintained a flow of over 11,000 bar. daily from its discovery in Nov. 1911, and is reported to have produced about 6,000,000 tons (46,200,000 bar.) up to 1925. In addition to the Maidan-i-Naftun field, the Ahwaz Pusht-i-Kuh, Qishm Island and the Persian Gulf regions are expected to yield petroleum.

'Iraq.—There are several petroliferous areas in the Tigris-Euphrates basin. Primitive development has yielded some oil in the Kirkuk-Mandali-Qasr-i-Shirin area north of Baghdad, in the Middle Tigris belt and in the Euphrates belt. Large-scale development of the fields was interrupted by the War, but interest in them was revived during the post-War period.

Palestine.—The first drilling for oil in Palestine, southwest of the Dead Sea, was interrupted by the War. Prospecting had previously been active in the area between the river Jordan and Dera'a, adjacent to the Hejaz railway.

India.—The principal source in India is the Yenangyaung field in Burma, about 272 m. north of Rangoon on Yenangyaung creek. Other important districts are the Singu, Minbu, Pakokku and Upper Chindwin. The oil is in rocks of Miocene age and is about 30° Baumé (0·8750 sp. gr.). Deep drilling was a feature of the development in this field after 1914. Some wells came in with a large initial flow, but fell off rapidly owing to the intense development of the territory. Coal-bearing rocks of Eocene age have yielded oil in small quantities in Assam and in the Punjab. India's production in 1924 was estimated as 7,500,000 bar., representing a substantial decline from its peak year.

Japan and Formosa.—Japan's principal oil production is found in the Echigo province field. Since 1908 the most important development has been in Akita prefecture. The first gusher was drilled in this field in May 1914, flowing at the rate of 12,000 bar. daily. Many other large wells have been developed. The Akita gushers have declined rapidly. Oil is obtained from coarse sandstone layers, interstratified with sandy shale of Tertiary age. The oil is about 25° Baumé (0·9032 sp. gr.). A small production is also obtained in Formosa. Production of Japan and Formosa in 1924 was estimated as 1,500,000 bar., representing a substantial decline from the peak.

China.—A joint investigation of petroleum resources in the provinces of Shensi and Chihli was undertaken in 1914 by the Chinese Govt. and a private corporation. Drilling of six wells began in the Yenchang field, Shensi, where previously a number of primitive wells had been put down and a small production obtained. In 1916 the abandonment of the enterprise was announced. No oil in commercial quantity was struck.

Oceania and the East Indies

Dutch East Indies.—Production of petroleum in the Dutch East Indies has shown a steadily increasing tendency. Production is obtained in Sumatra, Borneo and Java. Most of the oil-bearing rocks are associated with beds of coal and lignite of Miocene age. Oil of the Langkat district of Sumatra has a gravity of 33° to 55° Baumé (0·8589 to 0·7692 sp. gr.). Java oil is heavier, ranging between 23° and 40° Baumé (0·9150 to 0·8235 sp. gr.). Borneo oils from shallow wells have a gravity of about 14° Baumé (0·9722 sp. gr.), and from the deeper wells a gravity of from 27° to 33° Baumé (0·8917 to 0·8589 sp. gr.). Production of the Dutch East Indies, including a small production from British Borneo, was 10,500,000 bar. in 1924.

Papua.—Test drilling has been undertaken in Papua, and, while oil has been struck, difficulty has been caused by mud clogging.

Philippine Islands.—Prospecting and drilling work started in the Philippine Islands in 1920 in the Bondoc Peninsula district.

Australasia.—Extensive prospecting and drilling work have been done, especially in New Zealand in the vicinity of New Plymouth, in South Australia, in the Robe district, and in Queensland, in the Roma district. Exploitation in these districts has failed to develop petroleum production in commercial quantity. New South Wales has developed an oil-shale production amounting in 1922 to 32,489 tons, which, however, fell to 23,467 tons in 1923.

II. GROWTH OF THE INDUSTRY

Oil in the World War.—Petroleum was of vital importance in industrial, military and naval operations during the World War. Industrial plants required abnormally large quantities of lubricating oils and fuel oils. There was a rapid growth in the numbers of oil-burning ships, and a new demand for petroleum was made by aircraft, by the introduction of petrol-burning motor-launches, by tanks used in military operations, and by the creation of the motor transport. In all the belligerent countries special departments were organised to handle petroleum problems, and drastic restriction of home consumption was enforced. The inter-Allied petroleum council, consisting of representatives of Great Britain, the United States, France and Italy, was formed in 1917, and arranged for the requirements of each of the Allies and for the transportation of the petroleum allotted. America supplied 80% of the Allied petroleum requirements. The transportation of these great quantities necessitated large additions to tanker fleets, particularly those of Great Britain and the United States. In 1918 there were 2,628,961 tons of fuel oil alone shipped from the eastern seaboard of the United States for the use of the Allied navies. In the same year more than 1,000,000 tons of distillates and other petroleum products also crossed the Atlantic, entailing more than 500 tank steamer loadings. War-needs also brought a realisation of the value of petroleum products, and extensive investigations into possible substitutes were made.

Financial and Industrial Progress.—The expansion of petroleum activity involved a great increase in financial requirements. While the tendency was towards consolidation and the perfecting of large organisations, there was also, particularly in the United States, an extraordinary growth of smaller companies, some of them embracing all fields of petroleum enterprise. The Standard Oil and Royal Dutch-Shell groups are outstanding examples of world-wide petroleum operations, and the Anglo-Persian Oil Co., which originally confined its operations to Persia, expanded them to other fields to include all phases of petroleum activity. The original Standard Oil Trust, following prosecution under the Sherman anti-trust law, was broken up in 1911 into 33 companies, most of which were operating before as separate entities. Probably the most progressive of these companies, apart from the parent New Jersey company, is the Standard Oil Co. (Indiana) which in 1925 acquired a dominating interest in the Pan-American Petroleum and Transport Co., with principal producing properties in Mexico and with a distribution business for fuel oil and other products in many parts of the Western Hemisphere and in Europe.

In 1909 the approximate investment in the oil industry in the United States, tankage, refineries, pipe lines, tank cars, tank steamers and marketing equipment—was $800,000,000. In Jan. 1926 it was nearly $9,000,000,000, divided approximately into production $4,500,000,000, refineries $2,300,000,000, pipe lines $700,000,000, tank cars $270,000,000, marketing equipment $800,000,000, and tank steamers $430,000,000. Much of this expansion is attributable to the automobile, which has completely revolutionised the oil industry. In 1909 there were 311,000 automobiles registered in the United States: at the end of 1924 there were 17,600,000 depending upon the petroleum industry for gasolene and lubricating oil.

In 1924 the production of crude oil in the United States was 714,000,000 bar. and 78,000,000 bar. were imported, as against 128,000,000 bar. produced and an insignificant quantity imported in 1909. There were 357 refineries with a daily crude oil capacity of 2,481,000 bar. operating at the end of 1924, as against 147 refineries with a daily capacity of probably less than 500,000 bars. in 1909. The output in barrels of products by refineries in 1924 compared with 1909 was as follows:—

	1924	1909
Gasolene	213,000,000	14,000,000
Kerosene	60,000,000	46,000,000
Gas and fuel oils	320,000,000	40,000,000
Lubricating oils	28,000,000	13,000,000

Note: Figures from U.S. Bureau of Mines.

The great increase in the use of gasolene was accompanied by an increase only slightly less momentous in the use of fuel oil. The navies of the Great Powers began to use fuel oil shortly before the War, which made the conversion from coal almost complete, and, further, brought about the use of oil by fast passenger and cargo vessels. On June 30 1925 world oil-burning vessels (including motor ships) of 500 gross tons and over totalled 3,822, aggregating 19,372,615 gross tons, compared with 501 ships, totalling only 1,721,747 tons, registered in 1914.[1] The growth of the motorship, or the internal combustion Diesel and semi-Diesel engined ship, requiring a petroleum fuel oil, was the most pronounced development in shipbuilding from 1923 to 1925. In the United States fuel oil is in fairly general use under boilers in industrial plants. A new and growing use is in household burners; many types of these, however, burn a kerosene distillate called furnace oil. In 1925 the approximate annual consumption of gas and fuel oil in the United States was: by railroads, 63,000,000 bar.; merchant vessels, 55,000,000 bar.; United States Navy, 6,000,000 bar.; electric plants, 17,000,000 bar.; gas manufacturing plants, 23,000,000 bar.; and industrial plants and homes, 128,000,000 barrels.

Nationalisation.—Nationalisation of oil-bearing lands, *i.e.*, the retention or vesting of ownership of subsoil rights in the hands of the State, has been a pronounced tendency in certain countries. In Russia, petroleum lands were nationalised and are operated by the Soviet Government. Argentina's petroleum development has been almost entirely in the hands of the Government. In May 1917 a new Mexican constitution provided for the nationalisation of petroleum,

[1] Lloyd's Register and the U.S. Bureau of Navigation.

specifically Art. XXVII. and various decrees were promulgated in the attempts to carry out the nationalisation principle. Several efforts were made by the Mexican Congress to pass a petroleum code interpreting Art. XXVII., and in 1925, such a bill was passed by Congress. In other Latin-American countries nationalisation is generally adhered to in working out petroleum codes. Direct Government interest in petroleum development was brought about in Great Britain by the action of the British Govt. in becoming a majority shareholder in the Anglo-Persian Oil Company. Rumania in 1924 adopted and was putting into effect a new mining law which provided for the nationalisation of the oil industry.

Federal petroleum legislative activity in the United States has never gone so far as serious advocacy of nationalisation. In Feb. 1920 a general leasing bill was passed by Congress as a relief measure and as a means of practical handling of lands which had been withdrawn from public entry, including large naval oil reserves. In June 1920 there was further enactment giving the Secretary of the Navy powers covering leasing and operation of the naval reserves. In May 1921 a presidential decree authorised transfer of the administration of the naval reserves from the Secretary of the Navy to the Secretary of the Interior. The withdrawal of public lands was a conservation measure developed as part of President Roosevelt's broad conservation programme. Late in 1924 President Coolidge appointed a Federal Oil Conservation Board, comprising the secretaries of Interior, War, Navy and Commerce, to study the Government's responsibility with regard to the conservation of oil.

The American Petroleum Institute committee on conservation made an exhaustive study of the petroleum resources of the United States and of the future demand for petroleum, and rendered its report to the Federal Oil Conservation Board in Aug. 1925. The committee found no imminent danger of exhaustion of the petroleum resources of the United States.

III. TECHNICAL DEVELOPMENTS

Finding Oil.—The principal advance in the geological technique of oil finding is along the line of improvement in subsurface correlation by means of foraminiferal studies, additions to the knowledge of which are being made slowly but surely, and by means of mineral, and especially heavy mineral, determinations in well samples. The general application of geophysics by means of torsion balances and seismographs, has proven the greatest new aid to geology. The physicist has offered in these two types of instruments which will permit, under special conditions, the location of salt domes, faults and anticlines.

There are three types of torsion balances—Eotvos, Bamberger and Oertling—but all are essentially the same as the original Eotvos in principle, varying only in portability, sensitiveness and the presence or absence of a self-recording photographic attachment. These instruments give the differential in millionths of the density of adjacent portions of the earth's surface. Thus beds of a higher density below one part of the surface, as in the case of limestone-anhydrite capped salt domes, may be distinguished from those of lower density such as ordinary unconsolidated sediments, surrounding them. The seismograph attempts to make use of an entirely different principle—that of the differentiated velocities of pressure waves, refracted through different rock masses, such pressure waves being actuated by the explosion of a small charge of dynamite (one to two hundred pounds) at or slightly below the surface, and the recording of such waves, usually photographically, by means either of one of two general types of seismographs—mechanical and galvanometric.

Drilling Systems.—The principal drilling systems are: (1) percussion, which includes the standard cable tool (American system) and the pole tool (Canadian system); (2) hydraulic rotary system; (3) combination system; (4) hydraulic circulating system (*see* 21·319). Though differing in design and construction, the several drilling outfits have many features in common. Regardless of the method or system employed, the power plant generally consists of a portable boiler, capable of developing from 30 to 70 H.P. and a standard type of horizontal steam engine of from 20 to 50 horsepower. Well depths range from a few hundred feet to over 6,000 ft., the deepest producing wells being in California. Deeper drilling in the United States has accounted for much of the greatly increased production. A well of average depth in the mid-continent field could be drilled and equipped for less than $13,000 in 1913. In 1915 the cost increased to about $14,000; in 1918 to $24,000; in 1920 to $30,000 and in 1925 to about $35,000 or $40,000. In Mexico, where the wells usually have a great initial production and where the yield of individual wells is often restricted only because of inadequate marketing facilities or as a precaution against water inroads, the percentage of current production that might be termed " flush " is much higher than in any other producing country.

The Canadian pole tool system is used in Canada, while the deeper drilling in the Calgary district has been done by the standard cable system, and there has also been some rotary drilling. The standard cable system is principally used in Venezuela, although there has been a good deal of drilling with the rotary method and a combination of both. Wells in Colombia have been drilled by the cable system and combination cable and rotary. The standard cable system of drilling is generally used in Peru, but there has been some rotary drilling in the Zorritos field. Drilling in Argentina has been largely done by the Galician pole tool system, which is a modification of the Canadian system, the equipment providing for a larger and heavier rig. The American standard cable system is also in use in Argentina, and there is some rotary and also hydraulic circulating drilling. In Trinidad, rotary drilling is employed almost exclusively for this purpose.

The free fall system, a modification of the Canadian pole tool system, is used in Russia. In this there is a free fall of the tools, which are then picked up; American methods are also being adopted. In Galicia, as well as in Rumania, the Canadian pole tool system, modified and adapted, is generally used, but the hydraulic circulating system is also in use. The standard cable system with portable rig is used almost exclusively in Italy, and the same system, without portable rig, in Persia, India and Egypt. The Galician pole tool system is used in the Dutch East Indies. In Japan the rotary system, introduced in the Akita field in 1913, is used almost exclusively. Electric power has made advances in the United States, in Texas, Wyoming, California and the mid-continent fields. It has been adopted in Rumania, and in the Balakhani-Sabunchi-Romani-Surakhani area and the Bibi-Eibat field of Russia. Electrification of the Yenangyaung field of Burma has also been undertaken. The use of compressed air to increase oil extraction has been introduced in certain producing areas.

New Exploration Methods.—In the mid-continent field of the United States, core drilling (either by the diamond drill or ordinary rotary method) has been employed to advantage. Improvements have been made in taking cores from wells. Up to 1925 no satisfactory device had been worked out which would enable an oriented core to be obtained. The use of cores for determining the amount of dip, even without an orientation, is of value in finding oil. Palaeontologic examination of well cuttings will open up new sources of oil and much is being done on correlation by microscopic examinations. During the post-War period the most notable progress in the application of new methods was made in the Gulf Coast area of Texas and Louisiana, where the salt dome type structure governs oil accumulation. Geophysical methods have been applied with notable success. The discovery of three domes by means of the torsion balance and the seismograph is the first result of exploration by geophysical methods. Great possibilities exist of recovering from depleted oil fields. In 1925 four methods of oil recovery from depleted oil fields were in use: flooding, air or gas pressure, dewatering and mining. All these methods have been successfully used, the first three in the United States and the fourth in France. The most notable achievements in flooding are in the Bradford (Pennsylvania) field. Under the auspices of the American Petroleum Institute a movement to standardise oil-well equipment had gained great headway by 1925 and was being closely watched in other countries. Committees were working on the standardisation of specifications for steel and iron pipe, rig irons, wire rope and manila cordage, rigs and derricks, cable drilling tool joints, pumping equipment and engines, rotary drilling equipment, belting, oil-field boilers and steel storage.

IV. TRANSPORT AND STORAGE

Pipe Lines.—With its large crude oil production obtained from fields often far from refining and consuming centres, the petroleum industry of the United States has developed pipe line systems of great mileage and capacity (*see* 21.320). In the fields themselves there are networks of gathering lines connecting the wells with main trunk lines and railways; the trunk line systems connect the fields with the refining centres. It was estimated in 1924 that the length of pipe lines in the United States amounted to about 65,000 miles. Practically all of the crude oil produced is transported by pipe line, some of it only a few miles and some of it as far as 1,700 miles. Pipe lines in Mexico have been constructed from the Panuco and Topila fields to Tampico and from the southern fields to Tampico and directly from the southern fields to the Gulf coast, where sea loading lines are installed. There is an international trunk line running into Canada connecting with lines in Ohio. Pipe lines are part of oil development in all countries, usually connecting oil fields with refineries or with railroads or sea terminals.

Sea Loading Lines.—Sea loading lines have been installed and are operating in Mexico, Peru, Trinidad, Russia, California and other places. These lines make possible the loading of vessels several miles at sea and are usually installed where no deep water harbours exist and where, because of the shallow water, the building of piers would be very expensive. The lines are submarine and are usually coupled ashore, stretched out on rails, and drawn into the water by vessels. When it is impossible to couple the pipe ashore, this is usually done on barges or rafts and the line deposited as the work proceeds. The sea loading lines off Tuxpam, Mexico, have been pulled up following failure of Mexico's " golden lane."

Storage.—Crude oil storage facilities, steel tanks or reservoirs, are grouped together on what are generally known as tank farms. Steel tanks are usually of 37,000 or 55,000 bar. capacity, placed about 500 ft. apart from centre to centre. Each tank is surrounded by a levee of sufficient height to hold the entire content of the tank, and enclosed for the purpose of isolating fires. Crude oil is stored in steel tanks, concrete tanks and earthern reservoirs, while many of the lease tanks are wooden. In the United States, at the end of 1924, 348,000,000 bar. of crude oil were held in pipe line and tank farm

storage. Tanks are installed at refineries for holding oil during the running at the plants and for storage preparatory to shipment to markets. Stocks of refined products held at United States refineries at the close of 1924 totalled 114,000,000 barrels. Investigation and experimentation are constantly directed to the reduction of evaporation losses of crude oil and refined products during storage. Tanks are usually protected from fire by steam lines from the boiler house so that free steam can be turned into the tanks on the approach of a thunder storm. This steam displaces the explosive mixture in the tanks. The water spray method is also used. At pipe line stations, and at tank farms and refineries where there is a large number of tanks, fire protective systems which utilise a frothy or foam mixture are often installed.

Tank Vessels.—The tank vessel plays a large part in the modern petroleum industry. It is used for transporting crude oil from producing countries and districts to refining countries and centres, and for carrying refined products in bulk to the markets of the world. On June 30 1914 world tankers numbered 366 vessels, totalling 1,441,196 tons; on June 30 1925 the world's tankers of 500 gross tons and over numbered 1,072, with aggregate tonnage of 5,310,533 tons, of which 478 vessels, totalling 2,411,719 tons, were American and 352 vessels, of 1,936,132 tons, were British. Great advances have been made in tanker construction and in loading and unloading cargoes.

V. THE REFINING OF OIL

Refinery Operations.—The rapid expansion of the internal combustion engine, which, as developed in motor vehicles, began to be of importance as a consuming agency of petroleum products in 1907, caused gasolene (petrol) to become the chief by-product of crude oil. Later, the conversion of coal-burning vessels and industrial plants to the use of oil, and the extension of utilisation of the Diesel engine (an internal combustion engine which does not demand so volatile an oil as gasolene) in the marine and in the industrial fields, placed fuel oil in a position of great prominence. Even so great an increase in crude oil production as was recorded between 1908 and 1924 could not have supplied these consuming agencies had not refining methods been improved, new processes developed, and refinery capacity greatly expanded. As in the case of crude oil production the greatest refinery expansion has been in the United States. It is estimated that in 1915 there were 302 refineries with a crude oil capacity of 1,043,245 bar. daily; on Nov. 1 1924 there were 553 refineries with a daily capacity of 2,934,842 barrels.

United States refineries in 1924 ran 644,000,000 bar. of crude oil and produced 8,960,000,000 gal. of gasolene, 2,521,000,000 gal. of kerosene, 13,460,000,000 gal. of gas oil and fuel oil, 1,155,000,000 gal. of lubricating oil, 516,000,000 lb. of wax, 761,000 tons of coke and 2,546,000 tons of asphalt. The principal refining centres in the United States are in the mid-continent territory, in the Pennsylvania region, and along the Atlantic, Gulf and Pacific coasts. Every large producing area has developed, a refining industry, while the seaboard plants, in most instances, owe their location to strategic advantages respecting large domestic and export markets. Mexico has built up a substantial refining industry, although the largest proportion of its crude oil production is transported to the United States for topping and refining, in most part by Atlantic and Gulf coast plants. Most of the Mexican plants are topping plants (that is, they divide the crude into tops, distillates and gas and fuel oils) but there are a few more complete refineries. All the refineries are located along or adjacent to the Gulf of Mexico or the eastern seaboard, comparatively near the producing fields.

Canada has developed a substantial refining industry, these refineries operating on Canadian, United States, Mexican and Peruvian crude oil. There are one or more refineries or topping plants in Venezuela, the island of Curacao, Colombia, Trinidad, Peru and Argentina, these operating on domestic oil or oil imported from nearby territories. Galician crude oil is handled by refineries located within a radius of about 150 m. from the city of Lemberg, in and near the oilfields, and also by the continental refineries in Hungary, Austria and Germany. It is estimated that Galician refineries are capable of handling about 40% of the crude production. Rumania's refineries are mainly located in the Prahova district and also in the Bacău, Dâmbovița, Constantsa and Neam' districts. Russian refineries are located at Blacktown, a suburb of Baku, and at Grozni, Bolshaya, Rakushka, Ekaterinodar and Shirvansky. There are local refineries at Suez in Egypt, and in Persia, India, the East Indies and Japan; Persian oil is also being handled by a refinery at Swansea, Great Britain.

Refining Methods.—The processes employed in the separation of the various constituents of crude petroleum into marketable products are many and varied, and while often apparently complex in nature, can be ultimately resolved into one or more of the basic methods listed below, or else fall under the head of allied operations, such as blending, compounding, grease-making, distilling, etc. These latter are not strictly refining processes in a purely technical sense, but are all incidental to the general operation of a refinery. Basic refining methods are: fractional distillation, chemical treatment, cold pressing, fractional fusion, cold settling, decolourisation and cracking. Fractional distillation, distilling or "stilling" as it is often termed, may be defined as the separation by volatilisation of one group of petroleum constituents from another, in some form of closed apparatus, by the aid of directly or indirectly applied heat. Except in the case of a few unimportant crudes, it is universally practised and is the most important art in the whole scope of refining. Distilling methods may be classified under distillation by dry heat; (*a*) topping, skimming and stripping, (*b*) coking, (*c*) rerunning, (*d*) sweetening, (*e*) cracking; and distillation by steam; (*a*) steam stilling, (*b*) reducing, (*c*) cracking.

The adoption of continuous process stills was one of the most important advances, occurring about 1910. They were first introduced by Norman Henderson, a British chemist in connection with the distillation of shale oil. This system was subsequently universally adopted. Topping and skimming plants to raise the flash point and to dehydrate heavy oil multiplied rapidly, particularly in the United States. Numerous special refining processes have been introduced, and it is practicable to give only a partial list representative of types: the simplex refining (Trumbull) process, originally intended as a continuous topping system, has been so improved that it is now a highly efficient method for the fractionation of almost any type of crude; the Sharples process of centrifuging is another; the Edeleanu process brings out the possibilities of the separation of petroleum products by selective solvent action; a purely chemical process is that of Carleton Ellis, American chemist, for the production of Petrohol (isopropyl alcohol); more recently Dr. A. D. Little, American chemist, announced the development of secondary alcohol recovery processes.

In 1926 the petroleum industry was in the midst of intensive development of distillation methods, the most important phase of the business. Evidences of this are the bubble tower, thermal efficiency and high vacuum. Twenty years before, the early recognition of the value of heat exchange resulted in the use of a shallow tank or box in the ground filled with water and containing submerged pipes through which the ingoing cold oil and the rundown hot oil were circulated separately. From this exceedingly indirect beginning has come the highly developed heat exchanger with its compact arrangement and high-speed efficiency. Various types of drums and pots on the overhead lines from stills, particularly for the redistillation of light products, were the forerunners of the bubble towers and dephlegmating columns which serve their purpose in a more complete separation of desired products in a single or limited number of operations.

Scientific development along the line of chemical treatment has resulted in several new methods, such as the hydrochlorite process for the conditioning of light distillates, the process for the use of liquid sulphur dioxide, and various phases of the use of anhydrous aluminium chloride. Several extraction methods for reducing emulsions and obtaining more or less valuable by-products have also been proposed. Sulphuric acid and soda still remain the chief reagents for treating processes. Development of continuous counterflow methods, which have been of particular advantage in the handling of light products, is an engineering contribution to the advancement of the art of treating petroleum products. The old cumbersome method of removal of wax from petroleum products has been superseded by modern pressing equipment. The refiner now has at his disposal almost any range desired of artificially low temperature. One of the most convincing developments along this line has been that of the centrifugal method for the removal of wax in the production of bright stock, which has been utilised by the engineer in the conservation of crude oil supply; thousands of barrels of cut oil are now being conditioned to pipe line grade by this comparatively simple means. As regards filtration or decolorisation, Fuller's earth is the chief agency used for decolorising and purifying mineral oils; its use has been developed mainly along the line of recovery processes which serve to put the clay into a condition for re-use more or less approximating the fresh material. Some special furnaces have been developed for this purpose. More attention has recently been given to the use of finer grades of earth, which has resulted in the development of the so-called contact process. The application of this process consists primarily of the mixing or contacting of the fine adsorbent at much higher oil temperature than had been used for percolation. Claims are made for further gains in colour yield, as well as quality, when the oil to be contacted has received a light preliminary acid treatment with or without neutralisation. At the same time, considerable attention is being given to the improvement of adsorptive materials themselves, with the result that there are a number of high-powered clays on the market which give excellent results when properly applied.

Cracking Processes.—The growing importance of the internal combustion engine made necessary a higher yield of motor fuel from the limited crude oil supply, if the demands of this consuming agency were to be met. The progress that was made after 1913 in the cracking art represents the greatest scientific achievement of the oil industry between 1910 and 1925. Cracking has made possible the supplying of a sufficient quantity of gasolene to meet the tremendously increased demands of the motor car, as evidenced by the estimate that in 1924 cracked gasolene amounted to over 20% of the total gasolene manufactured at American refineries. The basic feature of all gasolene cracking is the subjecting of a hydrocarbon (such as gas oil) to superatmospheric pressures and high temperatures, which accomplish the breaking up or cracking of the molecules of the stock under treatment. The residue from one treatment by a crack-

ing process may be again and again subjected to the same process until substantially the entire mass is converted into gasolene. The percentage of gasolene which it is possible to extract from a given quantity of crude oil depends largely upon the quality of the oil. Cracked gasolene in general appearance is indistinguishable from first run or straight run gasolene and is not kept separate in handling or shipping.

Cracking processes may be classified into two groups: (1) processes in which the oil in vapour form is thermally or energetically treated (2) processes in which the heat or other form of energy is applied to the oil in liquid form, with some part of the liquid in contact with the vapour. The use of pressure or of catalysts may be a part of processes of either class (*see* 21.322). Actual commercial development dates from the patents of Dr. W. M. Burton, American chemist, in 1913. Dr. Burton's processes, controlled by the Standard Oil Co. (Indiana), were widely installed throughout the industry under licensing arrangements from 1917 to 1921. More recently the use of other processes have greatly increased. Probably the best known of modern successful cracking systems are the Burton, including the modifications of Humphreys, Clark and others; Ellis tube-and-tank; Cross; Dubbs; Holmes-Manley; and Jenkins; but there are many others employed by individual companies which are not so widely known because they have never been offered for licensing to other companies.

Natural Gas.—The United States and Canada produce all but a small fraction of the natural gas output of the world (*see* 21.321). The main areas of Pennsylvania, West Virginia and Ohio have developed remarkable staying qualities, and these three States produced some two-thirds of the total production of the Continent. The mid-continent field has shown a great increase in the natural gas production, and the Wyoming field has proved productive. There is some natural gas production in Russia, Rumania, Persia, Galicia, India, Japan and Mexico. The total production of natural gas in the United States in 1924 was 1,016,000,000,000,000 cu. feet. It is estimated that no less than 14,000,000 inhabitants of the United States use this fuel as a source of heat, light and power.

Natural Gasolene.—Natural gasolene, sometimes termed natural gas gasolene, or casing-head gasolene, has grown into a large industry and scientifically has made great strides. Although the foundation of the natural gas gasolene industry in the United States was laid in 1903–4, the real expansion of this important phase of gasolene production began in 1909. In 1911, the first year for which the statistics on the subject are available, 132 plants produced 7,425,839 gal. of raw gasolene from natural gas. In 1924 the industry included 1,096 plants, which produced 933,861,000 gal. of raw gasolene. Of the total, 639 were compression plants producing 257,894,000 gal., 445 were absorption plants producing 670,678,000 gal., and 12 were charcoal plants producing 4,064,000 gallons. In 1925 the methods of extracting gasolene from natural gas depended upon the principles of compression, cooling and absorption. The use of gasolene stabilising processes for minimising losses occasioned by evaporation and weathering of natural gasolene, has far-reaching influences upon the properties of products as obtained from the various extraction processes.

Marketing of Products.—Expansion of the use of petroleum products has resulted in many improvements in marketing methods and great additions to marketing equipment and facilities. In the United States a large number of tank cars is used in transporting products from refineries to consuming centres and to ports for shipment. The tank car is still used to some extent to carry crude oil from the field to refineries, chiefly when a new field is opened up and before pipe line connections have been made. Tank cars are widely used in Europe for petroleum products. There were 49,901 petroleum tank cars in the United States and Canada on Jan. 1 1914, and by 1924 the number had increased to 125,862. Rigid requirements are enforced in tank car construction in the United States. Cars must be of steam boiler quality, and exceptional strength is prescribed for the frame. The insulated tank car to handle highly volatile casing-head gasolene has been successfully introduced, and is also being adopted for transporting straight-run gasolene because it reduces loss by evaporation. The growth of motor vehicle gasolene demand, particularly extensive and rapid in the United States, has created new distributing methods and devices.

Fuel-oil bunkering stations have been established along the ocean routes to meet the increase in the oil-burning naval and merchant fleets of all countries. These stations include large storage tanks, and in some cases, berth and loading facilities, but in many instances they are simply storage reservoirs and oil is loaded on steamers from barges supplied from these stations. It is estimated that the number of fuel-oil stations for steamships located on trading routes approaches 300.

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Also R. Arnold, *Conservation of the Oil and Gas Resources of the Americas;* H. Barringer, *Oil Storage, Transport and Distribution;* R. H. Brownlee, *Development of Cracking Equipment;* F. Julius Fohs, *Technologic Progress in the Oil Industry;* C. M. Hunter, *Petroleum in Argentina;* H. F. Mason, *Reports of U.S. Bureau of Mines;* V. F. Marsters, *Geology of the Peruvian Fields;* E. de Golyer, *Statements on Mexico;* J. F. Oakleaf, *The Application of Science to Petroleum Refining;* L. C. Sands, *Oil Development and Production;* A. D. Smith, *Refining;* I. C. White, *The Rapid Exhaustion of Ohio's Natural Gas Resources.* (L. M. F.)

PETROLOGY (*see* 21.323).—Since 1910 there has been a steady advance in all departments of petrology. For many years the description of the microscopic characters of minerals and rocks was held to be, if not the only, at least the most important, part of petrographical literature. Text-books of petrography were in general a description of the recognised rock types, their composition, structure and the stages of their decay, with notes on their geographical distribution and their geological age. Chemical analyses were used principally as a means of identifying the classes to which individual rocks belonged and as a guide to the minerals of which the rocks consisted.

More attention of late years has been directed to other problems connected with rocks—such as the conditions of their origin, their chemical classification and the physical laws which determine what minerals shall be formed, in what order they will crystallise and through what stages they will pass when subjected to cooling, pressure and metamorphism. There is no difficulty now in attaining temperatures such as occur in the deeper parts of the earth's crust and in the interior of volcanoes and in maintaining these temperatures quite steady for several days or weeks if necessary. The electric pyrometer has reached such precision that an error of one or two degrees is all that need be expected in measuring temperatures up to 1600° Centigrade. Very high pressures can be easily obtained provided the temperature is low and there is no necessity to study the action of compressed gases. It is less easy, however, to perform experiments by which the action of steam and other gases on molten rock magmas at temperatures about 1000° and under pressures over 100 atmospheres can be exactly determined. More than one investigator has now been able to attain this, and a very correct reproduction of the conditions under which igneous rocks crystallise is consequently possible in the laboratory.

Descriptive petrology has been by no means in abeyance though the five years of war turned the activities of many geologists to other fields. Exploring expeditions, such as those of Scott, Shackleton and Bruce in the Antarctic, have brought home large collections of rocks which have been examined and described, and the constant activities of geological surveys in all parts of the world, together with the researches of geological specialists, have added largely to our knowledge.

Igneous Magmas.—Of the three great groups into which rocks are naturally subdivided, the sedimentary, igneous and metamorphic, the first is on the whole best understood and presents the smallest number of unsolved difficulties. The manner in which sediments are laid down on the bottoms of seas and lakes, in river deltas and valleys and on land surfaces, at the present time is open to investigation by simple means, and, except in the case of the deposits of the deeper parts of the oceans, is reasonably clear. Igneous magmas, on the other hand, are essentially obscure in their origin and history, and they have been the subject of much investigation in recent years. The origin of magmas is a problem belonging to geology rather than petrology. They have been regarded as unconsolidated remnants of the primeval molten globe, which by geological changes, such as the secular contraction arising from cooling and the pressures by which mountain chains have been upheaved, have

been afforded an outlet to the surface, where they appear as volcanoes, or have been forced between the rocks of the upper layers of the earth's crust, where they may be laid bare by subsequent denudation as " bosses " of granite or gabbro or intrusive sills of porphyry or dolerite. Others have held that magmas may arise in whole or in part by the fusion of solid rocks (of any of the above three classes); the agencies producing fusion being rise of temperature, either through crushing and movement or by depression into those regions where a high temperature naturally prevails, or through penetration of gases from the earth's interior which are not only intensely hot but are capable of combining and setting free large quantities of energy. It is conceivable also that deep within the earth's crust masses of rock occur at temperatures so high that, if pressure be relieved by the vaulting-up of the overlying crust or by fissures opening to the surface, they may become liquid and rise through any available channels.

Hardly less obscure than the origin of magmas is the question of their variety or differentiation. The outstanding fact in this connection is that no large developments of igneous rock are really homogeneous, and even in small masses a great number of varieties or rock-species occur frequently, differing in their chemical composition and their minerals. Granite, diorite, gabbro, norite and peridotite may all occur within a small outcrop not more than one or two square miles in area. The origin of differentiation has been much discussed. Some have ascribed it to diffusion or to a principle by which the heavier atoms in the molten mass will be concentrated either towards the bottom or towards the cooler edges or surfaces of contact with the surrounding rocks. Along these lines no satisfactory explanation has been found. More recent speculations have followed three lines: (*a*) subsidence or flotation of crystals; (*b*) absorption of sedimentary or other foreign rocks; (*c*) concentration of vapours.

(*a*) *Subsidence or Flotation of Crystals.*—When crystals form in a liquid they will, if heavier than the liquid, tend to subside and be collected near the base; and if lighter, they will tend to rise. If the crystals differ in composition from the liquid, as they usually do, consolidation will result in a mass which is not homogeneous. Thus, for example, olivine crystallises early in a basic magma and, being heavy, will tend to sink; consequently magnesia and iron will be in excess (and silica will be less abundant) at the base, while felspar will predominate towards the top of such a mass. Instances occur showing this arrangement, but they are very exceptional; it is not the case that dolerite and gabbro masses as a rule have a pale-coloured felspathic top and a dark base rich in olivine and the oxides of iron. For such cases as do occur another explanation is often available. If now it were possible at an advanced stage in crystallisation to drain away or force into another position the still liquid part of the magma a type of rock different from the original magma would be produced, because most of the heavy ferromagnesian minerals would have been abstracted.

(*b*) *Absorption of Foreign Rocks.*—A second method of differentiation which has received much attention of recent years is by absorption of country rock. A gabbro mass, for example, may be supposed to dissolve a felspathic sandstone with which it is in contact and thus give rise to a more acid magma which might be represented by quartz-dolerite or even by granite. Intrusive masses of igneous rock, as they ascend from beneath, break across the overlying strata and may shatter them into many small blocks. On these and on the surrounding walls a solvent action is likely to take place. If the invaded rock is heavier than the intrusive magma its fragments will tend to sink, and as they are warmed up they will slowly disappear. There can be no doubt that this action is by no means unusual, and many good instances of it are known, but there is little reason to believe that it is an important cause of differentiation. Where igneous rocks have absorbed sediment in any quantity they present in general an abnormal facies. Granites, for example, which have dissolved clay, slate or mica-schist usually contain andalusite, sillimanite, cordierite, garnet or corundum, minerals which do not normally occur in such rocks. The magmas are said to be " contaminated." Gabbros under similar conditions contain cordierite, garnet and an excess of hypersthene (forming cordierite norites) and are easily distinguished from normal gabbros. Absorption of limestone by some nepheline syenites is indicated by the presence of crystalline calcite in the igneous rock, and peridotites may contain corundum. Perhaps the diamond is an accessory of this type in olivine rocks which have dissolved graphitic matter. Even when igneous rocks are absorbed the result will as a rule be an abnormality. This is fairly evident in the majority of cases merely by a study of the analyses of true igneous rock types and ordinary sediments.

(*c*) *Concentration of Vapours.*—The theory that differentiation of magmas arises from the formation of partial magmas during cooling, which separated because they became insoluble in one another (as phenol does with water), is favoured by many geologists, but an examination of the physical laws determining the production of such magmas has led to the conclusion that nothing is known that would make this process appear likely. Many geologists, however, who have a wide knowledge of igneous rocks in the field, hold that there is evidence to show that differentiation took place before crystallisation began, and that the various types of rock were already distinct when they were injected in liquid form into the positions they now occupy.

It has been suggested, though it has not been clearly explained, that the gases dissolved in magmas determine the sequence of crystallisation and may exert a powerful influence in differentiation. A magma rich in gases when it begins to crystallise yields crystals of anhydrous minerals. The gases, if they do not escape, must increase in relative amount in the liquid residuum. The early minerals are those like olivine and augite, which can be crystallised without difficulty from anhydrous melts; the later minerals, such as the alkali felspars and quartz, crystallise readily only in presence of steam and other gases (or of solvents of a nature not usually present in rocks). In some respects the crystallisation of an igneous rock resembles the cooling and evaporation of a saline solution, the gases playing the part of solvent. The minerals appear in the order of their insolubility. It is probable that the history of magmas will never be clearly understood till a very careful study is made of the consolidation of rock-making silicates under high pressures of steam and other gases such as are known to abound in natural volcanic magmas.

Classification of Magmas.—The igneous rocks of one geological period and province have often so many peculiarities in common that they can be regarded as having resulted from the consolidation of a single reservoir of molten matter. The chain of volcanoes that fringes the shores of the Pacific Ocean from Tierra del Fuego to Alaska, and thence by Japan and the Philippines to Java and Sumatra, is characterised by rocks which have so much similarity in many important characters that they are certainly of allied origin, even if they have not proceeded from the one source. These rocks are all of Tertiary and recent age; their eruptions began in Eocene or Miocene time and have continued, with more or less frequent intermissions, up to the present day. For another example of this we may take the igneous rocks of the western and mid-Atlantic area, from Jan Mayen, through Iceland, the Hebrides, Canaries, Cape Verde Islands, etc.

All these volcanic centres have many rock types in common, and the whole assemblage is strikingly different from the Pacific igneous rocks. Each of these magmas has been taken as a type, and it has been found that in the older geological periods they are also represented; for example, the early Devonian eruptions in Scotland are distinctly of the Pacific type, while the carboniferous eruptions in the same district are of the Atlantic type. If we seek for a precise definition of their respective characters, it is not easy to give a complete answer. It may be said, however, that the Pacific suite has a great prevalence of hypersthene andesites, and andesites of all kinds. The Atlantic lavas, on the other hand, are predominantly olivine basalts, with trachytes and phonolites. Another feature which is especially striking is that practically all the rocks carrying nepheline and other felspathoids or " alkali minerals " are found in the Atlantic suites. This has been regarded as proving that the Atlantic magmas are richer in alkalis and the Pacific in lime, but it is by no means certain that this is the explanation. In fact, a full chemical discussion of the relations of these rock-series to one another has yet to be undertaken, but from the work of Becke it seems that the Pacific are essentially richer in silica, and in the " light " elements generally, while the Atlantic contain more of the " heavy " elements, such as magnesia, iron, chromium, titanium.

Several authors have pointed out that the rocks of the Pacific group are associated with a folded mountain chain, and consequently have appeared in a region undergoing lateral compression and upheaval; the Atlantic, on the other hand, are associated with a region of subsidence, with vertical dislocations along lines of fissure and faulting—in other words, a region subjected to lateral tension and depression. A third group of igneous rocks, very well characterised and distinct in many respects, is the pillow lavas or spilites, which are perhaps the most abundant volcanic rocks of the earlier geological periods and are very widespread in the Lake Superior district, middle Europe, Wales and Scotland. Among these lavas types rich in soda are common

and albitisation is a frequent pneumatolytic change. These rocks seem to accompany depressions formed in consequence of folding.

Experiments on Constitution of Binary Magmas.—A molten rock magma may be regarded as a liquid composed principally of oxides (mostly silicates). It crystallises from a variety of causes, of which cooling is the most important, though relief of pressure and escape of gases may also play a part.

The laws followed in such a case have been very carefully investigated, not only for metals, salts and organic compounds but also for many minerals. It is generally true that a mixture of two substances will have a lower consolidation point than either of the pure substances. Thus salt and ice, if mixed in the solid state at temperatures a little below the freezing-point of water, will melt, forming a liquid which is colder than the ice originally taken; and aqueous solutions of salts have always a freezing-point lower than that of pure water. For each pair of substances there is a definite mixture which has the lowest temperature of consolidation, and this is known as the *eutectic* mixture.

In the diagram (fig. 1) the horizontal co-ordinate represents composition, the vertical represents temperature. A mixture of any given composition is represented by a vertical line, and different points in that line represent different temperatures of the mixture. The two sloping lines AE and EB divide the diagram into two regions, of which the uppermost indicates substances in a purely liquid state; below the line the substance is in part or wholly in a solid condition. A vertical (composition) line, accordingly, when it cuts these lines shows where a substance begins to crystallise. The point where the curves meet is the eutectic point E, and shows the composition of the mixture which has the lowest freezing temperature, and the temperature at which it consolidates.

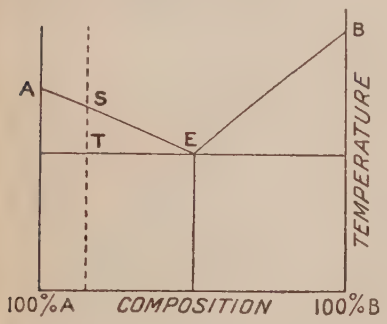

FIG. 1.

The horizontal line drawn through the eutectic point separates the diagram into two regions, a lower one in which the substance is entirely solid and an upper one in which liquid is present. If we take any vertical line in the diagram, it will indicate a mixture of definite composition ST and, followed downwards, it shows the changes taking place in such a mixture as the temperature falls. Above the line AE the mixture is a cooling liquid. At S crystallisation begins. At T the last liquid portion disappears and consolidation is complete; below T the substance is a cooling solid. The diagram refers only to substances that crystallise on solidifying; glasses are solids which essentially resemble highly viscous liquids in their properties. When crystallisation begins the substance which is in excess of the eutectic mixture will crystallise out first, the residual liquid becoming poorer in that component until it has reached the eutectic composition, when the two components will go on crystallising simultaneously till all is solid. The composition of the liquid will travel along the line AE from S to the point E, where it will remain constant.

Such a diagram is based on a series of experiments in which a known mixture of two substances (very carefully purified) is heated in a furnace (generally electric) to a temperature well above its melting-point. The mixture is then allowed to cool slowly and steadily, and its temperature recorded at short intervals or continuously by some form of pyrometer or recording thermometer. The rate of cooling can be very accurately ascertained and plotted (fig. 2). Crystallisation is attended by liberation of heat (the liquid losing its latent heat as it passes into a solid), and this involves a retardation of cooling. The simple liquid cools at a uniform rate; crystallisation begins and the cooling slows down; at a certain point the liquid is all crystallised and the mixture, now a solid mass of crystals, will go on cooling uniformly. The change of slope in the curve of cooling accordingly corresponds to the passage of the substance from S to E in temperature (or from the purely liquid to the purely solid areas).

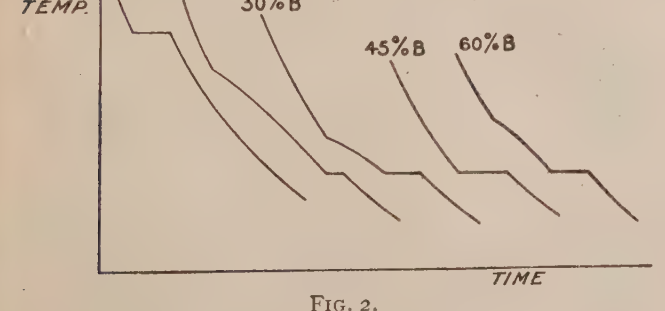

FIG. 2.

The physical condition of the substance at any given temperature can also be ascertained by the method of chilling. If the charge be taken from the furnace and plunged in water (or in some cases mercury) the mixture consolidates almost immediately, and any parts which were liquid will assume the form of a glass, or a very finely crystalline aggregate. This is especially the case with silicates, many of which crystallise with difficulty. Microscopic investigations will enable us to determine the nature and relative proportions of the crystals which were present. The results obtained can be checked by experiments on mixtures having a different composition, and in this way a complete diagram built up on a sound experimental basis.

The case outlined above is the simplest known. Many complications may appear, requiring special precautions and elaborate investigation. Thus the liquid may not begin to crystallise at the proper point on the upper curve, as some substances crystallise with difficulty and the liquid becomes "undercooled." A heating-up experiment may be tried to check the cooling experiments; the same phenomena should appear in the reverse order if no complications are present. Many silicates crystallise with great difficulty in ordinary crucible experiments (such as the felspars, albite and orthoclase). Again, it may be impossible to melt the mixture we desire to investigate in any furnace which is suitable for experiments of this kind. Magnesia, alumina and lime are examples of substances which cannot be fused at temperatures such as 1600° to 1700° C., which are the limits of accurate work in our laboratories at present; part of the diagram accordingly will be incomplete when substances like these are studied, but an approximate solution can generally be made by extrapolation. Another frequent complication is the appearance of transformations in the solid state. The first mineral to crystallise becomes unstable as the temperature falls and changes spontaneously into another crystalline form of the same substance. The change will be attended by an alteration in the slope of the cooling curve, for in such cases heat is either liberated or absorbed, and successful chilling tests can often be made by which the mineral transformation can be clearly demonstrated. Silica, for example, appears in three minerals, cristobalite, tridymite and quartz, the transition temperatures being 1470° and 870°.

Each of these minerals occurs in two forms. Below 1190° calcium metasilicate crystallises as wollastonite; above that temperature it forms another mineral, pseudo-wollastonite. Many of these "high-temperature" forms are not known as natural minerals, and as a rule they are very rare in rocks, probably because rock cooling is essentially a slow process, and the most stable forms at low temperatures are the only ones likely to be present when the mass has completely cooled. Some very interesting results have been obtained in this field of research; for example, it is known that quartz has two modifications, one above 575°, the other below that temperature, and it has been proposed to use quartz as a geological thermometer and to show at what temperature it crystallised in a rock mass. If above 575° it would appear as one kind of quartz and on cooling would pass into another; and by various indications, such as crystalline form, cracks, etc., a record of this transformation may be obtained.

Very interesting modifications of the process of crystallisation occur when two or more of the minerals formed are members of an isomorphous series and can in consequence form mixed crystals. This is very common among the minerals of igneous rocks, of which the felspars, pyroxenes, olivine (and probably also hornblende, mica, nepheline and the felspathoids) all belong to isomorphous series. If we have, for example, two components such as albite and anorthite, they will tend to form mixed crystals (known generally as plagioclase felspars). Anorthite has the higher melting-point (about 1550° C.); albite crystallises in crucibles only with great reluctance at a temperature about 1100° Centigrade. A mixture containing equal proportions of anorthite and albite will melt at about 1450°, and on cooling will begin to form crystals at that temperature. These crystals will contain about 60% anorthite—that is to say, they are enriched in the less fusible component. As crystallisation proceeds, the felspar that separates becomes gradually less rich in anorthite. The composition of the liquid also alters, because the crystallisation is abstracting anorthite molecules more rapidly than albite molecules.

This process may go on till the felspar has all crystallised, the last deposited being near albite in composition, and the crystals, examined microscopically, will show zones, of which the internal are rich in anorthite and the external are progressively richer and richer in albite. But if sufficient time is allowed, a reaction sets in between the crystals and the liquid; in other words, the felspars crystallised are not in equilibrium with the magma except at the moment of crystallisation, and as the magma becomes richer in albite it will attack the early plagioclase, replacing it by a variety containing more albite. These phenomena are well known to petrologists as zonal structure of plagioclase felspars; and corrosion of the cores and internal zones of the crystals is almost universal in such rocks as basalt and andesite. Rocks of similar composition which have

cooled very slowly, such as gabbro and norite, as a rule do not contain zoned plagioclase crystals, no doubt because equilibrium has been attained and homogeneous crystals formed by the process above described.

This may be illustrated by fig. 3. The horizontal line represents composition, the vertical temperature. A is 100% albite, B is 100% anorthite. The upper curve is the liquidus above which there is only

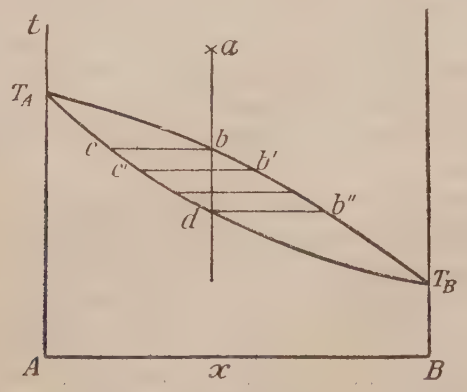

FIG. 3.

liquid; the lower is the solidus below which all is crystallised: between these lines is a space representing stages in which crystallisation is going on but still incomplete. Each point on the solidus has a corresponding point on the liquidus, which is found by drawing a horizontal line across the intervening space. A mixture of any composition, say *a* at *a*, is completely liquid. As the temperature falls it begins to crystallise at *b*. The crystals formed have the composition *c*. Further cooling results in the formation of crystals at *b'* the composition being *c'*. At *b''* all is crystallised, the last crystals being *d*. If resorption is completely accomplished the final crystals have the composition *a*, but they are usually more rich in albite: this will depend on the rate of cooling, the number and size of the crystals formed, and on a variety of other factors.

The theoretical investigations of Roozeboom and Gibbs have shown that five types of crystallisation of isomorphous substances may occur, in some of which the mutual solubility of the two components is unlimited, while in others it is limited so that only mixed crystals of certain types may occur. Several of these have been identified in rock-forming minerals, and others are suspected though not yet proved.

Ternary Magmas.—Magmas of three components (ternary) are much more complicated than binary magmas. To represent their behaviour a triangular diagram is necessary. Usually an equilateral triangle is employed, and the distance from any point to the three sides of the triangle is made to represent the three components of any mixture in their true proportions; the sum of these three perpendiculars is constant and equal to the height of the triangle; if lines be drawn through the point, parallel to the sides of the triangle, they will cut the sides at distances which will represent the relative proportions of the components. Any mixture of three components can be represented by one point in this triangle. To represent temperature another co-ordinate is required which is perpendicular to the plane of the triangular diagram: and a solid model must be made, resembling a triangular prism with flat base and an irregular surface representing the consolidation temperatures as the top of the prism. Each of the three vertical surfaces of the prism represents the behaviour of the mixture of two of the components.

To enable us to construct such a model a very large number of experiments must be made, first with binary mixtures and then with mixtures of the three substances. Their exact temperature of first crystallisation must be ascertained in each case, and also the nature of the mineral which crystallises. Simultaneous crystallisation of two minerals will follow, and the temperature at which the second mineral appears is to be determined. Three minerals will ultimately appear, and the last process will probably be the formation of a ternary eutectic at which the temperature remains steady till the liquid disappears and finally the completely solid mass cools down.

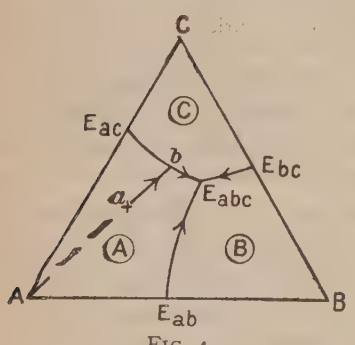

FIG. 4.

As a very simple case we may take the diagram in fig. 4. A, B and C represent the three pure substances. AB, BC and AC represent mixtures of two components. E_{ac}, E_{bc} and E_{ab} represent the three binary eutectic mixtures. The ternary eutectic is represented by E_{abc}, containing about equal quantities of C and B and a smaller amount of A. If *a* represent the composition of a certain liquid which is allowed to cool and crystallise, composition will change along the line A_{ab}. At a certain point the A component will crystallise out and the liquid will become poorer in A (richer in B and C), and the composition will change from *a* towards *b* (away from point A). After a time, the liquid becomes saturated for *b* which will start to crystallise, and now the liquid changes composition along the line *b* E_{abc} as the temperature continues to fall; finally C also begins to crystallise, and the ternary eutectic point is reached at which the three components crystallise simultaneously in definite proportions (represented by the position of E_{abc}) until it is completely solidified.

It is probable that nothing quite so simple as this occurs in ordinary rock-forming minerals, at least the silicates, but some metallic alloys show this type. In considering silicates the following matters must be kept in mind: (*a*) The liability to form compounds, which behave as new substances with their own fusion-points and eutectics. (*b*) The occurrence of isomorphous compounds is almost universal, and these form mixed crystals unstable in the changing magma, and liable to resorption (this may upset the formation of a ternary eutectic altogether). (*c*) Compounds may appear at an early stage which subsequently become unstable and are replaced by different minerals (incongruent). (*d*) Many silicates refuse to crystallise in ordinary crucible experiments (except in presence of solvents which do not appear in the final product).

We must also keep in mind that in the crystallisation of rocks certain conditions prevail which may modify the process to an unknown extent. Thus: (*a*) All magmas contain gases of various kinds which may have a very powerful influence in determining what minerals will form. (*b*) Intrusive magmas are under great pressure and the pressure diminishes as they rise to the surface; the pressure may act directly or by increasing the concentration of the gases dissolved in the magma. (*c*) Cooling in deep-seated magmas is extremely slow. This will tend to prevent supersaturation by undercooling and lessen the chance of the abnormality in the sequence of crystallisation which may appear in rapidly cooled melts. It will also favour the complete transformation of early unstable minerals into stable permanent forms. Many varieties of minerals have already been obtained experimentally which are not known to occur in rocks. They are stable only at high temperatures (and possibly under low pressures).

As an example of the effect of isomorphous minerals on the sequence of crystallisation we may take a mixture consisting of 50% diopside and 50% plagioclase (containing equal proportions of

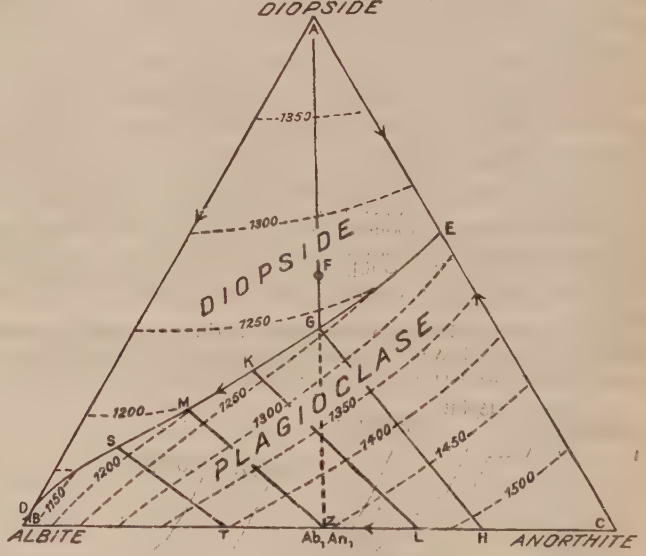

FIG. 5.

albite and anorthite). The composition diagram (fig. 5) is a triangle with each mineral at one of the corners, and the mixture is represented by a point (F). Crystallisation begins with a separation of diopside (supposed to be a simple mineral and not an isomorphous mixture, as it would usually be in rocks) at about 1275 degrees. At 1245° the excess of diopside (G) has separated out, and felspar begins to crystallise. It has about 75% anorthite (H). Thereafter diopside and felspar both crystallise, but as the temperature travels along the line EGD from G to K the composition of the felspar changes from H to Z (if we suppose that all the early felspar which is unduly rich in anorthite is stage by stage absorbed). The resulting rock has the mineral composition above stated; but if resorption of felspar is incomplete the last-formed felspar is richer in albite and has a composition T. The felspar crystals in that case are zonal with basic centres. If at any time crystallisation is suddenly brought to an end,

a glassy ground-mass will be formed, which is richer in soda and silica than the original magma and contains zoned felspar crystals. This is exceedingly like what takes place in many basaltic lavas. Again, if the original mixture had been richer in felspar, so that the composition point lay below the line DE, felspar would have crystallised out first. This seems to be in keeping with the structure of many dolerites, which contain felspar partly enclosed in augite crystals of later formation (ophitic structure), while others show that the augite appears in porphyritic crystals and began crystallising before felspar. Another interesting feature of this diagram is that there is no tertiary eutectic point, and the liquid residue continually changes in composition up to its final disappearance.

The phenomena of these component systems are extraordinarily varied. One of the best known is the system Al_2O_3–CaO–SiO_2 which has been very fully tested at the Geophysical Laboratory in Washington by Shepherd and Rankin. A copy of their diagram is given here (fig. 6). It is divided into fields, of which six are occupied by

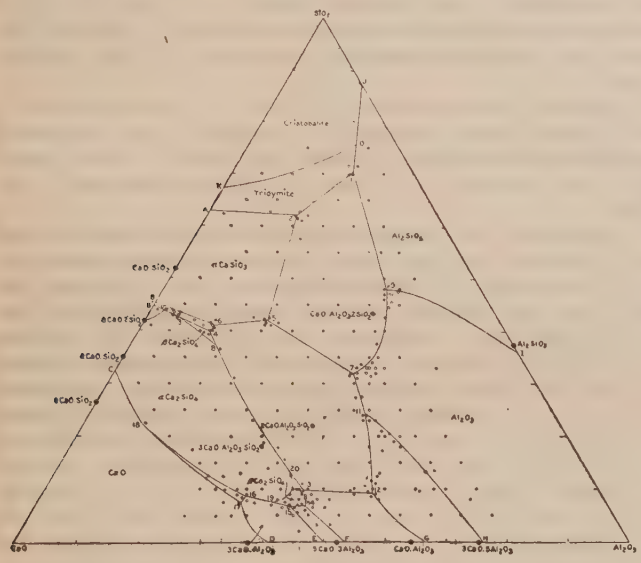

FIG. 6.

substances known to occur as minerals, cristobalite, tridymite, wollastonite, anorthite, sillimanite and corundum. In each of these fields the mineral named will crystallise if the temperature of the melt falls. The fields are separated by lines which show under what circumstances the two minerals whose fields adjoin will crystallise. Where three fields meet, the conditions exist at which three minerals will exist simultaneously (or, to express it otherwise, are in equilibrium with a liquid of the composition indicated). In no case do four fields meet in one point.

This system is also of much interest to technologists desiring to understand the chemistry of the manufacture of Portland cement. This is a mixture of lime, alumina and silica, with a fairly definite composition, and the compounds which form on fusing or sintering the mixture are indicated by the diagram. Similarly, the CaO corner of the figure shows what is the result of heating lime containing a little alumina and silica (impure limestone) to a very high temperature. Silica is also a refractory mineral and is used in silica-bricks and ganisters for lining furnaces. A little lime and alumina are mixed with it (either naturally or expressly to obtain certain results), and the behaviour of such mixtures is indicated by the appropriate corner of the ternary scheme. These investigations accordingly are of the greatest value in many industries such as pottery, steel-making, glass-melting, brick-making, cement manufacture, lime-burning and the quartz-glass industry. It should be noted that the compound Al_2SiO_5 which corresponds to the three common minerals of rocks, andalusite, sillimanite and kyanite should not be represented in this diagram. It has not yet been made in crucible melts. Another mineral, viz.: mullite, which has the composition $3Al_2O_3$, $2LiO_2$ is produced under these conditions.

Theory of Ternary Mixtures.—The theory of ternary mixtures has been very fully worked out mathematically by Willard Gibbs, Backhuis Roozeboom, Schreinemakers, Smits, Kuenen, Tammann and others, and may be said to be well understood in its main applications. Experimental investigation has also made great progress. It is a laborious matter, requiring great skill and very elaborate appliances. The diagram we have given showing the ternary system CaO, Al_2O_3, SiO_2, required over 7,000 experiments, in some of which the heating had to be continued for many hours and even for days; and the thermal results had usually to be checked by microscopic examination of the product. Other systems equally important have received very careful study. These are not so simple as the instance quoted, because mineral transformations, either during or after crystallisation of the melts, often give rise to many complications. Thus, for example, $CaSiO_3$ crystallises as pseudo-wollastonite at high temperatures, which may change to wollastonite at low temperatures. $MgSiO_3$ has four forms—kupferite, magnesia amphibole, enstatite and clinoenstatite. Where both these substances separate from the melt, none of the above-named minerals appears, but a diopside clinoenstatite solid solution or isomorphous mixture, which belongs to the common group of minerals known as the pyroxenes.

These facts are of the greatest interest to both mineralogists and petrologists. They have introduced many new minerals (artificial) to our knowledge, and taught us their relationships at atmospheric pressures in certain dry melts. They have also enabled us to understand many of the peculiarities of the minerals that occur in rocks, and the method of their origin.

As another instance we may quote the relations of forsterite (Mg_2SiO_4) and enstatite ($MgSiO_3$). Forsterite may crystallise from melts of suitable composition and after a time it may become unstable in the residual magma; then it is dissolved up or "corroded" and clinoenstatite replaces it. Again, if an enstatite ($MgSiO_3$) mixture be fused and allowed to cool, forsterite begins to separate out; it will tend to be reabsorbed and converted at a lower temperature to clinoenstatite, but if this be prevented the mixture solidifies as forsterite, clinoenstatite and quartz. To the petrologist this is of great interest, because forsterite is one of the constituents of olivine, a very common mineral of the basic igneous rocks. Now olivine generally occurs along with some member of the pyroxene group, and the olivine crystals show rounded outlines, which have been taken to indicate corrosion or resorption by the magma after crystallisation with concurrent formation of pyroxene. In some rocks there is clear evidence that olivine crystallised early and subsequently was entirely dissolved. In other rocks olivine is found enveloped in clusters of enstatite crystals which have evidently formed at its expense; and it is a very frequent characteristic of the olivines of gabbro and norite that they are surrounded by "reaction rims" or "corrosion borders" consisting of enstatite, tremolite and other magnesian silicates that have a higher percentage of silica than olivine itself. The meaning of these phenomena was fairly well apprehended by petrologists, and now their conclusions have been confirmed by experimental evidence. Another feature of some interest is that, in the ternary system under consideration, it has been shown that forsterite may crystallise early, then disappear by corrosion, and a second generation of forsterite may subsequently crystallise. Whether this is a common phenomenon is not yet known, and its exact relation to the frequent appearance of minerals in two generations in rocks remains to be demonstrated.

The number of ternary systems that have as yet been fully investigated is small, though the results are of the highest importance. Those which contain the alkalis potash and soda present certain special difficulties, such as the volatility of part of the mixtures and the difficulty of crystallising some of the minerals. Rapid progress is being made and it is unlikely that experimental difficulties will retard the advance of knowledge. A special case, of the greatest possible interest to the petrologist, arises where one or more of the components are volatile. Natural magmas are probably always richly charged with gases. The theory of such systems has been explored by Schreinemakers, Smits and others. Experiments with mixtures enclosed in steel bombs which can withstand great pressures at high temperatures have been very successful in certain cases, but as yet only the borders of this field have been explored. A good deal of work has been done on the dissociation pressure of sulphides of the metals, a subject of great importance as regards the paragenesis of natural sulphides and the conditions under which mineral veins have been formed. The effect of steam in the formation of silicates is under investigation and during the next few years will probably be the subject of much research.

Recent Developments.—The most recent developments of petrological investigation have followed certain well marked lines such as the behaviour of systems of more than three components, the effects of volatile ingredients at high pressures and temperatures, the theoretical basis of metamorphic processes and the genesis of mineral ore deposits (including the changes that effect secondary enrichment). Systems with many components can be handled only by means of mathematical developments. For example, a tetrahedron will represent a four-component system, but for higher orders of complexity special methods must be used which as yet have only received a preliminary discussion. The complicated series of solid solutions which many common minerals represent (such as tourmaline, mica, pyroxene) have been discussed on these lines, but only the simplest rocks are suitable for this method. Another line of advance has been the treatment of rocks as systems of three or four minerals, each having a complex composition, and with certain precautions this gives useful results.

Constantly increasing attention is being given to the effects of volatile constituents in determining the minerals which form in rocks and the transformations which take place during and after solidification. The solubility of water and other gases in silicate glasses at various temperatures has been determined, and it is shown that some of them may contain from 8% to 25% of water.

The calcite series has been very completely investigated as a mixture of CaO and CO_2, and its relations and properties are well known. Such series as copper and oxygen; silica, potash and water, and the

nature of the bond by which the water in zeolites is held to the other components have received very detailed investigation. The pneumatolytic or post-consolidation effects of vapours set free by crystallisation have attracted more and more attention, especially the formation of zeolites, albitisation, analcitisation, scapolitisation and the production of mica at the expense of original felspar.

In the study of metamorphism, new and fruitful advances have followed, especially the consideration of rocks as systems of mineral components in more or less complete equilibrium according to their composition and the conditions to which they are subjected. This was determined eventually by the phase rule, but the application is difficult, as rocks contain many components and no rock remains for an indefinite period in exactly the same conditions. An igneous rock, for example, has a gradually falling temperature, a metamorphic rock may suffer great changes in pressure or in temperature in the course of its history. Hence a simplified or modified phase rule must be devised for the case in hand. Still the broad fact remains that certain minerals may be expected to form in a rock of known composition according to the physical conditions to which it is exposed. The hydrous silicates of alumina, such as clay, are stable only at low temperatures; and are replaced by andalusite or sillimanite when the rocks are greatly heated, and generally by mica when there has been great pressure or movement. The recognition of distinct "facies" of rocks, each characterising special zones of pressure and temperature, has been carried to a great length by Swiss, Austrian and German petrologists, and is undoubtedly very helpful to the study of the science.

Along with this there has been an effort to classify mineral associations as groups of phases which may or may not occur together in stable equilibrium. For example, silica forms three minerals, each having more than one form (the commonest in rocks being quartz); alumina forms corundum; the combination of silica and alumina forms sillimanite, andalusite and kyanite (and also mullite). In a hypothetical rock consisting of silica and alumina, quartz and corundum should not occur together if the temperature has been raised above the point of combination. If we add magnesia to the two oxides mentioned above we get a further group of minerals such as enstatite, cordierite and spinel. Rules have been laid down which determine the associations of minerals which should occur together under various conditions in mixtures with the composition given above. In all this work the sciences of metallurgy, physical chemistry, and the crystallisation of saline solutions have exerted a very strong influence on petrological theory, and have stimulated research along new lines.

BIBLIOGRAPHY.—For the recent advances in physico-chemical and experimental petrology no English text-book is available. A. Harker's *Natural History of Igneous Rocks* (1909) gives a sketch of the subject from the standpoint of its time, but is now out of date. A more adequate work is H. E. Boeke's *Physikalische-Chemische Petrographie* (1915), which gives full references and is the best general account. J. H. L. Vogt's *Silikatschmelzlösungen* (1904) is interesting but very speculative. His *Sulphid Silikatschmelzlösungen* (1925), deals with some special aspects of the problem. The fundamental works on the theory of equilibrium are H. W. B. Roozeboom's *Heterogenen Gleichgewichte*, vol. 1 (1901), vol. 2 (1904) and its continuation (vol. 3) by F. A. H. Schreinemakers (1911). See A. Findlay, *The Phase Rule* (1923); G. Tammann, *Krystalliziren und Schmelzen* (1903). For English and American students the best authorities are the papers published by the workers of the Geophysical Institution in Washington. See also P. Niggli, *Lehrbuch der Mineralogie* (1920), *Die Leichtflüchtigen Bestandteile im Magma* (1920); R. A. Daly, *Igneous Rocks and their Origin* (1914); J. P. Iddings, *Igneous Rocks* (1913); A. D. Holmes, *Nomenclature of Petrology* (1920); J. Stark, "Petrographische Provinzen," *Fortschritte der Mineralogie* (1914); H. Rosenbusch, *Elemente der Gesteinslehre*, 4th ed. by Prof. Osann (1923); Jacques de Lapparent, *Leçons de Petrographie* (1923); F. Rinne, *Gesteinskunde*, 9th ed. (1923); A. Harker, *Petrology for Students*, 6th ed. (1923); H. Milner, *Sedimentary Petrography* (1922); a second edition of H. E. Boeke's *Physikalische-Chemische Petrographie* (ed. W. Eitel) has appeared (1923); O. H. Erdmannsdörffer, *Grundlagen der Petrographie* (1924); U. Grubenmann and P. Niggli, *Die Gesteinsmetamorphose*, 3rd ed., pt. 1 (1924); W. Eitel, *Physikalisch-Chemische Mineralogie und Petrologie* (1925); H. Rosenbusch and E. A. Wulfing, *Mikroskopische Physiographie*, 1st vol. of 5th ed., (1925). (J. S. F.)

PHARMACOLOGY (*see* 21.347c).—The rapid growth of the science of pharmacology has been one of the most striking features of the development of the science of medicine (*q.v.*) during the present century. A knowledge of the functions of the body in health and disease is obviously a necessary preliminary to the study of the changes produced by drugs upon these functions, and hence the development of pharmacology has been dependent upon the development of the sciences of physiology, pathology and bacteriology.

Organic Chemistry.—The only substances available for medical use a century ago were certain inorganic salts and crude vegetable extracts. The development of organic chemistry provided therapeutics with purified active principles of the crude vegetable extracts, and thus the use of crude preparations of unknown strength was replaced to a large extent by the use of chemical substances of known composition. Organic chemistry rendered a still more important service to pharmacology with the synthesis of organic compounds by which the number of substances available for use in therapeutics was increased indefinitely.

The anaesthetics, ether (1846) and chloroform (1847), were the first synthetic organic compounds to be used extensively in medicine. Twenty years later the first synthetic hypnotic, chloral hydrate, was introduced, and about 1885 the coal tar antipyretics, acetanilide and antipyrin, were discovered. Since then hundreds of new synthetic drugs have been discovered, and most of the important recent advances in pharmacology have been dependent upon the production of new synthetic drugs.

Salvarsan.—The discovery by Ehrlich in 1910 of salvarsan, a very potent remedy for syphilis, established a new method of research which has since yielded other results of great importance and promises to produce even greater successes in the future.

In his search for a substance which would kill the infectious organism of syphilis (*q.v.*), the *Treponema pallidum*, without injuring the patient, Ehrlich started with the knowledge that allied organisms, the trypanosomes, were killed by certain dyes and organic arsenic compounds. Not content with a random examination of the known compounds, he determined quantitatively which types of compounds were the most satisfactory for his purpose and then got new compounds prepared according to a definite plan. He made a systematic examination of a long series of organic arsenic compounds, determining in each case the minimal dose of the drug which would cure an animal infected with trypanosomes (minimal curative dose) and the maximal dose which the animal could tolerate (maximal tolerated dose). He termed the ratio:—

$$\frac{\text{(maximal tolerated dose)}}{\text{(minimal curative dose)}}$$

the therapeutic index, and sought for a drug with the highest possible therapeutic index. The compound salvarsan or arsenobenzole was the 606th arsenic preparation investigated, and in 1910 it was introduced as a remedy for syphilis. Two years later, Ehrlich introduced neosalvarsan or novarsenobenzole, which has to a large extent replaced salvarsan in the treatment of syphilis (*see* VENEREAL DISEASES). Ehrlich's brilliant success stimulated an intensive investigation of the action of organic metallic compounds upon diseases due to infections by animal parasites.

New Methods.—A number of important new methods of treatment have been discovered. Intramuscular injections of bismuth salts have been found to be of value in the treatment of cases of syphilis which are refractory to the organic arsenicals. Salts of antimony also have been found to have important new therapeutic actions. A century ago the production of subacute antimony poisoning by large doses of tartar emetic was a routine treatment for a very large number of diseases, but the revolt against the "heroic" methods of treatment of disease, in the middle of last century led to tartar emetic being almost abandoned as a therapeutic agent. The drug was discovered to possess the new and important therapeutic action of acting like arsenic as a specific disinfectant for animal parasites (*see* HOOKWORM). Intravenous injections of antimony salts have been found of great value in treating various diseases due to trypanosomal infection, and also have been found to cure the disease bilharziasis (*q.v.*).

Perhaps the most important internal disinfectant to be discovered is the compound "Bayer 205," a derivative of the dye trypan blue. This substance has a powerful action both in preventing and relieving the trypanosomal disease sleeping sickness (*q.v.*), the worst scourge of tropical Africa.

Sanocrysin.—The search for internal disinfectants with which to combat bacterial diseases has not achieved any very outstanding triumphs. Mollgaard has shown recently that an organic compound of gold, sodium aurithiosulphate, named "sanocrysin" can produce very remarkable curative effects, in a certain proportion of cases of tuberculosis (*q.v.*), but is equally capable of producing deleterious effects, and therefore great care is needed in its administration.

Antiseptics.—The special conditions of World War surgery made the discovery of powerful wound disinfectants an urgent problem, and a number of new disinfectant compounds of great activity were discovered, for example the dye "acriflavine," and the quinine derivatives "vuzin" and "optochin" (*see* ANTISEPTICS). Although the synthesis of the alkaloid quinine has not yet been effected, nevertheless its chemical structure is known, and it is possible to modify the structure of the alkaloid and thus produce new compounds. Vuzin and optochin are two quinine derivatives which differ from quinine in having a far more potent disinfectant action on bacteria. Another important new wound disinfectant is chloramine-T, an organic chlorine compound which acts by slowly liberating chlorine. The disinfection of the kidney and the bladder is another important problem in which advances recently have been made. A new organic compound termed hexyl resorcinol appears to be a more powerful urinary disinfectant than any previously known.

Use of Active Principles.—Most of the advances mentioned hitherto have depended upon the discovery of new synthetic organic compounds of greater potency than any known hitherto, but cures for other diseases have been discovered by substituting purified active principles for crude vegetable extracts.

Ipecacuanha has been known for more than a century to benefit amoebic dysentery, but the administration of the drug by mouth was limited by its action as an emetic. Sir Leonard Rogers showed in 1912 that subcutaneous injections of the alkaloid emetine, the chief active principle present in ipecacuanha, usually produced a rapid cure in cases of amoebic dysentery (*see* DYSENTERY).

Similarly, it has been known for many years that leprosy (*q.v.*) is often benefited by administration of Chaulmoogra oil, but it was found impossible to administer large doses of this oil by mouth on account of its irritant properties. Organic chemists isolated from Chaulmoogra oil certain complex fatty acids named hydnocarpic and chaulmoogric acids, which were believed to be the chief active principles present in the oil. Sir Leonard Rogers in India and Heiser in the Philippines introduced the method of injecting preparations of these purified fatty acids intravenously or intramuscularly and obtained remarkable curative effects even in the cases of leprosy of many years' duration (*see* LEPROSY). The most striking recent successes of pharmacology have been achieved in the cure of infectious diseases, because in most other serious diseases some vital organ has received irreparable damage, which drugs may alleviate but cannot cure.

Anaesthetics.—Important progress has, however, been made in the discovery of drugs needed to produce certain temporary alterations in the functions of the body. General anaesthetics are perhaps the most important group of drugs of this class. In 1924 and 1925 acetylene and ethylene were tried as substitutes for nitrous oxide, but at present it is doubtful whether the new gases will prove to have any marked superiority over nitrous oxide.

Many drugs produce some very useful action but have in addition some highly undesirable side action. Cocaine, for example, is an excellent local anaesthetic, with the grave disadvantage of sometimes producing dangerous effects on the brain. Of the large number of local anaesthetics, which have been synthesised in the hope of producing some complete substitute for cocaine, Novocaine is one of the best known and can replace cocaine completely for many but not for all purposes. Since 1910 a number of new compounds of great potency as local anaesthetics have been discovered, and probably it will soon be possible to avoid the use of cocaine almost completely.

Hypnotics.—Similarly, a host of new and very potent hypnotics have been synthesised in the hope of finding a reliable hypnotic which will not produce a habit, and is perfectly safe. Unfortunately, not much advance has been made in this field. In a few cases important new uses have been discovered for drugs which have been known for many years, such as the discovery in 1918 that quinidine, one of the alkaloids present in Cinchona bark or Jesuit's bark, can cure the important disorder of the heart known as auricular fibrillation.

Physiological Features.—The accurate analysis of the mode of action of drugs of well-established reputation has in certain cases greatly increased their value, making it possible to increase their dosage with safety and thus ensuring that sufficient of the drug is given to produce the physiological effect desired. The administration of digitalis in heart disease is a case where considerable improvements in technique of this character have been effected in recent years.

The study of the actions of extracts of the glands of internal secretion (*see* ENDOCRINOLOGY) is a field common to physiology and pharmacology. In 1886 it was shown that the two diseases myxoedema and cretinism, due to deficiency of the thyroid secretion, and previously considered completely incurable, could be cured by the simple remedy of administering dried thyroid gland by the mouth. In 1922 Banting obtained an extract from the pancreas, which he termed insulin (*q.v.*), and which he proved would relieve the disease of diabetes mellitus (*q.v.*).

Internal Secretions.—There are peculiar difficulties attending the study of the secretions of the endocrine glands. Active principles have been obtained from the parathyroid glands and the ovaries which also promise to be of value as agents for substitution therapy, where the normal secretions of these organs are deficient. Substances have been obtained from other endocrine organs which have no certain value as agents for substitution therapy but are drugs with powerful and interesting pharmacological actions. One such substance, adrenalin, was discovered in 1896, and has been found of great value in producing constriction of small arteries and thus acting as a haemostatic.

Extracts of the posterior lobe of the pituitary gland produce a rise of blood pressure and constriction of plain muscle and since 1916 this extract has been brought into therapeutic use, and is now very extensively used to cause contraction of the uterus, and thus to accelerate childbirth and to prevent the disastrous complication known as post-partum haemorrhage.

Vitamins.—The vitamins (*q.v.*) are biological products which have important pharmacological actions. They are unstable bodies of unknown chemical composition which are present in minute amounts in a large variety of fresh foods, but usually are absent in preserved foods. Several vitamins exist, and a regular supply of all of them is essential to normal development and health. Scurvy and rickets are two examples of diseases caused by vitamin lack. Lemon juice has been known for more than a century to be a specific cure for scurvy, and biochemists have now succeeded in concentrating the vitamins of lemon juice so that a child suffering from infantile scurvy can be given the vitamin equivalent of 20 lemons in a single day. Similarly, cod liver oil has long been recognised as a cure for rickets, and the vitamin of cod liver oil has also been prepared in concentrated form. The practical need for such preparation will, one hopes, be small in the future, for the knowledge gained regarding vitamins ought to result in the disappearance of these deficiency diseases. The most striking recent advances have been made along two lines, firstly in the synthesis of drugs which will kill parasites that produce disease, and secondly in the isolation of biological products with important pharmacological actions.

Parasitology.—The disease-producing parasites are of two classes, firstly the animal parasites such as the trypanosomes, and secondly the vegetable parasites, the bacteria. Very remarkable successes have attended the preparation of internal disinfectants for the animal parasites, and cures have been found for a number of the worst diseases that afflict mankind; in particular, cures have been discovered for a number of very serious tropical diseases (*q.v.*). Less striking success has attended

the endeavour to find disinfectants that will kill bacteria infecting the body, but a certain amount of progress has been made, and any advance in this field is of the greatest importance to the inhabitants of temperate climates, because most of the worst infectious diseases of the temperate zone are bacterial in origin.

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PHARMACY (*see* 21.355).—The International Congresses of Pharmacy, held at intervals from 1865 to 1913, brought the pharmacists of various countries together and afforded opportunity for the discussion of questions of international importance. A considerable amount of time and effort was expended in the endeavour to produce an international Pharmacopoeia and to ensure that all medicinal preparations should be the same, no matter in what country they were prescribed. The attempt failed, but it paved the way for the adoption of useful international regulations.

I. INTERNATIONAL PROGRESS

The congress held in Paris in 1900 recommended that a comparative table should be prepared showing the difference in the strength of medicaments bearing the same name in different pharmacopoeias; that the table should be distributed to medical and pharmaceutical authorities with the request that the possibility of unifying the strength should be considered; and that the Belgian Government be asked to convene a conference of accredited delegates from various nations with a view to arriving at a generally acceptable conclusion. This conference met in Sept. 1902 and issued a list of preparations upon which agreement as to strength had been reached. An international agreement embodying this list was signed in 1906 by the representatives of 18 nations and, substantially, all the decisions contained in it have been observed in the new issues of the pharmacopoeias of the signatory nations subsequent to that date.

A similar conference was held in Paris in 1925 to revise some of the decisions of the first conference and to take further steps towards the unification of the pharmacopoeial formulas for potent drugs and their preparations. Thus very important progress has been made towards international uniformity, at least in such drugs and preparations as most require it.

The 10th international congress held at Brussels in 1910 decided to establish a Fédération Internationale Pharmaceutique for the protection of pharmacy as a profession and as an applied science. The federation was established in 1912 at The Hague with Prof. Van Itallie and Dr. Hofman the first president and secretary respectively. Twenty-four national societies of pharmacy are now included in it, although Austria, Denmark, Germany, Hungary and Russia have retired since the World War. The last meeting of the international congress of pharmacy was held at The Hague in 1913. The Fédération Internationale Pharmaceutique has replaced it and has held meetings in 1922–3–4–5. Among the subjects discussed were pharmaceutical education, pharmaceutical nomenclature, pharmaceutical proprietary preparations, and the unification of the methods of assay.

Modern Pharmacy and Science.—The demands made upon the scientific knowledge and technical skill of the pharmacist have continually increased as shown by successive editions of the British, United States and other pharmacopoeias. The definition of the drugs has become more precise; tests of identity, limits of impurity, methods of assay have been introduced, and the use of the microscope required for the examination of many vegetable drugs. The introduction into medical practice of countless synthetic chemicals, of such organotherapeutical substances as the thyroid gland, pituitrin, etc., and of various vaccines and sera has imposed upon pharmacists the necessity of special study in order to understand them. The same may be said of the X-rays, and of the vitamins, the latter, in an impure form, being used in the form of compressed tablets or of capsules. Hypodermic injections are now commonly supplied sterilised and in ampoules, and the pharmacist must therefore be acquainted with the principles of sterilisation and with the action upon sensitive alkaloids of the heat used and the alkalinity of the glass of which the ampoules have been made.

The Qualifications of the Pharmacist.—In addition, therefore, to a knowledge of chemistry and botany as applied to pharmacy the pharmacist must be an expert microscopist. He must keep himself informed as to the new developments of therapeutics and must be competent to supply such medicines as the physician may prescribe. Disinfection and hygiene also come within his purview. To ensure his competency the Fédération Internationale Pharmaceutique agreed that the following subjects should find a place in the studies of the pharmaceutical student: chemistry (analytical, biological, physiological and pathological), pharmacy (chemical and galenical), pharmacognosy, micrography, toxicology, hygiene, legislation, pharmacology, botany, microbiology, mathematics, crystallography, disinfection, sterilisation and optics—a somewhat formidable list.

Modern Developments.—Developments in the treatment of diseases and in the nature and quality of the remedial agents required, which are the outcome of scientific research, have a direct bearing upon pharmacy. Barger, Dale, Carr, Stoll and others have shown that the important drug, ergot, contains two extremely powerful alkaloids, ergotoxine and ergotamine, upon which its activity chiefly depends, accompanied by various amines such as tyroamine and histamine, which possess a subsidiary efficacy. The two alkaloids are soluble in alcohol but insoluble in water and are easily converted into two inactive substances from which they can be regenerated. These discoveries opened the way to a rational galenical preparation of ergot which has proved very satisfactory.

For a long time the group of oxymethylanthraquinone drugs, which includes a number of purgative drugs such as rhubarb, cascara sagrada, etc., had baffled investigators as the crystalline oxymethylanthraquinones or their glucosides failed to explain, quantitatively at least, the action of the drugs. Maeder has isolated from elder buckthorn bark the glucoside glucorhamnin in which two sugar groups are present. The laxative action of glucofrangulin is such that the amount present in the drug corresponds to the activity of the latter. Probably similar glucosides will be found in other members of the group. Kiefer, working upon Cape aloes, showed that the resins previously considered inactive were, on the contrary, strongly purgative and isolated the substance to which the griping action was due and so made an important step towards a rational preparation of aloes. Bourquelot showed that many enzymes possess a synthetical as well as analytical action and prepared a number of synthetical glucosides and demonstrated the possibility of producing in the laboratory an entirely new class of compounds.

Stabilisation of Drugs.—Pharmacists have long desired to make from drugs galenical preparations which should contain the active constituents in the condition in which they exist in the plant. Goris and Arnould made an important step towards solving this problem by proving that the caffeine in fresh kola nuts exists in combination with kolatin, a combination which is broken up by an oxidase present in the fresh nuts. This oxidase can be rendered inactive by steam or alcohol vapour and the combination then remains unaltered when the nuts are dried and preparations made from them. Such treatment, or "stabilisation," of a drug will probably be extensively adopted. There is no doubt that, as in the case of kola nuts, the stablised drug will frequently possess a therapeutic action different from the drug that has not been stabilised, and investigations along this line are being attempted.

Medicinal Plants.—During the War large quantities of medicinal plants were collected in Great Britain, partly wild, partly cultivated. Attempts to place the cultivation upon a satisfactory footing failed, owing to the difficulty of obtaining assistance for the young industry. In France the Government afforded every aid, and under the direction of Perrot the industry is rapidly growing and much information is being collected as to the effects of soil, manures, etc., necessary to produce the best results. In the United States considerable attention has been devoted to selection experiments with drug plants, and marked progress has been made towards the production of the most suitable strains. The extremely high price of santonin led to a search for other sources of that important vermifuge. Greenish and Pearson showed that *Artemisia brevifolia*, which grows in abundance in Northwest India, contained sufficient santonin to make it a possible source of that substance. Van der Wielan

and Van Laren have cultivated in Holland a species of Artemisia which also contains santonin, so that cheaper supplies of the drug are only a question of time. Wallis and Mowat have studied the characters of the genus and thrown much light on the botanical source of the santonica of commerce. Wallis has also devised a satisfactory method for the quantitative determinations by means of the microscope, a problem to which much attention had been given.

II. CONDITIONS IN GREAT BRITAIN

The Poisons and Pharmacy Act of 1908 allowed a body corporate, and in Scotland a firm or partnership, to carry on the business of a pharmaceutical chemist or chemist and druggist provided that the business, so far as it related to the keeping, retailing and dispensing of poisons, was under the control of a registered pharmaceutical chemist or chemist and druggist. In the second place powers were given to the Pharmaceutical Society to divide the qualifying examination into two parts and to require candidates for the examination to produce satisfactory evidence that they had received a sufficient preliminary practical training in the subjects of the examination.

Before the necessary by-laws and regulations could be framed the society was involved in investigations and discussions preliminary to the National Insurance Acts of 1911 and 1913 by which the supply of drugs and medicines to insured persons was restricted to persons, firms and bodies corporate entitled to carry on the business of a chemist and druggist under the Pharmacy Acts of 1868 and 1908, thus admitting for the first time the important principle that the proper function of the physician is to diagnose and prescribe, and that of the pharmacist to supply the drugs and medicines so prescribed.

Educational System in Great Britain.—In 1920 the by-laws and regulations necessary for carrying the provisions of the Act of 1908 into effect were drawn up. They come into full force at dates varying from Feb. 1 1927 to Aug. 1 1929 and may be briefly summarised as follows:—

Before presenting himself for examination the candidate must have been registered as a student of the Pharmaceutical Society for which purpose he must have passed one of a number of entrance examinations ranging from the junior local examination of Cambridge or Oxford to the matriculation examination of the University of London. After registration he may proceed to the preliminary scientific examination, for which attendance at an approved systematic course of instruction of at least 440 hours in chemistry, botany and physics is necessary. Having passed this, or one of several alternative examinations, he will have to decide whether he will be content with passing the chemist and druggist qualifying examination or aim at the higher qualification by training for the pharmaceutical chemist qualifying examination. In the former case, when giving notice, he must produce a declaration that he has been trained under the direct supervision of a pharmacist in the dispensing and compounding of medicines for 4,000 hours spread over not less than two years in a pharmacy or in the dispensary of a hospital or similar institution approved by the council. He must also have attended an approved systematic course of at least 720 hours in pharmacy, pharmaceutical chemistry, pharmacognosy and forensic pharmacy.

If the candidate elects to proceed from the preliminary scientific examination to the pharmaceutical chemist qualifying examination, then he must be trained for at least 2,000 hours in a pharmacy or hospital and have attended an approved systematic course of at least 1,600 hours in botany, chemistry, pharmacognosy, pharmacy and forensic pharmacy. These statutory examinations are conducted by the Pharmaceutical Society.

The University of London has instituted the degree of bachelor of pharmacy in the faculty of medicine. To obtain this degree the candidate must have passed the matriculation examination of the university or an examination that would be accepted by the university in lieu of matriculation. At the intermediate examination in science, the subjects of botany, chemistry, physics and zoology or general biology are taken. For the final examination the course of study includes botany, chemistry, pharmacognosy and pharmacy and extends over two years. The candidate who has obtained the degree and wishes to practise pharmacy under the Pharmacy Acts must pass, in addition, an examination conducted by the Pharmaceutical Society in forensic pharmacy and must also have been trained for at least 2,000 hours in compounding medicines under a registered pharmacist in a pharmacy or in an approved hospital or similar institution. He will then be entitled to be placed upon the register of pharmaceutical chemists. He can also proceed to other university degrees. The universities of Manchester and Glasgow also confer the degree of B.Sc. with pharmacy as one of the subjects, but these degrees cannot at present be utilised for the purpose of registration.

Thus, whereas in 1920 there was no compulsory curriculum of any kind, the entrant into pharmacy will hereafter undergo what is practically a two years' approved systematic course of training for the lower qualification and a three years' for the higher; in addition, if he has matriculated, university degrees are open to him. This achievement places the pharmaceutical student in Great Britain on a level with those of most other countries. The Pharmaceutical Society has the power of according or withholding approval of the schools or institutions desirous of training candidates as well as of the courses given, and by this means exercises effective control over the education of the pharmacist.

Sale of Poisons.—Since the passing of the Poisons and Pharmacy Act in 1908 the number of substances brought within the range of Part I. of the schedule (those substances which may not be sold to any person unknown to the seller unless introduced by a person known to both parties and of which the sale must be duly registered) has been considerably increased. It now includes the following substances:—

Aconite, aconitine and their preparations; all poisonous alkaloids not specifically named, and their salts and all poisonous derivatives of alkaloids; arsenic and its preparations; atropine and its salts and their preparations; belladonna and all preparations or admixtures (except belladonna plasters) containing 0·1 % or more of belladonna alkaloids; cannabis (the dried flowering or fruiting tops of the pistillate plant of *Cannabis sativa*) and the resins prepared therefrom. Cantharides and its poisonous derivatives; coca, any preparation or admixture of, containing 0·1 % or more of coca alkaloids; corrosive sublimate; cyanide of potassium and all poisonous cyanides and their preparations; diamorphine (also known as heroin) and all preparations or admixtures containing 0·1 % of diamorphine; diethyl-barbituric acid and other alkyl, aryl or metallic derivatives of barbituric acid, whether described as veronal, proponal, medinal or by any other trade name, mark or designation; and all poisonous urethanes and ureides; digitalin and all other poisonous constituents of digitalis; ecgonine and all preparations or admixtures containing 0·1 % of ecgonine; emetic tartar and all preparations or admixtures containing 1 % or more of emetic tartar; ergot of rye and preparations of ergots; lead in combination with oleic acid or other higher fatty acids, whether sold as diachylon or any other designation (except machine-spread plasters); nux vomica and all preparations or admixtures containing 0·2 % or more of strychnine; opium and all preparations or admixtures containing 0·2 % or more of morphine; picrotoxin; prussic acid and all preparations or admixtures containing 0·1 % or more of prussic acid; savin and its oil and all preparations or admixtures containing savin or its oil; strophanthin and all other poisonous constituents of strophanthus; tobacco, any preparations or admixtures of (other than tobacco prepared for smoking and snuff), containing the poisonous alkaloids of tobacco.

The changes that have been made in Part II. of the poison schedule (those that must be labelled poison) are small; salts of barium (except barium sulphate) and zinc chloride and its liquid preparations, except those intended for industrial purposes, have been included and coca has been deleted.

By the Dangerous Drugs Act 1920–3 further restrictions have been placed upon the sale of morphine, cocaine, ecgonine, diamorphine, heroin and their respective salts and medicinal opium. Generally stated, these drugs may, with certain exceptions, be supplied only to physicians' prescriptions and a record must be kept of the quantities bought and sold.

Other Countries.—In the United States of America and in most other countries analogous regulations have been adopted for controlling the sale of poisonous drugs.

The Labelling of Poisons Order, which came into force on Jan. 1 1926 imposes further conditions upon the sale of poisons (whether contained in Part I. or Part II. of the schedule). This Order and the Act under which it is made require that, in general, every preparation containing as an ingredient any poison to which the Pharmacy Act 1868, as amended, applies shall bear on the label a statement of the proportion which such poison bears to the total ingredients of the preparation. By this means control is exercised over the sale of poisons forming constituents of proprietary or secret preparations. The Fédération Internationale Pharmaceutique is endeavouring to formulate a scheme for the uniform treatment of such preparations by all the States included in it.

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PHILADELPHIA (*see* 21.367), retaining its rank as third city of the United States, had in 1920 a population of 1,823,779, an increase of 274,771 over 1910; and in 1925 (U.S. census estimate) 1,979,364. The population of 1920 comprised whites 1,688,180; coloured 135,599. The increase in the white population since 1910 was 224,809, or 15·4%; while the corresponding increase in the coloured population was 49,962, or 58·3%.

Government and Finance.—The Bullitt Act, under which the city government had functioned since 1887, gave way in 1920 to the Woodward Act, which became effective with the beginning of the term of Mayor J. Hampton Moore in Jan. 1920. The new charter differs greatly from its predecessor. Under it a dual council is succeeded by a single body composed of one member for each 20,000 assessed voters in each state senatorial district, the membership in 1920 being 21. The councilmen serve for four years. The small council has shown its superiority over the earlier system in many ways; its great weakness is the lack of a system of minority representation. In the executive department, the department of supplies is superseded by a purchasing agent; and the department of health and public charities is separated into two departments with a director for each. Further provisions require a municipal budget system, enable the city to do its own street cleaning and garbage and ash removal and place the great majority of city employees under civil service rules.

The cost of city operations has grown steadily since 1911, when, under provisions of the state school code of May 18 1911, the Board of Education was separated from the city government. The combined cost in 1911 was $33,846,875. With the school expenses eliminated, the cost in 1912 of city government was $30,213,067; and, barring a slight decrease in 1913, it has grown steadily until it reached $70,531,801 in 1925. The tax rate, excluding school tax, was $1 in 1912, and $1.75 in 1922–6. This rate applied to real estate valued in 1926 at $2,940 million. On Jan. 1 1925, the gross funded outstanding debt of the city was $225,967,200, of which the commissioners of the sinking fund held $58,117,900. The interest and sinking fund amounted in 1925 to three-eighths of the tax levy.

Commerce and Industry.—As a manufacturing centre Philadelphia shared the general depression of 1914, but advanced rapidly with the European demand after the outbreak of the World War, dropping again after the War. Exports and imports of the Philadelphia customs district for recent years are shown (in thousands of dollars) in the following table:—

	Exports	Imports
1910	73,266	88,403
1915	90,666	72,948
1920	442,250	282,163
1921	130,672	122,302
1922	126,477	154,332
1923	106,508	219,710
1924	106,444	202,597
1925	119,064	215,343

The net tonnage of vessels entered at and cleared from Philadelphia customs district from and for foreign countries in recent years was as follows:—

	Entered	Cleared
1910 (June 30)	2,606,097	2,250,489
1915 (June 30)	1,938,510	1,786,441
1920 (Dec. 21)	3,518,865	3,806,981
1921 (Dec. 21)	2,866,630	2,530,244
1922 (Dec. 21)	3,126,399	2,601,711
1923 (Dec. 21)	2,930,003	2,204,710
1924 (Dec. 21)	2,363,623	2,097,822

A remarkable increase in the activities of the port was made possible by the completion of large parts of the 35-ft. channel from Allegheny ave., Philadelphia, to the sea. The channel, about 800 ft. wide throughout, was 80% completed on Dec. 1 1925, the remaining sections having a depth of 30 feet. The completion of the deeper channel opened the port to shipping of a heavier tonnage, and the result was manifest in the increased number of lines plying from Philadelphia. In 1914 there were 27 transatlantic and 5 coastal lines; in April 1921, 49 transatlantic and 10 coastal lines. Philadelphia in 1919 had 9,064 manufacturing establishments, with 281,105 employees, and products of $1,996 million. Metals and metal products were first, and textile production next, followed by food products, chemicals, clothing, paper and printing, leather and rubber products.

History.—Municipal history during the period 1910–8 was marked with few items of interest outside the political aspect and the natural effect of American participation in the World War. Between 1919 and 1925 many much-needed and long-discussed public works were undertaken; and among those already finished are the Parkway from City Hall to Fairmount Park, the Roosevelt Boulevard in the northeastern part of the city, the Cobb's Creek Parkway on the western boundary, and the Frankford elevated railroad. In 1926 a suspension bridge across the Delaware river, with a span of 1,750 ft., connecting with the city of Camden, N. J., was completed, as were also a beautiful free library building and the exterior of the municipal art gallery. This building stands on an Acropolis-like hill at the end of the Parkway and furnishes an imposing view from that avenue. A four-track subway, six and a half miles in length, is under construction on North Broad street; contracts for $61,000,000 had been let in 1925 and it was expected to be completed in 1927. The improvement of the harbour has been pressed forward, the latest (the 12th) modern municipal pier being completed in 1925 at a cost of $3,662,000. A plan, jointly financed by the railway and the city, has been adopted for the relocation of the elaborate system of terminals and trackage of the Pennsylvania railroad.

Preparatory to the celebration of the 150th anniversary of American independence in 1926, a municipal stadium, a convention hall, exhibition buildings, aviation fields and other accessories were in 1925 being constructed in south Philadelphia. The late John G. Johnson, who died April 14 1917, gave the city his collection of 1,300 pictures, appraised at $4,445,802. In May 1919, the art collection of Mrs. Emily L. Harrison was left to the Pennsylvania Museum and School of Industrial Art for permanent exhibition in Memorial Hall. In Oct. 1919, the George W. Elkins collection of paintings, containing 110 masterpieces of the Dutch, Flemish and 18th-century portrait schools,

was left to the city for display in the new art museum. In 1921 the late John Howard McFadden, a cotton broker, left to the municipality his collection of about 50 18th-century English paintings. The collection included the Gainsborough "Lady Rodney" and portraits by Romney and Raeburn. (A.E.McK.)

PHILATELY: *see* STAMP COLLECTING.

PHILIPPINE ISLANDS (*see* 21.392).—A group of 7,083 islands of the Malay archipelago, with an area of approximately 115,026 sq. miles. About 64,000 sq. m. of the area represent commercial forests; the area of the cultivated lands is about 14,000 sq. miles. The total population in 1922 was 10,906,482, the majority of whom were Christians, the remainder of the population consisting of Mahommedans, Buddhists and pagans. The population of Manila, the largest city, was 285,306 in 1918; that of Cebu was 65,502 in the same year; Albay, 52,756; Iloilo, 49,114; Lepa, 46,557. Some 87 languages and dialects are spoken throughout the islands, the most important being Tagalog, Bisaya (several dialects), Bicol, Pampanga, Pangasinan, Iloco, Zambal and Ibanag. English is spoken by about 30% of the population and Spanish is spoken by 20 per cent.

I. GENERAL

Government.—The Philippines are represented in the United States by two resident commissioners who have seats in the House of Representatives, with power of debate but no vote. The archipelago has a high measure of self-government. With the exception of the governor-general, vice-governor, auditor, deputy auditor and a majority of the members of the Supreme Court (but not the Chief Justice, who has always been a Filipino), all the higher officials, whether executive, legislative or judicial, are Filipinos. The islands are governed under the terms of the enabling or organic Act of Aug. 29 1916, commonly known as the Jones Act. The legislature consists of a Senate of 24 members and a House of Representatives of 91 members. All the legislators are elected by popular vote except two senators and nine representatives, who are appointed by the governor-general to represent the non-Christian provinces of Sulu and Zamboanga, Nueva Vizcaya, Mountain Province, Agusan, Bukidnon, Cotabato, Davao and Lanao.

Thus far, although there are two political parties in the field, the Philippines have not enjoyed a healthy party life; but there are signs that this condition will change as more and more of the young men who have been trained wholly under the American régime take their place among the voters. The two parties are the Consolidated Nationalist party (*Partido Nacionalista Consolidado*) and the Democrats (*Partido Demócrata*). The first is the more radical of the two, and has made an issue of the demand for immediate and absolute independence. The *Partido Demócrata*, while expressing itself in favour of independence, appears to be in favour of allowing political events to shape themselves more slowly. The number of qualified electors is in excess of 1,000,000; and in the general election of 1922 it was reported that 812,000 had actually voted. Gov.-Gen. Wood has recommended that the suffrage be extended to women.

The judiciary consists of a Supreme Court composed of one Chief Justice and eight associate justices, modelled largely after the Supreme Court of the United States; a court of first instance for each judicial district, except the district of the city of Manila, which has four judges; the municipal courts of Manila and Baguio; and a justice of the peace court for each of the 555 municipalities.

Defence.—Maintenance of public order in the Philippines devolves upon the municipal police and the Philippine constabulary. In 1914 the strength of the constabulary was 396 officers and 6,325 enlisted men of all ranks. The force was distributed throughout the islands amongst 149 stations. A force consisting in 1924 of about 12,000 troops of the U.S. Army, including five Filipino regiments, was maintained in the Philippines by the United States.

Education.—Education is free in all the public schools of the Philippines. The vice-governor is secretary of public instruction. In 1918 it was estimated that 24·46% of the school population were enrolled in the public schools. By 1923 the percentage had risen to 36·69%. The elementary teaching force in 1923 numbered 24,190; secondary teachers, 933; and supervisors, 657; while in 1918 there were only 14,523 teachers of all grades. Of the 1,087,732 elementary pupils in 1923, 634,350 were boys and 453,382 were girls. Of the secondary school pupils, 27,972 were boys and 13,293 girls. Of the teachers, in Dec. 1923, 15,327 were men and 10,453 women. Among them were only 368 Americans, of whom 177 were men and 191 women. Efforts were being made to increase the number of American teachers. Greater attention is given to health and sanitation in the public schools, and athletics are a recognised part of the curriculum.

The university of the Philippines is an insular government institution that was created since American occupation. It has schools of agriculture, education, engineering, liberal arts, law, medicine and surgery, veterinary science, dentistry, pharmacy, music, nursing, fine arts and forestry, a junior college of liberal arts and a university high school. Enrolment in all units for the academic year 1918–9 was 3,312; for the year 1923–4, 5,994. The university has had two American and two Filipino presidents, the incumbent in 1926 being a Filipino, Rafael Palma, who had formerly been a member of the Philippine commission, and had acceptably held other offices of trust under the Government. Expenditures for the university amounted to approximately 1,197,000 pesos for the year 1919 and to 1,717,000 pesos for 1923. There are many private schools, partly religious and partly secular, and many new parochial schools have been established. Among private institutions, the Silliman Institute and the Ateneo of Manila occupy high places, and the University of Santo Tomàs, the oldest university under the American flag, has played an important part in the history of the islands.

Finance.—The peso, practically stabilised at 50 cents United States gold currency by the operations of a gold standard and reserve fund, is the standard of value. It fluctuated considerably after 1916, reaching a discount of 15% in 1919 and over 12% in 1921, but is once more approximately at par. The estimated wealth of the Philippines in 1918 was 4,252,789,000 pesos, and in 1923, 5,495,482,000 pesos. The total wealth is capable of very great expansion as the potential resources are developed. The receipts of the Insular Government for the years 1918, 1920, 1921 and 1923 were 68,690,105 pesos, 99,404,913 pesos, 130,199,714 pesos and 71,108,722 pesos respectively; and ordinary expenditures for the same years were 57,496,044 pesos, 84,010,279 pesos, 118,194,211 pesos and 95,589,800 pesos, respectively. The total insular bonded indebtedness on Dec. 31 1923 amounted to 134,500,000 pesos; city of Manila collateral bonds, 5,500,000 pesos; provincial and municipal bonds, 13,920,000 pesos; making a total bonded debt on Dec. 31 1923 of 153,920,000 pesos. The total *per capita* debt rose from 2·81 pesos in 1919 to 12·26 pesos in 1923.

Production and Industry.—In the production of coconuts the Philippines rank amongst the foremost countries of the world, and this product has contributed largely to the economic progress of the islands. The nut furnishes copra, copra meal, coconut oil and butter, vinegar, desiccated coconut; and from the fibre of the outer husk coir mats and other articles are made. Rice production always falls short of consumption because farmers consider other crops more advantageous, and imports (mainly from French Cochin China) are necessary. Next to rice, maize is the most universal grain food, maintaining about 24% of the population. The sugar crop is steadily increasing in importance, especially since the installation of sugar centrals, where centrifugal sugar is made. Abacá, or manila hemp, the strongest commercial fibre known, has always been one of the principal crops, and upon it prosperity largely depends. As it can be grown successfully in no other region, the Philippines have a natural monopoly. It is extensively used in the manufacture of hats and textiles. Maguey, much inferior to abacá, is grown especially for the manufacture of binder twine. The Philippines are one of the chief tobacco-raising countries in the world. Exports of tobacco leaf and manufactures of tobacco were valued at 21,034,893 pesos in 1923 and 19,725,718 in 1924.

Livestock.—Carabao, the main dependence of the peasants, numbered 1,541,000 in 1922; cattle, 815,000; horses, 294,200; hogs, 5,241,200; goats, 1,012,600; and sheep, 257,700. Anthrax and rinderpest are among the most serious problems of the Philippines.

Forest and Forest Products.—The commercial forests are estimated to contain 200,000,000 board ft. of lumber, comprising both hard and soft woods. The Government owns about 99% of all standing timber. Public forests are not sold, but the exploitation of timber lands is granted by licence or concession. Among the most valuable of the forest products are rubber, bamboo, rattans, gutta-percha, gum copal, various resins, dyestuffs, tanbark and beeswax.

Minerals.—The output of gold increased from 141,209 fine grammes in 1907 to 2,537,162 grammes in 1923. Silver is found with the gold minerals, but native silver occurs in small quantities in Benguet and Mindanao. Iron deposits occur in Surigao (estimated at 500,000 metric tons), Bulacan (1,200,000 tons), and Camarines Norte. Although coal was discovered as early as 1827, workings have been so far slight and unsatisfactory in their output.

Manufacturing and Other Industries.—Agriculture is the most important basis of what manufacturing is carried on. Besides the manufacture of sugar and tobacco, abacá is made into cordage and textiles; various products into perfumes; fibrous substances into the famous Philippine hats; rattans and woods into furniture and other articles; vegetable compounds into soap; barks of the mangrove and camanchell tree into tanning materials; and various plants into dyes. Embroideries exports rose from a mere beginning in 1915 to about 12,000,000 pesos in 1923. Fishing ranks second to agriculture in the value of the product and the number of persons employed in it.

The following table shows the area under cultivation, the production and the value of the 10 principal crops for the years 1918 and 1923:—

Commodities	Area, hectares[1]		Production, metric tons[2]		Value, pesos[3]	
	1923	1918	1923	1918	1923	1918
Rice	1,675,870	1,368,140	1,882,992	1,539,187	149,475,950	135,163,375
Abacá (Manila hemp)	513,420	512,208	188,889	166,864	39,317,490	92,493,224
Sugar-cane	227,290	205,511	431,212	430,686	87,831,550	41,158,779
Coconuts	456,440	335,602	1,515,253,000 (number)	1,506,796,000 (number)	64,366,220	56,533,793
Tobacco	64,730	78,443	32,806	61,555	6,814,800	15,219,155
Maize	557,690	418,386	457,992	309,799	32,388,700	21,018,648
Maguey	28,575	32,601	27,033	15,665	3,018,770	3,707,213
Cacao	1,320	1,142	1,030	566	1,145,500	504,670
Coffee	1,156	768	1,328	722	787,300	445,983[f]
Sweet potatoes	80,350	47,594	188,483	313,068	3,751,100	(not available)

[1] The hectare is equivalent to 2·47 acres.
[2] The metric ton is equivalent to 2,204·6 lb. avoirdupois.
[3] The peso is nominally equivalent to 50 cents in U.S. currency.

Foreign Trade.—The peak was reached in 1920, when the value of exports reached 302,248,712 pesos and of imports 299,676,566 pesos. This was due to war conditions and the feverish demand of the early reconstruction period, when high prices ruled. In 1921, the total value of the foreign trade fell below that of 1920 by almost 200,000,000 pesos. In 1923, with increased demand and better purchasing power, exports rose to 241,506,980 pesos and imports to 175,599,494 pesos. In 1924 the increase in both exports and imports persisted, the former being valued at 270,689,325 pesos and the latter at 216,021,790 pesos. In 1923, about 86% of the export trade consisted of coconut products, cane sugar, abacá and tobacco products, and for many years the proportion represented by these products had been something over 80%.

The principal countries of export are the United States, Japan and Great Britain. Exports to the United States rose from less than 16,000,000 pesos in 1900 to 194,500,000 pesos in 1924; to Japan, from 1,500,000 pesos in 1900 to 12,500,000 pesos in 1924; to Great Britain, from over 16,000,000 pesos in 1900 to about 18,800,000 pesos in 1924. Imports from the United States were valued at 4,300,000 pesos in 1900 and at 120,700,000 pesos in 1924; from Japan, at approximately 800,000 pesos in 1900 and at 17,000,000 pesos in 1924; from Great Britain, at approximately 11,100,000 pesos in 1900 and at over 9,500,000 pesos in 1924. Other exports (in the order of their importance in 1924) were to Spain, China, Germany, France, Hongkong, the Netherlands, Italy, Belgium, British East Indies and Australia. Other principal sources of imports were French East Indies (almost wholly rice), China, Dutch East Indies, Australia, Germany, Switzerland, British East Indies, France, Spain and Japanese China. Trade with the United States was given a great impetus by the Underwood Tariff Act of 1913, which abolished all duties between the two countries. The principal imports from the United States were machinery, construction materials, motor-cars and accessories and cotton goods. Imports of agricultural machinery were especially important. The United States furnishes almost all the automobiles and trucks used in the islands. Cotton and manufactures thereof meet heavy competition from Great Britain. From China come many foodstuffs, and from Australia much of the wheat consumed and a good proportion of the meat. Trade with Japan has increased rapidly, while Great Britain has difficulty in maintaining its trade.

Communications and Transportation.—The good roads campaign, instituted almost at the beginning of the American occupation, has been one of the most important economic movements in the archipelago. The results are apparent in the better marketing methods made possible. There are two railway lines, one in the island of Luzon and the other in the islands of Panay and Cebú. The Luzon system, known as the Manila Railroad, is owned and controlled by the Government, but Gov.-Gen. Wood has recommended that it be sold or leased to a private company. The Manila Electric Co. (operated on a 50-year franchise and under the control of the J. G. White Management Corporation) has an extent of about 90 km. in Manila and the province of Rizal. It operates about 160 cars and carries about 33,500,000 passengers annually. The use of trucks and automobiles is increasing rapidly in all parts of the islands. In 1924 there were 914 post offices and over 500 municipalities with free delivery mail service. Mails are received three times weekly from China, twice weekly from Japan, once weekly from the United States, India, Java and the Straits Settlements and about fortnightly from Australia.

European mail is received and sent by way of the Suez Canal. It usually goes either way on an average of once weekly. In 1923 there were 397 telegraph stations (of which 24 were wireless stations) with 7,450 km. of line. The U.S. Army and Navy also had in operation seven wireless stations, one of which was open for commercial messages. Two cable lines ensure outside communication. In 1923 there were 14,122 telephones with 27,000 km. of wire. In 1899, 277 foreign vessels with a net tonnage of 322,130 entered harbour, and 273 ships with a net tonnage of 336,550 cleared for foreign ports. In 1923, 979 ships entered and 948 cleared, with net tonnage of 3,351,022 and 3,242,753 respectively. Manila is the chief port, but considerable shipping enters and clears through the minor ports of Cebu, Iloilo and Zamboanga, and smaller amounts through Jolo and Davao. In 1923, 230 steam and 730 sailing vessels were engaged in the inter-island trade. In all there are about 200 ports of call in the islands.

Banking.—By a charter granted on May 2 1916 by the Philippine legislature the Philippine National Bank was inaugurated, with an authorised capital of $10,000,000, the Government subscription being $5,050,000. The bank was made by law the depository of all Government funds by an Act of July 1 1916. A further legislative Act authorised the increase of capital to $25,000,000, of which the Government subscription was $12,700,000. The mint of the Philippine Islands has been established at Manila for the minting of Philippine coinage.

II. HISTORY

The Harrison Administration.—W. Cameron Forbes, who was appointed governor-general on Nov. 11 1909, was replaced on Oct. 6 1913 by Francis Burton Harrison, as a consequence of the victory of the Democratic party in the United States with the election of Woodrow Wilson as President. Harrison held office for seven years, resigning after the election of President Harding. In his place, Gen. Leonard Wood was appointed governor-general in Oct. 1921, and was still in office in 1926. When Harrison took office, the Filipinos were given a majority on the Philippine Commission, the Upper House of the Legislature as then constituted, thus assuring Filipino control of both Houses. Interpreting most broadly his instructions, Harrison accelerated the Filipinisation of the civil service. The result was that, while undoubtedly the elimination of American employees was, in some few cases, justifiable because of lack of efficiency or because of incompatibility, the service of many Americans who had laboured enthusiastically and unselfishly was lost to the Philippines. An added incentive to Americans to leave government service, intended expressly for that purpose, was provided by the enactment in 1916 of a temporary pension Act applicable to employees who had been in the Philippine service for six or 10 years or longer. Petition for retirement under this Act had to be made by a specific date. The 2,623 Americans in the civil service in 1913 had shrunk to 760 in 1920, while Filipino employees during the same period had risen from 6,363 to 12,947. By the end of Dec. 1923 the numbers were 562 and 14,167 respectively; and of the Americans 329 were school teachers, while the remainder were mainly engineers in the bureau of public works and constabulary officers.

Independence Movement.—During the seven years of the Harrison administration, when Filipino autonomy was exercised to a greater degree than at any other period, various events and movements led critics to take a discouraging view of Filipino efficiency in, and capacity for, self-government. These critics pointed to the troubles of the bureau of lands, the inefficient reorganisation of the bureau of science, the breakdown in the health service, with disastrous outbreaks of smallpox and cholera and the increase in tuberculosis, the backward steps taken in the rinderpest campaign, the results of the government's entry into business, and the harmful political background and activities, as abundant proof of the necessity of continued guidance by the United States. Other Americans considered that the Filipinos had progressed far enough on the road toward self-government to manage their own affairs, and desired that the United States withdraw its sovereignty at once or as soon as possible.

The most important political movement since 1907—the year when the first Philippine Assembly (the Lower House) was convened—was the campaign for independence. This overshadowed all else, and the question was cleverly kept to the fore by the Filipino political leaders. Undoubtedly a majority of the people desired independence, some immediately, others eventually; some absolute, others conditional. Those not desiring independence, or who thought that it should come only after a long period, hesitated to make their views public. Perhaps the most general sentiment in the United States was for withdrawal at some future date unless the Filipinos themselves asked that American control persist.

One of the earliest acts of President Harding was the dispatch of the Wood-Forbes mission to the Philippines to make a thorough investigation and report of conditions. After an exhaustive investigation, which took them into nearly every part of the archipelago, the heads of the mission submitted a comprehensive report advising that the time had not yet come to withdraw the sovereignty of the United States, and that the United States should not be left in a condition of responsibility without authority. It was in line with the findings of the report that the President appointed Gen. Leonard Wood governor-general to replace Francis Burton Harrison. Gen. Wood accepted the appointment, and immediately entered upon the thankless task of rebuilding American authority and prestige, which had been weakened by the preceding administration. In this, as might be expected, he met with the hostility of the political leaders, especially those of the *Nacionalista* party.

Governorship of Gen. Wood.—This hostility was apparent in various ways, and little effort was made to conceal it. General Wood's recommendations were shelved whenever possible; and complaints were made that he had surrounded himself with a "kitchen cabinet" and that he sought to govern by military methods. More serious opposition arose, however, in two cases. The first was Wood's reinstatement to office of an American detective, named Conley, who had long been connected with the police department in Manila; and the second was the veto of a bill enacted by the Philippine legislature remitting the penalty for the non-payment of the land tax. The Conley case was designated by the Filipino political leaders as an inroad by the governor-general on the prerogatives of the executive departments; and the veto as an unwarrantable meddling with purely domestic concerns over which the Jones Act gave the governor-general no power to veto.

With regard to Conley, the facts seem to be that because of his activities he had gained the ill-will of the gambling and criminal class, some of whom were able to exert considerable influence in certain quarters. Accusations of having accepted a bribe were brought against him, but several investigations made by the prosecuting attorney of Manila and the courts failed to disclose any official wrongdoing. The Secretary of the Interior demanded that a departmental investigation be made, but the governor-general refused and the investigation was carried on through the courts. Reinstatement being ordered, the secretary and then the mayor of Manila resigned. Accordingly, Wood reinstated Conley himself, and then accepted his resignation because it was found that he was guilty of an irregularity contrary to the rules of the civil service. With respect to the veto, the governor-general based his action on section 19 of the Jones Act, which outlines the procedure to be followed in all legislation enacted by the Philippine legislature.

The Filipino rejoinder to the reinstatement of Conley was the resignation on July 17 1923 of the President of the Philippine Senate and the Speaker of the House of Representatives as members of the Council of State, and of the departmental secretaries, with the exception of the Secretary of Public Instruction (who is also vice-governor, and, by law, an American), both as secretaries and as members of the Council of State. Wood, although surprised at the action, and regarding it as a challenge and a threat, accepted the resignations. On July 23 1923 the legislature, sitting as the commission of independence, ratified the action of the Filipino officials, and declared that it would defend the constitutional liberties of the Filipinos against the encroachments of the governor-general and keep inviolate the domestic autonomy already granted to the Filipinos, and upheld by the organic Act and the other laws in force in the country. The next day the same body declared that Wood should be recalled in the mutual interest of the Philippines and the United States. On Jan. 8, in a memorial to the Congress of the United States, presented by Manuel Roxas, Speaker of the House of Representatives, acting with the two resident commissioners, Isauro Gabaldon and Pedro Guevara, Wood was again charged with autocratic tendencies and with overriding Filipino rights. He was upheld by the Secretary of War and by President Coolidge, both in regard to his action in the Conley case and in the veto.

Autonomy Missions to U.S.—One of the features of the campaign for independence had been the sending of independence missions to the United States. Five of these missions had been

sent, namely in the years 1919, 1922, 1923, 1924 and 1925. The 1919 mission arrived while President Wilson was attending the peace negotiations in Paris. He sent a cordial message regretting his inability to receive the mission, with an assurance that the time seemed near for the realisation of Filipino hopes. The mission of 1922 was received by President Harding, who, while stating that he was not yet prepared to recommend the granting of independence, assured the mission that no backward step in the relations of Americans and Filipinos would be taken during his administration. The mission arriving in 1923 presented its memorial early in January. On Feb. 21, President Coolidge rather vigorously answered the mission, stating that inability to co-operate with Gov.-Gen. Wood, in view of the excellent administration he was giving, might be proof that Filipinos were unprepared for independent citizenship and that the time had not yet come for independence. The several missions, together with the independence propaganda and the influence of some Americans, both officials and private persons, were factors in the bills for greater autonomy or for the withdrawal of American sovereignty that were introduced into the first session of the 68th Congress. On these bills two extended hearings were held in the first half of 1924. None of the bills had become law by 1925; but they show the latest trend of legislation in the United States for the Philippines and point perhaps to even greater autonomy than is now enjoyed.

In May 1925 the Philippine Islands were received into the Interparliamentary Union, and the Filipino delegate to that union, Senator Osmeña, attended the 23rd convention of that body in Washington.

In the early part of 1926 news was received of the departure of an economic mission despatched to the Philippines by President Coolidge.

Because of the claim of the Netherlands Govt. to the island of Palmas, or Miangas, lying southeast of Mindanao, which has generally been regarded as part of the Philippine archipelago, the Netherlands and the United States agreed, on Jan. 23 1925, to settle the matter by arbitration. The case has been referred to the Permanent Court of Arbitration at The Hague, and the arbitral tribunal is to consist of a single arbiter. The United States has presented its first arguments which have been answered by the Netherlands government.

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(J. A. Ro.)

PHILLIMORE, WALTER GEORGE FRANK PHILLIMORE, 1ST BARON (1845–), British judge, was born in London Nov. 21 1845, the eldest son of Sir Robert Joseph Phillimore, Bart. (*see* 21.405). Educated at Westminster School and Christ Church, Oxford, he won the Vinerian scholarship and was elected to an All Souls fellowship. He was called to the Bar in 1868. In 1885 he succeeded his father as second baronet, and in 1897 was made a judge of the Queen's Bench division, being in 1913 appointed a lord justice of appeal and sworn of the privy council. He retired from the bench in 1916, and in 1918 was raised to the peerage. He was from 1905 to 1908 president of the International Law Association. In 1918 he became chairman of the naval prize tribunal. Lord Phillimore was English representative on the commission which sat at the Hague in 1920 to prepare the scheme of a permanent Court of International Justice.

Lord Phillimore's publications include *Three Centuries of Treaties of Peace and Their Teaching* (1917); he also revised J. H. Blunt's *Book of Church Law* and several of his father's works.

PHILLIPS, STEPHEN (1868–1915), British poet (*see* 21.407), died at Deal, Kent, Dec. 9 1915.

PHILOLOGY (*see* 21.414).—Since 1910 there has been a remarkable revival of interest in linguistic science. A number of linguists have turned aside from their specialist activities and concerned themselves with the restatement of fundamental principles. Among these works may be mentioned Otto Jespersen, *Language, Its Nature, Development and Origin*, and *The Philosophy of Grammar*; J. Vendryes, *Le Langage, Introduction Linguistique à l'Histoire* and E. Sapir's *Language: an Introduction to the Study of Speech*. These writers approach the study of language from notably distinct viewpoints, so that their books supplement rather than parallel each other. Jespersen is mainly concerned with the more important modern languages of Europe and takes into consideration a good many matters of practical interest ordinarily neglected by the scientific linguist. Vendryes writes from the standpoint of the Indo-Europeanist and stresses the comparative and historical points of view. Sapir, a specialist in American Indian languages, is chiefly concerned with formal and psychological fundamentals, and uses freely examples taken from the languages of primitive peoples.

Psychology.—It is very noteworthy that other social and humanistic sciences than linguistics itself have taken a serious interest in the data of language. Psychology, which had been disposed to neglect language behaviour, has begun to analyse it more carefully in terms of stimulus and response; of habit; of adaptive function. A notable contribution to the understanding of language as a particular type of behaviour is J. R. Kantor's paper on *An Analysis of Psychological Language Data*, in which the peculiar characteristics of speech, whether communicative or expressive, are sought in its indirect nature as a response, the "adaptive stimulus" being responded to not directly but in the form of a reference, while a secondary stimulus, generally the person spoken to, is substitutively reacted to. J. B. Watson, the extreme exponent of behaviourism, sees in language merely a series of highly specialised laryngeal habits, and goes so far as to identify language with thinking by interpreting the latter type of behaviour as implicit or "sub-vocal" laryngeating. Such ultra-behaviouristic interpretations of language are not likely to meet with the approval of the linguists themselves, but they may have a certain value in accustoming us to approach the study of language habits without necessary reference to the logicians' world of "concepts." There is reason to believe that the kind of psychology (*see* PSYCHOLOGY) which will prove of the greatest value to linguistic science is the *Gestalt psychologie* (configurative psychology), which is still in its elementary stages. In this type of thinking the emphasis on behaviour is placed on the total form or configuration of a sequence of acts viewed as a system. To apply configurative psychology to language one may say that no linguistic act, however elementary, can be looked upon as a mere response, nor can even the simplest speech articulation be understood in terms of muscular and nervous adjustments alone.

Language always implies a particular kind of selective organisation: no speech sound, as Sapir has shown in a paper on *Sound Patterns in Language*, is intelligible as a habit without reference to the complete system of sounds characteristic of a given language, the individual sound being defined not merely as an articulation, but as a point in a pattern, with the other points of which it has intuitively felt relations (*see* PHONETICS). For the more complex levels of linguistic organisation the pattern point of view is more obviously in place.

Philosophy.—Even more fruitful for linguistics than psychology has been the work of certain philosophers. As the relativity of all knowledge and all experience to the habitual symbolism by means of which they are expressed has become more and more clearly understood, philosophy has begun to take a very lively interest in the relation between language and thought, in the nature of the symbolic process exemplified in, but not exhausted by, language, and in allied problems of meaning, reference and classification of experience. Philosophers of standing, such as Cassirer, Delafosse and Ogden and Richards,

have been occupying themselves with linguistic problems as never before. New viewpoints have been arrived at which are of capital interest for both philosophy and linguistics. In an important work entitled *The Meaning of Meaning* Ogden and Richards have carefully explored the nature of the symbolic and referential process involved in the use of language and have classified the concept of "meaning" itself. Many problems that have occupied the attention of philosophers and logicians are shown to be not essential problems but pseudo-problems that arise from the almost unavoidable temptation to read an absolute validity into linguistic terms that are really devoid of meaning when they are disconnected from a more or less arbitrarily defined context.

Forms of Speech.—The study of forms of speech that are very different from those that most of us are accustomed to—say English, French or Latin— discloses the possibility of markedly distinct analyses of experience where one might naïvely suppose that our customary analysis via speech is resident, as it were, in the nature of things. Categories that are carefully developed in one language are but weakly developed, or not at all, in another. Even the elements of sensible experience, whether conceived of as thing (say "tree"), quality (say "blue") or action (say "give"), are not necessarily taken as equivalent ranges of reference ("concepts") in different languages, but may be included in, or distributed among, respectively different ranges. It may even happen that what in one language is a definite experiential concept, with an unambiguous mode of reference to it, finds not even a partial expression in another, but is left entirely to the implications of a given context. Such a language may be said to have no "word" or other element for the "idea" in question, from which, however, it need not in the least follow that it is incapable of satisfactorily conveying the total psychic sequence ("thought") or unit of communication in which the "idea," in another language, figures as an essential element. Linguistic expressions of this kind are naturally of the greatest value for our conception of the nature of "reality" and of our symbolised attitude toward it, and certain philosophers have not been slow to turn to language for this reason.

That in the process of thought linguistic mechanisms play an important part is beyond doubt. Material rich in interest for the philosopher, the psychologist, the philologist and the sociologist is afforded by the modes of classification in use in various language families, such as classificatory prefixes and generic determinatives.

Sociology and Anthropology.—Sociologists and anthropologists too have interested themselves in linguistic phenomena as indispensable to an understanding of social behaviour. Especial mention may be made of B. Malinowski's speculations on the linguistic expression of primitive peoples. The value of language as a delimiter and index of social groups is being increasingly recognised by sociologists. One may wonder, indeed, if there is any set of social habits that is more cohesive or more disrupting than language habits. Not only has language been an object of study in its own right, but it has shown itself increasingly to be of the greatest instrumental value in all historical studies. The best kind of ethnological and folk-loristic material is that which is secured in the form of native texts, for material of this kind is not open to the charge of misrepresentation of the native point of view. Accordingly, we find that the text method of studying the cultures of exotic peoples, whether lettered or not, has been growing in favour, in spite of the obvious difficulties of the method, implying as it does a preliminary study of the exotic language itself. Indeed, much of the most competent and authoritative ethnological information that we possess has been obtained as material ancillary to linguistic studies. One may instance, for America, the Kwakiutl publications of Franz Boas and, for Africa, the Shilluk texts of D. Westermann.

Place Names.—In another sense, too, linguistic researches have been of great assistance, and that is in enabling us to make inferences as to the history and prehistory of various peoples. The value of place names, *e.g.*, in the study of the former distributions of the various ethnic elements that go to make up the present population of England, is well understood (*see* FOLKLORE). Much of the prehistory of Europe and Western Asia is being rewritten with the aid of a profounder study of place names. The non-Hellenic character of hundreds of well-known Greek place names, such as Athenai, Korinthos and Tiryns, is interesting and important in connection with our rapidly increasing knowledge of the pre-Hellenic or Minoan civilisation of the Aegean and of the mainland of Greece. The Etruscan problem, too, has been furthered by a study of the recorded place and personal names of Etruria that are clearly not of Italic origin. These show so many resemblances to names recorded from western Asia Minor (*e.g.*, Lydia, Lycia) that there is now less hesitation than before to credit the testimony of Herodotus, who derives the Turrhenoi (Etrusci) from Asia Minor.

General Tendencies.—We may point out a number of tendencies in recent linguistic thinking. First of all, there is a growing realisation that the life of language is similar in all parts of the world, regardless of the race or cultural development of the speakers of the language, and that the rate of linguistic change is not seriously dependent on the presence or absence of writing. The supposed conservative power of a system of writing, it is now generally agreed, is altogether mythical. It is an illusion to imagine, for instance, that Chinese as a spoken language was hindered from the normal rate of change because of an early literary fixation. Not only have the modern dialects a notably different vocabulary from classical Chinese but their pronunciation has been so modified that it is clear that present-day Mandarin or Cantonese would be quite as unintelligible to Confucius as present-day Spanish to Cicero.

Internal Factors in Change.—The most important single factor making for an increased or retarded rate of linguistic change would seem to be the formal set of the language itself. It is significant, for instance, that the Semitic languages have changed very much less in the last 3,000 years than have the Indo-European languages. The Athabaskan (Déné) languages of North America, spoken by unlettered tribes which had, for the most part, reached but a very primitive level of culture, have tended to resist morphological change because of a certain formal equilibrium, despite the complexity of their grammatical structure, hence such widely separated languages as Navaho (New Mexico and Arizona), Hupa (Northern California) and Chipewyan (Mackenzie Valley) differ probably less than French and Italian (*see* ARCHAEOLOGY: CENTRAL AMERICA).

Consistency of Change.—One of the most impressive things about linguistic change within a given genetic group is the relative consistency of its direction over a long period of time. Well-known examples of this principle are the progressive simplification of the case system in all branches of the Indo-European family and the ever-increasing tendency to isolation in the structure of the Sinitic (Indo-Chinese) languages. It is very remarkable, too, that in many cases it can be shown that related languages have undergone similar developments independently of each other and at very different periods. "Umlaut," for instance, seems to have developed independently in West Germanic and in Scandinavian, just as certain tonal developments in modern Tibetan (central dialects) are significantly parallel to the far older tonal developments of the earliest Chinese. It is difficult to explain these parallelisms except on the assumption that a given formal set implies a certain liability to modification in one rather than in another direction.

External Contacts.—Important, yet less important than the inner "drift" of a language, is the tendency to change as a result of external contact. Not only lexical, but also far-reaching phonetic influences may be ascribed to the contact of unrelated languages. Although Annamite seems to be basically a Mon-Khmer language, therefore originally toneless, it has acquired a complicated tone mechanism which is, in principle, identical with that of the neighbouring Tai languages (Siamese, Shan, Laos, Thō). Morphological features, too, may be freely diffused, though the evidence for this is less convincing in most cases than for the spread of words and of phonetic elements and tendencies. Often it is difficult to say whether a morphological

parallelism is due to historic contact or to genetic relationship or to independent development.

The effects of bilingualism deserve attention, especially in those areas where permanent contact is established between two different families of speech, as in India, where Indo-Aryan languages are spoken in addition to Dravidian or Austric or Indo-Chinese tongues. The principles of the growth of *linguae francae* have also been examined, but much yet remains to be done. Internal social developments as well as exterior relations induce linguistic features of interest and of philological value in themselves. The phenomena recorded by anthropologists of secret speech, of slang, of special modes of speech associated with social divisions, women, age-grades, priests and kings bear witness to the importance and validity of linguistics in the study of social aggregates and their corporate manifestations.

Morphology.—The morphological classification of languages still leaves much to be desired. It is abundantly clear that the traditional classification of types of speech into isolating, agglutinative, inflective and polysynthetic is imperfect. It is difficult to find easily applicable criteria of general linguistic structure. Perhaps the safest plan is to adopt a number of distinct points of view and to classify a given language from each of these. Sapir suggests the possibility of three independent types of classification, based respectively on degree of synthesis, on the predominant " technique " (manner and degree of welding of elements into unities), and on the conceptual expressions. From the first point of view languages may be described as analytic (Chinese, Ewe), weakly synthetic (English, Tibetan), synthetic (Latin, Turkish, Japanese) and polysynthetic (Eskimo, Algonquin). The classification based on " technique " is into isolating (Chinese, Annamite), agglutinative (Turkish, Nootka, Bantu), fusional (Latin, French, Yokuts) and " symbolic," *i.e.*, with the characteristic employment of various types of internal change, such as vocalic and consonantal change, reduplication and differences of stress and pitch (Semitic, Shilluk). A conceptual classification would distinguish between languages which can and those which cannot freely derive words from basic elements and, further, between those which express the fundamental relational (syntactic) concepts as such and those which need adventitious concepts like gender or number to bring out these necessary relational ideas. There would, therefore, be theoretically four conceptual types of languages—pure-relational, non-deriving languages (Chinese), pure-relational deriving languages (Polynesian, Haida), mixed-relational non-deriving languages (but meagrely represented) and mixed-relational deriving languages (Latin, Semitic, Algonkin).

Phonetics.—Much progress has been made in phonetic research (*see* PHONETICS). A vast number of new sounds have been discovered and whole classes of articulation come to light from time to time whose existence could not readily have been foretold by an *a priori* phonetic analysis. The help derived by linguists from objective methods of investigation (various types of recording apparatus) has been welcome but, none the less, disappointing on the whole. A well-trained ear can readily make and classify sound differences which a kymograph does not materially help us to understand. As our knowledge of phonetics grows, we realise that sounds and phonetic discriminations originally believed to have a quite restricted distribution are really rather widely distributed. The Hottentot and Bushman clicks, partly borrowed by certain Bantu languages, seem to be confined to South Africa. But the curious glottalised consonants and voiceless laterals of Western American languages are found as well in the Caucasus and in a number of African languages. Again, tone differences or significant elements in the word are by no means confined to Chinese and related languages in Eastern Asia. We now know that pitch languages are exceedingly common. Most of the African languages that are not Semitic or Hamitic are pitch languages (Sudanese, Bantu, Hottentot, Bushman), while in aboriginal America a very considerable number of languages have been found to recognise tonal differences (*e.g.*, Athabaskan, Tlingit, Achomawi, Takelma, Tewa, Mohave, Mixteczapotec, Chinantec, Otomi and many others).

Genetic Relations.—For a long time linguists hesitated to look for genetic connections between the groups and isolated languages that had been established. There is an increasing tendency now to make larger syntheses and to suggest as at least probable, if not entirely demonstrable, relations that at first blush seem far-fetched. Among serious linguists Alfredo Trombetti is perhaps the only one who has ventured to commit himself to the theory of linguistic monogenesis and has actually attempted (*see* his *Elementi di Glottologia*) to show in what manner the various groups of languages that are generally recognised are related to each other. The most important general survey of languages published in recent years, *Les Langues du Monde*, edited by A. Meillet and Marcel Cohen, is very conservative in the matter of genetic theories, but even in this a number of syntheses are allowed that would not have passed muster a few decades ago. There is no doubt that as our comparative knowledge becomes more profound we shall be enabled to extend our genetic groups with safety.

North and South American Languages.—We can only glance at some of the new genetic theories. The incredibly complicated linguistic picture of North and South America, which has long been proverbial among linguists is likely to become very appreciably simplified. R. B. Dixon, A. L. Kroeber, P. Radin Sapir, G. R. Swanton and P. Rivet are among those who have sought to bring order out of the linguistic chaos that still largely prevails in America. For the groups of languages spoken north of Mexico and in part in Mexico Sapir suggests a greatly simplified classification into six genetic groups, Eskimo, Nadene (Haida, Tlingit-Athabaskan), Hokan-Siouan, Algonquin-Wakashan, Penutian and Aztek-Tanoan. These groups, aside from Eskimo, embrace languages, however, which differ vastly more than the Indo-European languages. In South America Rivet has connected various groups of languages hitherto believed to be unrelated. He has also attempted to prove a relationship between certain Fuegian languages and the languages of Australia, and between the Hokan languages of California and Polynesian.

The Austric and Australian Languages.—More likely to prove sound than these latter theories is Father W. Schmidt's linguistic synthesis which passes under the name of " Austric " and which includes the vast group of languages—Mon-Khmer (Mon-Khmer proper; Khasi; Proto-Malaccan, Nicobarese; Munda) and Malayo-Polynesian.

Analysis of the Australian languages by Father Schmidt seems to disclose the existence of a definite distinction between the northern and southern groups. The northern group is resolved into two main divisions with a third division of an intermediate nature. There are marked differences in the southern group, some of which are regarded as approaching Tasmanian (now extinct) and as therefore markedly primitive. To a very large extent linguistic differences in this area, claims Father Schmidt, can be correlated with, variations of, or differences in, other cultural features such as social organisation.[1]

African Languages.—In Africa we may note as important the discovery of a language spoken in the east-central portion of the continent: Sandawe, which is unmistakably related to Hottentot, spoken far to the south. This lends an unexpected colour to theories long prevalent as to the Hamitic affiliation of Hottentot. The sharp line of demarcation which used to be drawn between the Bantu and Sudanese languages is giving way. Everything points to the fact that the Sudanese languages are a worn-down form of a language, or group of languages, which was genetically related to Bantu. A number of Sudanese languages possess class prefixes (or suffixes) that are strongly reminiscent of the Bantu prefixes, while bare survivals of these elements persist in a great many other Sudanese languages.

The publication of Sir H. H. Johnston's work on the Bantu languages was an event of first class scientific importance. It summarises and surveys with masterly power the sweep of this family of languages throughout Africa and argues that " the Bantu family was finally moulded by some non-negro incomers of

[1] *Anthropos*, vol. 8 (1912), p. 260 and p. 463; vol. 9 (1913), p. 526.

possibly Hamitic affinities, akin at any rate in physique and culture, if not in language, to the dynastic Egyptians, the Gallas and perhaps most of all to those 'Ethiopians' of mixed Egyptian and Negro-Nubian stock that, down to 1,000 years ago, inhabited the Nile basin south of Wadi-Halfa and north of Kordofan."

Indo-European, Semitic and Hamitic Languages.—Hermann Möllers' very systematic and detailed attempt to connect Indo-European and Semitic (the relationship of which to Hamitic is now generally recognised) seems not to have been cordially received by either the Indo-Europeanists or the Semitists, but to the general linguist who studies his works his demonstration seems highly suggestive, not to say convincing. Less solid seems to be the attempt of N. Marr, a Russian linguist, to establish a "zaphetic" group of languages, consisting of the Caucasic languages, Basque, and that large number of still very imperfectly known languages which preceded the Indo-European group in southern Europe and western Asia (Etruscan, Minoan, "Asianic" [early Hittite]).

More and more it is becoming evident that the linguistic cartography of the Near East and of Europe was a complicated one in remote times. The discovery and partial decipherment of a series of cuneiform "Hittite" inscriptions from the second millennium B.C. proves a number of interesting things—that a language closely related to Sanskrit and known from quoted terms was spoken in the neighbourhood of the Hittite country; that the language of the Hittite rulers had unmistakable Indo-European features, but was not typically, or even mainly, Indo-European in character; and that an older Hittite language was quite unrelated to this. Just what relationship, if any, the non-Indo-European elements of these Hittite languages bear to "Asianic" (Lycian, Lydian, Carian and others) and the Caucasic, remains to be discovered (*see* ARCHAEOLOGY: WESTERN ASIA).

Discovery of Tokharian.—Perhaps the most interesting linguistic discovery that has been made of recent years in the domain of Indo-European philology, apart from the "pseudo-Hittite" documents just referred to, is the presence of two dialects of a language, generally termed Tokharian in Chinese Turkistan, as late as the 7th century A.D. Tokharian is quite distinct from any other known Indo-European language and has thrown light on a number of points of Indo-European grammar. In certain phonetic respects it agrees more closely with Greek and Latin than with the Indo-Iranian languages that were geographically nearer to it.

Pisacha Languages.—Problems of an interesting nature are raised by the evidence published (1919) in vol. 8, part 2, of the *Linguistic Survey of India* by Sir George Grierson, who describes the Dardic or Pisacha languages as not possessing all the characteristics either of Indo-Aryan or of Eranian. They exhibit almost unaltered and in common use words which in India are hardly found except in Vedic Sanskrit. The wild, mountainous country in which these languages are found has not attracted the conqueror. An interesting feature is the survival of words from Burushaski, a form of speech which has not yet been satisfactorily related to any other language group.

Karen Languages.—Examination of the languages spoken in Burma, an area not covered by the *Linguistic Survey*, has justified the view that the Karen group of languages constitute a new family of languages which exhibits features resembling those of the Chin and Sak languages, even of some of the sub-Himalayan dialects. Sir George Grierson suggests the possibility of a widespread pre-Tibeto-Burman population, which was absorbed, with parts of its language, by the later Tibeto-Burman immigrants.

Other Families.—The Man family is similarly regarded as distinct but it is a newcomer from Southern China, whence further evidence may be available to identify its main relationship. There are thus in the confines of the Indian Empire language stocks of world-wide distribution and languages—the Dravidian tongues—Burushaski, Karen, Man and Andamanese, which survive in isolation. It has been surmised that Dravidian languages may be related to Sumerian or to Basque, or to a common prototype, but conclusive evidence has not yet been put forward in proof of these hypotheses.

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PHILOSOPHY (*see* 21.440).—Philosophy is the branch of knowledge which aims at ascertaining the ultimate character of reality. In this it differs from science, which, observing and experimenting within the field of experience, seeks to exhibit the results so ascertained in the form of general principles. Science investigates the structure of experience, but does not, broadly speaking, try to get behind it. Philosophy, so far as its metaphysical aspect is concerned, asks what experience means and what are its foundations. The distinction has been made more sharp by the emergence of the theory of knowledge which inquires what is signified by being *for* mind, as contrasted with the object world being assumed to be self-subsistent, without reference to any function of knowledge in its constitution. The latter is the subject of ontology. The former claims that ontology is no more than a branch to be included properly as a phase in the wider theory of knowledge which is sometimes called epistemology.

The emergence of the theory of knowledge as such has become definite as metaphysics has been developed. This development culminated in the teaching of Kant at the end of the 18th century. Kant insisted that, when its true nature was ascertained, knowledge must be recognised—firstly, as more than a property of the individual self which we find in the object world of experience; secondly, as having its foundations in a synthetic unity of activity which, as the condition under which alone experience was possible, could never be presented as an object within it; and, thirdly, as the activity of thought, identical in all individuals, because foundational of both their experience and themselves, which must be recognised if we were to hope to account for an objective universe identical and one and the same for all individuals. These individuals were objects in experience, as well as subjects in knowledge, and as such objects were moulded by their stations and conditions in nature. But they were in their more general character the manifestation of the synthetic activity which, as the foundation of mind and perception, was present in all of them.

Earlier Systems.—The sharp distinction, made by Kant for the first time clearly, was not equally apparent in the old Indian or Greek philosophy. In the earlier philosophies men were less troubled by the difference supposed to exist between knowing and being. The great systems of Indian philosophy show little consciousness of this, which has been the prominent difficulty for modern and Western metaphysics. This is not altogether to the discredit of the older systems. Indian and Greek thought as we find the latter in Plato and Aristotle and in Plotinus, are almost equally free from the perplexity that has been caused by an undue insistence on that divergence of knowing from being which modern metaphysics has made prominent. Indeed, even Descartes, Spinoza and Leibnitz were hardly more troubled over this divergence than were their predecessors in the older metaphysics.

Kant's Position.—But the psychological tendency of modern times, and the constant turning to experience, made the problem more acute. How could the mind, as an object in experience, be regarded as creative of its object world? This was the problem to which the philosophy of Kant addressed itself, and he solved it by making the distinction above indicated between the two aspects of mind, as an object in nature and as, at the same time, inherently creative. For him mind created its objects by operating under the forms of space and time on a raw and unformed material, and such as the senses might in themselves afford, and shaping it in the process into a formed world. It might be that the ultimate source of this raw material was mind itself in its initial aspect, or it might be that the raw material was

supplied *aliunde*. Into this question Kant declined to enter. The structure of experience was such that the question could not be solved.

Hegel and Others.—After the time of Kant great divergence of view became apparent on this problem. Schopenhauer, early in the last century, found in Will the explanation of Kant's "thing in itself" and the source not only of mind but of the raw material. Bergson, later on, found that source in his "durée," time not yet spatialised, which was the ultimate form of reality, an activity which lay deeper down than either mind or its objects. But in the early part of the 19th century, the doctrine of Kant was expanded in a wholly different direction. It was held that Kant had taken a view too narrow of the nature of knowledge, even as he had stated it in the principle of its foundational synthetic unity. For Fichte, Schelling and Hegel knowledge meant and covered much more. It was not by them confined by Kant's list of categories deduced from the abstract principles of the judgments of formal logic.

In Hegel, especially, the start was made from our experience, and knowledge was treated as foundational to the whole of this and as including even the distinctions made within feeling and volition. It is not surprising that, in an age when nothing was deemed to have been sufficiently worked out unless it could be exhibited in the form of a complete system, the ideal of knowledge thus arrived at should have been sought to be exhibited as a system of an absolute kind, in which God and all forms of apparent externality to thought not less should be displayed in a fully systematised and detailed form as the substance of an entirety in which knowledge as foundational was what could not be transcended. Such a conclusion was of course a great advance on that of the cautious Kant, but it accorded with the tendencies of what Kant had taught.

The Absolute.—After Hegel's time the doctrine of the absolute so conceived passed out of fashion in Germany, but in other forms it was taken up in Great Britain by such teachers as T. H. Green and Edward Caird, who gave it a restricted shape but one which was still in substance Hegelian. They were succeeded as leaders of thought by F. H. Bradley and Bernard Bosanquet, but these struck out a different conclusion. There was for them an absolute, but the form of knowledge, always relational, was insufficient for its rendering. There was an alternative form in which they themselves sought to render it, that of a kind of knowledge in which relational thought and bare feeling were both transcended, and which culminated logically in an absolute of a new kind within which both fell. Their teaching, issuing as it did in fresh doctrines of logic and psychology, exercised much influence, but did not create any large or definite school of adherents. In the United States the German doctrine of absolute idealism was taken up by such writers as Royce and Creighton, but its progress was deflected by the seminal teaching of William James and others, who ceased to rely on thought as the exclusive instrument, and called people back to the function of feeling in constituting experience. On this basis Pragmatism and New Realism—which does not shrink from finding in the objects of our experiences the presence even of universals—have made much progress, especially in America.

Modern Developments

The outcome of these somewhat divergent movements is that it is difficult to lay down generally the position of philosophy to-day. There is no single tendency to be found in it, and all that is clear is that psychology is receiving much more attention than it did in the 19th century. On the other hand, the influence of objective idealism is still strong, and there is perhaps less of a tendency to throw it into antithesis to psychological work than was formerly the case.

The influence of the new developments of physical science which are characteristic of the present century are exercising much influence, but, so far as can be seen, an influence which is not destructive of the new point of view which has grown out of Kant's teaching as to the importance of the part played by knowledge in the constitution of experience. In Germany itself this is also the case. Writers like Cassirer and Husserl lay stress on it, and there appears to be a diminishing interest in the alternative special departure from Kant which Schopenhauer founded, and to which Bergson has given a new development in a different shape. Herbart, Lotze, Vaihinger, Mach, Riehl, Avenarius, Lange and others in Central Europe, show a tendency to recur to actual experience, and to treat the ideals which are sought for its foundations as belonging to a region of working hypotheses, but hypotheses merely. The impulse has often been toward the identification of truth with mental occurrences, what is sometimes called psychologism. "Back to Kant" means the repudiation of the effort to connect the ideals of Kant's successors with what we actually find in our experience.

In Great Britain it is more difficult to sum up the position definitely. There is still a great deal of the idealism, in the wider sense of the word, which refuses to be content with that to which Kant restricted himself. To call British idealism Hegelian would be wrong, for there is little interest in what Hegel felt himself bound to, the construction of a theory of the nature of what is absolute. Bradley was the last writer to lay stress on such a necessity. Still there is a good deal of writing in which the positivism of Kant has been laid aside. On the other hand, there is probably a large number of British students of philosophy who have wholly rejected the mandate of idealism as such, and have deliberately elected to confine themselves to the investigation of the structure of actual human experience. This problem is not the same problem as the other, but, in restricting themselves, these thinkers (and the same thing is true of thinkers in the United States and France) have taken the view that the apparently certain results which the progress of science and especially of psychology afford are giving them fresh ground on which to build up epistemology. In logic as well as in psychology this tendency is apparent.

It is not possible to forecast the future. So much work is being done, and so many fresh views are being brought forward, that the only thing that is certain is that modern movements, especially in this country, are not likely to stand still or to remain where they are. Not only science but literature also is reacting on philosophy, and the future will not disclose what are still its secrets.

Philosophy and Ethics.—The development of the ethical side of philosophy has naturally been profoundly influenced by the changes on the metaphysical side. The early moral philosophy of India was closely bound up with the religious outlook. The attempt to penetrate to the character of the ultimately real carried with it the sense of the obligation to renounce external goods and not less the interests of the individual self. The principle of renunciation in this way came to be the basis of Indian ethical thought in various forms. In ancient Greece, great as was the influence of Plato, the most distinctive and influential teaching of ethics was that of Aristotle. His influence has endured through the Middle Ages right down to our own times. He directed his investigation of the principles which regulate human conduct to the chief good. This he found to consist, not in pleasure, but in happiness. This is the activity of the highest part of man's nature. It is the activity of reason, which is the highest human faculty aiming at no end beyond itself. It bids us seek, not extremes, but the mean as that in which the self at its best can be active undisturbed. Aristotle worked out his ethical system from a survey of human nature in all its practical forms.

Kant, however, reshaped this conception. For him the determining motive power was to be sought in ideals, ideals which could never be presented as phases in actual human experience, but which moulded it. The conceptions of God, of freedom, and of immortality were for Kant of this order, and they were the foundations of ethical obligation. This sharp separation of knowledge from the content of experience led him to formulate the rule for conduct in a somewhat abstract form, the obligation to act always on maxims which applied universally and without reference to particular circumstances. His successors, and particularly Fichte and Hegel, found this, as we should expect from

their metaphysical tendencies, too abstract as a guide for humanity. They introduced the conception, intermediate between that of positive law on the one hand and of pure ideals on the other, of "Sittlichkeit," the obligation inspired by society in its members of what may be called "good form" or the "right thing to do." This new idea has exercised great influence in various forms. It is nearer to what Aristotle taught than to the doctrine of Kant. It has enabled moralists to avoid the narrowness of utilitarianism on the one hand and of pure idealism on the other, and it has imparted a new significance to society as an ethical influence. The ethical philosophy of to-day is of very varied orders. But prominent throughout is the idea of values as a basis for morals. That quality should be unchallengeable as a guide to conduct is no new notion, but it is one that in a variety of forms has gained increasing importance in recent ethics.

French and Italian Developments.—In an article confined to prominent features in the history of philosophy it is not practicable to follow out the secondary developments of the history of thought. Such developments have importance both in France and in Italy. In France there were three influences, which led to corresponding schools. There was that of the physicists and physiologists initiated by Cabanis and continued by Pinel and a group of Paris physicians.

Then there was a psychological school in which Maine de Biran, writing in the beginning of the 19th century, was a pioneer. This school insists through him that we have immediate experience of the self and of a not-self. On this experience a metaphysical system is built based on a direct awareness, such as Bergson a century later set up as the foundation of his *durée*. In course of time the school founded by Maine de Biran came under the influence of the Scottish spirit in philosophy, that of Reid and Dugald Stewart, who had broken away from the principles of Kant. Cousin was the most prominent of this French section. Comte exercised much influence of a scientific tendency, and, after an interval, the school of Bergson attained to great prominence not only in France but outside it. In Italy the movement has been in the direction of an intellectualist idealism. The influence of Hegelianism is marked, but in the hands of thinkers like Croce and Gentile the doctrine has assumed a form of its own. *See* AESTHETICS; ANTHROPOLOGY; BIOLOGY; ETHICS; LOGIC; PSYCHOLOGY; SCEPTICISM; etc.

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PHONETICS (*see* 21.458).—Considerable developments have taken place in phonetic science since 1910. The nature of many known speech-sounds has been determined with greater accuracy than before; attention has been given to features of pronunciation previously barely touched upon (notably intonation and the theory of phonemes); many new languages have been subjected to phonetic analysis; new methods of teaching pronunciation have been evolved, and the use of phonetic methods in practical language teaching has been greatly extended.

The Organic-Acoustic Method.—The most useful practical method of determining the formation of speech-sounds is still the "organic-acoustic" method, *i.e.*, estimating the position of the tongue by muscular sensation and by comparison of the acoustic quality of the sound to be analysed with that of other sounds of known tongue positions. This method has been supplemented by experimental methods (the use of apparatus, such as the phonetic kymograph, artificial palates and X-ray photography). For illustrations of the use of the kymograph and artificial palates see D. Jones's *Outline of English Phonetics* (1918 and 1922). X-ray photography was adopted first by E. A. Meyer as long ago as 1905,[1] and has been followed by other

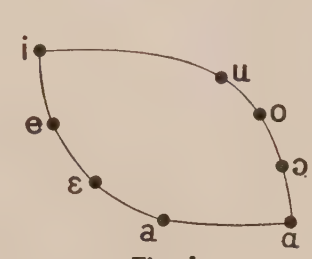

Fig. 1.

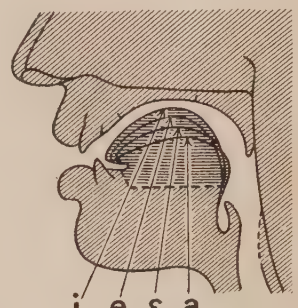

Fig. 2.

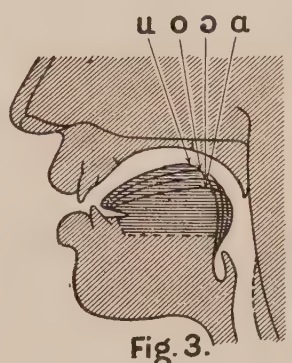

Fig. 3.

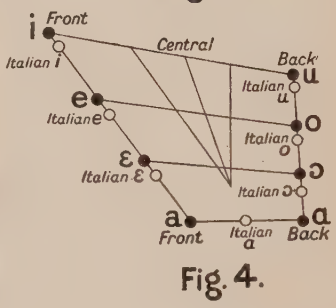

Fig. 4.

FIG. 1.—Graphic representation of tongue positions of vowels. FIG. 2.—Tongue positions of i, e, ɛ, a. FIG. 3.—Tongue positions of a, ɔ, o, u. FIG. 4.—Diagram illustrating the nature of the vowels of Italian, by reference to the cardinal vowels. (Cardinal vowels shown by black dots; Italian vowels by circles.)

investigators. Particularly noteworthy are the X-ray photographs taken of the mouths of Daniel Jones and Stephen Jones by Dr. H. Trevelyan George[2] and a remarkably good set of 30 skiagrams of the mouth of Stephen Jones taken by H. A. Harris and F. Melville in the Department of Physiology, University College, London, in 1925 (not yet published). E. A. Meyer has also obtained valuable results from an ingenious adaptation of the artificial palate.[3]

The relative tongue-positions of vowels may be indicated graphically by dots placed on a figure of the shape shown in fig. 1. Figs. 2 and 3 show the reasons for this. The upper curve from i to u in fig. 1 is parallel to the roof of the mouth; the descending part, u–*a*, indicates the limit of possible vowel-positions of the tongue in the backward direction. The descending part, i–a, of the lower curve indicates the limit of possible vowel-positions of the tongue in the forward direction, while the part, a–*a*, which is nearly horizontal, represents the lowest positions which the tongue can take up. The highest part of the tongue in pronouncing any vowel may be represented

[1] See article by him in *Medizinisch-pädagogische Monatsschrift für Sprachheilkunde*, Nos. 8, 9 (1907).

[2] Some of these are reproduced in *Proc. Royal Institution* (1919).

[3] See his "Untersuchungen über Lautbildung" in *Festschrift W. Viëtor* (Marburg, 1910), and "Beiträge zur Schwedischen Phonetik" in *Vox*, Part I (1916).

by means of a dot placed at the appropriate spot on the circumference or in the interior of this diagram.

In practical language teaching, this diagram is generally replaced by one of the shape shown in fig. 4. The introduction of angles serves to render the placing of the dots more definite and intelligible to ordinary learners, and facilitates the demarcation of a series of vowels known as "central" vowels, which are represented by dots placed within the inner triangle shown in fig. 4. This vowel figure, though being by no means mathematically accurate, is more accurate than its predecessors, the triangular arrangement (adopted by Viëtor and others), the square (Bell and Sweet) and the form ⌵ (Passy).

The quality of vowel sounds is dependent upon other factors besides the tongue-position. Foremost among these are the positions of the lips, which are now generally classified as "spread" (as for [i][1]), "neutral" (as for [a]), "open rounded" (as for [ɔ]) and "close rounded" (as for [u]). Some writers still use Sweet's further classification, based on the muscular condition of the tongue, into "narrow" ("tense") and "wide" ("slack," "lax") vowels. Others, however, now consider it better to classify according to the width of the pharyngeal passage, as this can be more satisfactorily measured than can the degree of tenseness or laxness of the tongue muscles. Thus [i] (as in *eat*) has a wide pharynx; [æ] (as in *cab*) has a narrow pharynx.

The Cardinal Vowels.—One of the most important modern developments of phonetics has been the establishing of a system of "cardinal vowels" as a standard of vowel-quality. By reference to eight vowels which have been carefully chosen, it is possible to describe the vowel-sounds of any language more accurately than before. Their relations to each other are shown by the black dots in fig. 4; it is taken as a convention that Nos. 7 and 8 have close lip-rounding, and that No. 6 has open lip-rounding. The old plan of describing vowels by key-words from existing languages has been discarded, since key-words are pronounced in a variety of ways by different speakers.

The eight primary cardinal vowels were selected as follows: The vowel sound produced with the front of the tongue raised as high as possible towards the hard palate is chosen as cardinal vowel No. 1. It is represented by the symbol [i]. All the i-like sounds occurring in any language or dialect (*e.g.*, the different varieties of English [i] in *eat*, French [i] in *vite*, Hindustani [i] in *bhī*) can be described by reference to this fixed vowel position and the description understood by any reader knowing the value of cardinal vowel No. 1. The vowel sound produced with the tongue held as low and as far back as possible is cardinal vowel No. 5, the symbol for which is [ɑ]. English [ɑ] as in *calm*, French [ɑ] in *pas*, Swedish [ɑ] in *glad*, have values not far removed from cardinal [ɑ], and may be accurately described by reference to it. The cardinal vowels Nos. 2, 3 and 4, represented by the symbols [e], [ɛ], [a], were chosen so that the distances between successive pairs of cardinal vowels are, from the acoustic point of view, as equal as a highly trained ear can estimate. Nos. 6, 7 and 8 [ɔ], [o], [u], are "back" vowels so chosen as to form a continuation of the acoustic series [i, e, ɛ, a, ɑ].

A set of secondary cardinal vowels (phonetically [y, ø, œ, ɐ, ɐ, ʌ, ɤ, ɯ]) is derived from the primary cardinal vowels by adding lip-rounding to [i, e, ɛ, a, ɑ] and unrounding [ɔ, o, u]. There are also some "central" vowels, of which the chief are [ɨ] (intermediate between [i] and [ɯ]), ʉ (intermediate between [y] and [u]), [ə] (the "neutral" vowel) and [ɚ] (variety of the vowel in *bird*).

The cardinal vowels can only be learnt from a teacher who knows them, or, failing that, from a gramophone record.[2] By means of dots placed on the cardinal vowel chart, together with instructions as to lip positions, anyone familiar with the cardinal vowels can form a good idea of the acoustic effects of foreign vowels, even if he has never heard them pronounced by a native. Thus fig. 4 shows the nature of the vowels of Italian (shown by circles).

Phonemes.—Another development of far-reaching importance has been the elaboration of the theory of "phonemes," which has placed the distinction between a "broad" and "narrow" transcription on a firmer basis. The speech sounds (phones) existing in any one language are much more numerous than the average native speaker of that language imagines. They can be grouped into families technically called "phonemes." Each phoneme contains the most frequently used member of that family and a number of subsidiary members which take its place in certain positions in connected speech. For example, the sound of [h] in *hoop* is not the same speech-sound as that in *he* or in *half*. These and other varieties of [h] occurring in English belong to the English "h-phoneme." In Japanese, the h-phoneme includes such very different sounds as a voiceless palatal fricative [ç] (used before [i]) and a voiceless bilabial fricative [ɸ] (used before [u]). In the speech of most English people, the initial [l] in *little* ("clear" l) is not the same sound as the final [l] ("dark" l). These two l-sounds, and others with varying degrees of "clearness" and "darkness," belong to the English l-phoneme; the particular variety to be used in any given word or phrase depends upon the nature of the surrounding sounds. The a-phonemes in Russian and in Arabic contain members differing very widely from each other; the Arabic a-phoneme includes vowel-sounds ranging from a sound near to (æ) (as in *man*) to (ɒ) (as in *not*) and (ʌ) (as in *cup*), the character of neighbouring consonant sounds being responsible for these variations. In French the l-phoneme includes a voiceless ([l̥]) which is used when such words as *oncle, simple* occur finally.

In connected speech the use of the chief members of phonemes alone would never cause misunderstanding, for they are sufficient to distinguish the meanings of words; the proper use of the subsidiary members, though not essential for intelligibility, is nevertheless necessary if one wishes to speak a foreign language "like a native."

Two different speech-sounds may be members of the same phoneme in one language but belong to different phonemes in another language. Thus in Welsh and Zulu there exists a variety of voiceless [l̥] (represented by *ll* in Welsh, *hl* in Zulu); this sound is a separate phoneme from [l] in these languages, contrary to the usage in French. [ɑ] (as in *psalm*) and [æ] (as in *Sam*) are separate phonemes in English, but they are members of the same phoneme in Russian.

Phonetic Transcription.—It is, of course, impossible to assign a symbol to every known speech-sound. An unambiguous representation of a given language is effected when a distinctive symbol is assigned to each *phoneme*, for it is only by the phonemes of a language that words are distinguished in meaning. A "broad" system of transcription is now defined as one which provides *one letter per phoneme;* such a type of transcription is adequate for most practical purposes. A more elaborate system ("narrow") is often necessary in comparative phonetics and in recording dialects with minute accuracy. Narrow forms of transcription may also be useful, in helping to remember the rules governing the use of subsidiary members of phonemes.

Intonation.—The subject of intonation (the rise and fall of voice-pitch) has received much attention since 1910. Researches into the sentence intonation of English, French and German have resulted in the discovery that the apparently complex intonations of these languages are reducible to systems consisting of a few simple rules. Each language is found to have certain characteristic "tunes" which undergo modifications under special circumstances, such as the two kinds of emphasis ("prominence" and "intensity").[3]

[1] Letters in square brackets are phonetic symbols (International Phonetic System).

[2] Double-sided record No. B 804 in the catalogue of the Gramophone Co. (363 Oxford St., London, W. I.).

[3] The first comprehensive work on intonation was H. Klinghardt and M. de Fourmestraux's *Französische Intonations-übungen* (1911, rev. ed. 1925, Eng. ed. 1923); other notable contributors are H. Klinghardt and G. Klemm *Übungen im Englischen Tonfall* (1920); H. E. Palmer, *English Intonation* (1922); M. L. Barker, *Handbook of German Intonation* (1925); H. Klinghardt, *Deutsche Intonation* (1926).

Valuable research work has been done on the intonation of " tone languages " (Pekingese, Cantonese, Burmese, Japanese, Punjabi and various African languages). It has been established that in most " tone languages " the tones of words in connected speech are often different from the tones of the same words when said by themselves; the actual tones used may be grouped into " tonemes," just as phones are grouped into phonemes. It has been found that in Bantu and in Japanese tones are used not only to distinguish words of entirely different meaning but also to perform grammatical functions such as the distinction between different parts of the same verb. Details of some recent investigations will be found in several of the books given in footnotes to the next paragraph, also in Beach " Tonetics " in *Bantu Studies* (Dec. 1924).

Languages Analysed since 1910.—Languages of which a partial or fairly complete phonetic analysis has been made for the first time since 1910 include Pekingese,[1] Cantonese,[2] Burmese,[2] Panjabi,[2] Bengali,[3] Sinhalese,[4] Zulu,[5] Yoruba,[6] Yaunde,[7] and a number of other African languages.[8] Important additions have been made to our knowledge of the phonetic structure of several European languages (including Welsh,[2] Russian,[9] Polish[2]) and the non-European languages, Arabic,[10] Japanese,[11] Sechuana,[2] Hausa[11] and other African languages.

The study of these languages has brought to light many new phonetic facts besides tone systems, *e.g.*, the true nature of affricates (such as the numerous sounds represented by *ch* by English writers on Eastern languages), the existence of " sulcal " sounds (sounds formed with a furrow down the middle of the tongue), voiced " implosive " (suctional) sounds (as in Sindhi), and p, t, s, and other sounds with simultaneous glottal stop.

Increasing Use of Phonetic Methods in Practical Language Teaching.—The use of phonetic methods, with or without the help of a phonetic transcription, is now recognised as essential by the foremost language teachers in many countries, especially in England, Germany, Scandinavia and Japan. These methods are now used in a great number of secondary schools in England, chiefly in connection with the teaching of French; they are also used in many training colleges for the purpose of enabling the students in training to become efficient teachers of English pronunciation. During the last 14 years several official reports have appeared in which phonetic methods are advocated: *Board of Education report on the teaching of modern languages, circular 797* (1912); *Report of a conference on speech training*, issued by the London County Council (1916); *London County Council report on the teaching of French in secondary schools* (1917); *Report of the Government Committee on the teaching of English in England* (1921); *Report of the Government committee on Modern Languages* (1918). The necessity for phonetic research in connection with Oriental and African languages was emphasised by the *report of the Government Committee* (1918), and phonetics has now for some years been included as a subject for candidates for the Indian Civil Service.

BIBLIOGRAPHY.—Among recent books dealing with methods of language teaching, in which the use of phonetics is advocated, may be mentioned W. Ripman, *The Early Teaching of French* (1915); H. E. Palmer, *The Scientific Study and Teaching of Languages* (1917); H. G. Atkins and H. L. Hutton, *The Teaching of Modern Foreign Languages* (1920). (D. J.)

[1] See Beach, *The Phonetic Structure of Pekingese*, not published, but may be seen in the library of the University of London; Yuen Ren Chao, *A Phonograph Course in the Chinese National Language.*

[2] See L. E. Armstrong, *English Phonetic Reader* (1923).

[3] See N. C. Chatterji, *Bengali Phonetics* (International Phonetic Association); also *Bengali Phonetic Reader*, in University of London Press series.

[4] See D. Jones and H. S. Perera, *Colloquial Sinhalese Reader* (Manchester, 1919).

[5] See Doke, *The Phonetics of the Zulu Language* (Univ. of the Witwatersrand Press, Johannesburg), and C. Meinhof, " Zur Lautlehre des Zulu " in *Zeitschrift fur Eingeborenen Sprachen*, vol. 14, part 4 (1924).

[6] See A. Lloyd James, " The Tones of Yoruba," *Bull. Oriental Studies*, vol. 3, part 1 (1924).

[7] See M. Heepe, *Jaunde-Texte* (Hamburg, 1919).

[8] See publications of the Hamburg Colonial Institute.

[9] See M. V. Trofimov and D. Jones, *The Pronunciation of Russian* (Cambridge, 1923).

[10] See Gairdner, *The Phonetics of Arabic* (Oxford Univ. Press).

[11] See O. Pletner, " Musical Accent in Japanese Morphology," *Bull. Oriental Studies*, vol. 3, part 3 (1925). Jimbo, " The Word Tone of the Standard Japanese Language," *Bull. Oriental Studies*, vol. 3, part 4 (1925).

PHONOGRAPH (*see* 21.467).—The progress which has been made since 1910 in phonographic reproduction of sounds has resulted in two chief improvements. First, notes of speech or music, which formerly presented great differences in their degrees of reproducibility, may now be reproduced with such evenness and impartiality that the ear can scarcely detect any difference between the effectiveness of reproduction of one note and that of another. Secondly, the range of notes which may be effectively reproduced has been extended from about $3\frac{1}{2}$ octaves to approximately $5\frac{1}{2}$, nearly $1\frac{1}{2}$ octaves being added at the lower end of the scale and about $\frac{1}{2}$ octave at the higher end.

Effects of Electrical Recording.—These improvements were effected chiefly through the substitution, for the former mechanical linkage, of an electrical linkage between the diaphragm receiving the initial sound waves and the stylus recording their equivalents on the wax record. This electrical linkage consists of a vacuum tube amplifier and associated circuits, its purpose being to increase the power delivered by the transmitter whose diaphragm receives the initial sound. This increased power is used for operating the recording stylus. It is, therefore, no longer necessary to design the receiving diaphragm and the mechanism for driving the recording stylus with a view to their sensitivity; instead, the objective is to ensure that they follow, with maximum faithfulness, the vibrations of the initial sound waves. The above applies to the making of records in large auditoriums, as well as in the studio.

Reproduction.—Progress has likewise been made in the reproducing of the sound from the records. The vacuum tube amplifier (*see* AMPLIFIERS) may be used also in the linkage between the device operated by the needle following the grooves of the record and the diaphragm creating the sound waves for the listeners' ears. The sound may thus, if desirable, be greatly magnified. In the home, however, where this magnification is not necessary, a mechanical reproducing system in which great improvements have also been effected, is sufficient and simpler.

Material.—Another major improvement concerns the material and manufacture of the finished record, whereby the surface noise or " roar " has been materially reduced. In some cases this has been effected by laminating the record, the body consisting of a cheap, hard material to which adheres paper coated with the high-grade grooved material.

Result of New Methods.—By reason of the improved methods of making the records, the artists are now free to perform in a more natural manner than formerly, and at such a distance from the " pick-up " device that the normal reverberations from the studio walls may be duplicated in the recorded sound.

Figs. 1 and 2 on plate show, respectively, a group of artists recording by the old method and the same group recording by means of the electric process. It will be noticed in fig. 1 that the artists were grouped very closely about the horn. Only two of the violins were of standard construction, the rest being of the type known as the " Stroh," strung in the manner of a violin but so arranged that the bridge vibrates a diaphragm attached to a horn. This horn was directed toward the recording horn, as shown by the player in the foreground. With such an arrangement of musicians, it was very difficult to arouse the spontaneous enthusiasm which is necessary for the production of really artistic music.

In fig. 2 the musicians are sitting at ease more nearly in their usual arrangement, and all are using the instruments which they would use were they playing at a concert. Furthermore, the pick-up device is now sufficiently far away from the orchestra to receive the sound in much the manner that the ears of a listener in the audience would receive it. In other words, it picks up the sound after it has been properly blended with the reflections from the walls of the room. It is in this way that the so-called " atmosphere " or " room-tone " is obtained.

Effective Limits.—The range of effective sound reproduction has now been increased virtually to the limits inherent in the material from which records are made. The limit at the lower end is fixed by the fact that a very low frequency note will cause the recording needle to cut from one groove into an adjacent one

(or, in a vertical cut, will penetrate so deeply as to tear the wax instead of cutting away with a clean surface), while, at the upper end, it is fixed by the cuts in the record becoming so fine and sharp that the reproducing needle will not follow them. The increase in effective range of notes recordable by the new process has resulted in the virtual elimination of metallic tones, characteristic of the earlier phonographs, and of the muffled quality of higher notes, provided the reproducing machine covers a similar range. The sibilants, also, which failed formerly to make themselves heard, may now be reproduced naturally.

The latter two improvements are due to the accurate recording and reproducing of the higher harmonics, vibration frequencies

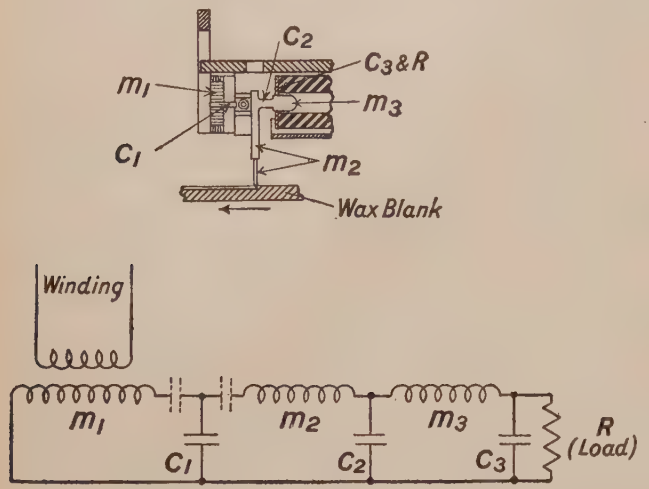

FIG. 1.—The inductance labelled m_1 represents the mass of the armature which, when acted on by the magnetic field, forms the driving portion of the mechanical system. The condenser c_1 produces the flexibility of the shaft connecting the armature to the stylus holder; m_2 represents the mass of the stylus holder and stylus; c_2 the flexibility of the shaft connecting the stylus holder with the metal piece which fits into the rubber damping element; m_3 the mass of this metal piece; and c_3 and R represent the properties of the damping element. The two condensers shown dotted and unlabelled represent the effect of the magnetic field on the armature and the restoring force of the balancing springs which hold the armature in its central position.

up to 6,000 cycles per sec. being successfully recorded, *i.e.*, about ½ octave above the highest note on the pianoforte. The elimination of metallic sounds is due to accuracy in recording and reproducing low notes and to the impartiality with which the various notes are treated. In the earlier machines, the fundamentals of the lower notes failed to be reproduced, but the ear of the listener, hearing the higher frequency harmonics of these notes, added the fundamentals, although the result lacked " body " and sounded " tinny." Were it not for this constructive faculty of the ear, the older phonographs and loud-speakers would have been useless. With the recently attained accuracy in actually reproducing the fundamentals of tones as low as 100 cycles per sec. (1½ octaves above the lowest note on the pianoforte), the result has gained remarkably in naturalness.

Recording Methods.—Fig. 1, a diagrammatic sketch of one of the recording instruments and of the equivalent electric circuit, shows the manner in which the recording needle is controlled in response to the voltage fluctuations set up by the sound-receiving diaphragm. This instrument is a mechanical filter of the low pass type, providing the two undesignated condensers are omitted. In this particular case the filter has three sections and a terminating resistance. In designing mechanical analogues of such a system, the problem presented is threefold: first, that of arranging the parts so that they form repeated filter sections; second, determining the magnitudes of these parts so that the separate sections all have the same characteristics; third, providing the proper resistance termination. The necessity of meeting these three conditions simultaneously probably prevented the solution of this problem by cut-and-try (non-scientific) methods. The credit for the use and design of such mechanical analogues for this purpose is due in large part to H. C. Harrison.

Such a filter when properly designed will secure a sensitiveness at the various pitches represented by curve A in fig. 2. The actual recorder, however, owing to the presence of the two undesignated condensers shown in fig. 1, has a loss of response at the low pitch end as indicated by curve B (fig. 2). This loss is unfortunately necessary in order to avoid the large amplitudes which accompany the low pitched notes and which would cause the trace on the record to cut from one groove over into its neighbour.

Systems Employed.—Many early attempts were made to design mechanical transmission systems having a wide frequency range in which highly damped single or multi-resonant systems were employed. In these attempts both of the obvious methods of increasing the damping were used, namely, that of adding a resistance to the system and that of increasing the value of the compliance and decreasing mass in such proportion as to maintain the same natural frequency. The results of these two methods are shown in fig. 3. The former reduces the sensitivity of the system at the point where it is most efficient (curve B as compared with curve A, which represents the response of the singly resonant system chosen for illustration). The second method increases the response at the points where the system is less sensitive, namely, away from its resonance point (curve C, as compared with curve A). Curve D represents the response when a band pass type of system is used whose resistance impedance is the same as that of the system shown in curve A.

Some of the earlier attempts to improve the range of reproduction employed multi-resonant systems. The results of the filter theory have shown how these resonances should be coordinated so that, when a proper resistance termination is used, high efficiency and equal sensitivity are obtained over a definite band of frequencies by elimination of response to all frequencies outside the band. With either the electrical or the mechanical

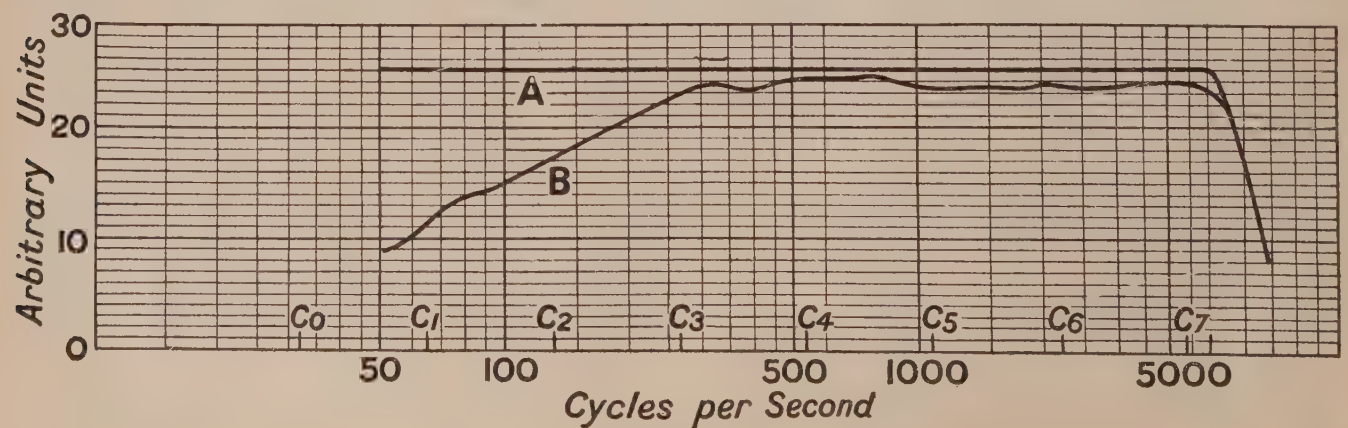

FIG. 2.—Curve A shows the response, that is, current, in the series branches of a low-pass filter as a function of pitch. Curve B shows a calibration of one of the recording instruments.

FIG. 1. Scene in recording studio, showing the means required with the older phonograph to create the necessary power for marking the record. The artists are grouped closely about the horn, and the weaker instruments (violins) are specially equipped with amplifying horns. FIG. 2. Studio scene, for recording by means of newer devices. The artists, playing naturally, are at a distance from the receiver, which picks up the sound after it has been properly blended with reverberations from the walls of the room.

(Courtesy of Victor Talking Machine Co., Camden, N.J., and the Amer. Inst. of Electr. Eng.)

case of a repeating filter, each section considered by itself resonates at the same frequency, but when combined into a short-circuited filter of n sections there will be n natural frequencies. However, when such a system is terminated with a resistance

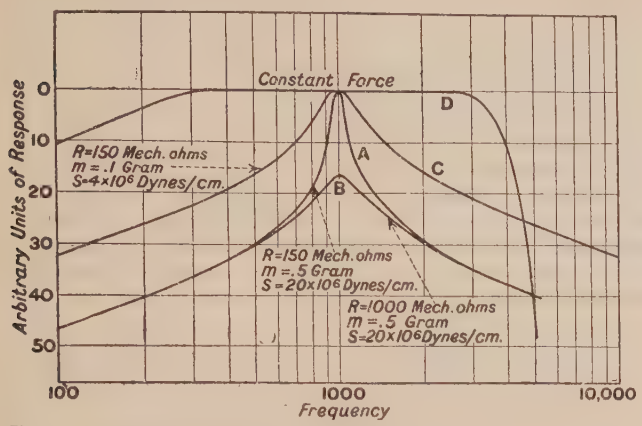

FIG. 3.—Diagram showing response for various values of mechanical constants.

which equals the nominal characteristic impedance in the transmission band, uniform response in the terminating resistance is obtained over the entire band.

New Phonograph.—Fig. 4 shows a diagrammatic sketch of the mechanical system of the new phonograph, while fig. 5 shows the equivalent electrical circuit. From these diagrams it is evident which units in the mechanical system correspond to the various electrical parts. As the series flexibilities c_2, c_4 and c_6 have been made so large that the low frequency cut-off caused by them lies well below the low frequency cut-off of the horn, an inappre-

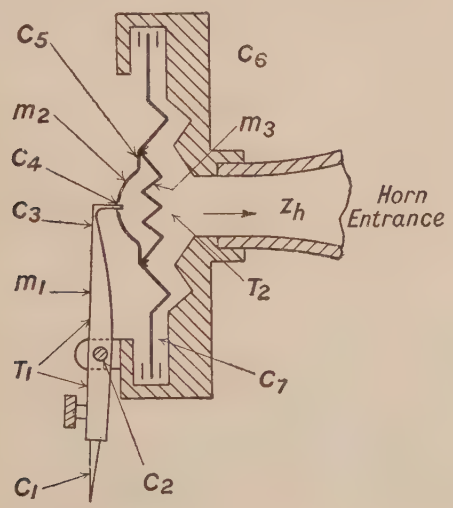

FIG. 4.—Diagrammatic sketch of the mechanical recording system of the phonograph.

ciable error is introduced in using for design purposes formulae of low-pass filters.

The two formulae which have been used are as follows:—

$$f_c = \frac{1}{\pi}\sqrt{\frac{1}{mc}} \quad (1) \qquad z_o = \sqrt{\frac{m}{c}} \quad (2)$$

where f_c = cut-off frequency of a lumped transmission system in cycles per second, c = shunt compliance per section in centimetres per dynes, m = series mass per section in grammes, z_o = value of characteristic impedance over the greater part of the band range. This may be called nominal mid-shunt or mid-series impedance. Their actual values in the transmission band being at any frequency f, mid-series $= z_o\sqrt{1-\frac{(f)^2}{f_c}}$ mid-shunt $= \frac{z_o}{\sqrt{1-\frac{(f)}{f_c}}}$

Equations (1) and (2), which form the basis of the design work, contain four variables, f_c, c, m and z_o. It is, therefore, necessary to determine two of them by the physical requirements of the problem, after which the other two can be determined mathematically. The upper cut-off frequency f_c was arbitrarily chosen at 5,000 cp. as a compromise between the higher frequencies occurring on the record and the increase in surface noise as the cut-off is raised. The choice of the other arbitrarily set variable came after considerable preliminary experimenting, and was fixed by the difficulty of obtaining a diaphragm which is light enough and has a large enough area. Hence the effective mass of the diaphragm m_3 (figs. 4 and 5) was fixed at 0·186 grammes, which value can be obtained by careful design. The effective area can be made as large as 13 sq. centimetres.

Design of the Horn.—By the proper use of these two formulae with the two arbitrarily set variables it has been possible to determine mathematically the magnitude of the parts comprising the mechanical system. When this design is complete there still

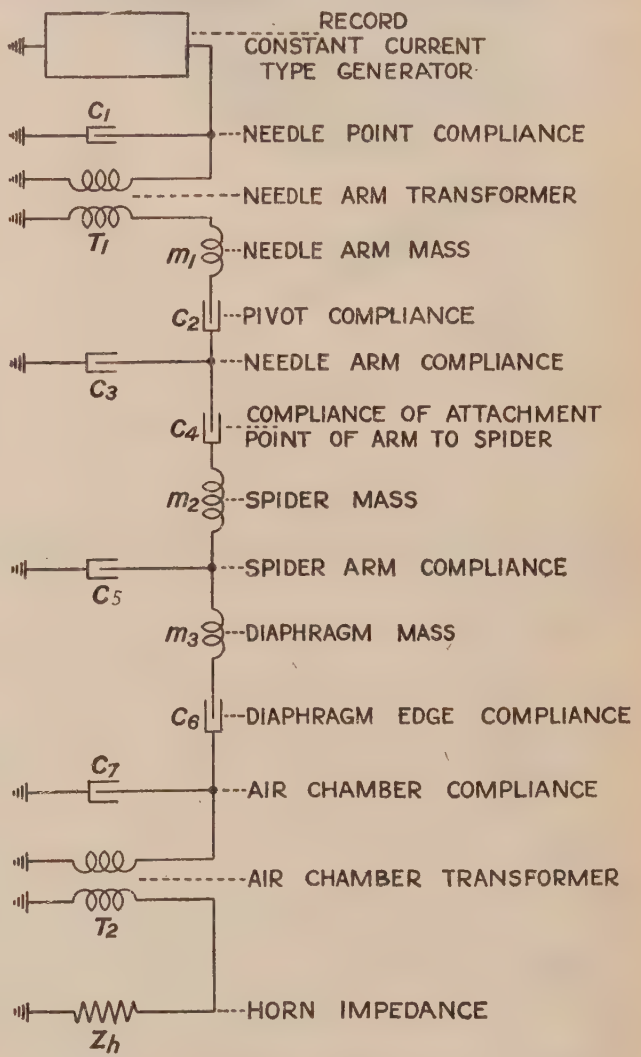

FIG. 5.—Electric equivalent of the system shown in fig. 4.

remains the terminating resistance, z_h, of figs. 4 and 5. This is supplied by the horn, which has been made of the logarithmic type. Certain general properties of logarithmic horns have been understood for some time.

There are two fundamental constants of such a horn—the first is the area of the large end and the second is the rate of taper. The area of the mouth determines the lowest frequency which is radiated satisfactorily. The energy of the frequencies below this is largely reflected if it is permitted to reach the mouth. From the equations given by Webster,[1] it can be shown that all logarithmic horns have a low frequency cut-off which is determined by the rate of taper. If the rate of taper is so proportioned that its resulting cut-off prevents the lower frequencies from reaching the horn mouth, the horn will then radiate all frequencies reaching its mouth and very little reflection will result. It is, therefore, possible to build a horn having no

[1] Much credit is due to P. B. Flanders, who carried out the mathematical investigation of these relationships; and to A. L. Thuras, who developed a method of checking experimentally the mathematical theory.

marked fundamental resonance. Since the characteristics of the horn are determined by the area of its mouth and by its rate of taper, the length of the horn is determined by the area of the small

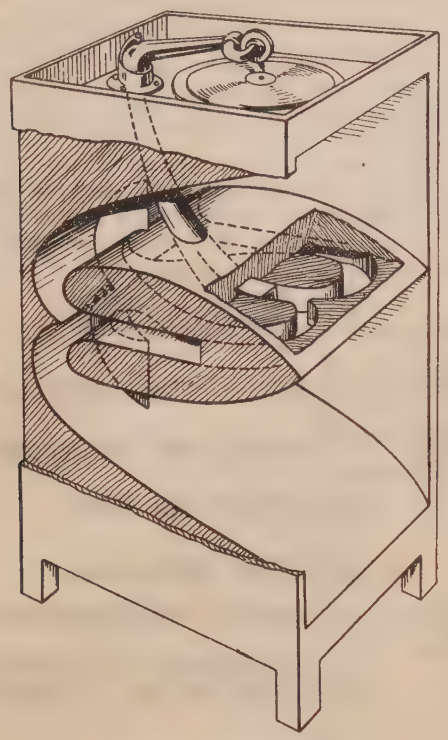

FIG. 6.—Sectional view of folded horn.

end. This area is determined in turn by the mechanical impedance and effective area of the system which it is terminating. It is seen, therefore, that the length of the horn should not be considered as a fundamental constant.

An interesting feature of the horn which has been built commercially is its method of folding. The sketch in fig. 6 shows a shadow picture of the horn. It will be noticed that the sound passage is folded only in its thin direction, which permits the radius of the turns to be small and thereby makes the folding compact. Fig. 7 shows the sensitiveness at various pitches of a phonograph designed as described above with a logarithmic horn whose rate of taper and area of mouth opening place the low cut-off at about 115 cycles. It also shows a similar curve for one of the best of the old style phonographs. Curve A represents the new machine, while curve B represents the old style machine. With this new equipment, it is easily possible for a listener to receive the full artistic effect of the music which is being reproduced, and with certain types of music it is no exaggeration to say that he may have the feeling of actually being in the presence of the artist. (*See* SOUND.)

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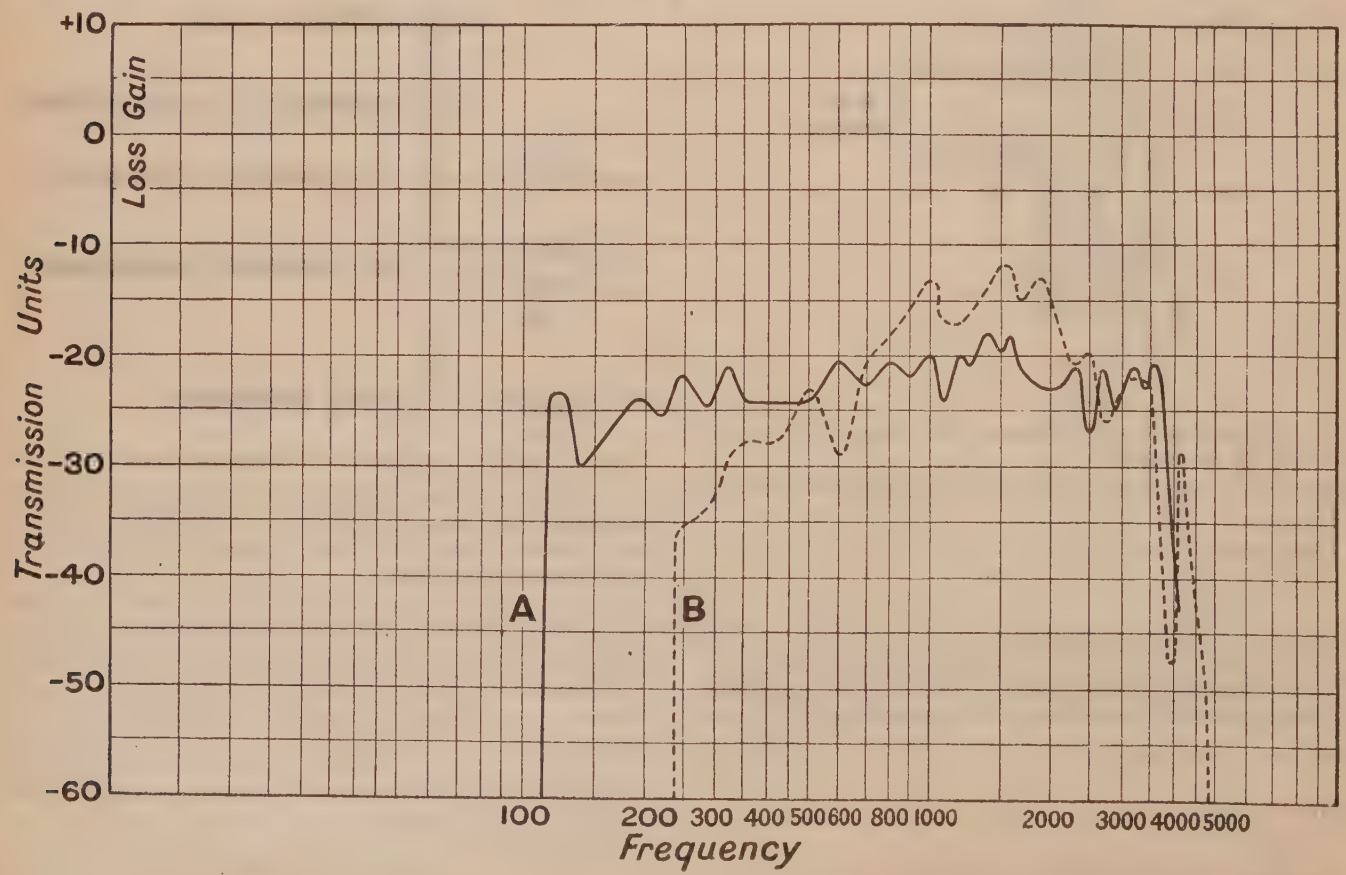

FIG. 7.—Curves showing sensitiveness at various pitches for the old and newer phonograph. Curve A represents the performance of the band pass filter type and curve B of the oldstyle machine.

PHOTOELECTRICITY.—Hertz noticed in 1887 that an electric discharge passed more easily between two neighbouring conductors when the negative electrode was illuminated by an electric spark. Hallwachs and others demonstrated that an insulated metallic conductor loses negative electricity when illuminated by light of short wave-length. This loss, observable in vacuo as well as in gases, is known as the photoelectric effect. It is proportional to the intensity of the illumination and to the time for which it acts. It varies with the wave-length of the light, and for each metal there is a wave-length for which the effect is produced. For the alkaline metals this critical wave-length is in the visible part of the spectrum.

Towards the close of the 19th century Sir Joseph Thomson and Lenard showed by exact experiments that negative charges were formed by the emission of electrons, and that the photoelectrons thus projected possessed a relatively small velocity (of the order of 10^7 cm. per second). Curie and Sagnac proved a similar phenomenon in the case of Röntgen rays.

C. T. R. Wilson showed later that ionisation in gases through which X-rays pass is really due to the formation of ions within the gaseous medium, by the rapid photo-electrons removed from the molecules under the influence of radiation.

All electronic emissions can be measured as to: (*a*) the number of corpuscules emitted per unit of time, and (*b*) their individual velocities. Investigations to determine these values in the case of photoelectrons showed that although the intensity of the exciting radiation affects the number of electrons emitted, their maximum velocity is entirely unaffected (Lenard), this latter quantity, or rather the energy of each corpuscule (Richardson, Hughes, Compton), depending solely upon the wave-length of the rays employed, and being a linear function of the frequency of the exciting radiation. This law, the extent and scope of which has been pointed out since 1905 especially by Einstein, is bound up with the quantum theory of light. (*see* QUANTUM THEORY).

Denoting the frequency of the exciting rays by ν and Planck's constant by h, the following relation for the energy of the electrons holds:—

$$\tfrac{1}{2}\, mv^2 = \mathrm{V}e = h\nu - k. \qquad (1)$$

Where the velocity of the photoelectrons is sufficiently great to cause a variation of their mass with kinetic energy to be appreciable the above relation must be written in the form:—

$$h\nu = m_0 c^2 \left(\frac{1}{\sqrt{1-\beta_2}} - 1 \right)$$

From the numerical point of view it is convenient to express the electronic energy ($\frac{1}{2}mv^2$ when the velocities are insufficient to cause the variation of the mass to intervene) in the form eV, where e is the electronic charge and V the difference of potential required to impart the energy to the electron. The electronic charge being constant, it follows that each electronic velocity is characterised by a definite voltage, and we may write the quantum relation (1) in the form:—

$$\mathrm{V} = \frac{12{\cdot}345}{\lambda}$$

where V is expressed in volts and the wave-length λ in Ångström units.

Consideration of the relation (1) shows that the slope of the straight line representing the relation between the energies of the frequencies, is exactly equal to Planck's constant h, and moreover the phenomenon must present a threshold when the frequency of the exciting radiation is just sufficient to overcome the work of extraction K.

The minimum frequency of the light required to produce a photoelectric effect proceeds continuously towards the red end of the spectrum as the illuminated body becomes more electropositive (alkaline metals): it was thus hoped to obtain for each body a critical frequency which would have been of significance. Unfortunately, parasitic effects due to contact differences of potential have prevented the exact determination of these constants.

Research has given to photoelectric phenomena a significance of increasing importance, since the loss of electrons which may be produced either by corpuscular shocks or by the emergence of radiation is, in reality, the preliminary excitation which conditions the emission of spectral rays by the atoms. (SEE ATOM; ATOMIC ENERGY.)

In the Rutherford-Bohr atomic model the electrons are imagined as rotating around a nucleus and divided into layers or levels characterised by their energy or emission. When a radiation of high frequency, such as X-rays, strikes an atom, it may communicate to an electron of the K layer, for example, energy equal to its quantum—that is to say, remove a photoelectron which possesses, on coming out of the atom, kinetic energy equal to the quantum of the incident radiation, diminished by the energy of emission. At the same time, the re-arrangement of the electrons which restores the atom to the normal state will be accompanied by the emission of the spectral series corresponding to the electronic layer involved.

In the case of rays of lower frequency (ultra-violet, visible light) the energy absorbed may carry the electron to a level further removed from the nucleus, without extracting it completely (resonance potential); when the quantum absorbed is sufficiently large the electron is expelled as in the case of X-rays (ionisation potential).

The study of photoelectric phenomena is simplified when the velocity of the electrons emitted is sufficiently great for them to travel an appreciable distance, thus rendering negligible the contact potential differences experienced in the case of solids and liquids. The action of high frequency rays like X-rays is therefore better known than that of the ultra-violet and visible rays, which can act only upon the superficial electrons of the atom, that is to say those feebly bound electrons which play such an important rôle in the phenomena of conduction, cohesion and chemical affinity. At the present day explanations of photoelectric phenomena start from the absorption of light by a Rutherford-Bohr atom obeying Einstein's law, and the phenomena first studied, the charge of illuminated conductors follow in consequence of this principle.

The emission of electrons produced by ultra-violet and visible light has been the object of much experimental and theoretical work. O. W. Richardson has considered the relation between photoelectric and thermionic effects particularly from the theoretical point of view. Millikan has studied the influence of the contact potential differences on the emission of electrons when different metals are illuminated in vacuo by ultra-violet rays.

Ever since the researches of Elster and Geitel, physicists (in the case of radiations of low frequency) have distinguished between a normal and a selective effect. In the case of the selective effect the intensity of the effects observed depends upon the orientation of the plane of polarisation of the incident light, so that if the liquid, sodium-potassium alloy for example, is illuminated, the maximum result is obtained when the electric vector vibrates in the plane of incidence.

The photoelectric effect is exactly proportional to the intensity of the light received, and this property is utilised in photometry by means of photoelectric cells—the current of which may be amplified at will. They furnish at the present day the most sensitive and precise instruments for measuring very feeble radiation intensities. Astronomical physics, in particular, makes great use of them.

Radiation may produce the ejection of electrons in matter under bombardment by a very different process; A. H. Compton has shown that the diffusion of X-rays may be accompanied by an increase of the wave-length (that is to say, a diminution of the quantum associated with the radiation) and at the same time by the emission of a " recoil electron " whose kinetic energy is exactly equal to the loss of quantum suffered by the incident radiation.

By this theory the encounter between an electron and a quantum of light is compared with a ballistic collision in which the energy and momentum are conserved.

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(DE BR.)

PHOTO-ENGRAVING (*see* 22.408).—This term is applied properly only to those photomechanical processes of reproducing pictures which print from a relief plate. This article, however, deals with similar processes which print from flat surface (planographic) and from sunken lines (intaglio). In Great Britain the term "process" is generally employed instead of "photo-engraving."

Essential Principles.—By sensitising a metal plate and by photographically printing an acid-resist on it, which protects certain areas, and then etching the unprotected parts with acid, a relief, or intaglio, plate is produced, which can be inked and mechanically printed. All photomechanical reproductive processes are based on the fact that pictures are made up of small grains or dots, whether they be of ink, of paint or of photographic emulsion. Concentration of these small grains or dots, bringing them closer together, gives, when printed, a solid colour, while distribution or scattering so that the grains are farther apart, gives a tone—a colour not solid, but tending in some degree toward white. Therefore, to reproduce solids or tone, it is only necessary to reconstruct a grain or dot formation on a printing plate or on a printing medium, which will transfer printing ink to paper in the same ratio of concentration as that which produced the tones of the original. Grain or dot formations differ in the numerous processes. Some are irregular as produced by gelatine colloids, resin or bitumen dust, while others are symmetrical, resulting from the ruled cross line half-tone screens.

Relief or Cameo.—Relief plates have their printing elements on a plane; the areas between them are sunken. Ink is applied to the surfaces by means of a roller and printing is effected by transfer of the ink from the relief areas to the paper. The printing elements vary in size, but all print with a uniform intensity.

Plano or Flat.—Planographic printing is done from metal, stone, gelatine or other suitable material, on which the image has been formed of a greasy ink. The surrounding areas, comprising the spaces between the grains or dots, have an affinity for moisture and when so impregnated reject greasy ink.

In printing, both water and ink rollers are used. The former keeps the un-inked surfaces damp, so the deposit from the ink roller will adhere only to the image to be printed. The materials used for some classes of planography are impregnated with ink repellents, such as mercury. These require no water roller, the repellent acting in its stead. As with relief plates the printing elements in planography print with uniform intensity, but they vary in size.

Intaglio or Sunken.—Intaglio plates have their lines, dots or grains sunken like grooves or cups. The printing ink is forced into the depressions and scraped or wiped off the surrounding higher areas. Printing is done with considerable pressure, usually on dampened paper, which sinks into the depressions and extracts ink from them. The depth of the grooves or cups is proportionate to the intensity of tone. The deposit of ink extracted from them varies therefore in thickness and, as it is transparent, yields a range of tone proportionate to its density. Unlike the other two groups, intaglio plates depend not upon the variation in size of the pointing elements but upon their different intensities.

Action of Light.—There are some 10 different photomechanical processes included in the three general groups, and many more subdivisions of each, but all have for their basis the phenomenon of the action of light, through a negative or diapositive, on a bichromated emulsion. Gelatine, glue, shellac, bitumen and other similar materials, in solution with ammonium bichromate or potassium bichromate, when spread on a supporting base and dried, are rendered insoluble in a ratio directly proportionate to the intensity of light to which they may be exposed. Relief and intaglio plates, which are etched, employ this principle to obtain an insoluble photographic image which will act as an acid-resist. All areas not so protected will be subject to attack by the etching acid. In planography, the insoluble areas retain ink and reject moisture, while the soluble hold moisture and reject ink. These principles are fixed, but their application varies in the different processes.

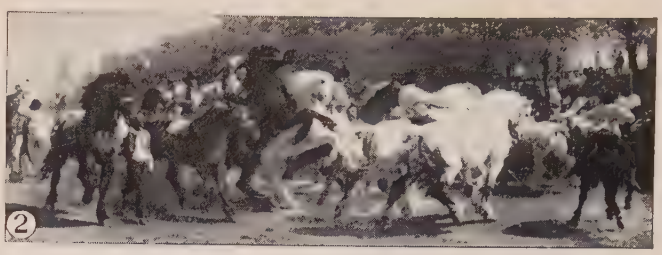
Photo-Engraving.—Photo-engraving comprises two classes of plates, line and half-tone, although there are many combinations and modifications of these two. A line plate is made from an original comprising definite lines, grains or dots of sufficient size to permit their being photographed, printed on metal and the areas between them etched. If the original comprises tones, as in a photograph or painting, then a half-tone must be employed to reproduce it. It is photographed through a ruled glass cross line screen, placed slightly forward of the photographic plate in the camera. The light from the original, forming the image, spreads in passing across this intervening space, producing dots which vary in size proportionately to its tones.

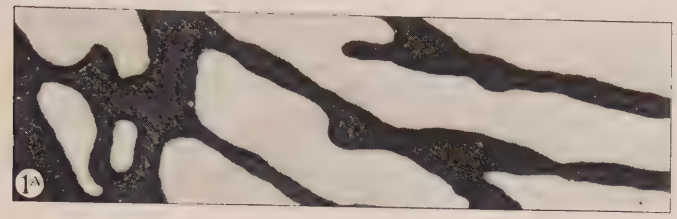
The metal, usually zinc or copper, is coated with a bichromated emulsion and the line or half-tone negative placed in contact with it and exposed to light. That which passes through the transparent areas of the negative renders the emulsion insoluble. The print is washed, removing all soluble emulsion, and heated, producing an insoluble acid-resist of all lines or dots as photographed. The areas between these are etched, leaving the printing elements in relief. Early relief processes included the swelled gelatine and the washed-out gelatine methods. In the former the gelatine was bichromated and printed from a negative. The soluble areas were then saturated with moisture and allowed to swell sufficiently to make an intaglio of the image, which was then moulded and electrotyped. The washed-out method required that the emulsion be printed in a similar manner, but the gelatine was thicker and the soluble areas were washed away to give the necessary relief for printing.

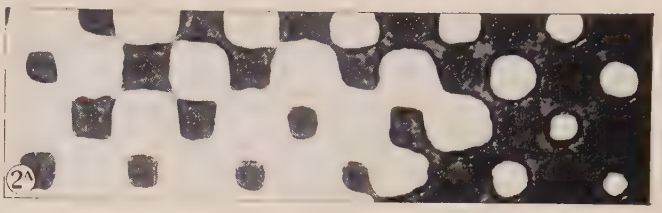
Photo-Lithography.—This art in its various branches comprises the entire photomechanical planographic group. Only when the lithographic stone is used as a base, is it lithography. When on metal it is called planography, and when on gelatine it is called collotype. The latter embraces such methods as Albertype, Artotype, Heliotype, Gelatine Printing, Aquatone and Sperati. The Sperati Process has the ink repellent incorporated in the base and requires no dampening roller.

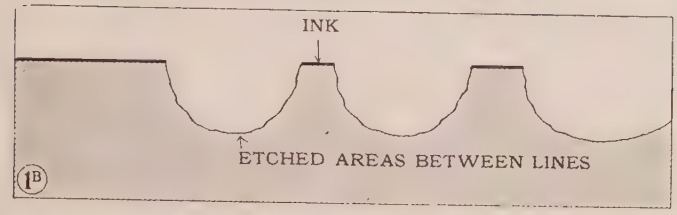
The general procedure in all planographic methods is to use a bichromated albumen or gelatine emulsion, printed from either a line, half-tone or continuous tone negative, only the insoluble areas retaining the greasy ink. The sensitised emulsion may be spread on the stone or metal before being printed, or may be printed on one base and transferred to another by means of transfer paper. In the Albertype, Artotype and other similar methods, the colloids of gelatine are employed to produce the tone variations, each colloid acting as an individual grain or dot. A development in the printing methods of planography is to print from the metal plate to a cylinder covered with a sheet of rubber called an offset blanket. This in turn prints on the paper the pliable blanket conforming under pressure to the inequalities of the paper. Aquatone employs certain features of three different methods. The base is a patented substance, bichromated, and printed from a line or half-tone negative. The printing is by offset.

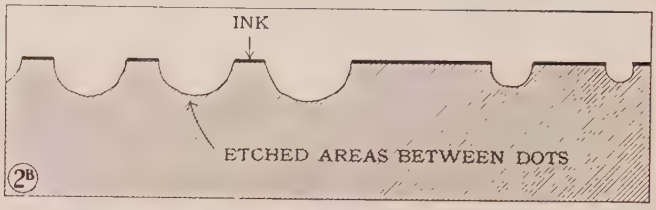
The Intaglio Group.—This group includes photogravure, rotagravure, with its many trade names such as rotogravure, alcogravure, art gravure and others, as well as photo-intaglio line engraving and photo-intaglio half-tone engraving. In each of the gravure methods a continuous tone (screenless) diapositive

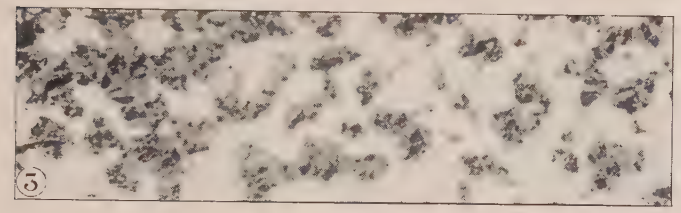


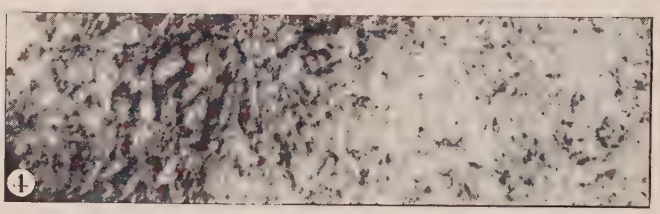


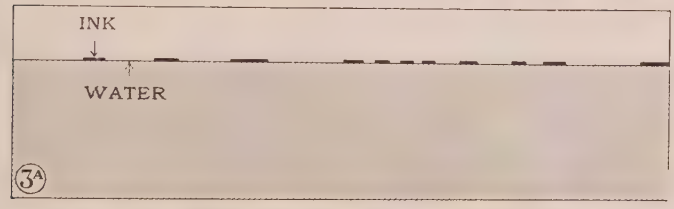


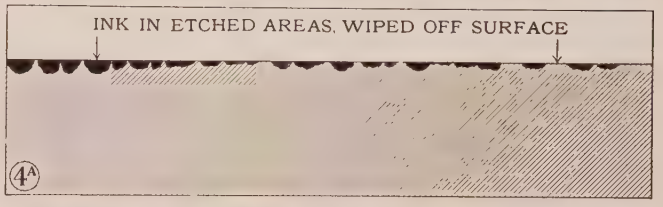


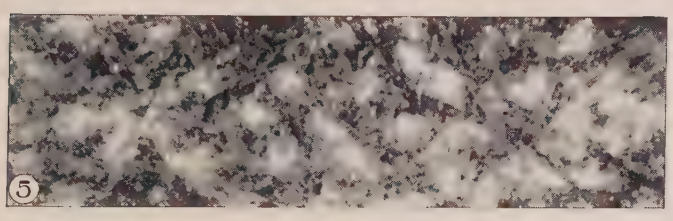


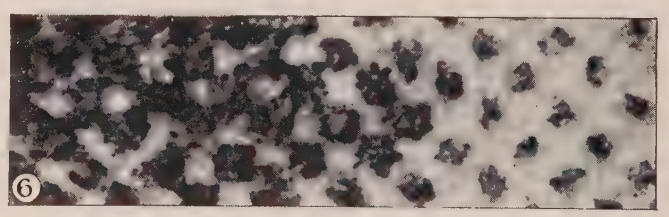


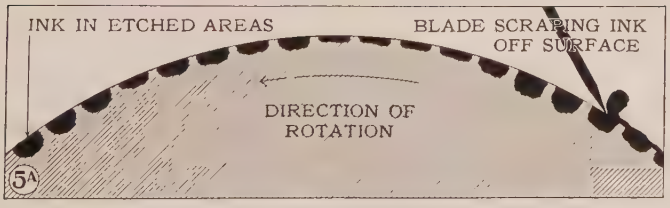












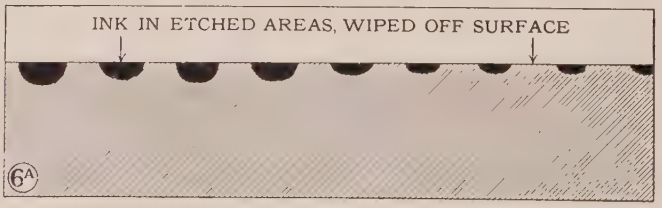


FIG. 1. Relief line impression. From pen-and-ink drawing.
FIG. 1A. Photo-micrograph of minute portion of fig. 1.
FIG. 1B. Magnification of cross section, line plate (foot of fig. 1A).
FIG. 3. Photo-micrograph of impression from lithographic stone.
FIG. 3A. Magnification of cross section of lithographic stone.
FIG. 5. Photo-micrograph of impression from rotogravure cylinder.
FIG. 5A. Magnification of cross section of rotogravure cylinder.

FIG. 2. Relief halftone plate impression. From photograph.
FIG. 2A. Photo-micrograph of minute portion of fig. 2.
FIG. 2B. Magnification of cross section, near foot, of fig. 2A.
FIG. 4. Photo-micrograph of impression from photogravure plate.
FIG. 4A. Magnification of cross section of photogravure plate.
FIG. 6. Photo-micrograph of impression from intaglio halftone plate.
FIG. 6A. Magnification of cross section of intaglio halftone plate.

Impressions from and magnifications of various Relief, Planographic and Intaglio printing processes. All photo-micrographs and drawings of cross sections are magnified about forty-five times.

is used instead of a negative for photographic printing. As the tonal ranges result from a variation in the depth of each dot or line rather than from their size, it is not necessary to use a half-tone negative. It is essential, however, to establish a cellular structure of grains or dots which may be etched in varying depth.

Rotogravure.—In this a special screen of transparent lines is first printed on a bichromated gelatine base mounted on a paper backing. The diapositive is then surprinted and the print developed by washing. The finished print is transferred to a copper cylinder and the paper backing stripped off. The image is represented by gelatine in varying thickness representing its tone range. While insoluble, the gelatine is porous, and in the etching the acid solution seeps through to attack the metal. The seepage is proportionate to the thickness of the gelatine, and a variation in etched depth results. The printing ink is quite fluid and is cleanly scraped off the surface by a thin, razor-edged blade, called a " doctor."

Photogravure.—In this the plate is flat, and a fine bitumen or resin dust is dropped on it until the metal is about half obscured, which is to say that the area of grains is about equal to the areas of exposed metal. The plate is heated, melting the grains and forming a resist called a " ground." The print is made on sensitised gelatine, developed and transferred to the prepared metal. The etching principle is similar to that employed in Rotogravure, but the spaces between the grains resolve into irregularly shaped cups which vary in depth. A somewhat stiff ink is forced into the depressions and wiped off the surface.

Photo-intaglio.—Photo-intaglio line engravings are etched after producing on the metal a resist made by printing from a line diapositive. Photo-intaglio half-tone engravings are similar in principle, but are printed from a half-tone diapositive. These methods differ from the rotogravure and photogravure in that the lines or dots, while etched into the metal, print with a variation in size but not in intensity. In different localities these various processes and methods are known by different names, hence it is impossible to classify them under a universal title, but they have all been described here under photo-engraving, and the subdivisions separately indexed under the descriptive titles generally employed. (*See* also PRINTING.) (H. A. GK.)

PHOTOGRAPHY (*see* 21.485).—In this article photography is treated under four different heads. The first is introductory and general covering, among other topics, amateur, professional and aerial photography, radiography and amateur cinematography. The second deals with photographic manufacture; the third, with colour photography; and the fourth is an account of the general principles of photography in the light of recent knowledge.

I. INTRODUCTORY AND GENERAL

Photography is now applied to very many fields. It is employed in astronomy—in which photographic has almost superseded visual observation—microscopy, spectroscopy and many other fields of science, for a discussion of which reference must be made to the corresponding articles.

Amateur Photography.—The use of photography for making personal records has extended very greatly since portable cameras and sensitive materials were introduced, and the tendency is continually towards a simplification of the work to be done by the user and a diminution in the amount of expert knowledge required to get good results. This has resulted in the establishment of commercial firms to develop and print photographs made by the amateur, so that the great majority of photographs are now taken by those whose knowledge of the subject is limited to that necessary for making the exposures. The cameras used are chiefly of the folding type using a cartridge of film and often of very small size.

The film can be loaded into the camera without the use of a dark room and removed after exposure for development. After an exposure has been made, an inscription may be written with a stylus on the red paper protecting the *autographic* film. The pressure of the stylus removes the dark-coloured wax from the " carbon " paper. An opening in the back of the camera where the writing is done is then exposed to light, which penetrates the translucent red paper and prints the inscription on the film. For development, the films are hung by clips in deep tanks and are then printed by artificial light upon gaslight or developing-out papers which are made in different degrees of contrast to suit the negatives obtained. As a general rule the photographic dealers will deliver prints from an exposed roll of film within two days. Enlargements are made upon bromide paper, frequently by means of enlarging cameras in which the focus is automatically maintained correct while the scale of magnification is varied (*see* fig. 1 on plate). In addition to roll films, films in packs are largely used, each separate unit having a tab of paper attached to it by which it can be withdrawn after exposure. A small number of cameras still use plates or flat cut out films in suitable holders.

Almost all the cameras used in amateur photography are designed primarily for use in the hand and are only occasionally used upon tripods. In addition to the small portable cameras, many amateur photographers use reflex cameras and folding cameras fitted with focal plane shutters. A number of makers have introduced lenses working at very large apertures f/2 and f/2·5 (*see* fig. 4 on plate) and special cameras fitted with these lenses have been used for photography in ordinary rooms and under poor light conditions (*see* OPTICAL GLASS). Such equipment is very valuable under extreme conditions, but has the limitation that large aperture lenses have little depth of focus and consequently must be focused very exactly if good results are to be obtained.

Professional Photography.—This may be divided into the two great fields of portraiture and commercial photography. Portrait photographers are tending more and more to work by artificial light, thus rendering themselves independent of the variations of daylight. Large units employing mercury vapour lamps, arc lamps and nitrogen tungsten incandescent lamps are now available. The materials used by the portrait photographer are plates or flat films. There is a growing tendency to make negatives not larger than 5 in. x 7 in. and to make the prints by projection. As a printing material, the gelatino-chloride printing-out paper has been supplanted almost entirely by developing-out papers. In England, bromide paper is very generally used, while in the United States a slower chloride paper is employed professionally, some grades of this paper having a long scale suitable for printing from the high quality, professional negatives. Portrait prints are no longer intended for insertion in albums and are supplied generally in card folders. Lightings are of the most varied type, and of recent years many unusual lightings have been introduced as a result of the influence of the motion picture upon the work of the professional photographer.

Commercial photography is now very wide in its field, a large number of advertisements being illustrated photographically and photographs often taking the place of samples in the hands of salesmen. Commercial photographs are printed usually upon glossy papers and are mounted upon linen in such a way that they can be handled and filed conveniently. They are not infrequently tinted by hand, a practice which has almost gone out of use for other fields of photography.

Aerial Photography.—Photography from the air is utilized for military purposes as well as for surveying. Its use during the World War was very extensive, thousands of negatives being taken every day by the armies. The first aeroplane cameras were modifications of standard cameras with usually a focal plane shutter, and the material was generally plates carried in holders and later in magazines adapted for quick changing. Hand-operated cameras using magazines were later developed and were used largely in 1916 and 1919. Later, semi-automatic plate cameras were designed in which the observer released the shutter while the mechanism operated the changing of the plates. In the last years of the War these cameras were made of very considerable size and weight, sometimes as many as 50 plates 18 cm. x 24 cm. in size being carried on a camera at one time. Towards the end

of the War film cameras were developed carrying rolls of film giving 100 exposures 18 x 24 centimetres. The great advantage of such cameras is, of course, the light weight of the material used. In 1918 entirely automatic film cameras were made, the changing of the film and the exposure being carried out by means of a motor, either electrical or driven by the wind (*see* fig. 3 on plate). In 1926 the automatic film cameras were used almost exclusively in the United States while plate cameras—either automatic or hand-operated—were still employed by the European air services.

From the photographic point of view the most important phenomenon encountered when working from a great height, as in an aeroplane, is the scattering of the light by the atmosphere, an effect which is generally known as *haze*. Since this scattering is greater for shorter wave-lengths of light, it can be eliminated to a considerable extent by the removal of the blue light and by the use of only longer wave-lengths. In order to accomplish this, the materials used are generally sensitive to red light, and filters can be used with satisfactory results as to exposure; under such conditions great penetration through hazy atmosphere is possible. Excellent photographs have been taken from the greatest height which an aeroplane can attain.

While aerial photography is an immense aid to the military both for the detection of enemy operations and also for the preparation of maps, its application to precision surveying is subject to limitations. It is not possible to note with sufficient accuracy the height and angle of the aerial camera for a map to be made without correction for errors, and consequently aerial surveying requires the provision of bases of known position on the ground which can be included and used to scale and correct the photograph. This limits its use in surveying (*q.v.*) since such measured bases are not always available. Nevertheless there are many purposes for which aerial surveying is very well adapted. A fire survey of a city can be made with sufficient accuracy by aerial photography at less than one-tenth of the cost of a corresponding ground survey. This makes it possible to repeat the fire surveys of rapidly growing cities at much more frequent intervals than could be done otherwise. Surveys of lakes and forests can be carried out by the aeroplane rapidly and with sufficient accuracy for many purposes. (*See* ARCHAEOLOGY: *Air Survey*; SURVEYING.)

Radiography (*see* RADIOTHERAPY; RÖNTGEN RAYS).—In this branch of photography very special conditions of work are involved. From its introduction in 1896, when X-rays were discovered by Röntgen, the field of radiography—almost entirely in connection with its medical application—has grown until at the present time approximately as many negatives are taken by means of X-rays as are made in portrait studies.

The earlier radiographs were made on plates of the same type as those used for portraiture; improvements were made by the introduction of large quantities of silver salt into the emulsion, while later attempts were made to load the emulsion by the addition of salts of other metals in such a way that the absorption of the X-rays would be increased and high sensitiveness obtained. There is reason to believe that these attempts were based on an incorrect understanding of the laws of the absorption of the X-rays. A considerable advance in the technique was made when double-coated film was introduced, a special X-ray emulsion being coated on both sides of the film, so that the image was formed half on the front and half on the back. In 1926 it was customary to use such films in combination with one or more, generally two, so-called intensifying screens. These intensifying screens consist of a layer containing calcium tungstate coated on a suitable support. The calcium tungstate fluoresces under the influence of the X-rays, transforming a portion of the X-rays into light which is active photographically. The general method of working, therefore, was in 1926 to expose the film in a cassette; that is, a holder in which the film is pressed into contact with an intensifying screen on each side.

One of the great difficulties in obtaining radiographs of good quality, especially when photographing through portions of the body of considerable thickness, is the presence of scattered radiation or secondary X-rays produced by the scattering of the primary X-rays in the tissues. Measurements have shown that the scattered radiation generally accounts for as much as three-fourths of the entire density of a radiograph taken through the body, and since this scattered radiation does not contribute to the formation of the image, it naturally produces a great lowering of contrast and general loss of detail and quality. The only method found to eliminate this is the use of what is known as the *Potter Bucky* diaphragm in which a number of strips of lead are adjusted so that they point toward the source of the X-rays. In order to prevent their forming shadows, the diaphragm is moved during exposure, and under these conditions the strips of lead cut out much of the scattered radiation, which is not proceeding from the source of X-rays but is scattered in all directions, and thus enable the image to be formed to a much greater extent by the direct X-rays coming from the focal point (*see* fig. 2 on plate). For dental work the film is supplied in special packages to be held inside the mouth, usually with a backing of lead foil to stop secondary radiation and to enable the package to be moulded to the shape of the mouth. Dental radiography has been extending very rapidly, and in 1926 radiographs of the teeth were among the most valuable guides to the operations of the dental surgeon.

Amateur Cinematography.—Cameras have been placed on the market by means of which amateurs can take motion pictures without the use of the elaborate and expensive apparatus employed by the professional cinematographer. Some of these cameras, while of small size, use motion-picture film of standard width (35 mm.) and differ from professional apparatus only in the short length of the film which they take and in their low cost. Cheaper forms of projectors taking standard film are also supplied for the use of amateurs, but the cost of the films and their development and printing have prevented any rapid extension of the use of this apparatus among the general public. Cameras have been introduced taking sub-standard film particularly intended for use in amateur cinematography. Two sizes have been introduced: In France, a film 9½ mm. wide has been introduced by the Pathé Co.: 30 metres are supplied in magazines for use in a small camera (*see* fig. 5 on plate), and the film after exposure is developed by the user or by photographic dealers by means of a reversal process which transforms the original negative into a positive which is then ready for use in a projector.

The Eastman Kodak Co. in 1923 introduced a film 16 mm. wide to make a picture approximately one-sixth of the area of standard pictures, and they and other makers have placed on the market cameras and projectors adapted to take this small size of film (*see* fig. 6 on plate). The film is packed with paper leaders attached to the end in a special form of light-tight packing so that it can be placed in the camera without the use of a dark room, and after exposure the processing is done by means of a special reversal process which transforms the negative into a positive ready for projection and which it is claimed enables errors in exposure to be corrected to a certain extent during the processing, a sufficient degree of latitude in exposure thus being retained. Duplicates can be made from the original positives, standard size film can be reduced to the 16 mm. size and the 16 mm. film can be enlarged to give pictures of standard size, although in doing this a certain amount of graininess in the resulting print is inevitable. The reversal process gives to the original prints very great freedom from grain, so that when projected they are entirely satisfactory upon the screen.

The cameras supplied for this branch of photography are usually portable and are motor-driven so that once threaded, they require no attention until the film is finished. For all these amateur instruments copies of theatrical films from various libraries are available for use in the home, and it is probable that such small and portable projectors may also find an application in the school and lecture-hall.

II. MANUFACTURE OF PHOTOGRAPHIC MATERIALS

The manufacture of photographic sensitive materials is a very specialised industry. Approximately 40,000 people are employed in the whole photographic industry throughout the world, about

FIG. 1. Autofocus enlarger; the size of the enlargement is varied by raising or lowering the lens, the focus being held automatically at the correct point. The negative is placed in the holder between the bellows and the lamphouse above it. FIG. 2. Radiographs made with (left) and without (right) the Bucky diaphragm. FIG. 3. Automatic aerial film camera with Zeiss Tessar lens. FIG. 4. Large aperture camera, taking pictures $2\frac{1}{4}$ in. by $3\frac{1}{4}$ in. on plates through 10 cm. focusing lens, working at f:2·0. FIG. 5. Pathé amateur motion picture camera, pictures 9 mm. by $7\frac{1}{2}$ mm. FIG. 6. Pictures 10 mm. by $7\frac{1}{2}$ mm. on 16 mm. film.

(Fig. 3. Courtesy of Fairchild Aerial Camera Corp., N.Y.)

20,000 being engaged in the manufacture of materials sensitive to light, with which this section deals, and the remainder in the manufacture of cameras and in the wholesale distribution of the products to the retailer.

With the introduction of the gelatine dry plate, the preparation of materials by photographers for themselves diminished very rapidly, and the manufacture of ready-prepared material took its place. The first dry plates appear to have been placed upon the English market in 1877. In 1880 the manufacture of gelatine dry plates was general in England and was commencing in Belgium, Germany, France and the United States.

The prototype of the modern photographic film was made by coating upon paper emulsion of the kind used for making dry plates, the paper negative being printed, generally after preparation with oil or wax to make it more translucent. In 1885 paper in a roll intended for making negatives was introduced together with a roll holder fitting the back of the existing cameras, the paper being coated on a special coating machine from which was derived the present film and paper coating machines. Later, paper was coated with soluble gelatine so that the gelatine emulsion could be stripped from the paper base, and finally in 1889 emulsion coated upon a flexible film support made of nitrocellulose was placed on the market. This film was first made by spreading upon a glass table a solution of nitrocellulose which when dried was coated with a substratum to make the emulsion adhere and then coated with gelatine emulsion, the whole film being stripped from the table and cut up for use.

In 1891 a method of packing the film to make it daylight loading was devised, this being done by winding it inside a protective sheet of black paper of such a length that the camera could be loaded without exposing the sensitive film to light, and in 1903 the film used in cartridges was coated on the back with gelatine so as to counteract the tendency to curl produced by the coating of emulsion on one side.

In 1885 the coating of bromide emulsion paper by a continuous coating-machine was commenced, and about 1890 gelatine-chloride printing-out paper was introduced by Abney. In this paper the sensitive salts were a mixture of silver chloride and silver citrate containing an excess of free silver nitrate and also free citric acid. A similar paper prepared with collodion as the vehicle instead of gelatine was known in the United States as *Aristotype* paper and in Europe as *collodio-chloride* printing-out paper. With these printing-out papers a visible image was obtained by printing under a negative in bright light for a considerable time, and this image was then toned by the deposition of gold before fixation. In 1897 chloride emulsion papers were introduced; they were made without an excess of silver nitrate and therefore were suitable for development in the same way as bromide paper but differed from bromide paper in that the salts produced by the reaction of the silver nitrate with the soluble halide were not removed by washing. These papers are about 200 times slower than bromide paper and are known in the United States as *developing-out* paper and in England as *gaslight* papers.

Until 1900 the photographic industry was carried on in small factories under the direct personal control of the owner. At the present time, however, photographic manufacture is organised chiefly in modern factories manufacturing on a large scale, and using specially designed machinery at every step of the process. In the largest of these factories, the output of motion-picture film alone exceeds 150,000 m. in a year. Nearly 5,000,000 lb. of cotton are used each year for the manufacture of film, and over three tons of pure silver bullion are used each week. The total power required exceeds 20,000 H.P., and the consumption of coal is over 500 tons a day.

The process of manufacture may be divided into three distinct sections: 1. The preparation of the base; 2. The preparation of the emulsion; 3. The coating of the emulsion on the base and the cutting and packing of the material so prepared.

Preparation of the Base.—Photographic glass is the specially selected, best quality of thin sheet glass made in a factory which prepares sheet glass for all purposes. Even under the best conditions only about a quarter of the sheets made are fit for photographic use, the remainder being used for glazing. Photographic glass is made very largely in Belgium in the factories near Charleroi, and in England at St. Helens. A considerable amount is also made in the United States. The glass is supplied cut to sizes which are multiples of those used by photographers. The glass arrives packed in straw in boxes holding usually about two gross sheets, and after unpacking and preliminary inspection, is cleaned by an automatic machine into which it is fed. The glass plate is received between rollers and passes through a strong solution of soda between revolving brushes which remove the dirt from the surface, and at the end of the machine is coated with a substratum, usually a weak solution of gelatine containing chrome alum, by means of which the emulsion is made to adhere to the glass. The glass is then dried in a heated oven, examined for defects, and if passed is packed in a tray and transferred to the coating-room.

In the manufacture of film base the first step is the preparation of cotton linters for nitrating, the treatment consisting of cleansing the linters very thoroughly and drying them. They are then nitrated in centrifugal machines and when they have absorbed the necessary amount of nitrogen—12–13%—the resulting nitrocotton is soused in water and the washing commenced. This washing is a long process, and is continued until the material is entirely free from absorbed acid, after which it is dehydrated, the water being displaced by the alcohol. The dehydrated nitrocotton is then dissolved in tumbling barrels or mixers in suitable solvents, those commonly employed being acetone and methyl alcohol, and at the same time the so-called softeners, such as camphor, are added, these resulting in a flexible film. The viscous nitro-cotton solution, which appears rather like honey, is known in the United States as dope. This is now spread out into a thin film by coating it on a travelling surface. In the United States the coating is generally done on to large wheels about four feet across and about 20 ft. in diameter which rotate slowly about their axes so that by the time one rotation is completed the solvents have been evaporated sufficiently to set the film, which can be stripped off the wheel, and dried further by passing through drums. The operation is thus continuous, the film base, as it is called, being prepared in rolls of about 2,000 feet. In Europe it is customary to coat a film about 24 in. wide upon a metallic belt from which the film can be stripped after one rotation in the same way as from a drum. The surfaces of these belts and drums must necessarily be prepared very carefully, the wheels being usually made with a highly polished nickel surface, while the makers of the belt machines recommend that they be coated with gelatine.

Non-inflammable Film.—Since cellulose nitrate is highly inflammable, supplying itself the greater part of the oxygen which it requires for combustion, there has been much work done on the preparation of film which is not inflammable. The most promising substance for this purpose is cellulose acetate prepared by treating hydrated cellulose with acetic acid and acetic anhydride in the presence of a suitable catalyst. Acetate film is slow burning, burning with about as much difficulty as thick paper, and should it catch fire it is very easy to extinguish. It has the disadvantage that on keeping it tends to dry out more rapidly than nitrate film and thus becomes brittle and while it is very suitable for use where proper precautions against fire cannot be taken, as where films are used in homes or schools, it has not the wearing qualities necessary for use in the motion-picture theatres, where the high speed of projection, the great heat of the projection lamps and the continued operation is a great strain upon the film.

During or after manufacture the film base is coated with a substratum to make the emulsion adhere and is then ready for coating. The thickness of the film base depends upon the use to which it is to be put. Base for use in the roll film cartridge is $3\frac{1}{4}$ thousandths of an inch thick; motion-picture film, $5\frac{1}{2}$ thousandths; and portrait and X-ray film used flat, about $7\frac{1}{2}$ thousandths.

Paper Base.—Photographic paper base is generally made by mills which specialise in its manufacture, the chief factories for

this purpose being in Belgium, France and Germany; but in the United States the bulk of the photographic paper base is made in the same factory where the rest of the production of photographic paper is carried on. The paper is prepared very largely from rag stock, although a small amount of wood pulp is sometimes added. After inspection the raw rag stock is washed and digested and is then treated in the beater until its preparation is such that it will make a homogeneous, strong sheet. The making is done on Fourdrinier machines, and the sheet is given a tub sizing in addition to the sizing given in the beater. Great care is necessary to exclude traces of impurities and especially of metals such as copper and iron from the paper stock.

The paper is usually given a coating of baryta before it receives the photographic emulsion. In this process a suspension of baryta (barium sulphate) in gelatine is coated over the surface of the paper, several coatings being sometimes applied, and not infrequently the paper is calendered after baryta coating in order to get a perfectly smooth glossy surface. Baryta coated paper is transferred to the emulsion coating-room in rolls of about 2,000 feet.

Emulsions—Emulsions are of two general types: washed and unwashed. Emulsions to be coated on glass or film are always washed. In the first case the precipitation of the silver salts is effected by adding a solution (about 10% in strength) of silver nitrate to a small quantity of gelatine dissolved in a solution of the halide salts which, in the case of negative emulsions, are usually potassium bromide containing a small proportion of potassium iodide. When precipitation is complete, the emulsion is digested in order to produce an increase of sensitiveness, and the bulk of the gelatine is added so that when cooled it will set to a jelly. Instead of increasing the sensitiveness of the emulsion by holding it at a high temperature for some time, it may be digested at a lower temperature in the presence of ammonia, and not infrequently the silver nitrate is precipitated with ammonia and then re-dissolved in excess before the precipitation of the halide is commenced. The set emulsion is cut up into small portions and is washed in running water in order to remove any excess of halide salts and also the soluble nitrate produced in the reaction. After washing it is given a final digestion and is ready for coating upon the base.

The emulsions used for printing papers are of three general types: bromide papers, which are made with a washed emulsion essentially identical with that used for coating upon glass and film for use in making lantern slides and positive motion pictures; unwashed chloride emulsions in which the emulsion is coated on the paper in the form in which it is mixed without any removal of the soluble salts by washing; and emulsions also made without washing but in which the silver salts are a mixture of chloride and citrate, and in which there is free silver nitrate present, these papers darkening visibly when exposed to light and thus giving a printed-out image which is toned and fixed.

Coating and Packing.—Dry plates are coated by passing them on a travelling belt under some device through which the emulsion is allowed to spread out over the surface of the glass. This may take the form, for instance, of a trough with a slit in the bottom or of a stepped weir down which the emulsion flows, reaching the plate by means of a flap which rests lightly on the surface of the plate. The coated glass travels forward on to a belt or rollers which are kept wet with ice-cold water, and there the emulsion sets. At the other end of the machine the plates are taken off, placed on the racks, and dried slowly and evenly. They are then cut to the requisite sizes by means of machines using diamonds and are packed in boxes of one dozen for supply to the market.

Paper is coated by passing from a stock roll around the coating roll which is immersed in about half its depth in a trough of emulsion, the paper as it travels upward carrying the emulsion with it until it passes over a large roll supplied with cold water, which chills the emulsion so that it sets, the setting being completed by passage through a refrigerated box. The coated paper then passes forward to a drying-room in which it is hung up in large loops varying in length from five to 20 ft., the loops travelling down the room continuously by means of a chain and the paper drying as it travels, so that at the other end the coated and dried paper can be reeled up into a roll. This roll of paper is then cut into sheets, and the sheets stacked on the top of each other are cut by means of guillotines into sheets of the size required for the market, each sheet being inspected for defects before packing.

Film is coated in almost exactly the same way as paper. Film for roll cartridges is coated with gelatine on the back to prevent its curling and is slit to the requisite width and then cut into the lengths required for the cartridges. The film is then spooled on to a core having metal ends so as to protect the edges of the film from light, the film being wound in with black paper or with red paper having an insert of "carbon" paper similar to that used for making duplicates on the typewriter, this type of film being known as *autographic*.

Film Packs.—Film is also supplied in film packs, in which the film is cut into sheets of the required size, and to each sheet is attached a tab, the tabs being numbered consecutively. A set of tabs is then assembled into a pack so that as each tab is pulled, the film is removed from the front of the pack, leaving the next film in position for exposure, the tabs being torn off and thrown away.

Radiographic Film.—Film of greater thickness, coated with gelatine on the back is used in the flat form in holders similar to those used for plates and thus is cut and packed exactly as plates. For radiography, film is coated on both sides with emulsion, since the X-ray can penetrate the emulsion with very little loss of density. For dental radiography small films are supplied in special packets ready for use without any further protection from the light.

Motion-picture Film.—Motion-picture film is slit from the original roll to the exact width required, 35 mm. in the case of standard film, and before packing is perforated on the edges in accordance with the standard gauge used for the cameras and projection machines. Motion-picture film comes on to the market in two general varieties: negative film used in the cameras and positive film on which the pictures are printed and from which they are projected. Negative film is supplied in ordinary and superspeed varieties and also made colour sensitive under the name of "panchromatic" film. Positive film is supplied either on nitrate base, that used most generally, or on acetate safety base, which is slow-burning. For amateur motion-picture photography the film is supplied in the United States and England, 16 mm. in width made on slow-burning acetate base only, and is supplied in lengths of 100 ft. packed with paper leaders at the ends and on a special protective spool so that the cameras can be loaded in daylight. This film is made to be reversed directly to a positive so that the same film as is used in the camera is employed for projection. (G. Ea.)

III. COLOUR PHOTOGRAPHY

The methods which are used at the present time for reproducing objects in colours by photography are dependent upon the suggestion made by Clerk Maxwell. According to Young's theory any colour may be considered to be due to the stimulation of the three primary sensations of red, green and violet. In order to reproduce any colour, therefore, we may analyse the different proportions of these three primary colours in it and then synthesise the colour by superimposing the three primaries upon a screen in projection. To illustrate this, Maxwell took three photographs of a coloured ribbon, one through a red solution, one through a green solution, and a third through a blue solution. From these three negatives, three transparencies were made which were projected each by means of the coloured light by which it was taken, Maxwell adding a fourth picture taken and projected by yellow light.

In 1869 Ducos du Hauron published a small book on colour photography in which he laid down the principles of three-colour photography, on which all later work has been based; and at approximately the same time Charles Cros published an article in which he had independently come to practically the same results. Du Hauron's book is astonishingly complete and contains a very clear account of the two fundamental processes of colour

LOWER MANHATTAN, NEW YORK CITY

An aerial view of the skyscrapers of lower New York, the financial centre of the city. The tower in the centre background is that of the Woolworth Building (792 ft. high)—except the Eiffel Tower, the tallest structure in the world. The large structure in front of it, the Equitable Building, is 485 ft. high and occupies one entire block. The tower appearing to the left of the latter building and partly hidden by it surmounts the Singer Building (612 ft. high). In front of the Equitable Building is the pyramid-like tower of the Bankers' Trust (539 ft. high) on the corner of Wall and Broad streets. From the upper right-hand corner of Battery Park (left foreground) runs Bowling Green, a small elliptical area from which Broadway begins and runs northward, although, in the picture, its course is completely hidden by buildings.

(Aerofilms, Ltd.)

WESTMINSTER: THE HEADQUARTERS OF THE BRITISH GOVERNMENT

The main thoroughfare in this aerial view of the centre of an Empire is Victoria street, running past Westminster Abbey which can be recognised by its two noble western towers. There England's kings are crowned and her illustrious dead are buried. Victoria street runs into Parliament Square and thence to Westminster Bridge which here crosses the Thames. The group of buildings to the right of the bridge and facing the river is the Houses of Parliament with the Clock Tower containing Big Ben at one end and the Victoria Tower at the other. Almost beneath the Clock Tower is the "Hall of Rufus" or Westminster Hall, where Warren Hastings was impeached. On the left, leading from Parliament Square, is Whitehall, in and around which are the headquarters of the various departments of the British Government. On the other side of the river are St. Thomas's Hospital, facing the Houses of Parliament, and, somewhat to the left, the new headquarters of the London County Council. Behind this can be seen the roof of Waterloo Station, which covers a greater area than any other of the London termini.

photography including their application by different methods. These processes are known as the " additive " (that employed by Maxwell) and the " subtractive " processes.

The practical development of colour photography was, however, delayed for many years by the difficulty that the photographic materials available were sensitive only to the blue and violet of the spectrum; it was with the greatest difficulty that materials sensitive to the visible spectrum could be obtained and with such materials very long exposures were required.

The introduction of colour sensitising by Vogel in 1873 first made colour photography possible, and the introduction of the isocyanine and carbocyanine sensitisers at the beginning of the 20th century made it practical. F. E. Ives was the first to develop Maxwell's process in practical photography. He took photographs through three dyed gelatine filters upon materials sensitised with the best dyes available at that time and projected the transparencies by means of triple lanterns devised for the purpose, these synthetic colour pictures obtained by the additive process giving extremely good colour reproduction upon the screen. He also devised the apparatus known by him as the *Kromskop*, in which the three pictures could be viewed superimposed upon each other and illuminated by light of suitable hue, so that a combined additive image produced by the three colours could be obtained without the use of a projection lantern.

Principle of the Subtractive Process.—The " subtractive " process, which was employed by Ives, depends upon the production of colours by subtractive absorption instead of by the addition of the colours to each other in projection. Suppose that over a sheet of yellow gelatine, which will absorb the blue light, is put a sheet of magenta gelatine, which will absorb the green light; then, since the yellow absorbs the blue light, and the magenta the green light, only the red light is transmitted; a red image can thus be obtained either by projecting it through a red filter or by putting a magenta image on the top of a yellow one. In the same way a green image can be obtained by putting a blue-green one on the top of a yellow one, when the yellow will cut the blue out of the blue-green and leave only green.

In working the subtractive process, the three negatives are printed in coloured dyes, the picture taken through the red filter being printed on gelatine dyed blue-green, the one taken through the green filter on gelatine dyed magenta, and the one taken through the blue filter on gelatine that was dyed yellow. Now, if the three are cemented together in register, the resulting transparent colour picture will reproduce the colours of the original subject and will be a transparency which can be viewed in the hand, or examined in front of an artificial light, or projected in a lantern.

Screen Plate Process.—In his book, Ducos du Hauron suggested one modification of the additive process which has since become of practical importance and is known as the *screen plate* process. He suggested that the surface of the glass plate or film might be covered with tiny filters—red, green and blue, the sensitive emulsion being coated on top of these and photographed through the filters. This was carried out in practice by Joly, who made plates by ruling alternate lines of red, green and blue-violet by means of a ruling-machine, and later by Lumière, who made the autochrome plates by covering the glass with starch grains dyed in the three primary colours.

In addition to the processes of ruled lines worked out by Joly and by MacDonough in Chicago, and the Lumière process, a process invented by Christensen dependent upon the use of dye particles of dammar emulsified in a suitable liquid has been exploited commercially in Germany, and plates have been made in England by printing the lines in bichromated colloids.

When such colloids as gelatine, fish-glue, etc., are treated with a solution of bichromate, dried and exposed to light, they become insoluble in water. If, then, a glass plate be coated with a solution of bichromated fish-glue, and the coated plate be exposed to light under a black line screen which allows only one-third to be exposed at a time, two-thirds being protected by the black lines, and then washed in water, one-third of the entire surface will be covered by lines of fish-glue, which can be dyed. After the dye has been mordanted to prevent it running, the plate can be recoated with glue, registered in position on the printing screen, and printed so as to get a second glue line which can be dyed in the second colour, provided that the first line has been protected from the action of the dye by coating it with a varnish or otherwise. The third line can be printed by exposing the plate through the back, when the first two lines will act as a screen for the third, and in this way we can build up a three-colour line screen.

In Germany, Krayn used thin sheets of coloured celluloid of the three primary colours and piled them on top of one another to get a pile of alternate layers of red, green and blue. By cutting sections down through this pile, sheets of celluloid made up of strips of each of these red, green and blue layers were obtained. Screens have also been made by mechanical printing or a combination of this with dyeing, and a number of other methods are possible and have been proposed for making the screens.

All the various processes of colour photography which have been described are applicable to motion-picture work, though, owing to the long exposures required and the loss of light by absorption, no practical process utilising the principle of the screen plate for cinematography has been developed. The motion-picture process, however, like other processes of colour photography, divided clearly into additive and subtractive processes, and, as in the case of the photography of stationary objects, the additive processes developed first.

Additive Methods.—In the case of motion pictures, there are two methods of additive synthesis. Either one may project on the screen the three pictures simultaneously, as is done in the triple projection lantern, or the colour units may be projected successively, relying upon persistence of vision for the blending of colours.

Kinemacolour Process.—The oldest practical cinematograph colour process is a two-colour process utilising persistence of vision for the addition of the pictures. By means of a rotating disc of colour filters placed in front of the camera, pictures are taken on panchromatic film alternately through a red and green filter, the pictures being taken at twice the normal speed, so that for each complete picture, two negatives are made, one through each filter. The positives from these negatives are projected through a machine, similarly equipped with a rotating shutter, which is made to operate synchronously with the picture, so that the pictures taken through the red filter are again projected through a red filter, and the green pictures similarly through a green filter. The succession of red and green pictures upon the screen produces complete synthesis by persistence of vision and gives the effect of a two-colour additive picture. This process is known as the *Kinemacolor* process and enjoyed a considerable success.

The Gaumont Process.—The most complete and satisfactory process of colour cinematography is undoubtedly the simultaneous three-colour additive process worked out in its complete form by Gaumont. Three lenses are used in the camera, and three pictures are taken through the primary colour filters upon the same strip of film. The positives are projected in a machine fitted with a corresponding pull down and gate, and with three condensers and three sets of objectives fitted with special registering devices. The results given by this process are admirable.

The Subtractive Process.—An advantage of the subtractive colour process is that the film so produced can be shown in any ordinary machine, and this advantage is even greater in the case of motion pictures than in the case of ordinary lantern slides. The obvious method of making subtractive motion pictures would be to make three negatives and to superpose the negatives upon each other in printing, recoating the film each time and using a dyed bichromatic process or a process in which the silver image is made to mordant the dye and so is transformed into a colour image. The recoating and re-registering, however, present very great difficulties in practice and would make the process very costly. The practical subtractive processes of colour cinematography use only two colours: these two colours may be either in the one emulsion layer, or in two emulsion layers on

opposite sides of double-coated film, a method which appears at the present time to offer considerable advantages in the direction of simplicity.

It is clear that since there are two sides to a film, it is possible to coat an emulsion on each side of the film and to print the red image on one side and the green on the other. This process has been worked out to a practical end in several ways, some of the colour images being produced by the mordanting of a dye upon an image obtained by the conversion of the silver into some suitable substance or by the imbibition of a dye into the gelatine or by toning by chemical means to coloured images.

Prizma Process.—Of the two-colour subtractive processes, the Prizma process, depending on the use of mordanted images, was successful for a number of years. This is a typical two-colour process, the red and green negatives being printed on opposite sides of double-coated film and the coloured images produced by mordanting dyes on to images obtained by replacement of the original silver image by materials capable of mordanting the dye.

Technicolor Process.—In the Technicolor process, the images on opposite sides of the film are gelatine reliefs prepared by printing through the back of thin films and then cementing the two films back to back, developing, bleaching and washing away the gelatine which during bleaching has been left soft as a result of the absence of an image. The gelatine relief so obtained is coloured with suitable dyes.

Kodachrome Process.—In the Kodachrome process positives are printed from the original negatives and these are printed on opposite sides of double-coated film to produce negative images. These silver images are removed by a solution which renders the gelatine impermeable where the silver grains were acted on by the solution. After fixing, washing and drying, the film is dyed on both sides in the appropriate colours, the dyes penetrating the permeable gelatine only where no negative image was present and thus producing a positive image consisting of pure dye.

IV. GENERAL PRINCIPLES

Modern photographic emulsions consist of a precipitate in gelatine of flat crystals of silver bromide, generally hexagonal or triangular in shape. These crystals have a cubic lattice, and the addition of iodide to the emulsion produces crystals in which the iodine replaces bromine directly in the lattice, and slightly increases the lattice spacing. The distribution of different sizes of crystals depends upon the method by which the emulsion is produced, and the properties of the emulsion depend upon that distribution (*see* fig. 1). The silver halide grains act as units both toward light and toward the action of the developer, so that each individual grain acted upon by light becomes developable when a sufficient amount of action has taken place, and it will be completely reduced by the developer; but the exposure of one grain will not affect any other grain unless the chemical action of development can spread by contact from one to the other (*see* fig. 2).

If we suppose that the same amount of photo-chemical product (latent image) makes either a large or a small grain developable, then, other things being equal, the larger grain contributes a larger amount of silver to the image and thus gives more density for the same amount of light action than a smaller grain. For this reason alone, emulsions containing large grains would be more sensitive than those containing small grains, but experiment has shown that this is not the only factor and that larger grains require less light action to become developable than small grains. Further it has been shown that the seat of this sensitiveness is concentrated in specks in the grains, and the sensitiveness of the grain depends upon the presence and the number of these sensitive specks.

Being different in nature from the silver bromide itself, it was suspected that the specks were derived from the gelatine, since some gelatines give emulsions which are much more sensitive than others. A material was extracted from gelatine which was identified by Dr. S. E Sheppard with allyl mustard oil, which in ammoniacal solution becomes allyl thiocarbamide. Allyl thiocarbamide reacts with silver bromide, and the compound of the two in alkaline solution produces silver sulphide, so that the sensitising specks may be ascribed to the presence of minute traces of silver sulphide on the surface of the silver bromide grain. The ripening process characteristic of the preparation of gelatine bromide emulsions may be ascribed partly to the development of grains of larger sizes from those of small dimensions and partly to the production of the sensitising specks of silver sulphide on the surface of the grain.

The exact action of light upon the grains is not well understood, though much research work is being done on the subject. For a discussion of the various theories which have been proposed, the literature must be consulted.

The photographic properties of an emulsion are expressed by its characteristic curve, the present form of which was originally suggested by Hurter and Driffield. In this curve, which is shown in fig. 3, the density is plotted against the logarithm of the exposure. The density is the logarithm of the reciprocal of the transparency ($D = \log 1/T$) and has been shown experimentally to be proportional to the mass of the silver per unit area. The amount of silver which will produce a density of unity, corresponding to a transmission of 1/10th of the incident light, is

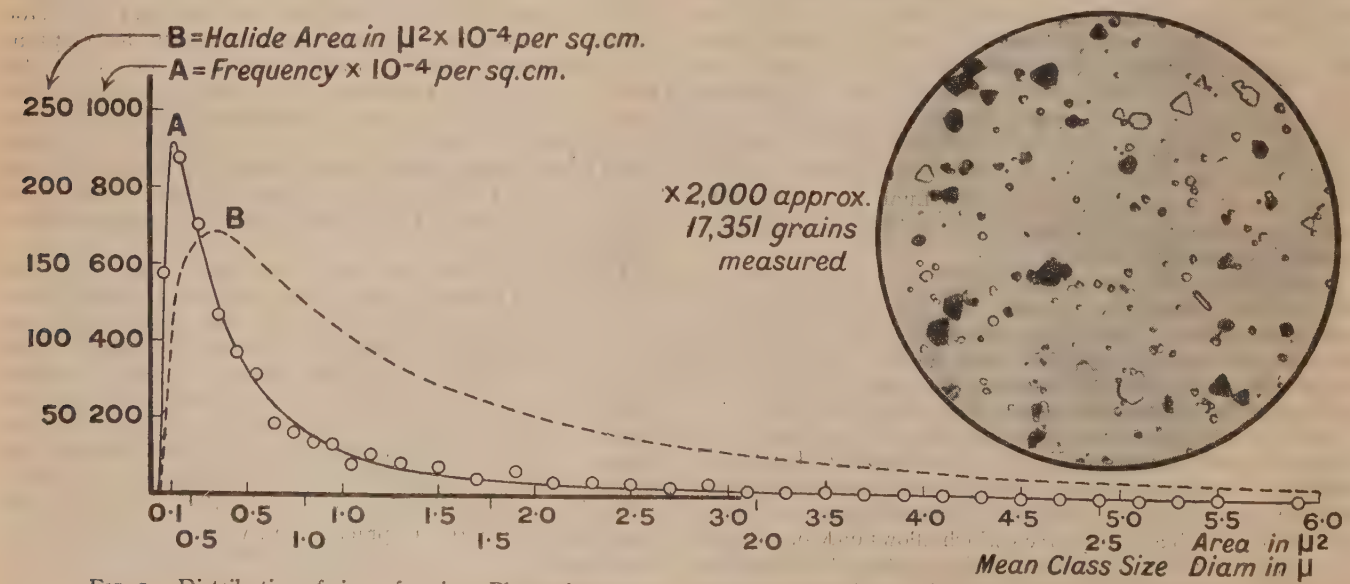


FIG. 1.—Distribution of sizes of grains. Photomicrograph of emulsion showing grains of silver bromide, developed and undeveloped, and curve plotted from measurement of such grains.

Three examples of direct colour photography. The top left-hand view is from a snapshot taken at 6.0. a. m. (Photographs by H. A. Key.)

termed the " photometric constant." For ordinary photographic emulsions about 10 milligrammes of silver will produce a density of unity on one square decimetre of surface. The curve obtained by plotting the density against the logarithm of the exposure shows three fairly well-defined regions: the initial part, convex to the log E axis, termed the region of *under-exposure*; the middle part, which approximates to a straight line, termed the region

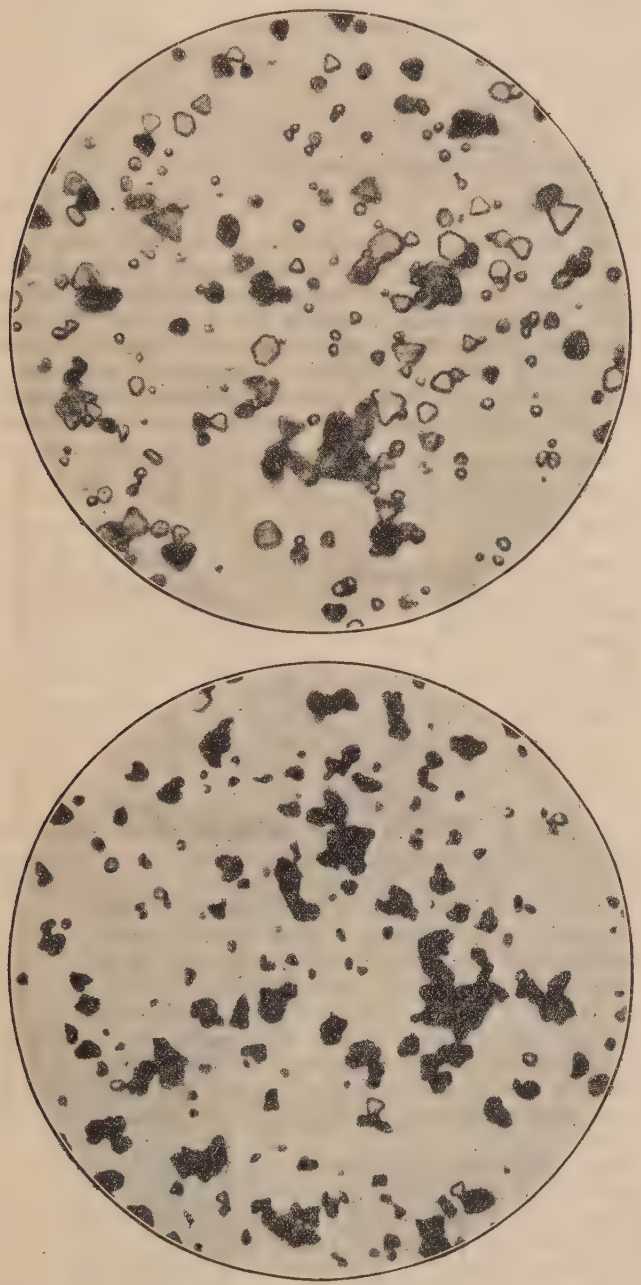


FIG. 2.—Undeveloped and developed silver grains. The undeveloped silver bromide crystals are transformed into amorphous black grains of metallic silver.

of *correct exposure;* and the upper part, concave to the exposure axis, termed the region of *over-exposure.* If we prolong the straight line portion to cut the exposure axis at a point I (this was termed by Hurter and Driffield [fig. 3], the *inertia of the material*) and the reciprocal of the inertia is taken as a measure of the sensitiveness of the material, the slope of the straight line portion, that is, the tangent of the angle θ, is termed the *development factor*, known in photography as γ.

The value of γ increases with time of development, the increase tending to a limit termed $\gamma\infty$ (gamma infinity), which measures the extreme contrast of which a plate is capable. We shall return to the significance of these quantities for photographic printing and reproduction later; meanwhile, we may note that the straight-line portion of the characteristic curve can be represented by the equation,

$$D = \gamma\ (\log_{10} E - \log_{10} i)$$

where E is the exposure (intensity of light $\times$ time) to light, γ is the development factor, *i.e.*, tan θ in fig. 3, and i is a constant,

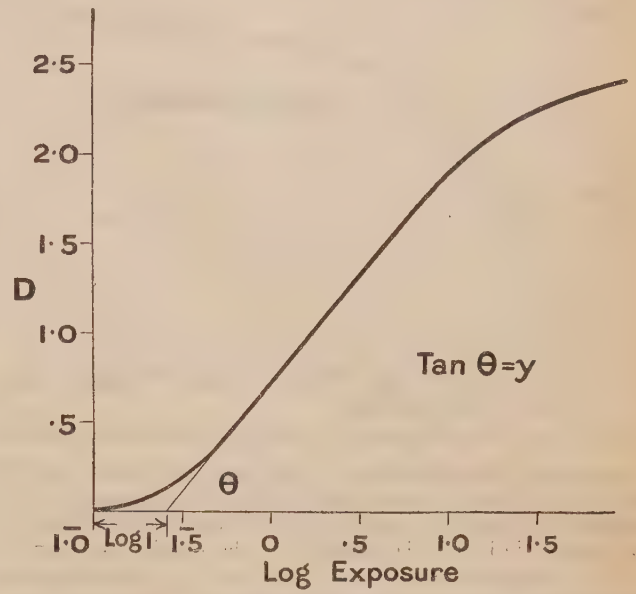


FIG. 3.—Hurter and Driffield curve. The density of the negative plotted against the logarithm of the exposure to show the characteristics of the emulsion.

the exposure at which the straight line cuts the axis. Although this equation can be regarded as only an approximation, it is a very useful one, furnishing a reference standard for the phenomena of both development and exposure. It will be seen that as long as this equation holds for different degrees of development $D = k\gamma$, E being constant, that is, any function representing change of density with degree of development will be true also for γ. This is expressed in Hurter and Driffield's Law of Constant Density Ratios. The normal manner in which the density and gamma change with time of development, if this law holds, is represented in fig. 4.

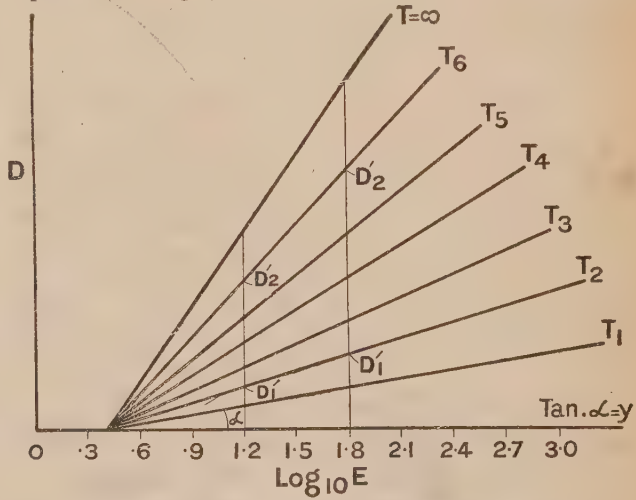


FIG. 4.—Change of density and gamma with time of development. As the time of development is increased, density and gamma increase.

The characteristic curves intersect at a point ($\log_{10} i$) on the $\log_{10}/E$-axis. The value of γ increases with time of development, but less and less as development proceeds, and ultimately reaches a limit which is characteristic of the plate but also depends to some extent on the developer. If we now develop (for different times) plates which have been given a series of exposures increasing in geometric proportion, measure the densities and plot the

resulting curves and then plot γ (or density D) as a function of time, we get a curve of the type shown in fig. 5. It will be seen that γ (and density) increase rapidly at first, then more slowly, finally reaching a limit.

Making certain simplifying assumptions, the mathematical function representing this curve can be obtained. Let us suppose,

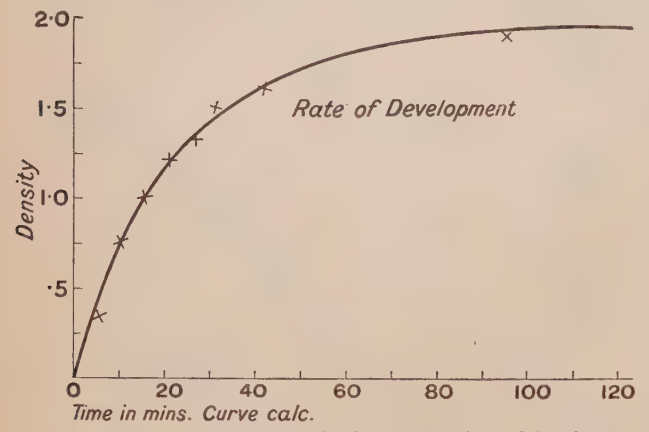


FIG. 5.—γt curve. Growth of γ with increasing time of development.

in agreement with the approach of the curve to a limit, that D^{∞}, the limiting density, corresponds to the total developable silver bromide for any fixed exposure. The density undeveloped at any time t will be $D^{\infty} - D$, where D is the density developed at time t. Supposing other factors—such as the concentration of the developer in the film, its rate of diffusion, temperature, etc.—constant, we can then put the rate of development, $\frac{dD}{dt}$, proportional to the *undeveloped* density *i.e.*, $\frac{dD}{dt} = k\ (D^{\infty} - D)$, where k is a constant. This equation gives on integration

$$k = \frac{I}{t}\log_e \frac{D^{\infty}}{D^{\infty} - D} = \frac{I}{t}\log_e \frac{\gamma^{\infty}}{\gamma^{\infty} - \gamma} \text{ or } D = D^{\infty}(I - e^{kt}); \gamma = \gamma^{\infty}(I - e^{-kt})$$

The constant k is termed the velocity-constant of development.

When bromide is present in a developer, the straight line portions of the characteristic curve when produced do not meet

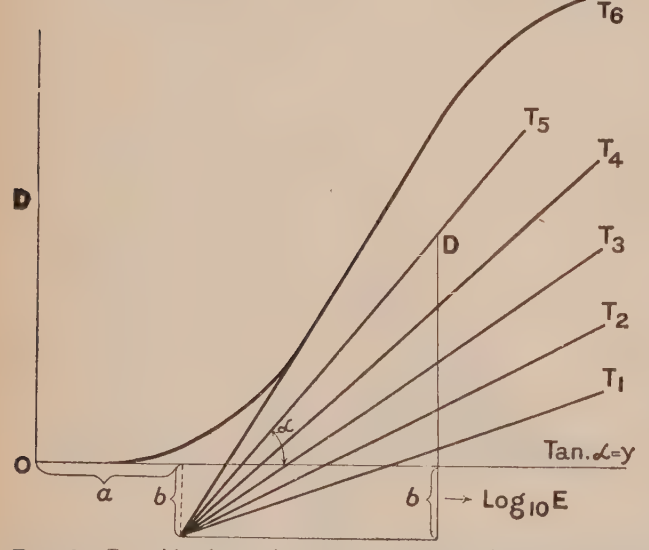


FIG. 6.—Bromide depression curve. Bromide in the developer causes a depression of the convergence point.

upon the exposure axis but at a point somewhat below it, the effect of bromide being equivalent to a constant depression of density in the straight line portion of the curve (*see* fig. 6.). This depression of the intersection point shown as b can be used for evaluating the action of bromide, and since an inverse functional relation exists between the reduction potential of the developer and the bromide concentration which will produce a given depression of the intersection point, a scale can be obtained expressing the relative energies of developers. The following table from A. Nietz gives what are probably the most reliable data.

	Relative Energy
ferrous oxalate	0·3
p-phenylene diamine, hydrochloride (no alkali)	0·3
p-phenylene diamine hydrochloride (alkali)	0·4
hydroquinone (standard)	1·0
p-phenyl glycine	1·6
hydroxylamine	2·0
toluhydroquinone	2·2
p-aminophenol (hydrochloride)	6·0
chlorhydroquinone	7·0
dimethyl p-aminophenol (sulphate)	10·0
monomethyl	20·0
diamidophenol	30·40

Since the inertia is expressed in exposure units (m.c.s.) its numerical value depends upon the light source employed in the measurement of the characteristic curve. Hurter and Driffield used originally the standard candle and then a pentane lamp; at the present time electric-light sources and acetylene burners are employed. The International Congress of Photography in 1925 recommended as the standard light source for photographic work the adoption of one visual candle-power of light of colour

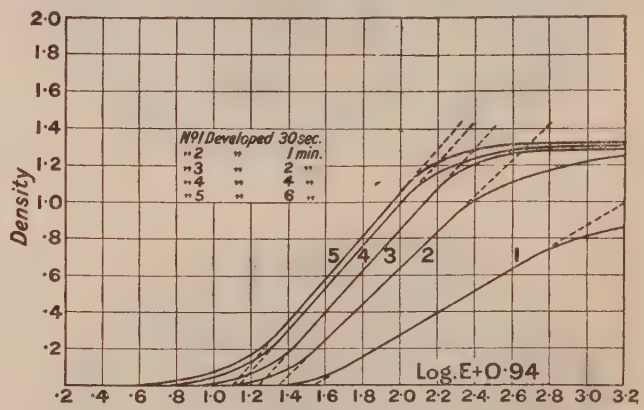


FIG. 7.—Characteristic curves of papers with increasing times of development. Increasing time of development produces regression of inertia without affecting γ except during induction period.

temperature 2,360° absolute. Many workers prefer to use a light which has been modified by passage through a filter which is reducing its quality approximately to that of sunlight, corresponding to a colour temperature of approximately 5,000° absolute. The so-called "H & D" speeds of photographic materials thus depend entirely upon the light source and other conditions used in testing, and the speeds given by one maker are not comparable on casual inspection with those from another source.

The photographic characteristics of printing papers can be measured by a procedure similar to that used for negative materials, but in this case it is not the mass of reduced silver which is of chief importance but its relative reflecting power. The reflection density is thus the logarithm of the reciprocal of the reflecting power ($D_s = \log_{10} 1/R$), the reflecting power being measured with illumination at 45° to the plane of the paper. The characteristic curve obtained with different times of development is shown in fig. 7, and it will be seen that the effect of increase in time of development is to produce a regression of the inertia without change in γ except in the very earliest stages, where the curves are usually of a distorted form. The following constants may be derived:—

Constant	Symbol	Significance
(a) Maximum (reflection density)	Dmax	Highest attainable density.
(b) Contrast element (reflection density)	$\frac{dD}{d\log_e I}$	Differential.
(c) Gamma element (reflection density)	γr	Value of (b) for straight-line portion, or at inflexion-point.

Constant	Symbol	Significance
(d) Latitude element (reflection density) . .	L	Range of intensities reproduced on straight-line portion.
(e) Rendering power (reflection density) . .	R	$\frac{10L}{S}$
(f) Total scale (reflection density)	S	Range of intensities reproducible by density differences.
(g) Standard exposure (reflection density) . .	Es	The exposure in m. c. s. necessary to print through a negative density of 2·0.

From a study of the characteristic curves of the materials used in making the negative and of the material used for printing the negative, the reproduction of the tones of the original subject in the photograph may be traced. By " tone " is understood the variation from light to shade in the subject or the gradation of luminosity apart from colour. This problem is the central one of photographic theory and is fundamental to practically every application. Physical tone may be taken as equivalent to light intensity or photometric brightness, whether this be intrinsic or reflected. Physiologically, it is apparent brightness that matters, and this can conveniently be treated as physical brightness modified and interpreted by the human eye.

The physical range of tones in a subject may be determined photometrically. In ordinary landscapes a range up to 1 to 10 is low; 1 to 30 or 1 to 40 is a normal contrast; 1 to 60 and upwards, high; 1 to 250, extreme. The limits of correct rendering are fixed by the straight-line portions of the characteristic curves. For methods of computing the tone reproduction given in any photographic operation, the papers by F. F. Renwick and L. A. Jones must be consulted.

The resolving power of photographic materials may be defined as the distance between two closely adjacent images which can just be distinguished. It is limited primarily by what is termed the irradiation or spreading of the image due to diffusion of the light in the film. This spreading of the image has been investigated by astronomers and used as a basis for a method of stellar photometry.

In addition to the irradiation factor, the resolving power depends upon the development factor attainable in the material. The sharpness of an image, in fact, is theoretically equal to the development factor divided by the turbidity factor. Both of these factors are functions of the wave-length of the light used in exposure, so that the resolving power is naturally dependent upon the colour of the light. In addition to these two factors, a psychological factor enters into resolution dependent upon the graininess of the image.

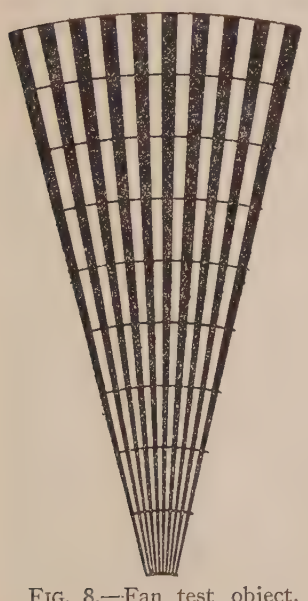


FIG. 8.—Fan test object, used for measuring the resolving power of photographic materials.

Photographic images on development show with lower power magnification, as used in projection and enlarging, a granulation which is objectionable in such operations. L. A. Jones and N. Deisch have shown that it may be measured and numerically expressed on the assumption that *G*, the graininess, is directly proportional to the distance at which it becomes just visually imperceptible, this being compared with the distance at which a structure of known period, *e.g.*, a fine cross-line screen, just disappears. Suppose a screen of 2,000 lines to the inch to be equivalent in this way to a given granularity of the developed image, the latter may be said to have a graininess of 2,000.

The practical resolving power of photographic materials can be measured by photographing the reduced image of a fan-shaped black and white grating (*see* fig. 8) and measuring the extent to which the lines are resolved.

Colour Sensitiveness.—Silver bromo-iodide materials are sensitive to the ultra-violet, violet and blue of the spectrum, the limit of sensitivity in the green being at about 550 μ. Recent investigations in which the sensitivity has been plotted against wave-length for equal amounts of energy show as far as measurements have yet been made that the sensitivity rises to a maximum at about 480 μ. in the case of materials of high sensitiveness and is constant throughout the violet and ultra-violet. When the spectrum below λ 300 is photographed, the absorption by the gelatine becomes important, and below λ 200 ordinary photographic materials are practically useless. Schumann suggested the use of plates made without any gelatine, silver bromide being precipitated and allowed to settle at the bottom of a deep dish on to glass plates. A method which has been used recently for the photography of the short wave-length ultra-violet is a fluorescent coating of mineral oil which transforms the short ultra-violet waves into blue light and these produce an effect upon the plate.

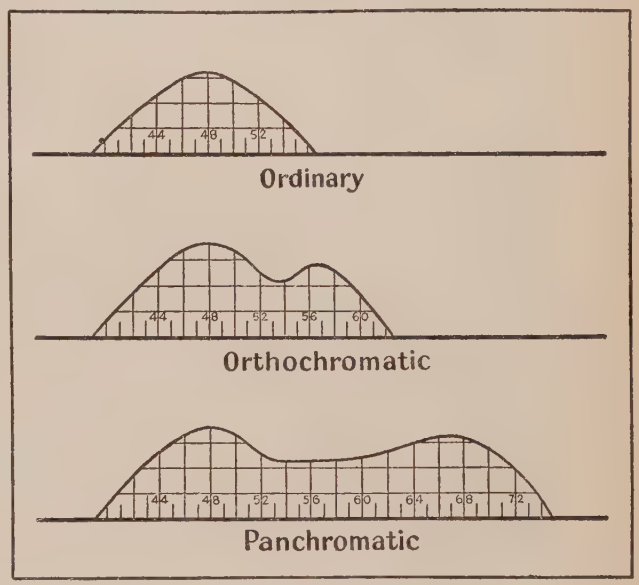


FIG. 9.—Spectra of ordinary, ortho and panchromatic materials, taken in a diffraction grating spectrograph in front of the slit of which is placed a black grass wedge

The sensitising effect of dyes discovered by Vogel has been developed very greatly. Erythrosine, that is the tetra-iodo derivative of fluorescein, was found by Eder to be the most suitable dye for sensitising in the green and yellow and has been adopted by photographic manufacturers throughout the world, the materials so sensitised being known as *orthochromatic* materials. In fig. 9 are shown the spectra of an ordinary material, an orthochromatic one made by the use of Erythrosine, and a panchromatic one made by the use of the dyes introduced by the Hoechst Dye Works soon after 1900.

A new period in the development of the sensitivity of photographic materials arose with the discovery of the sensitising power of Ethyl Red by Miethe and Traube in 1902, Ethyl Red being a dye produced by Spalteholtz in 1883 by the combination of quinaldine ethiodide with quinoline ethiodide in the presence of alkali. E. Koenig at the Hoechst Dye Works introduced several dyes analogous to Ethyl Red which are known as the *isocyanines*; and in 1906 Homolka produced another class of dyes now known as the *carbocyanines* by effecting the condensation in the presence of formaldehyde, the first of these dyes to be introduced being Pinacyanol. By the use of Pinacyanol, generally in combination with some of the isocyanine dyes, materials are rendered *panchromatic*; that is, sensitive to the whole visible spectrum up to and including the red. Soon after

the introduction of Pinacyanol, the Hoechst Dye Works introduced Dicyanine, which sensitises far out into the infra-red but is difficult to use. It has, however, been employed with success for the photography of spectra up to λ900. In 1919 Adams and Haller discovered a new dye, Kryptocyanine, with its maximum sensitiveness at λ760, and this dye makes it possible to take photographs by infra-red light with a very short exposure; it is employed even for motion-picture photography. A new dye discovered by H. T. Clarke in 1925 makes it possible to photograph the spectrum without difficulty up to λ900, the maximum sensitiveness of this dye being at λ820. (C. E. K. M.)

PHOTOSYNTHESIS (*see* 21.748).—The term photosynthesis is very commonly applied to the process by which green plants build up organic food material under the action of light. It is not altogether a satisfactory term, for as the literal meaning is "synthesis under the action of light" it would include any chemical synthetic process of this type. Also it is not at all certain that the actual *synthetic* process is due to the action of light. The term carbon-assimilation is also employed though it carries with it the suggestion that carbon itself rather than carbon dioxide is assimilated. The expression "photosynthetic assimilation of carbon dioxide" is probably the most accurate description. During recent years there has been a very large output of work on this branch of plant physiology and the field is a very wide one. The subject has been admirably reviewed by Stiles.[1]

Pigments.—The process of photosynthesis in plants is associated with certain pigments which absorb the incident light; the energy so obtained is employed in the building up of complex organic substances from carbon dioxide and water, oxygen being at the same time evolved. It should be realised that the whole life of the globe is dependent on the photosynthetic power of green plants; they alone are able to manufacture their own food material. Non-green plants and animals have not this power, but are entirely dependent for their food on the green plant. In the case of the higher plants, the pigments of the green leaf, as we know mainly from the work of Willstätter and his collaborators,[2] are four in number — *Chlorophyll a*, $C_{55}H_{72}O_5N_4Mg$, a blue-black crystalline substance, greenish blue in solution; *Chlorophyll b*, $C_{55}H_{70}O_6N_4Mg$, a green-black substance, green in solution; *Carotin*, $C_{40}H_{56}$, an orange-red substance found also in carrots, and *Xanthophyll*, $C_{40}H_{56}O_2$, a yellow substance. The two first are the green pigments and are often termed "chlorophyll," the other two are the yellow pigments. The amounts of these do not vary very greatly in different leaves. The average amounts are given below:—

	Percent of Fresh Weight	Percent of Dry Weight
Chlorophyll *a*	0·2	0·63
Chlorophyll *b*	0·075	0·24
Carotin	0·017	0·05
Xanthophyll	0·033	0·09

In green algae the same four pigments are present; in the brown and red algae and blue-green algae chlorophyll is present in association with other pigments which give these plants their peculiar colour. The assimilating pigments are not dissolved generally in the cell but are associated with denser portions of the protoplasm of definite form, known as plastids; it is apparently in these plastida that the special physical and chemical processes characteristic of photosynthesis occur. It is generally accepted that the two green pigments are the most important in the process of photosynthesis. One of the functions of the green pigments is clearly that of absorbing the necessary energy for the decomposition of carbon dioxide, and their solutions show very characteristic absorption bands particularly in the red-orange and the violet end of the spectrum. Whether in addition the chlorophyll reacts chemically with the carbon dioxide is still in doubt. Willstätter and Stoll [3] hold that the carbon dioxide combines with the chlorophyll to form a definite compound on which light acts; it is thus converted into a substance of the nature of a peroxide which can be acted upon by an enzyme. Warburg [4] holds that by the action of light upon the chlorophyll there is formed oxygen and a "photochemical primary product," which then reacts with a derivative of carbon dioxide; this derivative, the "acceptor" is reduced, and the chlorophyll is reformed.

Products of Photosynthesis.—Sachs (1862) was the first to relate the carbohydrates appearing in the leaf to the process of assimilation; he was responsible for the dictum that starch was the "first visible product of assimilation." This was based on the fact that in the case of many plants it appeared in the plastids of the leaf in the light and disappeared again in the dark. It is now generally agreed that carbohydrates of some kind are the main products of photosynthesis though many monocotyledons form little or no starch, but much sugar in the form of glucose, fructose and cane sugar. Which carbohydrate is first formed is a matter still in dispute. In green leaves exposed to light cane sugar accumulates markedly, and this has led to the view that it is the first-formed sugar. A much more plausible hypothesis would seem to be that hexose sugars (glucose and fructose) are first produced, and that when these reach a certain concentration cane sugar is formed from them. This view is supported by the work of Weevers.[5] The starch arises in all probability from glucose; it would seem likely that there is a critical concentration of sugar in the chloroplast above which starch is formed from the sugar, and below which the starch is converted back into sugar. This is confirmed by the fact that by floating them on sugars of high concentration such leaves as are normally starch-free will produce that substance in their chloroplasts.

Formaldehyde Hypothesis.—Baeyer in 1870 put forward the suggestion that in the process of photosynthesis formaldehyde (CH_2O) is produced with the help of chlorophyll under the action of light, and that the formaldehyde then polymerises to form sugar. Since that time the view that formaldehyde is an intermediate product in photosynthesis has been very commonly held. Although formaldehyde can be produced from carbon dioxide and water under certain conditions and hexose sugars can arise from it, yet there is no clear evidence of the presence of formaldehyde in the green leaf. The formaldehyde theory, though attractive in its simplicity, cannot be said to rest on any very secure foundation.

Effect of Various Conditions on the Rate of Photosynthesis.—The rate of this process is affected by the concentration of carbon dioxide available, by the amount of water, by the intensity of the light and by its wave length, by the chlorophyll content, by the supply of oxygen and of mineral salts and also by many other internal conditions, or factors as they are called. It used to be supposed that all these factors acted independently, but it was shown by the work of F. F. Blackman [6] that the factors are closely inter-related. He put forward the "theory of limiting factors," that in any set of conditions the rate of the process was determined by the factor present in the lowest intensity. The view that under any set of conditions it was only by the increase of the intensity of one factor that the rate of process could be increased requires some modification in the light of recent work; it is clear, however, that if any factor A is present at very low intensity, it will prevent an increase of another factor B having the marked effect upon the rate of the process which it would have produced if the factor A were acting at a higher intensity.

Bearing this relationship of the factors in mind, we find that with increasing concentration of carbon dioxide the rate of assimilation goes up proportionally, if the concentration is not too high and light and temperature are sufficient. Similarly with increasing light-intensity the rate of assimilation goes up proportionally if the temperature and concentration of carbon dioxide are sufficient. With higher light intensities there is probably a falling off in the rate, as with higher concentrations of carbon dioxide. With a moderate temperature, if other conditions are favourable, the rate of assimilation obeys the Van't Hoff rule, approximately doubling for each rise of temperature of 10° C. At higher temperatures somewhere in the neighbourhood of 25° C., the injurious effect of high temperature appears and the rate begins to fall off. The process of assimilation

is little sensitive to the concentration of oxygen, reduction to 1–100th of the normal amount having no effect but complete absence of oxygen acts injuriously.

A number of *internal* factors must markedly affect the rate of photosynthesis, but the only one that has been closely investigated (by Willstätter and Stoll) is that of the chlorophyll-content. It was found that the photosynthetic rate per unit of chlorophyll (the "assimilation number") varied markedly in different plants and even in the same plant. Leaves of yellow varieties were found to show very high rates in proportion to the amount of chlorophyll present, though the rate in these leaves is less influenced by temperature than is that of fully green leaves. Clearly there is some internal factor (or factors) other than chlorophyll content which is controlling the rate. This may be termed the "protoplasmic factor." Willstätter and Stoll conclude that the factor is an enzyme. A reduction in the water content of the leaf has also been shown to be associated with a certain amount of reduction in the rate of photosynthesis.

Effect of Quality of Light on Photosynthesis.—The question of the effectiveness in photosynthesis of light of different wave lengths has been hotly debated by physiologists for many years. The question is a complicated one since in white light there are great differences in the energy-value of the rays of different wave lengths, and the different rays are absorbed to a very different degree by the chlorophyll and the colourless parts of the leaf. In the case of the leaf there is little doubt that with equal intensity of incident light the red rays are more effective than the blue. The work of Warburg and Negelein quoted below indicates also that for equal quantities of light energy *absorbed by the chloroplast,* the red rays are considerably more effective than the blue.

Efficiency of the Photosynthetic Process.—It is known that the green leaf is comparatively inefficient as a producer of assimilation material. Brown and Escombe[7] attempted to determine the efficiency of the green leaf by comparing the energy of the light absorbed with the absorption of carbon dioxide, the assumption being made that glucose was produced in the leaf from the carbon dioxide. Their results are only very approximate but they indicate that the efficiency is only about 1%, increasing however with low intensities of light to about 4%. A large proportion of the energy absorbed is used in transpiration, and with the higher intensities of light the concentration of carbon dioxide is too low to allow of the light being fully effective. The most accurate experiments on the efficiency of the photosynthetic process are those of Warburg and Negelein[8] with the unicellular alga, *Chlorella.* With such a plant there is no question of transpiration, and the experimental arrangements were such that practically the whole of the light received was absorbed by the chloroplasts of the cells; in the case of the leaf a considerable amount of the light passes through and a certain amount is reflected.

Warburg and Negelein show that with decrease in the intensity of the light the efficiency goes up, *i.e.*, a larger proportion of the light absorbed is made use of in photosynthesis, the rate of the latter process being measured by the production of oxygen. In their earlier experiments they obtained an efficiency of 71% when using yellow and yellow-red rays; the methods employed for calculating this were, however, not altogether satisfactory. In their later work they obtained results of 59% for red light, and 34% for blue light. Whether these percentages are the maxima that can be obtained is not yet certain; internal factors may have been present which reduced the rate. The results do show, however, that under these special conditions (carbon dioxide 4%, temperature 10° C. and a very low intensity of red light) the photosynthetic process in the green plant may exhibit a higher level of efficiency than that of any photochemical process studied in the laboratory. The apparent inefficiency of the green *leaf* is no doubt largely due to the fact that much of the energy of the light is used in transpiration and also to the fact that there is a large amount of absorption by structures in the leaf other than the chloroplasts.

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PHOTOTELEGRAPHY.—The problem of transmitting diagrams, pictures and particularly photographs, has engaged the attention of communication engineers since the earliest days of the telegraphic art. It has, however, only been within the last few years that practical success has been achieved, leading to the inauguration of regular commercial picture transmission services on established communication systems.

Elements of the Problem.—The problem of transmitting pictures to a distance may be considered as divided into five steps. The first step is to analyse the picture into its elements, or to scan it. The second step is to provide means for translating the variations of light and shade of the picture into transmittable signals—for instance, electrical impulses or variations of current strength. The third step is to provide a transmitting system such as wires for carrying electrical current, capable of faithfully conveying the signals to a distant point. The fourth step consists in retranslating the transmitted signals into various values of light and shade. The fifth step is provision for some means of synchronisation, that is, of assuring that the recomposition of the transmitted signals places the received picture elements in their proper relative positions.

Analysing or Scanning Means.—Any picture may be resolved into small elements, each of uniform tone value. The problem of analysing the picture for transmission purposes consists in running over or scanning each of the minute elements of the picture in some regular manner. Several different devices have been suggested and used for this purpose. Prominent among these are cylinders on which the picture, usually in transparent form, as for instance on a celluloid film, is wrapped. The analysing point, such as a stylus or a small spot of light, is located at a fixed point in relation to the apparatus and the cylinder is given a screw motion about its axis whereby every point of the picture is in turn passed over the analysing point. Other devices used, where the picture signal is initiated by the action of light, employ mirrors and prisms. A frequently suggested device consists of two mirrors arranged to oscillate about axes at right angles to each other—one mirror scanning the picture in a right and left direction, and the other in an up and down direction. For the same purpose, prisms of variable angle have been used, whereby the spot of light or an image of the picture is oscillated in two directions.

Translation of Picture Tone Values into Electrical Current Variations.—The most primitive method of going over from the light and shade of a picture to variations of electric current consists in the division of the picture into small elements, and the estimation or measurement of the average tone value of each such element. This estimate or measurement may then be transmitted as a number or symbol in a code, for subsequent interpretation at the receiving end. A later development was to produce the translation by means of a photographic relief, such for instance as a bichromated gelatine photograph, in which the different lights and shades of the pictures are represented by different elevations. Another development of the same idea is embodied in the production of a line or dot picture of the "half tone" type in which the various shades are reproduced as lines of variable width suitable for the production of electrical contacts of varying duration. The more modern forms of picture transmission apparatus employ photo-sensitive devices, such as light sensitive resistances (*e.g.*, selenium *q.v.*) or photoelectric cells. These devices vary the strength of an electric current in more or less approximation to the strength of the light. Selenium cells and similar devices which figured prominently in earlier suggestions of this sort are unsatisfactory because their response to light variations is non-proportional and is subject

to considerable lag. The alkali metal photoelectric cell is the most satisfactory form of light-sensitive device as its response is proportional to the intensity of the light and is instantaneous. The currents furnished are, however, quite small, and the practical application of photoelectric cells was delayed until the development of the vacuum tube amplifier, by means of which the photoelectric cell currents may be amplified to a value suitable for use on commercial transmission lines.

The electrical signals derived from any of the methods mentioned for translating light and shade into electrical current variations may be applied directly to a transmission line or may be used to make an intermediate record, such as a perforated tape of the kind used in telegraphy. The use of an intermediate record of this sort possesses advantages where the character of the transmission line is such that the order of a succession of signals may be differentiated while their intensity is difficult to retain.

Transmission.—In the present state of the communication art, it is essential that the picture signals should be of such intensity and quality that they may be transmitted over existing communication systems. Such systems may be submarine telegraph cable, wire telephone or telegraph, or radio telephone or telegraph. The greatest success has thus far been achieved on wire lines because of their relative freedom from static, variations of transmission level, and interference in general. Given a picture-transmitting apparatus which provides signals of a sort appropriate for existing transmission lines, the transmission of pictures becomes a problem differing little from the transmission of telegraph or telephone currents, requiring, however, a high degree of constancy and freedom from interference, because of the permanent injury done to a picture by any disturbances, however brief, occurring during its transmission (*see* TELEPHONY).

Translation of Electric Signals into a Picture.—The signals received over the transmission line may be retranslated into values of light and shade by any one of several methods. The various tones may be reproduced by variable sized structures, as in the half tone process, by the use of a pen under varying pressure, or by the use of dots of various sizes produced by a printing device, such as a typewriter controlled by the incoming signals. The picture tones may also be reproduced by fixed-sized areas of different density, as by a controlled air brush, or by chemical action induced by the current; or by varied exposure of a photographic sensitive surface. Variation of the exposure of a photographic sensitive surface may be accomplished by passing the variable incoming picture current through a light-producing device, such as an incandescent filament or a vacuum tube lamp, or by varying an opening through which light is incident on the film. Devices of the latter type are called "light valves." They consist in general of strings or ribbons positioned in front of small apertures and of such small mass as to vibrate with satisfactory amplitude when actuated by the picture signals.

Synchronisation.—The accurate synchronisation of the sending and receiving ends may be accomplished by some form of clocks at the two ends, kept at identical rates by the occasional transmission of synchronising signals. Synchronisation may also be accomplished by sending signals during the transmission of the pictures. These may either be sent at those times when the scanning device temporarily passes off the edge of the picture, bringing the apparatus at the two ends into step, or they may be sent continuously during the process of transmission. In the latter case the synchronising signals must be transmitted over a channel separate from the picture channel.

Practical Processes.—Picture transmission over communication lines of short length has been accomplished during the past 25 or 30 years by various experimenters, among whom may be noted Korn, Amstutz, Thorne Baker and Belin. Recent systems, which have been worked out for use on modern communication channels, include the "Telepix," the Bartlane, and the system of the American Telephone and Telegraph Co., the latter now in commercial operation between some of the principal cities of the United States. In this system the picture to be transmitted is put in the form of a positive photographic print on celluloid film. This is placed on a transparent cylinder which is advanced and rotated by a screw motion. A minute spot of light is focused on the surface of the film and passes through it on to an alkali metal photoelectric cell. The current from the photoelectric cell is amplified and then used to "modulate" or vary the strength of a "carrier" alternating current of voice frequency suitable for efficient transmission over telephone lines (see fig. 1). At the receiving end, the incoming current operates a light valve (see fig. 2) the light from which falls on a sensitive photographic film moved in synchronism with the film at the sending end. The transmission of a 5-in. by 7-in. picture built up of adjacent strips 1/100 in. in width is completed in about seven minutes. Synchronism of the sending and receiving ends is secured by transmitting low frequency impulses from a tuning fork to impulse motors at the two ends. The synchronising pulses are transmitted on a carrier frequency lower than that used for the picture, and the two different carrier currents (of approximately 1,300 and 400 cycles per second frequency), which go over a single pair of wires, are separated from each other at the receiving end by electrical filters (see fig. 3). The system is adapted for the transmission of all kinds of pictures and diagrams. News photographs form a considerable part of the traffic, but finger prints, mechanical drawings, advertising material, autograph signatures, etc., are also transmitted.

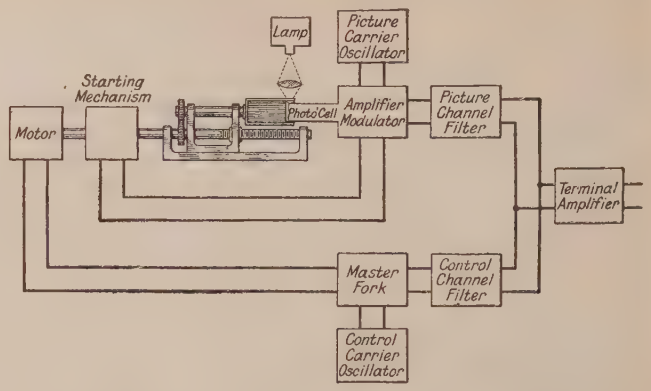


FIG. 1.—Schematic diagram of sending end apparatus for transmission of pictures by the American Telephone and Telegraph Company system. The picture to be sent is in the form of a celluloid film transparency, wrapped around a transparent cylinder. A beam of light passes through the film and falls on a photoelectric cell. The electric current thus produced is amplified by vacuum tube amplifiers, and is used to modulate a voice frequency alternating current, produced by a vacuum tube oscillator. The entire picture is scanned by advancing and rotating the transparent cylinder by a screw motion, the motive power being furnished by an impulse motor controlled by a tuning fork. The fork also acts as a modulator for low frequency alternating current to be sent to the receiving end to control the speed of the receiving cylinder. Both picture and speed control signals go on the same pair of wires.

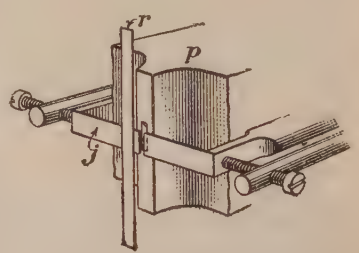
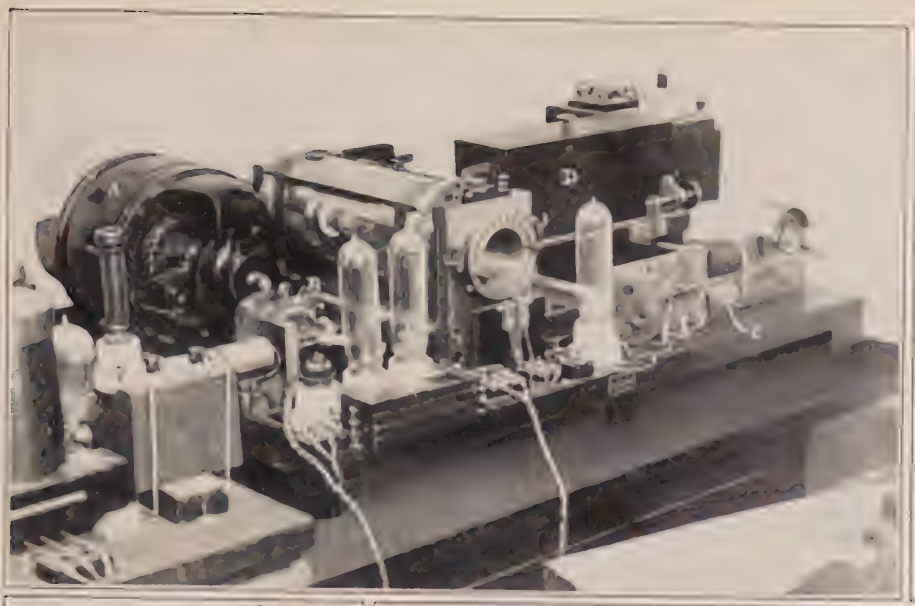
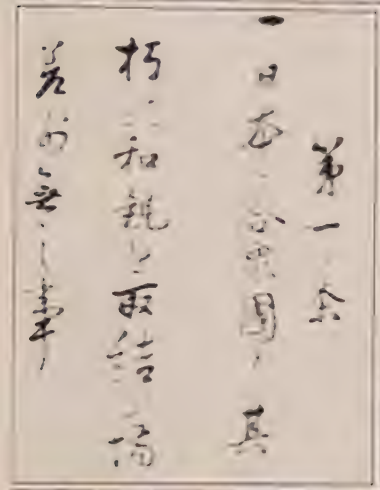
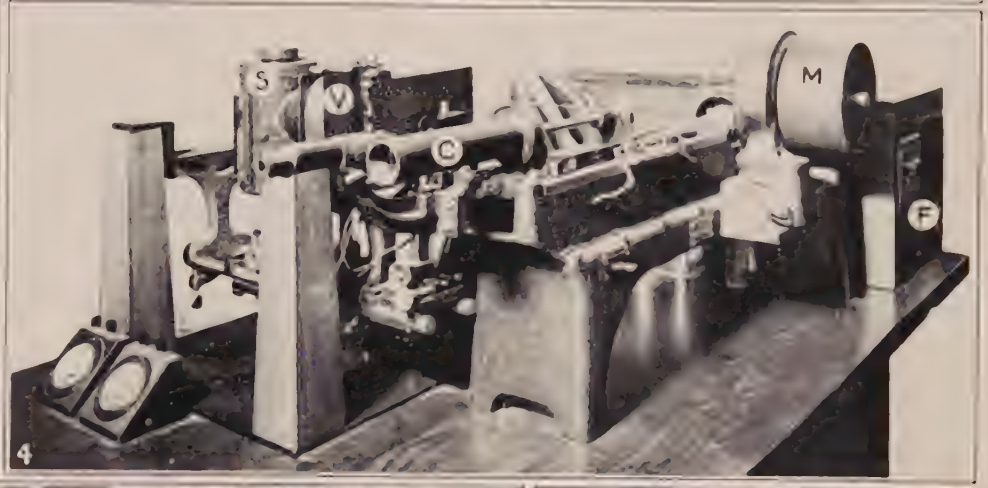


FIG. 2.—Details of a "light valve," used in apparatus for receiving electrically transmitted pictures. *r* is a fine ribbon of electrically conducting material, through which the incoming current flows. The ribbon stands in a magnetic field produced by an electro-magnet, one of whose pole pieces is shown at *p*. The pole pieces are pierced by a narrow hole, through which passes a beam of light whose size is limited by he adjustable jaws *j*. When current flows through *r*, the ribbon is deflected to one side by an amount proportional to the current, thus permitting the beam of light to fall on a photographic sensitive film, which is being moved in exact synchronism with the picture at the sending end.

The system just described is capable of use not only on wire circuits, but on wireless circuits. These latter are, however, inherently less stable and are used only where wire channels are not available. Other systems using radio for picture transmis-







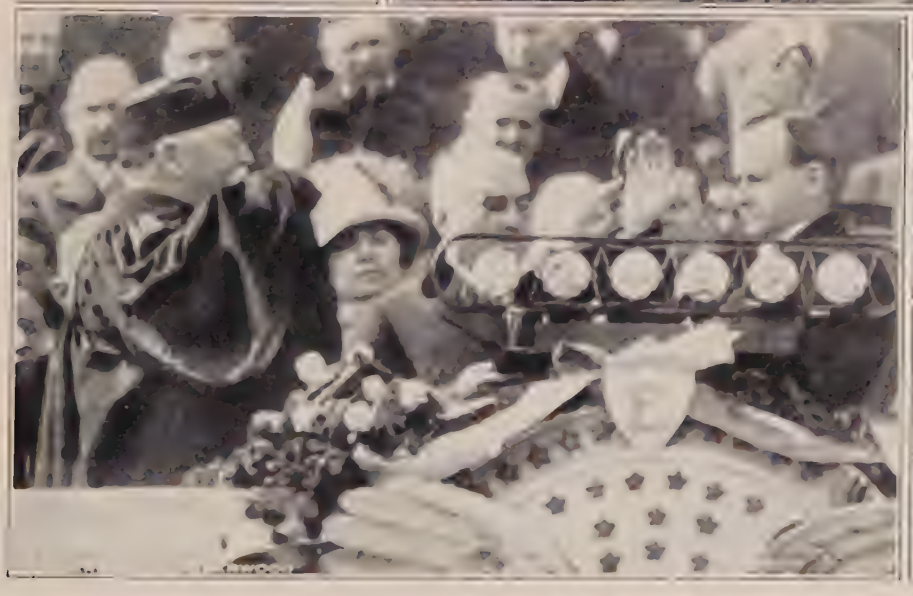


FIG. 1.—Sending Apparatus. (Radio Corp. of America.)
A special constant speed motor (A) actuates the gearing (B) which drives the glass cylinder (C) back and forth in front of the photoelectric cell box (D). Magnets (E) advance the camera box (D) down the length of the glass cylinder to cover the complete picture rotating on the cylinder line upon line.

FIG. 2. Electrically Transmitted Finger Print. (American Telephone and Telegraph Company System.)

FIG. 3. Electrically Transmitted Autograph Material, Japanese-American Treaty of 1853. (Am. T. and T. Co. Sys.)

FIG. 4. Receiving Apparatus. (Am. T. and T. Co. Sys.)
(M) synchronous driving motor, driven by tuning fork, in box, F, controlled by low frequency carrier current over telephone line. (C) cylinder on which sensitive film is wrapped. (V) light valve, actuated by picture signals transmitted over telephone line on voice frequency carrier, and controlling the amount of light falling on film from light source S.

FIG. 5. Inauguration of President Coolidge, March 4 1925. Picture as transmitted over Am. T. and T. Co. lines from Washington to New York, Chicago and San Francisco.

FIG. 6. Enlarged Portion of Electrically Transmitted Picture, as built up by strips of varying density. (Am. T. and T. Co. Sys.)

FIG. 7. Enlarged Portion of Electrically Transmitted Picture, as built up by lines of varying width, suitable for direct use in typographic printing. (Am. T and T. Co. Sys.)

sion have been developed by C. F. Jenkins, Belin and the Radio Corp. of America. The system employed by the Radio Corp. has been worked out with particular view to minimising static and other disturbances peculiar to radio. The tone values of the picture are determined by the number of pulses per unit

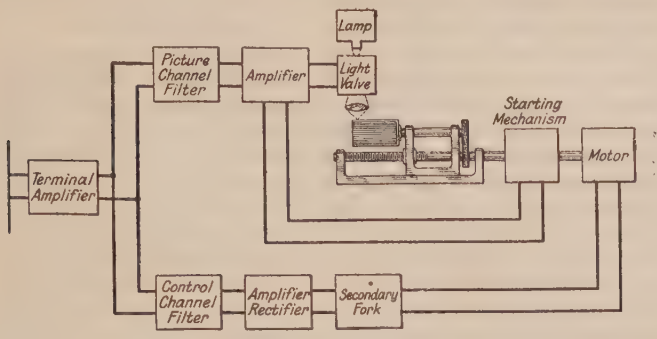


FIG. 3.—Schematic diagram of receiving end apparatus for transmission of pictures by the American Telephone and Telegraph Company system. The incoming picture and speed control signals, each on its own "carrier" frequency, are separated by electrical filters. The speed control signals drive an impulse motor which rotates a cylinder similar to that at the sending end, but carrying an unexposed photographic sensitive film. Picture signals are received by a light valve, which controls the intensity of a spot of light falling on the sensitive film.

length of travel of the scanning device, all pulses being recorded as of equal strength. Pictures have been sent by this apparatus over very great distances, the maximum being from Honolulu to New York (*see* TELEPHONY).

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PHTHISIS: *see* MINERS' PHTHISIS; TUBERCULOSIS.

PHYSICAL CHEMISTRY (*see* 6.65).—This is the branch of science which unites physics and chemistry. Whilst chemistry was originally occupied by the changes which matter undergoes in composition, classical physics describes the properties of relatively few substances, the materials, as far as composition is concerned, remaining constant during a physical change. The progress of knowledge led to a more intense study of chemical properties, and attempts were made to express the laws of chemical change in mathematical terms. On the other hand, physics investigated an increasing number of chemically individual substances, and the department of physical chemistry developed, covering the ground where the two sciences overlapped one another.

HISTORY OF THE SCIENCE

In the early days of science, chemistry and physics were not differentiated. Later, the great progress of physics and the discoveries of Newton accelerated the search for the laws governing chemical processes. Perhaps the greatest interest was aroused by the case of solution, which lies on the border between physics and chemistry. Newton even tried to apply the theory of gravitation to this phenomenon, maintaining that a salt is dissolved in water if the particles of salt have a greater attraction for water molecules than they have for one another. Newton found that such interaction gave an insufficient explanation, and repulsion is responsible for the distribution of dissolved molecules in a solvent. In a certain sense he hereby introduced the idea of osmotic pressure, which plays an important part in modern theories.

Lavoisier made a strong distinction between such cases as salt or sugar dissolving in water and a metal dissolving in an acid. The latter process he called dissolution. The recovery of the salt or sugar is simple, that of the metal from solution in an acid is difficult. The solution of a metal in an acid is an undoubted chemical process, the solution of a salt in water might as well be regarded as a physical as a chemical process.

Lavoisier also drew attention to the fusibility of salts, and concluded that "caloric" and water would aid one another in dissolving matter, *i.e.*, solubility should increase with rise in temperature. Though true in most cases, certain salts, such as calcium sulphate, exhibit decrease in solubility with increase in temperature.

Richter and Berthollet differed from Lavoisier in regarding solution as caused by chemical affinity. Since the composition of a saturated solution changes with temperature, Berthollet denied the law of constant proportions; the establishment of the atomic theory on an experimental basis negatived Berthollet's view. Further, Gay-Lussac (1805) discovered that the volumes of two gases, measured under equal conditions of temperature and pressure, which unite to form a compound, bear a simple relationship to one another. This was followed by the law of Avogadro (1811), according to which equal volumes of different gases, under the same conditions as to temperature and pressure, contain equal numbers of molecules.

MATHEMATICAL CHEMISTRY

The kinetic theory of gases was developed on the mathematical side and led to estimates of molecular and atomic dimensions; the atomic theory seemed to have been thoroughly established. Opposition to the theory recurred towards the end of the last century (Wald, Helm), and received some support (Ostwald, le Chatelier); the matter is now of purely historical interest.

The analogy between the Brownian movement (discovered by the English botanist, Robert Brown, in 1827) of small particles, such as pollen grains, and the translatory motion of the molecules of a gas was eventually recognised and the mathematical theory worked out by von Smoluchowski and Einstein. Convincing proof was afforded by the experiments of a number of workers, especially Svedberg and Perrin, and the results were used to calculate the number of molecules, N, in a gram-mol. of a gas, *e.g.*, in 32 grammes of oxygen. The most reliable results of Svedberg and his pupils is $N = (6{\cdot}0 \pm 0{\cdot}005) \times 10^{23}$. Fletcher's figure is very close, Perrin's value about 10% higher.

Rutherford, Geiger and Regener counted the number of α particles emitted by a given quantity of radium in a second, and determined the rate of decay of radium. As, according to Faraday's law, the charge of a gramme of hydrogen ion is 96,550 coulombs, they could determine the charge of an α-particle, which is double as great as that of a β-particle, the smallest known quantity of electricity, or the atom of electricity. Rutherford in this manner found $N = 6{\cdot}2 \times 10^{23}$. Dewar and Boltwood found independently of each other $N = 7{\cdot}1 \times 10^{23}$. The exceedingly accurate measurements of Millikan gave the electrical atom, e, equal to $(4{\cdot}774 \pm 0{\cdot}005) \times 10^{-10}$ electrostatic units, corresponding to $N = (6{\cdot}062 \pm 0{\cdot}006)10^{23}$.

From Planck's theory of heat, $N = 6{\cdot}2 \times 10^{23}$; the same number is arrived at from measurements of the charge of droplets condensed from water vapour by means of Röntgen rays.

In 1839 Gay-Lussac pointed to the great analogy between a gas and a dissolved substance. In 1870 Rosenstiehl made the following remarkable statement: "The osmotic force is analogous to the elastic force of vapour."

Use of Thermodynamics.—Kirchoff applied thermodynamics (1858) to the vapour pressures of solutions, especially of sulphuric acid. The law of mass action was deduced in 1864 by Guldberg and Waage, which they enunciated in 1867 in its present form:

$$C(AB) \cdot C(DE) = K \cdot C(AE) \cdot C(DB),$$

where C(AB) is the concentration of the salt AB, etc., and K is a constant dependent on the temperature (and the nature of the solvent). This formula holds good for a homogeneous equilibrium, *i.e.*, one at which the four salts AB, etc., are totally dissolved. For a heterogeneous equilibrium, at which some salts, *e.g.*,

AB, are not totally soluble, one has to introduce for C(AB) the concentration of the saturated solution of AB at the given temperature in the solvent used. Guldberg and Waage carried out a great number of experiments, especially on the equilibrium between the concurrent systems $K_2CO_3+BaSO_4$ and $K_2SO_4+BaCO_3$. They also made investigations on the velocity of reactions, especially of the solution of metals in acids. They maintained that the velocities of reaction at a given temperature are proportional to the concentration of the reacting substances, in this case the acid. The last equation therefore says that the quantity of AE×DB formed in a certain time is equal to the quantity of AB×DE transformed back to AE and DB in the same time.

In 1869 and 1873 Horstmann deduced from thermodynamics the laws of chemical equilibria between gaseous substances. He found his conclusions verified by experiments. The theory of Guldberg and Waage was further simplified when Horstmann showed that his formula (for gases) was applicable.

Latent Heat.—From the second law of thermodynamics, Clapeyron had shown that the latent heat of vaporisation of water could be determined from measurements of the pressure of its saturated vapour at different temperatures, and, in 1869, utilised the formula of Clapeyron for calculating the heat of vaporisation of ammonium chloride from the observed vapour pressure. From the known heat of formation of calcium carbonate, Horstmann (1870) calculated dissociation pressures which were verified by comparison with Debray's experimental values. Similar calculations were made with regard to the pressure of water vapour over sodium phosphate dodecahydrate.

Two years later Guldberg took up the question of the evolution of carbon dioxide from calcium carbonate and deduced the famous formula:

$$\frac{d \log p}{dT} = \frac{g}{ART} = \frac{Q}{2T}$$

where p is the dissociation pressure, T the absolute temperature, R the gas constant, A the inverse value (1·426) of the mechanical equivalent of heat, and g the heat of dissociation of 1 gramme; Q is the corresponding value for 1 gramme-molecule when R = 2 (more accurately 1·985).

Equilibrium.—In 1885, Van't Hoff showed that if a chemical equilibrium is expressed in the form A+B+C+. . .x=K (E+F+G+. . .y), K being the equilibrium constant, Guldberg's equation is applicable if K is introduced in place of p.

Dissociation.—In 1873 Hortsmann continued his theoretical investigations on the question of dissociation, using the experimental figures of Wurtz on hydrobromide of amylene, $C_5H_{11}Br$, and those of Wurtz and Cahours on pentachloride of phosphorus, PCl_5.

Freezing Points.—In 1867, 1868 and 1870 Guldberg demonstrated theoretically that the lowering of the freezing point of a solution under that of the solvent as well as the corresponding increase of its boiling point are proportional to each other and to the corresponding lowering of its vapour tension under that of the solvent. He gave the constants which represent the factors of proportionality. He verified his conclusions on the figures of Wüllner and of Rüdorff concerning the behaviour of salt solutions in water.

Willard Gibbs' (1879) celebrated memoir on "Equilibrium of Heterogeneous Substances" received little attention at the time of its publication.

Helmholtz (1882) independently developed part of Gibbs' deductions, more especially with regard to electromotive force.

Boiling Points.—Raoult gave (1878 and 1882) important data regarding boiling points, vapour pressures and freezing points of solutions of a great number of substances in different solvents, whereas only aqueous solutions had been used previously, the latter behave a little irregularly. He deduced empirical laws, the simplest of these, viz.,

$$\log e \frac{p-p'}{p} = \frac{n}{N+n}$$

where p = vapour pressure of pure solvent and p′ = vapour pressure of a solution consisting of n molecules of solute in N molecules of solvent, was deduced subsequently by Planck from theoretical considerations. From this formula the corresponding formula for the freezing point and the boiling point may be calculated according to Guldberg's deductions. It is supposed that the solute has no sensible vapour pressure, and that on freezing only the solvent separates out from the solution.

Electrolytic Dissociation.—In 1877 Pfeiffer measured the osmotic pressure of a solution of one gramme cane sugar in 99 grammes water at 6·8°C. and he drew Van't Hoff's attention to the measurement of Pfeiffer. Van't Hoff found that if the molecular weight of cane sugar is 342, and if it were possible to vaporise 1 gramme of sugar at 6·8° so that it filled 100 c.cm., it would exert a pressure of 508 mm. mercury according to Avogadro's law. The osmotic pressure is therefore within the errors of observation, and equal to the pressure the same quantity of matter would exert as a gas. This was of practical importance in determining molecular weights. Van't Hoff showed that two solutions of the same osmotic pressure possess common freezing point (or boiling point or vapour pressure), and proved his thesis by Raoult's experimental values. Electromotive forces and chemical equilibria were attacked successfully, the vapour pressure p in Guldberg's equation being replaced by the equilibrium constant, K.

It was found that in the case of strong acids, strong bases and salts the molecular weight as determined by lowering of vapour pressures, lowering of freezing point, or rise in boiling point, was always less than the generally accepted value. This necessitated the use of an "isotonic coefficient," i, in the case of strong electrolytes. Thus, for instance, potassium chloride in a solution of 0·3% possesses a molecular weight of only 39·2, *i.e.* 1·9 times less than 74·5. This seemed very improbable.

Electric Conductivity of Solutions.—In order to understand this, we must consider the electric conductivity of salt solutions. Faraday found the first and fundamental law of this phenomenon. He observed that the quantity of metal deposited by a galvanic current on an electrode is proportional to the quantity of electricity which has passed through the electrode and also proportional to the equivalent weight of the metal. The first law is very natural; it was already enunciated but not strictly proved by Berzelius. The second law, Faraday's law, says that equivalent quantities of different metals—and the same is true for other substances—are deposited on electrodes after the same quantity of electricity has passed through them.

Kohlrausch found that the molecular conductivity of a salt solution in water, *i.e.*, its specific conductivity divided by its concentration, increases with dilution. The ions of the salt carry the electricity with them according to Faraday in equal quantity for each ion—we suppose, for simplicity, that the ions are univalent. Now, in dilute solutions every ion travels independently of the other ions, and its mobility is dependent only on the viscosity of the solution which is caused by the friction against the solvent, in this case water. Therefore, in highly diluted solutions every ion should contribute just as much as every other ion of the same kind to the transport of electricity—in other words, the conductivity should at a given temperature be strictly proportional to the number of ions, *i.e.*, to the concentration of the salt. Since the conductivity increases at a slower rate than the concentration, the simplest explanation is to suppose that only some of the molecules conduct, the others not taking part. With increasing dilution, the non-conducting become conducting molecules.

Experience shows that the molecular conductivity, *i.e.*, the specific conductivity divided by the molecular concentration, increases asymptotically to a maximum value for infinite dilution, at which all molecules are conducting. If the molecular conductivity at a dilution v is called μ_v and that at infinite dilution is called μ_∞ the fraction of conducting molecules is evidently μ_v/μ_∞. This is of course true only at constant temperature and for rather dilute solutions, the fluidity of which may be regarded as equal to that of pure water. This fraction is called

the coefficient of dissociation, because we must suppose that the non-conducting molecules have their generally accepted molecular weight, just as other non-conductors according to Van't Hoff's law. On the other hand, the conducting molecules, *e.g.*, of KCl, possess their conducting power only because their ions, the kation, in this case K, and the anion, Cl, carry their atomic electrical charges ($4{\cdot}774 \times 10^{-10}$ electrostatic units, positive for each ion K and negative for each ion Cl) in opposite directions through the solvent. It is evident that these "migrating" ions move freely until they meet an ion of opposite sign and unite with it, thus forming a non-conducting molecule, the total charge of which is zero, and which therefore does not move along the potential gradient. In other words, we conclude that the conducting molecules are decomposed into their two ions and the degree of dissociation is measured by the fraction.

Dissociation.—It is evident that a molecule dissociated into two free ions must exert double as great an influence on the lowering of the freezing point as a non-ionised molecule. If a molecule gives three ions, as for instance $BaCl_2$, its action is three times greater after the dissociation than before it. Generally, if a molecule gives n ions its influence becomes n times greater in the dissociated than in the undissociated state. It is easy to see that this circumstance gives a possibility of calculating the degree of dissociation by means of determinations of the freezing point, or of the osmotic pressure of vapour pressure, or even of the boiling point of a solution according to Raoult's laws.

The solid basis of the theory of electrolytic dissociation is the good agreement between the degrees of dissociation calculated for dilute solutions from the electric conductivity and from the freezing point.

Electromotive Force.—In 1877 and 1882 Helmholtz gave a thermodynamical theory of the electromotive force of galvanic cells which he confirmed by measurements, especially of concentration elements. In 1888 and 1889 Nernst developed a theory of concentration elements founded on the theories of osmotic pressure and of electrolytic dissociation. It gave the same results as the theory of Helmholtz for the total electromotive force. But Nernst went further. He calculated the three electromotive forces, at the junction between the two electrolytic solutions of different concentration and at the two contact surfaces between metal and electrolyte. In this latter case he expressed the potential difference with aid of his conception of the "solution pressure." Planck gave in 1890 the theoretical formula for the more general phenomena of potential differences at the contact surfaces between any two electrolytic solutions. Negbaur confirmed experimentally the theory of Planck. The oxidation- and reduction-elements were also investigated from this theoretical view point by Bancroft.

Transport or Migration Numbers of the Ions.—Hittorf determined the change of composition in different parts of a solution contained in a long glass vessel, through which an electric current of given strength was carried during a measured time In this manner he could calculate how much the positive and the negative ion each contributed to the conductivity. The corresponding partial conductivities are called the transport numbers of the ions. If their sum is taken as unity, they are called migration numbers.

The molecular conductivity of a solution is equal to the sum of the two transport numbers of the ions, multiplied by the degree of dissociation. These numbers increase rapidly with temperature, owing to the simultaneously diminishing frictional resistance to the motion of the ions. This resistance is regarded as chiefly due to the viscosity of the solvent. In water, the fluidity is nearly exactly proportional to the transport number of the acetate ion in the interval 0° to 156°. The partial conductivities of the different ions approach to that of the acetate ion and to each other with rising temperature between 0° and 306° according to experiments of A. A. Noyes.

Theory of Diffusion.—Closely connected with his theory regarding electromotive forces stands Nernst's theoretical calculation of the diffusion coefficients for different electrolytes. Here he supposed that the dissociation of the electrolytes was complete. His results agree fairly with experimental values found by different observers. The theoretical value is a little higher than the experimental one, which is easily explicable, as the dissociation is not complete and the osmotic pressure has not attained the limiting value.

Nernst's formula indicates that HCl will diffuse more rapidly if a salt is added to its solution. This is easy to understand. If the H ion were alone in the solution, it would at 18° move 4·8 times more rapidly than if the Cl ion were alone in the solution. But electrical forces cause them to move together, whereby the velocity of the diffusion diminishes to a mean value, 2·95. It is easy to show that the diffusion of H (in HCl) increases with addition of sodium ions in good agreement with calculation (Arrhenius, 1892). This is the most direct proof of electrolytic dissociations.

Additive Properties.—If we dissolve a substance in water at a given temperature, we find that a certain property, *e.g.*, the specific gravity, increases (or decreases) nearly proportionately to the percentage or concentration of the dissolved substance. For sufficiently dilute solutions the proportionality is exact.

If the dissolved substance is dissociated, the property P may be expressed as the sum of three terms, the first one the property P_w of the solvent, mostly water, and the two others proportional to the concentration of the dissociated parts, mostly ions. In other words, the following equation holds:

$$P_{ij} = P_w + K_1C_i + K_2C_j$$

If there are only two ions I and J the two terms K_1C_i and K_2C_j suffice. K_1 and K_2 are two constants, characteristic for the ions I and J. If we now dissolve another substance, *e.g.*, a salt, which dissociates into the ions I and L, we have

$$P_{il} = P_w + K_1C_i + K_3C_l$$

consequently;

$$P_{ij} = P_{il} = K_2C_i - K_3C_l$$

If we now choose the concentration, *e.g.*, expressed in molarity equal to n

$$P_{ij} - P_{il} = n(K_2 - K_3)$$

In other words, the difference between the properties of two salts with a common ion I is proportional to the concentration and to the difference between two constants K_2 and K_3 characteristic for the two ions J and L; they may be accompanied by any ion I of the opposite electric charge. This is the law of additive properties, which is only valid for totally dissociated salts, *i.e.*, at extreme dilution. But it is found that also for higher concentrations this law is often valid. This depends upon the circumstance that in many cases the effect of the undissociated part is very nearly equal to the sum of the effects of the ions contained in it. This peculiarity is often explained so that the salt is completely dissociated. But in some cases, *e.g.*, for the lowering of the freezing point, it is found (by Raoult) that the property is not additive, which depends upon an incomplete dissociation.

Thermochemistry

During chemical changes heat is usually evolved or absorbed, the amount depending generally on the temperature at which the change takes place. Many measurements were made by Berthelot and Julius Thomsen in the latter part of the 19th century.

Before the introduction of the calorimetric bomb (constant volume method) determinations of the heat evolved or absorbed were usually carried out at constant pressure. Since change in volume generally occurs, the results obtained need correction in order to obtain the theoretically more important value, the heat of reaction at constant volume. For if a reaction takes place at constant pressure p and the volume v at the end of the reaction is less than v_0 the initial volume of the reacting substances, the amount of work $p(v-v_0)$ done by the system

on the surroundings has a negative value, *i.e.*, this amount of work has been done on the system and the heat of reaction is correspondingly greater than if the reaction had taken place at constant volume.

Frequently, the heat of a reaction A is incapable of direct measurement. Usually it is possible to carry out two (or more) partial reactions B and C whose algebraic sum is equal to A. For the heat changes U_A, U_B, U_C we have the equation

$$U_A = U_B + U_C.$$

so that two of the quantities being known from experiment we obtain the third by addition.

Berthelot and Thomsen believed that the direction of a reaction depends on U being a positive magnitude, *i.e.*, heat being evolved. Reactions in which heat is evolved are called exothermic, those in which it is absorbed, endothermic. Berthelot tried to explain the occurrence of endothermic processes by maintaining that foreign (not caloric), *e.g.*, electrical energies, interfered in the process. Now we know that the free energy, usually denoted by A, is the determining quantity, and thereby the values of U have lost a great part of their importance. It is to be observed that at absolute zero U=A, and that at low temperatures the difference U−A is rather small compared with U in most cases, therefore the mistake of the thermochemists is explicable.

The values of U and A may easily be calculated if we know how U changes with temperature. According to a theoretical formula of Debye the specific heat is proportional to the third power of the absolute temperature in the neighbourhood of absolute zero. With the knowledge of the specific heats of the reacting substances at higher temperatures it is possible to find the value of U at any temperature with sufficient approximation, if this value is known at ordinary temperature. At T=o, U=A. As according to the second law of thermodynamics, $T\,dA = (A-U)dT$, it is possible to find A at any temperature, when U and $dA-dT$ are known, as Nernst describes in his treatise on "the new heat-theorem." The free energy A corresponds to the potential energy in mechanics, and therefore any chemical reaction will proceed in such a direction that A decreases. In certain cases A can be measured directly, as with galvanic cells.

Chemical Equilibria.—The simplest case of an equilibrium is that between a liquid and its vapour, discussed above. The same formula is valid for the solubility of a substance in a solvent, and also for the equilibrium-constant, characteristic of a chemical reaction. The simplest chemical reaction is that of the undissociated part of an electrolyte with its ions. This equilibrium has been investigated by Ostwald for weak acids and by Bredig for weak bases, and it has been found valid (Ostwald's law). By means of the change of the equilibrium constant of weak acids Arrhenius calculated their heat of dissociation and from this their heat of neutralisation in good accordance with thermochemical observations. The equilibrium constant of dissociation in all cases investigated at not too low temperatures diminishes with increasing temperature, whereby the heat of dissociation is found to be negative at higher temperatures. Therefore some weak acids possess a lower conductivity at higher than at lower temperatures, which was previously regarded as impossible. The calculations agree very well with the observations.

The Phase Rule.—For heterogeneous equilibria, Gibbs has given his important phase rule. We may at first regard the simple case of water. Water occurs in three different modifications, as ice, water and vapour. For each of these is valid an equation of condition $f(p,t,c) = o$, where p and t represent the obtaining pressure and temperature and c is the concentration of the substance in the ice phase, liquid phase and vapour phase. If the three phases co-exist in a vessel, we have three equations for determining the three variables. From the tables of vapour pressure at different temperatures we find $p=4{\cdot}57$ mm. Hg, $t = o{\cdot}oo76°C$. The three concentrations are proportional to the densities. Here we have only to do with one substance. The number of phases is three. If we had put a sufficient quantity of a soluble salt, *e.g.*, sodium chloride, in the water, two solid phases—one of ice, another of salt crystals, one fluid—salt solution, and one gaseous—water vapour would have been present. These can only co-exist at the eutectic point, $-21{\cdot}3°$. In general, if we have *n* substances they may give $n+2$ phases at the "point of transition." If we take away one phase, *e.g.*, the solid in the first example, we have only two phases, vapour and fluid, above the transition point. Then we may fix one of the variables p or t, but then the other becomes determined, *e.g.*, p as a function of temperature. If also another phase, *e.g.*, the gaseous one, disappears, we may choose any pressure and temperature, but if these are fixed, we obtain also a fixed concentration, which in this case may be expressed in gramme water per cubic centimetre. The phase rule owes much to Roozeboom and Schreinemakers, and Van't Hoff has applied it in his remarkable investigations on "oceanic deposits of salts."

An interesting equilibrium is that which occurs when an acid is added to a solution of a salt of another acid. In this case a certain quantity of the corresponding salt of the first acid is formed. Julius Thomsen and Ostwald determined this decomposition by thermal and optical measurements. Arrhenius found very good agreement of these values with those calculated from dissociation constants.

Adsorption Phenomena.—If we have a substance, *e.g.*, acetic acid, dissolved in water containing charcoal particles in suspension, we find that a great deal of the acid is "adsorbed" by the particles so that after some time equilibrium is attained, at which point, according to Freundlich,

$$y = KC^n,$$

where y is the adsorbed quantity per gramme of charcoal, K is a constant dependent on the origin and history of the charcoal and the temperature, C is the concentration of the acid remaining in the aqueous solution, and n a constant number. This equation has been verified in a great number of cases, though the theoretical deduction is lacking. At high values of C, n diminishes with increasing C.

The adsorption phenomena play a very great rôle in colloidal chemistry, and therefore also in biochemistry. (*See* COLLOIDS and BIOCHEMISTRY.)

Amphoteric electrolytes which have both basic and acid character play an important rôle in biochemistry; their equilibria have been investigated by many biochemists, especially by Jacques Loeb.

Velocity of Reactions.—The rate of change of a chemical process is proportional to the concentration of the catalyst (*q.v.*) and that of the substrate. Sometimes the quantity of the catalyst changes also during the chemical change. In this case the change of its concentration must be taken into consideration. Of this kind are the so-called autocatalytic processes. The agreement of theory with experiment is satisfactory. The effect of the catalyst in most cases $\dot{H}$ or OH' ions is affected by the presence of neutral salts, the so-called salt-action. In most cases their action accelerates the velocity; in some cases, *e.g.*, saponification of esters, the velocity diminishes when salts (of the type KCl) are present.

Arrhenius found that the same equation is valid for the increase of the velocity of reaction with temperature as that for the corresponding change of the constant of equilibrium. This equation has proved to be generally valid. He therefore supposed that only a very small part of the substrate reacts chemically which is in chemical equilibrium with the chief, very nearly total, quantity of the substrate. The "active" part of the substrate may be an allotropic form of the chief part, or it may consist of the molecules which have a very great molecular motion (Marcellin). Trautz, McC. Lewis and Perrin independently of each other expressed the idea that the radiation of heat provokes the formation of the active substrate, and that a special radiation, in most cases infra-red and different in different cases, activates the molecules. It is difficult to give experimental proof of this theory.

The "heat of activation" Q in the formula is very different

in different cases. For the reactions investigated, saponifications of ethyl acetate and inversion of cane sugar by acids, Q has the values 5,579 and 12,800, which are of the same order of magnitude as that of Q for common chemical processes. For biochemical processes we find very different values, from Q=3,150 for the precipitation of egg-white, and Q=5,000 for the inversion of cane sugar by means of invertase, up to Q=81,000 for the spontaneous destruction of tetanolysin and Q=99,200 for that of a haemolysin from goat-blood.

The spontaneous decomposition of the radioactive substances does not change within the very widest limits of temperature. The same is the case for some photo-chemical processes such as the common photographic process with silver bromide and gelatine, or the reaction of oxalic acid with ferric chloride. In other cases the temperature has a comparatively small influence (Q is sometimes about 2,000) on photochemical processes.

Activity.—The determination of dissociation constants by different methods, *e.g.* electric conductivity, electromotive force of concentration cells, lowering of freezing point, etc., only gives concordant results in the case of dilute solutions. For concentrated solutions disagreement results from the circumstance that the conductivity depends upon the molar concentration, whereas the thermodynamic phenomena are connected with the numerical concentration. But even in rather dilute solutions, below 0·1 normal, for which the two kinds of concentration are very nearly proportional, very great discrepancies are observed. This depends on the corrections which should be applied in different cases. Milner showed that a correction ought to be introduced for the thermodynamic quantities, especially the value of the molecular lowering of the freezing point. Debye and Hückel found that another correction should be applied to the determinations of molecular conductivity. These two corrections are due to the influence exerted by the electrical charges of the ions. Other corrections are due to the viscosity, which has a great influence on the conductivity but probably none or only a very small one on the freezing point. In great dilutions this correction vanishes. But this is not the case with that due to the hydration of the ions, which has an opposite influence on the conductivity to that on the freezing point. Even the change of the dielectric constant may have some influence. These different corrections are still only imperfectly investigated.

In order to escape all these difficulties, many authors as Milner, Debye, and Hückel, accepted an idea of Sutherland, that the strong electrolytes are completely dissociated, or they may practically be regarded as completely dissociated (Bjerrum). It is also maintained that even crystals are completely dissociated, because their Röntgen-spectra are caused by atoms and not by molecules, that therefore we must suppose that also the most concentrated solutions of strong electrolytes are completely dissociated. It is difficult to understand this, for ions are free to move under the influence of electrical forces, and that is very rarely the case with the atoms of a crystal. It is true that such a migration is found for sodium atoms in quartz crystals, but they must be regarded as being in solid solutions together with SiO''_3-ions in the crystal. Glasses are also electrolytes, but are regarded as extremely viscous fluids.

The change of the molecular freezing point and of other connected properties with concentration is explained as depending on a property called activity, which is empirically determined, but so that the thermodynamical laws shall be valid. The investigations regarding activity have increased our knowledge, but a theoretical explanation of the physical causes for the complicated change of the activity with concentration has not been given.

See ATOM; BIOCHEMISTRY; CATALYSTS; COLLOIDS; CRYSTALLOGRAPHY; ELECTRON; ISOTOPES; MATTER; PHYSIOLOGY; etc.

The chief English textbooks are: S. Arrhenius, *Textbook of Electrochemistry* (1902); Sir James Walker, *Introduction to Physical Chemistry*, 9th ed. (1922); W. Nernst, *Theoretical Chemistry* (1923); A. J. Allmand and H. J. T. Ellingham, *Applied Electrochemistry* (1924); J. R. Partington, *Chemical Thermodynamics* (1924); H. S. Taylor, ed., *Physical Chemistry* (1924); M. de K. Thompson, *Theoretical and Applied Electrochemistry* (1925); W. McC. Lewis, *A System of Physical Chemistry* (1925). (Sv. A.)

PHYSICAL TRAINING.—The history of physical training since 1910 has been marked by (1) a notable improvement in the whole basis of the training itself, (2) a growing recognition of the value of such training during the formative years of childhood, and (3) the growth of administrative measures directed toward the establishment of a uniform system of training in all the schools which form part of the national system of education.

I. IN GREAT BRITAIN

Until 1902, physical training was permissive in the elementary schools; in that year it was established as an integral part of the curriculum, and the Board of Education issued a model course for the upper departments of the schools. Under successive revisions the model course, which originally consisted largely of military drill, has developed into the present Syllabus of Physical Training, based on the Swedish system and providing for the needs of all children between the ages of 5 and 14. Faith in the sufficiency of mechanical drills has been succeeded by a broad conception of physical education as a many-sided and vital process, directed to securing the careful and well-balanced cultivation of the physical powers of each individual child, and to the formation of habits of self-discipline by learning to control the body and to work in harmonious concert with others. Physical education as now understood includes systematic and graded exercises chosen for their physiological and corrective results, folk-dancing, swimming, organised games and sports, in fact all those things which make for physical well-being, implant a love of healthy outdoor pursuits, and contribute to the making of useful citizens.

In 1909, the medical department of the Board of Education was made responsible for the inspection of physical training in all state-aided schools and institutions and for the general supervision of the arrangements made for such training by the local education authorities. In all the elementary training colleges physical training as a professional subject was made compulsory, and encouragement was given for the formation of courses for the teachers already in the schools. A special grant was established in 1917 for the purpose of encouraging local education authorities to employ expert organisers of physical training, who should assist the teachers by advice, demonstration and training to make the most of their opportunities. The results obtained have abundantly justified the policy of the grant, and have shown that the organiser is an essential factor in a scheme of training under which the class teacher is responsible for the instruction of his own class. The physical training in the elementary schools has thus been directed into the right paths and the efficiency of the teaching steadily improved.

The varied problems connected with the physical training of adolescent girls and boys are not capable of solution on the basis of a common syllabus for secondary schools. Reliance therefore has to be placed on the trained teacher who can formulate and carry out his own schemes. Girls' secondary schools can generally obtain the services of an expert teacher trained at one of the several physical training colleges for women. For this reason the physical training at the girls' schools, at least in the better ones, has for some time been conducted on the right lines.

Training in Secondary Schools.—Much less progress has been made with the boys' secondary schools, due partly to the lack of properly trained men teachers and partly to the fact that the need for systematic training has not been so fully recognised. The tendency has been to regard games as sufficient for the boys' physical development. It must, however, be admitted that the physical training of which these schools have had experience has not inspired general confidence in the efficacy of this form of instruction. Recent experiments indicate that a specialist training in physical education is unlikely to attract men of the right type in sufficient numbers to make the institution of a prolonged course of training an economically sound proposition. A solution may be found in encouraging the ordinary form masters to take part in the work after undergoing a short course of training, and in providing some instruction for students in secondary training colleges.

Secondary schools generally have facilities for physical training which the elementary schools do not possess; they have their own playing fields and usually some form of indoor accommodation, often a gymnasium, the classes are smaller and suitable clothing is worn. But in many of the secondary schools the growing pressure of whose academic work is often allowed to crowd physical training out of the time-table of the older pupils, the advantage of systematic physical training throughout the whole of school life needs to be more fully recognised. (*See* EDUCATION: *Literature.*) (F. H. G.)

II. IN THE UNITED STATES

Physical education advanced with giant strides in the United States during the years 1910–26. The World War had a powerful influence in centring attention on this subject, because one out of every three who were examined for service was rejected on account of disability. Before 1915, only three states had laws requiring the teaching of physical education in the public schools. During the period of the World War and the three years following, 25 states passed Acts compelling the teaching of physical education, and between 1921 and 1925 six other states passed similar laws, bringing the total to 34.

Most state laws provide for the organisation and supervision of courses in physical education for both sexes in the elementary, secondary and normal schools. Many states have made provision for training teachers in this subject in the normal schools, the courses for which must be passed satisfactorily before candidates are given their licence to teach. The professional training of teachers has contributed greatly to the advancement of physical education. There were in 1925 more than 40 schools, including normal schools, colleges, universities and private schools which graduate well-trained teachers, and the number is rapidly increasing. About 95% of the preparatory schools, colleges and universities have departments of physical training. Several states have a state director of physical education with assistants to supervise the work. It also has become the practice in large cities to have directors. The time requirements for exercise for the pupils average from 15 to 30 min. daily. It is estimated that the total cost of physical education in the public schools of the United States was in 1925 more than $15,000,000.

Systems of Training.—The German and the Swedish systems made definite contributions to the cause of physical education, but their formal work found their strongest opponent in the British system of playing games, which gradually has become the dominating principle of physical education in the United States. Marching, dancing, free-hand exercises and calisthenics with dumbbells or wands, usually form a part of the formal drills, but emphasis is laid upon the exercises in which play is the central theme. No nation in the world has so many outside agencies organised to promote the spirit of play either as a means of physical education or in conjunction with its main purpose.

Foremost among these is the Playground and Recreation Assn. of America, which is aggressive in arousing public interest in favour of play spaces with instructors, especially for the children. As a result of the momentum given, in part by this association, more than $20,000,000 are now expended annually in the United States for public recreation. Many thousand paid and voluntary workers give instruction in organised play in over 8,000 playgrounds and gymnasiums. Several other national organisations, working independently, practically all being constituent members of the National Amateur Athletic Federation, are promoting and administering programmes of physical education, some of them of a high order. Among these should be mentioned the Y.M.C.A., the Y.W.C.A., American Turner Bund, American Legion, Bohemian Sokol, The National Assn. of State High Schools, Boys' Club Federation, Catholic Boys' Brigade, Boy Scouts of America, Girl Scouts, Camp Fire Girls, Jewish Welfare Board, Order of DeMolay, The National Collegiate Athletic Assn., the Amateur Athletic Union and the Knights of Columbus. Other organisations not now nationally organised, such as Municipal recreation depts., athletic clubs, industrial companies, settlement houses, Churches and Sunday schools, civic and fraternal organisations, etc., also are doing valuable work in physical education. It is estimated that more than 10,000,000 boys of elementary and high school age receive physical training from the above and other organisations mainly in athletic games. (A. A. St.)

PHYSICS.—While recognising the tendency of each generation to consider itself important and its contributions to progress unique, the historian of the future will probably estimate the 30 years ending with 1925 as the most extraordinary in the history of the world up to the present in the number and the fundamental character of the discoveries in physics to which they have given birth, and in the changes brought about by these discoveries in man's conceptions as to the nature of the physical world in which he lives.

There has been no period at all comparable with this unless it be the period about 300 years ago, which saw the development of Galilean and Newtonian mechanics. This was indeed of incalculable importance for the destinies of the race. The conceptions then introduced are not only the basis of modern *material* civilisation, but they were the cause of a very complete change in man's whole intellectual and spiritual outlook—in his philosophy, his religion and his morals. But the discoveries in physics of the past 30 years justify the expectation, at least, of as great if not greater consequences—consequences, too, which are already beginning to be realised.

To appreciate how stupendous a change these discoveries have already wrought in human thought, it is only necessary to reflect that of the six basic principles which at the end of the 19th century acted as the police officers to keep the physical world running in orderly fashion, namely,

1. The principle of the conservation of the chemical elements,
2. The principle of the conservation of mass,
3. The principle of the conservation of energy,
4. The principle of the conservation of momentum,
5. The principle underlying Maxwell's Electrodynamics,
6. The principle of entropy or the second law of thermodynamics,

there is not one, the *universal* validity of which has not been questioned recently by competent physicists, while most of them have been definitely proved to be subject to exception.

The principle of the conservation of the chemical elements went with the discovery of radioactivity. The principle of the conservation of mass vanished with the experimental discovery of the increase in the mass of the electron with speed as the velocity of light is approached. The principle of the conservation of energy suffered a change in aspect when both experimental and theoretical evidence came forward that energy and mass are related by the Einstein equation $MC^2=E$, for in that equation the ideas of energy and of mass become completely scrambled. The principle of the conservation of momentum is denied *universality* by the quantum theory. The Maxwell equations are violated in atomic mechanics. The principle of entropy is thus far the only entirely unimpaired rudder to the ship of 19th-century thinking.

Further the speed with which new discoveries and new points of view are coming into modern physics shows as yet no abatement. Fifteen years ago it was thought that the revolution had pretty well spent its force, that the main group of new ideas had already been introduced. But a listing of the most outstanding discoveries of the past 30 years shows that the great majority of them belong exclusively to the period here in review—namely, the last 15 years—and all of them belong at least in part to this period. The immensity of the progress made within it will be best appreciated through a rapid review of this whole list and brief comments upon the origin and the particular significance of each discovery.

1. *The Discovery of the Electron.*—This was a very gradual process covering about 150 years and participated in by many workers. Franklin, Faraday, Weber, Helmholtz, Stoney, Lorentz, Zeeman, J. J. Thomson, Lenard, Townsend, Wilson and others,[1] but the actual isolation and the exact measurement of the electron occupied the first seven years of the period in review,[2] 1910–25.

2. *The Discovery of X-rays.*—This falls clearly outside the present period but practically the whole of the *quantitative working out* of the properties of X-rays and the great discovery in 1912 of their wave nature[3] lies wholly within it.

3. *The Discovery of Quantum Mechanics.*—This began at about the year 1900 with the work of Planck, but the last 15 years have contributed enormously to it, as will appear as the enumeration of discoveries proceeds.

4. *The Discovery of the Principle of Relativity.*—Though the special principle dates from about 1905 and therefore lies within the first half of the last 30-year period, the formulation by Einstein of the general principle belongs wholly to the period in review. Its birthday was in 1915 and its most precise and significant experimental verification through the measurement of the bending of starlight in going past the rim of the sun, the discovery of the enormous spectral shift of lines coming from the companion of Sirius,[4] and the beautifully consistent measurements of the displacements of solar spectrallines,[5] has all been the work of the past few years. It is too early to estimate the significance of D. C. Miller's very recent observations on ether-drift.

5. *The Discovery of Radioactivity.*—This belongs indeed wholly to the first half of the 30-year period, but the definite proof that lead is a product of the radioactive disintegration of both uranium and thorium, and the application of this fact to the fixing of the minimum age of certain uraninites from the Black Hills in South Dakota as 1,677,000 years,[6] to take but a single concrete case, is very new and marks an important advance in the process of elaborating a very much more definite geologic time scale than has heretofore been available.

6. *The Discovery of the Nuclear Atom,* through the experiments on x-ray scattering begun about 1912 and carried on for 10 years, mostly at Manchester and at Cambridge, England,[7] falls wholly within the last 15-year period and has been epoch-making in its consequences.

7. *The Discovery of Crystal Structures,* through the aid of X-ray spectroscopy[8] dates from only 1913. It has completely revolutionised crystallography and opened up a new world of definite knowledge about molecular and atomic arrangements in solids.

8. *The Discovery of Atomic Numbers* (1913–24) and the definite fixing of the total number of possible elements between hydrogen and uranium as 92,[9] both being included, is perhaps the most beautiful and the most simplifying discovery ever made. Nature never came so near surrendering herself to her lover without reserve and revealing herself in beautiful and simple grandeur as when Moseley found that all the elements fitted into a single arithmetical progression—a progression, too, which could mean nothing except that the positive charge on the nucleus of each atom moved up by unit steps from 1 to 92 in going from hydrogen to uranium—a progression which at once robbed atomic weights of their long-usurped right to act as arbiters of the chemical destinies of atoms, and restored this place to its legitimate possessor, the electrical charge of the nucleus. Some day a poet will arise who will make an epic for the ages out of young Moseley's discovery. The X-ray spectroscopists[10] and those who have recently extended the X-ray laws into the field of optics,[11] have contributed to the establishment of the complete generality of the Moseley progression, but they have merely finished the structure which he designed.

9. *The Discovery that the Energy Communicated to Electrons by Ether Waves is Proportional to the Frequency of the Absorbed Waves.*—This was vaguely suggested by Planck in 1900, more specifically by Einstein in 1905, but the experimental proof of its correctness is perhaps the most momentous achievement of modern physics; and it has all come about since 1912. The achievement is momentous not merely because the equation $\frac{1}{2}\,mv^2 = h_2 - P$ ranks with the equations of Maxwell in its consequences, but because the relation itself is new, undreamed of in 1895, and altogether revolutionary, demanding a return to some elements of the corpuscular theory of ether waves. It was proved first very exactly in photoelectric experiments with light waves,[12] then during and after the War with X-rays,[13] and then with γ-rays.[14] Most of the preceding discoveries were wonderful *additions* to knowledge, explorations in heretofore unknown fields but not subversive of established conceptions. This one, however, wrought havoc with existing theories and demanded a new formulation of ideas about the relations of ether physics and matter physics. Its significance for the future can scarcely be overstated.

10. *The Discovery of the Meaning of Spectral Lines.*—Bohr[14] in setting up his theory of atomic structure merely generalised the preceding discovery. With unusual insight into the method of constructive science, he incorporated all the past and merely superposed upon celestial mechanics the assumption, almost inevitable (if Einstein's equation is correct) that when an ether wave is *emitted* as well as when it is being absorbed the foregoing relation between energy and frequency still holds, *i.e.*, that the emitted wave frequency is given by $E_2 - E_1 = h_2$, the E_2 and E_1 being the electronic energy before and after emission. Combining this with the experimentally established Ritz-Balmer equation, he brought out sharply the unitary or atomic character of angular momentum, clearly one of the two or three most fundamental discoveries of all time, for it will presumably always be the basis of all atomic mechanics. It had been dimly glimpsed before in the work of Planck and Einstein, definitely stated by Nicholson and Ehrenfest, but from Bohr's time on Quantum theory took on a definiteness, almost a visualisability before unknown.

11. *The Discovery of Isotopes.*—This discovery did not begin to be made until 1913, when chemists and physicists approached it from two different angles; first, the chemistry of the radioactive elements and second, positive ray analysis.[15] It was completed only after 10 years of work by physicists in analysing by positive ray methods 46 of the first 55 elements of the periodic table. Its significance lies in the four following facts: first, that it has resurrected completely the discredited and amazingly simple Prout hypothesis that the masses of all atoms are exact multiples of the mass of a primordial atom; second, that it has enabled us to count with certainty the exact number of positive and negative electrons inside every nucleus—positives being equal in number to the atomic weight, negatives to the atomic weight minus the atomic number; third, that the failure of hydrogen to fit exactly into the above scheme constitutes excellent evidence for the Einstein conclusion as to the interconvertibility of mass and energy; and fourth, that the difference in stability (decay-time) of radioactive isotopes suggests new possibilities in the reading of the structure of the nucleus, *i.e.*, it gives us new eyes for peering inside the tiniest organism yet found—the nucleus of the atom.

12. *The Discovery of "The Excited Atom."*—The purely theoretical reflections in 1921 of two mere youths in Denmark, Klein and Rosseland, resulting in the proof that if atoms can be thrown by impact, as experiment shows that they can, into a quantum state of higher energy than the normal—appropriately called an excited state—then unless the second law of thermodynamics is to be violated there must be a heretofore unrecognised mechanism by which an excited atom can return to its normal state without radiating at all, but rather by throwing back all the potential energy of its excited condition through a so-called "collision of the second kind" into an electron or an atom projected from the collision with a kinetic energy that may be 100 times the average energy of molecular agitation. This is a very recent discovery of the first magnitude and of possibly immeasurable significance. It has already made it possible through the work of the experimental physicist[16] to see a collision-mechanism by which a negligible number of mercury atoms can absorb ether-wave radiations and transfer that energy to the act of exciting thallium atoms to radiate their characteristic frequencies. It for the first time reveals a definite mechanism, sought in vain by the best thinkers of the 19th century, by which the energy of ether waves may be absorbed by matter and transformed into heat. It takes in one case, at least, the mystery out of the words "catalytic agent." It suggests why very minute quantities of vitamines, etc., may be the intermediaries through which very vital processes are brought about. It makes the future bright with promise for the better understanding of explosive processes. Indeed the properties of excited atoms may possibly be the foundations of a new era in both industrial and biological science.

13. *The Discovery of the Artificial Disintegrability of Atoms.*—This was glimpsed about 1912 through the appearance of hydrogen lines where hydrogen unless artificially produced from other elements should not have been present, and new claims of spectroscopic evidence of a similar sort are now being advanced, but the unambiguous proof is contained in Rutherford's[17] direct experiments showing that hydrogen atoms can be knocked out of other atoms by alpha-ray bombardment. The method shares with that which will introduce new resolution into the study of the masses of isotopes, the promise for the future reading of the conditions of the electrons within the nucleus.

14. *The Discovery of Relativity Inside the Atom.*—It was as late as 1917 before Sommerfeld[18] began his wonderful work on the interpretation of the fine structure of spectral lines—work which began for the first time to reveal the correct principles underlying quantisation, finally so penetratingly formulated by Epstein. Seldom in the history of physics have purely theoretical formulae had such amazing successes in the field of precise prediction as have Sommerfeld's relativity-doublet formulae and Epstein's extension of the same sort of orbit considerations to the prediction of the number and character of the multiplicity of lines found in the Stark effect. The whole interpretation of spectroscopic line structure through changes in so-called azimuthal and inner quantum numbers is one of the great achievements of all time resulting from the interplay between penetrating theoretical analyses and skilful and refined experimental technique.

15. *The Discovery of New Experimental Techniques for Seeing Invisible Ether Waves.*—Such long-wave technique[19] has completely bridged within the past two years the gap between artificial electromagnetic waves and heat waves, and in the short-wave region hot-spark vacuum spectrometry[20] and beta-ray methods of analysis have practically filled in completely the gap between the optical and the X-ray fields, while far above even the gamma rays of radium a new group of rays of well-nigh infinitely high frequency has been found (*see* below). This continuous passage of frequencies from a thousand billion billion per second, over into the zero frequency, *i.e.*, over into static electrical fields, all these waves possessing identical characteristics as to speed of propagation, as to polarisation and as to relations of electric and magnetic vectors, demands one and the same sort of transmitting mechanism or medium to take care of them all, by whatever name it may be called, whether a "world-ether" or "space," this last term meaning no longer emptiness, but emptiness endowed with definite properties, if such an Hibernicism suits one's taste.

16. *The Discovery of New Properties in Conduction Electrons.*—The direct measurement[22] of the mass of conduction electrons, the discovery of a general increase in conductivity with the application of enormous pressures,[23] of superconductivities[24] and the very recent proof that, when intense electric fields pull conduction electrons out of metals, the energy of thermal agitation assists not at all at ordinary temperatures but does assist at very high temperatures,[25] all these recent discoveries, especially the last, begin to clear up the contradictions in the electron theory of metallic conduction, and to enable the quantum theory of specific heats to be applied in a new and illuminating way to the condition of the electrons in metals. The new results are full of promise for the better understanding in the near future of the moot subject of metallic conduction.

17. *The Discovery of Quantum Jumps Inside the Nucleus.*—The very recent proof[26] that gamma radiations obey the same quantum jump laws obeyed by X-rays and light rays and the still more recent proof that the initial act in a radioactive change is the ejection of an alpha or beta ray—possibly by virtue of the actual loss of mass of the nucleus through electronic settling and the transformation of this mass into the energy of the ray, following the Einstein relation governing the interconvertibility of mass and energy—this is a discovery of the first importance for the future understanding of one of the most fundamental processes in nature, namely the growth and transmutation of the elements.

18. *The Discovery that the Law of the Conservation of Momentum is Applicable to the Encounter Between a Light Quant and a Free Electron.*—This very recent and very amazing discovery[27] seems to put the final nail into the Einstein conception of radiant energy travelling through space in the form of vibratory light darts of some sort, but at the same time it emphasises the apparent impossibility of the physicist finding in his present stage of development any one consistent and universally applicable scheme of interpretation. It is a discovery of the very first magnitude, one of whose chief values may be to keep the physicist modest and undogmatic, still willing, unlike some scientists and many philosophers, not to take himself too seriously and to recognise that he does not yet know much about ultimate realities.

19. *The Discovery of the Summation of two Quantum Jumps Into a Single Monochromatic Ether Wave.*—The very recent proof brought forth first by the properties of band spectra[28] and second by the discovery of two electron jumps through study of pp groups in line spectra,[29] that an atom can integrate the combined energy of two distinct and simultaneous quantum jumps into a single emitted monochromatic wave, is of fundamental importance, because of the new light which it throws upon the nature of the act in which a ray of light is born and projected on its way through space. The discovery of two electron jumps uniting into a single monochromatic ether wave seems to preclude the possibility that there is any vibrating mechanism in the atom executing vibrations synchronously with the period of the emitted monochromatic wave. That the atom has this power of transforming, in some as yet mysterious way, the energy of every atomic shudder into a monochromatic ether wave is amazing. Whether we shall ever be able to visualise the process more definitely than we can now no one knows.

20. *The Discovery of the Failure of the Relativity Explanation of all Relativity-doublets.*—The impasse pointed out within a year[30] between the heretofore recognised causes of doublets in optics and in X-rays, an impasse which necessitated the finding of a new cause which would yield exactly the same formula as the relativity cause—a really terrible necessity in view of the extraordinary quantitative success of the purely theoretical formula following from the mere postulation of the change of the mass of the electron with speed—this impasse has apparently just been resolved within two months by two young Dutchmen, Oulenbech and Goudsmit, who find, *mirabile dictu*, that the assumption that every electron in the universe spins with one unit of angular momentum either right-handedly or left-handedly yields a formula of exactly the same form as does the relativity cause. This assumption not only saves the relativity explanation but, combined with it, furnishes a much better correlation of all present spectroscopic facts than we have heretofore had. It represents probably a fundamental advance in our understanding of the nature of the most nearly ultimate thing with which physics deals, namely, the electron. The physics of the future bids fair to hear much of the spinning electron.

(21) *The Discovery of Cosmic Rays.*[31]—That something very fundamental is going on all through space, that nuclear transformations each of enormous energy value corresponding to the fall of an electron through as much as 30,000,000 volts, are actually taking place in all directions about us in the outer stretches of the universe and that the signals of these cosmic changes can be detected here has just been proved. It is a discovery most stimulating to the imagination. Call it the music of the spheres if you wish! Anyway man can hear it now and may sometime know more about it.

Of these 21 fundamental discoveries, at least 16 fall wholly within the past 15-year period and all of them have belonged in no small degree to it. Physics as yet seems to show no signs of approaching senility. What the future has in store, no man knows but at present there seems to be well-nigh limitless possibilities ahead for applications even if the pace of discovery should sometime slacken.

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(*See* also ASTRONOMY; ATOM; ATOMIC ENERGY; ATOMIC WEIGHTS; CHEMISTRY; CRYSTALLOGRAPHY; ELECTRICITY; CONDUCTION OF; ETHER; GASES, ELECTRICAL PROPERTIES OF; ISOTOPES; MATTER; QUANTUM THEORY; RADIOACTIVITY; RAYS; RELATIVITY; SOLAR ENERGY; SPACE-TIME; SPECTRUM; TRANSMUTATION OF ELEMENTS; UNIVERSE: ELECTROMAGNETIC-GRAVITATIONAL SCHEMES.)

(R. A. M.)

PHYSIOLOGY (*see* 21.554).—Much new knowledge has been gained in practically every branch of physiology in the period 1910-26. More and more attention is coming to be paid to the chemical aspects of the subject.

Nature of Muscular Contraction.—Although the energy upon which muscular contraction depends comes ultimately from that locked away potentially in the food, the process by which it is set free is of a fundamentally different nature from that of a heat engine. The amount of heat derivable from the potential energy of the tension which is developed during the initial process of contraction may be about equal to the amount which is actually set free, an efficiency which far exceeds the possibilities of a heat engine (A. V. Hill). The efficiency of the entire process of contraction is of course much less than this, although it is also considerably greater than that of a heat engine.

This tension, instead of being degraded to heat, may do mechanical work by the muscle contracting, and during the contraction phase there is no evidence that combustion is occurring; thus no oxygen is used up, and contraction can occur equally well in the entire absence of oxygen as in its presence. The only demonstrable chemical change that occurs during contraction is that glycogen disappears and an equivalent quantity of lactic acid makes its appearance (Meyerhof). The actual contraction is apparently dependent on the sudden conversion of some of the glycogen of the muscle into lactic acid, which brings about a change in the surface tension at the interface between the sarcoplasm and the muscle fibrils. At the end of the contraction phase the muscle possesses less potential energy, and during the next, or recovery, phase this energy is restored through a part (four-fifths) of the lactic acid which was produced during the contraction phase being built up again into glycogen, by energy which is supplied by oxidation of the remaining part (one-fifth) of lactic acid.

A. V. Hill has shown that the amount of heat which is given out in a complete cycle of contraction is only 19% of that which would be given out were all of the lactic acid produced and removed during the complete cycle of contraction oxidised. At the end of a complete contraction in the presence of oxygen there is therefore less glycogen than at the start, but the amount of lactic acid is unchanged. During the recovery process alone oxygen is used up and CO_2 produced, and this combustion process is accompanied by a further liberation of heat which has been found to be 1·5 times greater than that liberated during the contraction phase. The evidence supporting this theory of muscular contraction depends on thermometric measurements of isolated muscles made by A. V. Hill and his collaborators, by the use of very sensitive thermopiles and on chemical analyses by Hopkins and Fletcher and, more recently, by Meyerhof. The theory is summed up in the following scheme:

Contraction	1 gr. glycogen → 1 gr. lactic acid	= Total energy +296
Relaxation	1 gr. lactic acid → sodium lactate	cal. (1).
Oxidative recovery	0·19 gr. lactic acid → $CO_2 + H_2O$ +684 cal. (exothermic).	
	0·81 gr. lactic acid → 0·8 glycogen	−240 cal. (endothermic, =444 cal. (1·5).

the net result being that (296+684−240)= 740 cal. of energy are liberated with a loss of 0·19 gr. glycogen. It is also evident that the recovery heat production is 1·5 times greater than the initial heat production.

Since these experiments on isolated frog muscle show that oxygen is required to restore the energy material (glycogen), it is to be expected that strenuous exercise in the intact animal will result in the accumulation of lactic acid in the muscles, because oxygen cannot be supplied to them, by way of the blood, quickly enough to oxidise the acid. It has been shown (A. V. Hill, etc.) that the increased oxygen intake *during* rapidly performed, hard exercise, such as a quick "mark time" movement of the legs, is relatively small when compared with the amount which is required for a considerable time *after* it. This "oxygen debt" is for the purpose of oxidising the lactic acid which accumulated in the muscles while the violent contractions were going on, and it may last for over an hour following exercise of less than one minute's duration. It falls off quickly immediately after the exercise, and then very slowly.

It can be shown that the total excess or oxygen inspired, over the resting requirement of the body, in the performance of quickly exhausting exercise is just sufficient to oxidise an amount of lactic acid which, by accumulating in the muscles, would raise the percentage in them to the fatigue maximum which is actually observed, by chemical analysis, to occur. Some of the lactic acid also overflows into the blood, so that some appears in the urine, but the greater part is removed by gradually going back into the tissues, where it is oxidised, this process being probably the cause for the long-drawn-out payment of the debt. During moderate exercise, as lactic acid accumulates in the muscle, the oxygen intake becomes greater, so that after a while a steady state becomes established, in which just sufficient oxygen is being absorbed to keep the lactic acid at a constant level, and so long as the latter is not produced at such a speed that the oxygen intake cannot keep pace with it (which is largely dependent on the adaptive process of the circulation), the exercise may be kept up for a long time. Leonard Hill had previously demonstrated the improvement in staying power which results from breathing oxygen during muscular exercise, so that athletic training consists essentially in learning how to bring about the steady state.

Increased breathing and the appearance of fixed acid in the blood both combine to cause a large excess of CO_2 to be expired, so that the respiratory quotient, CO_2, during hard muscular work may rise from its resting O_2 value of about 0·8 to over unity. For a short period after the exercise the quotient may rise still higher, because the excess O_2 intake falls off relatively more quickly than the CO_2 output, which must remain high so as to bring the H-ion concentration (cH) of the blood down to the normal level. The maintained hyperpnoea during exercise is mainly due to this increase in cH. At a later stage, when breathing has returned to normal, the base, which is gradually set free, because of oxidative removal of lactic acid, combines with CO_2 and so causes the output of this gas to become relatively reduced, giving a low respiratory quotient. When the *total* O_2 excess intake and the total CO_2 excess output are deter-

mined during short periods of exercise (*i.e.*, both during and following it), the interesting fact has come to light that respiratory quotient equals about 1, which indicates that carbohydrate must be the source of the energy of contraction in the intact animal, just as with isolated muscle. When the exercise is more prolonged the quotient falls below unity, since O_2 has to be retained in order to convert into carbohydrate such substances as fat, which contain relatively less oxygen. This process probably occurs in the liver.[1]

The Capillary Circulation.—Since they are composed of thin flat endothelial cells placed side by side, the capillaries have been considered incapable of dilating or contracting independently of changes in the pressure of the blood flowing in them, brought about by variations in the calibre of the minute arterioles. The first to observe independent alterations in the calibre of the capillaries was Stricker (1865) and this was confirmed by Roy and Graham Brown (1879). Convincing evidence was furnished by Dale and Richards, who showed that the capillaries dilate while the arterioles constrict during the depressor action of histamin (B-imin-azolyl-ethylamine), whereas the arterioles alone dilate with acetyl choline. When the rate of outflow was measured in a perfused preparation of the mesenteric blood-vessels, these observers found that acetyl choline always caused dilatation, whereas histamin caused constriction, although both lowered the arterial blood pressure. They also observed that a small dose of histamin, 0·01 mg., caused a flushing of the denervated paw, while acetyl choline had no effect, indicating that the former drug had specifically dilated the capillaries. It was later possible to explain the condition of *shock* following larger doses of histamin as due to extensive dilatation of the capillaries, on account of which the blood stagnates in them.

While the results of these researches made it necessary to postulate alterations in the calibre of the capillaries that are independent of changes in that of the arterioles, they did not furnish direct evidence that this occurs. Krogh examined microscopically the superficial capillaries of the muscles in frogs and mammals, using strong reflected light as a source of illumination. In resting muscles the capillaries are relatively few in number, and so narrow that the red corpuscles can pass along them but slowly and, often, only after marked distortion in shape. After activity, on the other hand, many more capillaries become visible, and the blood flows rapidly through them. As the circulation returns to the resting state, the capillaries again become narrower and many disappear from view; but even in a group derived from the same arteriole all do not behave alike, indicating that the degree of contractility varies. After the congestion caused by the irritation of pinning out the tongue of the frog subsides, many of the capillaries disappear from view. Krogh observed that scratching the surface of the tongue along the course of a small vein might cause a capillary, previously invisible, to become opened up so that corpuscles moved into it. If now the mechanical stimulus was applied in a line just in front of the end of this branch, the dilatation gradually extended, until at last a visible capillary had become formed of sufficient length to join with an arteriole, when the previously stagnant column of blood corpuscles immediately changed into a quickly flowing stream from arteriole to venule. This contractility of the capillaries is believed to depend on the presence of cells (Rouget cells) with numerous protoplasmic branches which encircle the endothelium of the capillary walls.

The tone of the capillaries is controlled partly by hormones and partly by nerves. Krogh found that marked local dilatation of the capillaries of the frog's tongue can be induced particularly with epinephrin. Capillaries in other regions may, however, be refractory towards epinephrin. He has also offered evidence to show that the normal tone is maintained by the presence of some constituent of blood plasma. This substance can be dialysed, and it withstands heat. It bears many resemblances to pituitrin. There is also evidence of control through the nerves. Hooker in 1920 showed that the capillaries in the cat's ear become constricted by stimulation of the cervical sympathetic. The red area which becomes developed on the skin of man by drawing a pointed instrument along it is due to dilatation of both arterioles and capillaries, through a reflex action which is set up by the stimulation of the pain receptors.

The reflex arc in these cases involves the nerve centres in the spinal cord, since the reaction is abolished by cocainisation of the skin, or by section of the sensory nerves or roots. Irritation of the tongue of the frog is also followed by the development of a hyperaemic zone, but the reaction is not abolished by section of the lingual nerve, so that it cannot be a true reflex. On the other hand, it is abolished by cocainisation or by degeneration of the peripheral nerves, so that some form of so-called axon reflex must be involved. The response of the capillaries and arterioles to local stimuli varies greatly in different vascular areas, and in different species of animal. Capillaries also react toward changes in temperature, and they are sensitive to light. The erythema which is set up on the human skin by exposure to ultra-violet rays only disappears gradually and is followed by desquamation of the epidermis and by pigmentation.

The Regulation of the Reaction of the Blood.—This or its H-ion concentration (expressed as cH, or for convenience the negative exponent pH) can be measured, either electrometrically (hydrogen electrode) or colorimetrically. In the latter method, the unclotted blood is placed in a small dialyser which is surrounded by a perfectly neutral (pH7) isotonic saline solution. After a few minutes the solution assumes the same pH as the blood, and this can be measured by adding to it an indicator, such as phenolsulphonephthalein, which changes in tint at a pH of about 7, and then comparing the tint with those produced in a series of phosphate solutions of varying, known pH's, containing the same concentration of indicator. The colorimetric method gives a slightly higher pH (blood more alkaline) than the electrometric. While in the body arterial blood is slightly alkaline, its pH by the electrometric method being 7·35–7·4 and by the colorimetric 7·6. It is maintained practically constant, but it tends to become less alkaline (*i.e.*, pH lower) when large amounts of fixed acid enter it, as after violent muscular exercise (lactic acid) or in diabetes (oxybutyric and acetoacetic acids). This tendency is, however, compensated for by stimulation of the respiratory centre, so that CO_2 is expelled from the blood in the lungs. The condition thus established is called *compensated acidosis*, and it is characterised by the blood being unable to take up as much CO_2 as the normal, when exposed to various partial pressures of this gas. Its *alkaline reserve* is said to be lowered. When CO_2 is deliberately blown off from the blood, by forced breathing, a relative excess of base comes to exist in the blood—*alkalosis*—so that an excess appears in the urine, making it alkaline in reaction. Both acidosis and alkalosis are associated with characteristic symptoms.

The Oxygen and Carbon Dioxide of the Blood.—For investigating the factors which govern the transport of CO_2 and O_2 by the blood, use is made of dissociation curves, which depict the relationship between the amounts of gas absorbed at various pressures. When CO_2 is added to blood it combines with base (Na) in the plasma to form $NaHCO_3$. The Na is derived partly from NaCl and partly from Na-protein, thus: $NaCl+H_2CO_3=NaHCO_3+HCl$; and Na-protein $+H_2CO_3=NaHCO_3+$H-protein. Since HCl cannot remain as such in the plasma it migrates through the envelopes of the red corpuscles to react in their interior with the potassium salts of phosphoric acid and haemoglobin thus: $HCl+K_2HPO_4=KH_2PO_4+KCl$; and HCl+K-haemoglobin = KCl+H-haemoglobin. In virtue of these reactions the CO_2 is absorbed without significant changes in pH (buffer action), and the plasma can take up considerably more CO_2 when corpuscles are present than when they are absent. Pure plasma also absorbs CO_2, but in an entirely different manner from that of a solution of bicarbonate, because of the protein present in it (see above equation).

[1] A. V. Hill and his co-workers have also published numerous papers bearing on the physical aspects of muscular contraction, but the technical details are such that it is impossible to give a condensed account of the results.

When haemoglobin combines with oxygen, its acidity is increased so that it attracts more base and thereby liberates some H_2CO_3 from bicarbonate. Consequently, the CO_2 dissociation curve for arterial blood is lower than that for venous blood. Such a process occurs in the lungs, thus facilitating the removal from the venous blood of its CO_2. On the other hand, the loss of O_2 from the blood, which occurs in the tissues, causes oxyhaemoglobin to be replaced by the less acid, reduced haemoglobin, so that the absorption of CO_2 is facilitated by some base being set free. Not only do these changes in O_2 content alter the CO_2-carrying power of the blood, but changes in CO_2, by affecting the pH, also influence the O_2-carrying power of the haemoglobin. The migration of O_2 which occurs from the blood into the tissue cells in the capillaries is therefore due, not only to its attraction because of the low oxygen pressure in them, but also because CO_2 migrates into the blood so as to lower pH.

A quantitative relationship therefore exists in blood among the following: (1) the free O_2; (2) combined O_2 (oxyhaemoglobin); (3) free CO_2; (4) combined CO_2 ($NaHCO_3$); (5) pH; and (6) NaCl of plasma. L. J. Henderson, to whom much of our knowledge of the reaction of the body fluids is due, has shown that the relation existing among these six variables is such that if any two are known the remaining four can be computed, and he has expressed these relationships in graphical form.

Mountain Sickness.—Certain characteristic symptoms, known as mountain sickness, supervene at high altitudes. The importance of the problem does not depend on there being any particular practical value in knowing how to prevent the establishment of the condition, but rather because the general disturbance of the bodily mechanisms to which the symptoms are due furnishes an opportunity, by comparison with the normal, to determine the relative importance of certain physiological adaptations. It is now clearly recognised that reduction in the oxygen pressure, due to the rarefaction of the air, is the underlying cause of the symptoms, several features of which demand attention. The symptoms do not become developed during short stays in the rarefied atmosphere, and they are therefore not usually observed in short flights to great altitudes in flying-machines or balloons. They do not, as a rule, become acute on reaching a high elevation on a mountain by railway until after a day or so, unless muscular exertion is attempted. The acute symptoms are severe enough to incapacitate the individual, and they include headache, a sense of great fatigue, sleeplessness, often nausea and vomiting, with various circulatory and respiratory symptoms, including cyanosis. After one to four days the acute symptoms disappear but less definite ones remain, such as mental sluggishness, readiness to fatigue, breathlessness on moderate exertion, sleeplessness, etc.

In peoples who have lived for long at altitudes such as those obtaining in the Andes (14,000–16,000 ft.) the bodily functions are apparently quite normal, except that muscular exertion leads to breathlessness more readily than it should. There are also certain minor deviations from the normal, such as cyanosis (blueness), tendency to clubbed fingers and a change in the shape and the diameters of the thoracic cavity. The most significant feature of mountain sickness from the physiological standpoint is the disappearance of the acute symptoms after a few days' acclimatisation. In an Anglo-American expedition to Pike's Peak, under the leadership of J. S. Haldane, F.R.S., in 1912, the important conclusions were drawn: (1) that the symptoms are due to anoxaemia (that is, a subnormal pressure of oxygen in the blood supplying the tissues); and (2) that acclimatisation depends on increased breathing and on the development by the pulmonary epithelium of the power to secrete oxygen into the blood from the air in the lungs. Under physiological conditions at sea-level this secretion of oxygen does not take place, since diffusion is adequate to determine the passage of oxygen into the blood.

A more recent expedition (1921–2), under the direction of Mr. J. Barcroft, F.R.S., to the Peruvian Andes failed to obtain evidence of any secretion of oxygen by the pulmonary epithelium at an altitude of 14,000 feet. Acclimatisation was found to depend on (1) an increase in lung ventilation, which raises the tension of oxygen in the pulmonary alveoli by 10–12 mm. and, therefore, also the tension in the arterial blood; (2) alteration in the power of the blood to absorb oxygen, so that at a given pressure of this gas a larger percentage is absorbed (O_2-dissociation curve); (3) decided increase in the percentage of red corpuscles, and therefore of haemoglobin, in the blood. The greater amount of haemoglobin increases the store of loosely bound oxygen carried into the capillaries, so that the venous blood is more saturated with oxygen than would otherwise be the case; but the chief advantage of this adaptation is a secondary one, the significance of which was demonstrated in subsequent experiments, in which it was found that when blood removed at sea-level was deprived of some of its CO_2, separated into plasma and corpuscles by centrifuging, and these two parts then recombined, so that the percentage of corpuscles was the same as that of persons acclimatised to rarefied air, the dissociation curve for O_2 assumed the same form as in the blood of persons acclimatised to high altitudes. No decided alterations in the reaction of acclimatised blood could be detected, although the tension of CO_2 in it, because of the hyperpnoea, was lower than at sea-level.

The Function of the Parathyroid Gland.—Removal of the four parathyroid glands is soon followed by the appearance of symptoms which are quickly fatal. The condition is called parathyroid tetany. Carnivorous animals are far more susceptible than herbivorous, and in the former substitution of the usual diet by one of milk and bread prevents the onset of the symptoms. Administration of calcium can also prevent their development. When one of the glands is left no acute symptoms may develop, although general nutritional disturbances gradually become evident, such as faulty development of the bones and teeth in young animals and a low assimilation limit for sugar. Two chemical changes in the blood have been found to be associated with parathyroid tetany: (1) a deficiency in the free calcium and (2) accumulation of guandin and its appearance in the urine.

The above symptoms may be removed by grafting a parathyroid gland from the same species of animal, thus suggesting an internal secretion, and Collip prepared from the glands an extract, *parathormone*, which is capable, when injected subcutaneously into parathyroidectomised dogs, of promptly removing the symptoms of tetany. After one injection the animals remain free of the symptoms for about 60 hours; but if the injections be repeated the animals may remain permanently free of them and the blood calcium rises to, or above, the normal level (10mg.%). Repeated injection of the extract into normal dogs also causes the blood calcium gradually to increase, and when a certain level (about 20mg. Ca. per 100 c.c. blood) has been reached characteristic symptoms supervene, consisting at first of weakness and hyperpyrexia and, later, of vomiting and diarrhoea, often accompanied by the appearance of blood in the vomitus and stools. The blood also becomes very viscid and darkly venous in colour, and the usually fatal outcome is probably due to a failure of the blood to circulate through the capillaries because of its stickiness. Herbivorous animals, such as mice, rabbits, guinea-pigs, do not show these symptoms on injecting parathormone (Macleod and Taylor).

The Neuro-Muscular System.—A valuable experimental analysis of the reflexes concerned in maintaining the position of the animal body while at rest and in movement has been contributed by Magnus. It will be recalled that a certain condition of extreme tonic contraction of the extensor muscles supervenes upon removal of the cerebrum (the decerebrate rigidity of Sherrington). It is now established, by the method of section at different levels of the brain, that the centre concerned is located in the medulla oblongata above the level of calamus scriptorius but below that of the red nucleus. This centre excites increased tone of the extensor musculature, and its effects are counteracted, in the intact animal, by impulses coming from another centre located in the red nucleus, which excites their antagonists, the flexors. When an animal in decerebrate rigidity is placed in the standing posture it can maintain this attitude, but it cannot retain it if disturbed.

On the other hand, if the section be anterior of the red nucleus, the animal can right itself if displaced from the standing posture. Working with preparations of these types Magnus and his co-workers have shown how reflexes initiated from different sense-organs, such as the labyrinth, the eyes and the proprioceptive nerves of the muscles, interact among one another to bring about the various postural reactions of the body. Magnus distinguishes between *static* and *stato-kinetic reflexes*. The former include the *postural reactions* when the body is at rest, and they may be reflexes of pose, in which the body remains fixed in a certain position; or *righting reflexes*, which are those which come into play to restore the pose after it has been disturbed. Stato-kinetic reflexes are produced by the actual movement of the body rather than the position which results from this movement. As an example of the methods employed in these studies, reference may be made to experiments illustrating tonic neck reflexes and tonic labyrinth reflexes. To demonstrate the former the labyrinth is removed in a decerebrate preparation, and it is found that when the head is moved so that certain of the neck muscles are put on the stretch and others relaxed the limbs assume definite positions which are characteristic for each position of the head, but which are not the same for the fore and hind limbs nor for those of opposite sides of the body. To demonstrate labyrinthine reflexes the labyrinths are left intact, and movements of the muscles of the neck are prevented by encasing the neck of the preparation in plaster of Paris. Variations in the orientation of the animal then result in poses of the limbs which are characteristic for each position, but in this case all four limbs behave alike. Destruction of the labyrinth abolishes these reactions.

Glutathione.—The very difficult problem of the mechanism of tissue oxidations has been considerably elucidated by the discovery of Sir F. Gowland Hopkins that a comparatively simple substance called *glutathione* can be prepared from various tissues, although not from the blood or connective tissues. Chemically, it is a depeptide of cysteine and glutamic acid, and it has recently been synthesised by Stewart and Tunnicliffe. In the reduced form its general formula may be written $G{\cdot}SH$, where G· represents glutamic acid and SH cysteine. When it is oxidised the following reaction occurs: $2\ G{\cdot}SH \rightarrow G{\cdot}S{\cdot}S{\cdot}G + H_2$. It is probable that a peroxide is formed during its oxidation, and if this occurs in the tissues the peroxide would be available for complete oxidation.

Much attention has also been given to the hypothesis of Wieland that the oxidation of the majority of substances consists essentially in the removal of hydrogen, rather than the addition of oxygen. As applied to tissue oxidations, this means that enzymes called hydrogentransportases act by transferring hydrogen from one oxidisable substance (hydrogen donator) to substances which become reduced (hydrogen acceptors). For many of the studies in this field methylen blue has been used as the acceptor, the speed of the reactions being measured by the time required to effect its decolorisation in vacuo.

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PIANO: *see* MUSICAL INSTRUMENTS.

PIAVE: *see* VITTORIO VENITO, BATTLE OF.

PICASSO (1881–), Spanish painter. Pablo Ruiz was born in Malaga, Spain; he took the name of his mother, Picasso. In his sixth year the family moved to Barcelona, where his father was a professor at the Academy of Arts, and where the son held his first exhibition. A Spaniard living and working in Paris, he is perhaps more typical of the present age, more deeply influenced by the uncertain and tortured spirit of the times, than any other painter alive. During the years 1906–12 he was associated with Georges Braque in developing Cubism, a method of painting which, in spite of excesses and debasements, has definitely modified the world's conception of that art. In Picasso's Cubism painting for the first time becomes deliberately conscious of the new world of the machine, and of the modifications in the eye made by familiarity with all its complicated and exact patterns. The logical conclusion of his theory was a kind of painting which used form and colour not to imitate nature but to create a plastic world of its own that would have no connection with the world of nature, that would in fact be a pure and abstract art like mathematics. But Picasso abandoned Cubism before it reached that logical conclusion which his strain of Spanish mysticism had led him to visualise so differently. Herein lies the clue to his astoundingly fertile but unstable genius. Compared with Cézanne and El Greco, who were his most important masters, he lacks that staying quality, that capacity to endure, which is one of the requisites of great art. His sensory receptiveness is inexhaustible, but his creative power is limited by his lack of resistance. Since his desertion of Cubism, he has gone back to Ingres, and his recent work shows sheer virtuosity of draughtsmanship without any great emotional quality. Picasso's numerous works are mostly to be found in private collections. (*See* PAINTING.)

BIBLIOGRAPHY.—The fullest account of Picasso is found in Maurice Raynal's *Picasso* (1922). Other works are Guillaume Apollinaire, "Picasso," *La Plume* (May 1905); *Les peintres cubistes* (1913); Fritz Burger, *Cézanne und Hodler* (1913); Max Raphael, *Von Monet zu Picasso* (1913); Jan Gordon, *Modern French Painters* (1923); Paul Westheim, *Die Architektonik des Plastischen* (1923); Elie Faure, *History of Art* (1924).

PICKERING, EDWARD CHARLES (1846–1919), American physicist and astronomer (*see* 21.528), died at Cambridge, Mass., Feb. 3 1919.

PICKFORD, MARY (1893–), American motion picture actress, was born at Toronto, Canada, April 8 1893. She made her first appearance on the stage at the age of five with the local Valentine Stock Co., and when eight went on tour, playing the part of Jessie, the little mother, in *The Fatal Wedding*. She came to New York under the auspices of Belasco, creating the part of Betty Warren in *The Warrens of Virginia*. Her first motion picture work was undertaken with D. W. Griffith as an extra, but she returned for a time to Belasco, taking the part of Juliet in *A Good Little Devil* at the Republic Theatre in New York. In 1913 she came back to the screen with Famous Players Co. and rose to the first rank. In 1916 the Mary Pickford Film Corp. was organised and she received a salary higher than that paid to any other motion picture actress. In 1918 she became an independent producer and went to California. In 1919 she was the prime mover in the formation of the United Artists Corp. or "Big Four," composed of Miss Pickford, Charles Chaplin, Douglas Fairbanks and D. W. Griffith. Taking juvenile characters, Miss Pickford was for long the most popular screen actress in the world. Among the best known and most artistic of her pictures were *Tess of the Storm Country*, *Little Lord Fauntleroy* and *Dorothy Vernon of Haddon Hall*. She married Douglas Fairbanks, the motion picture actor and producer, March 28 1920.

PIETERMARITZBURG, Natal, S. Africa (*see* 21.592), had a population (1921) of 25,160 and with the suburbs of 36.023. Something like half (17,998) were whites. In 20 years the white population had increased by 3,400 only. Maritzburg, as it is commonly called, retains its pleasant, dignified character, has many fine public buildings, and is the religious, educational, professional and agricultural centre of Natal. Up to 1910 the Natal Parliament, abolished at the establishment of the Union, met here; it is now the meeting place of the provincial council, the seat of an Anglican bishop, and of the Natal division of the Supreme Court. University College is a constituent college of the University of South Africa. Its agricultural shows are noted for their excellence. Fort Napier, where thousands of German prisoners were interned during the World War, is now used as quarters for government and railway servants.

PILNYAK (1894–), Russian novelist. Boris Andreevich Vogau, who later took the pen name of Pilnyak, was born Sept. 29 1894 in Mojaisk, Moscow province. His childhood and early

youth were spent on the Volga and among the peasants and the land administration "intellectuals." He studied economics at the Moscow commercial institute and began publishing stories in 1915. During the Bolshevik revolution Pilnyak lived in Moscow and also travelled through Russia studying the new conditions. In 1923 he visited England and Germany. His works deal with the first chaotic stage of transition from the old Tsarist Russia to the "new world" of the Soviet Republic. He is the most prominent figure in post-revolutionary fiction. His sympathies are with the peasants as opposed to the town and his stories are deliberately fragmentary and read like diaries and chronicles.

PILSUDSKI, JOSEPH (1867–), Polish soldier, was born in Nov. 1867 in Zulow (Zulowo), County of Vilna (Wilno) of an ancient family tracing their origin from the Lithuanian Princes of Ginet. He was educated at the Gymnasium of Wilno and attended the Medical Faculty at the University of Kharkov.

In 1887 Pilsudski was involved in an anti-Tsarist plot and sentenced to five years' penal servitude in Eastern Siberia, although the trial clearly established his innocence and his deprecation of terrorist methods. In his exile he learnt to know the Russians well. He returned to Wilno in 1892 and commenced his political activities there. As regards his convictions he was a Socialist, but he realised that a democratic State, free from political oppression was necessary in order to safeguard the natural development of the social system; consequently the political independence of Poland was introduced into the programme of the Polish Socialist party (P.S.P.) formed by him. "Romanticism of aims—realism of means"—that is how he described his creed and methods.

In 1894 he commenced the publication of the secret paper *Robotnik* (The Workman) and during the next ten years this paper voiced the most radical and outspoken opinions in Poland. *Robotnik* was edited, printed and distributed by Pilsudski himself. The risk of penal servitude for life did not deter him; wherever he went he inspired confidence and encouragement. His courage, keen sense of humour, attractive personality and good breeding made him the idol of the working classes; he was revered by the intelligentsia for the tenacity of his convictions, for his fearlessness and his iron will.

In 1894 he married Mlle. Marie Juszkiewicz; and assisted by his wife gradually increased the scope of his political activities. Armed resistance against the atrocities of the Russian Govt. was introduced into the programme of his party. Meetings and demonstrations were, in consequence, protected against the police and the military by armed detachments of workmen. Every year on May 1 blood flowed down the streets of Polish cities, reminding the nation that there were principles worth dying for by a "sudden and untimely death." In 1900 Pilsudski and his wife were arrested in the offices of the *Robotnik* in Lódź and for a year he was kept in a special cell in the notorious "Tenth Pavilion" of the Warsaw Citadel. In order to avoid a life sentence Pilsudski simulated insanity, and was, in consequence, transferred to the St. Nicholas Hospital in St. Petersburg (Leningrad). On May 13 1901 he was rescued, the result of an ingenious plot of the Polish Socialist party. He lived in London for some time and returned to Cracow in 1902.

Pilsudski's attention next became concentrated on the organisation of "armed resistance." Lack of munitions, however, frustrated his plans for an insurrection during the Russo-Japanese war. He went to Japan in order to enlist her support, but met with indifference from the Japanese Government. In spite of the failure of his mission, Pilsudski continued to organise his men by private means. After the Russian revolution of 1905 and the convocation of the Duma in St. Petersburg Polish revolutionary activities were discontinued, but the Russian Constitutional Govt. continued to pursue the policy of its predecessors with regard to Poland. Pilsudski transferred his headquarters to Cracow and Lwow and commenced his activities amongst the refugees from the Russian provinces of the country. The seemingly chimerical idea of a "private Polish army" was conceived there. An officers' school was established in Lwow and branches of the "sharpshooters" (Strzelec) were formed throughout Galicia.

In a lecture delivered in Feb. 1914 before the Geographical Society in Paris, Pilsudski prophesied the imminence of the World War; he expressed the opinion that the ideal conclusion of such a war, from the Polish point of view, would be for Austria and Germany to conquer Russia, and for France to win a victory over Germany. True to his opinions, he sided with Austria when war broke out. The total strength of his "army" was 3,000 infantry and a squadron of cavalry insufficiently armed and equipped; the remaining 7,000 of his men were dispatched to Hungary by the Austrian general command. Pilsudski resisted vigorously every attempt of the Central Powers to employ his own legions outside the frontiers of Poland. When, in Nov. 1914, the Germans attempted to send the legions over to the Western front, he broke through the Russian columns and, in disobedience to Austrian orders, returned to Cracow. His brigade took part in numerous battles in which it exhibited great bravery and exemplary discipline. As a leader of his troops Pilsudski was unsurpassed. Calm, brave, simple and devoted to his men, he became the idol of his subordinates. His mere presence in the trenches inspired the troops with the hope for glory and a certainty of victory.

When, after the collapse of the Brusilov offensive, Russia was virtually conquered, Pilsudski turned against the remaining partition Powers, *i.e.*, Germany and Austria. In July 1916 he resigned the command of the Polish legions in consequence of the abuses of the German and Austrian occupation authorities in Polish territory. At the same time he sought to establish relations with France and Great Britain through his colleagues, MM. Sokolnicki and Narutowicz. His attitude, which was quite natural, was, however, met with distrust by the Allied Powers. On Nov. 5 1916 the independence of Poland was proclaimed by the Central Powers and Pilsudski accepted the position of Minister of War in the newly formed Council of State. Within a short time he formed the semi-secret Polish military organisation, *i.e.*, Polska organizacia wojskowa ("P.O.W."), which spread throughout the country and was instrumental in disarming Germans and Austrians in 1918.

When the Polish legions in Russia, commanded by Gen. Musnicki, proclaimed Pilsudski their spiritual leader, and when his own legions refused, in July 1917, to take the oath of "fraternity of arms with Germany and Austria," Pilsudski was arrested by the Germans and imprisoned with his chief-of-staff Gen. Sosnowski in the fortress of Magdeburg, whence he was released in 1918 by the German revolutionary authorities. He arrived in Warsaw on Nov. 4 and completed the disarmament of the armies of occupation. The Regency Council, established by the Germans, resigned in his favour and all military organisations in the country submitted to his command. An efficient and disciplined army was soon formed. With this army Pilsudski maintained the independence of Poland, which was menaced on all frontiers by the Bolshevists, Lithuanians, Ukrainians, Czechs, and Germans (in Silesia) and laid the foundations of a strong, democratic State. Vested with dictatorial powers, he, like a modern Washington, summoned the Constituent Diet elected by general ballot. He gave his country everything which he thought was necessary for its constitutional development; like a lion he guarded its inviolability and its prestige. His great mind, his sense of justice, his deep and disinterested love for his country gained for him the admiration of his people. His election as Chief-of-State was unanimous; and the army conferred upon him the supreme honour of First Marshal of Poland.

In foreign politics Marshal Pilsudski proved himself to be a cautious and far-seeing statesman. His military genius was exhibited particularly during the war of 1920. Believing that Poland ought to pursue the traditions of its "golden age" (14th, 15th and 16th centuries), he undertook the expedition to Kiev in 1920. He captured Kiev in order to hand it over to Poland's ally the Ukraine, in the same way as he took Dunaburg to hand it over to Latvia. Unfortunately, the Ukrainians were too weak to take advantage of Pilsudski's victories; his plans for

a Polish-Ukrainian Federation failed and the Polish troops retreated from Kiev. The strategic aim was, however, achieved; the southern flank of the Russian army which was to attack Lwow and the oilfields was completely disorganised, and thus the Bolshevists were forced to attack from the north. Their numerical superiority gave them initial advantages. Disregarding the opinions of all his military advisers, Pilsudski concentrated along the River Wieprz his devoted regiments and by a lightning attack, which he led himself, broke through the Russian front and dispersed the Bolshevist hordes collected round Warsaw, where they expected an "easy victory." Pilsudski's victory saved not only Poland but the whole of Europe from a new war and conflagration.

Personally modest, although grand in his ideas, Joseph Pilsudski retired from public life when he became aware that his actions and advice evoked distrust and intensified party feeling. His retirement did not weaken factional wrangling, however. On the contrary it intensified the decay of Parliamentary life and multiplied cases of administrative corruption. When this trend of events became a menace to the Republic, Marshal Pilsudski came to the conclusion that, as the creator and spiritual leader of the modern Polish state, he could no longer remain inactive. Supported by his devoted army, he demanded the strengthening of the authority of the President, a greater measure of Government independence from a faction-ridden Parliament and the impeachment of all persons guilty of corruption, regardless of their standing or party support.

Marshal Pilsudski's opponents succeeded in gaining the formal support of Wojciechowski, President of the Republic. The military demonstration undertaken by the Marshal on May 12 developed into a three days' army conflict in the streets of Warsaw resulting in the resignation of the President. The National Assembly, convoked by his successor, Monsieur Rataj, marshal of the diet, elected, by a great majority, a new President in the person of Joseph Pilsudski. The results of the election were hailed with tremendous enthusiasm throughout the whole country, particularly among the peasant and working classes. Pilsudski, however, desirous of devoting himself entirely to the army, did not accept the high office and recommended Prof. Ignacz Mosieki as the most suitable candidate. The latter was elected President and called upon Monsieur Bartel to form a Government which would undertake internal reforms on the lines proposed by Pilsudski. The Marshal himself accepted the office of Minister of War and chairman of the Supreme Army Council. (W. St.)

PIRANDELLO, LUIGI (1867–), Italian dramatist and novelist, was born June 28 1867 on a country estate near Girgenti (Sicily). He first went to Rome at the age of 19, staying there until 1891, when he went to Germany and graduated in philosophy at the University of Bonn. He subsequently returned to Rome and taught at the girls' high school until 1923. His first literary essays were in verse, a volume entitled *Mal giocondo* published in 1889, followed by a poem *Pasqua di Gea* (1891) and *Elegie renane* (1895). Another Sicilian writer, Luigi Capuana, persuaded him to devote himself to fiction, and in 1894 he published his first novel, *L'esclusa*, in which his somewhat bitter realism already finds expression. Besides the comic novel, *Il turno*, he began to publish short stories in ever-increasing numbers, the somewhat painful humour of which soon attracted public attention: *Amori senza amore* (1894), *Quando ero matto* (1903), *Beffe della morte e della vita* (1902, 1903), *Bianche e nere* (1904), etc. In 1904 his most celebrated novel, *Il fu Mattia Pascal*, appeared, the story of a man, who having shammed being dead, tries in vain to begin his life anew in a different atmosphere and under another name, but fails lamentably. Other collections of short stories followed: *Erma bifronte* (1906), *La Vita Nuda* (1910), *Terzetti* (1912). He set forth his artistic creed in two volumes entitled *Arte e scienza* (1908). In 1913 his novel, *I vecchi e i giovani*, describing the drama of Italian life after the Risorgimento, was published in the *Rassegna contemporanea*. Other volumes of short stories appeared between 1914 and 1926, such as *La trappola* (1915), *Un cavallo nella luna* (1918), *Il carnevale dei morti* (1919), *Tu ridi* (1920), and another novel *Uno, nessuno e centomila* was published in the *Fiera letteraria*.

In 1920 he said of his own art:—

> I think that life is a very sad piece of buffoonery; because we have in ourselves, without being able to know why, wherefore or whence, the need to deceive ourselves constantly by creating a reality (one for each and never the same for all), which from time to time is discovered to be vain and illusory . . . . My art is full of bitter compassion for all those who deceive themselves; but this compassion cannot fail to be followed by the ferocious derision of destiny which condemns man to deception.

This despairing outlook attained its most vigorous expression in Pirandello's plays. In his youth he had shown a certain contempt for the drama, but in 1912 he was persuaded by the Sicilian playwright, Nino Martoglio, to dramatise one of his own short stories, *La Morsa*, as a one-act piece. His first three-act comedy, *Se non così* (1917), was produced by Marco Parga at Milan in 1913; and then many plays—dramas and comedies—of which the most celebrated are *Il berretto a sonagli*, *Liola* (1917), *Così è se vi pare* (1918), *L'uomo, la bestia e la virtù* (1918), *Ma non è una cosa seria*, *Come prima, meglio di prima*, *Sei personaggi in cerca d'autore*, *L'imbecille*, *Enrico IV.*, *Vestire gli ignudi* (1918), *La vita che ti diedi*, *L'altro figlio*, *Ciascuno a suo modo*, *La sagra del signore della nave*, *La giara*.

Pirandello's dramatic art was at first criticised for being too "cerebral," for not seeing life as it really is and for arbitrarily deforming it. The Roman critics first discovered the real meaning of Pirandello's ideology and the human sense of his plays. His main themes are: the necessity and the vanity of illusion, the multiform appearances, all of them unreal, of what is presumed to be the truth, man is not what he thinks he is, but he is "one, no one and a hundred thousand," accordingly as he appears to this person or to that, and is always different from what he creates himself in his own mind. Hence the supreme catastrophe, when a moral looking-glass suddenly reveals to him the image of himself which others see, *i.e.*, what he *is* to others. Most of Pirandello's plays deal with a lower middle class milieu, peopled with clerks, teachers, lodging-house keepers, etc., from whose modest vicissitudes he draws conclusions of vast human significance. Typical is *Così è se vi pare*, in which he proves that it is impossible to know the real truth. *Enrico IV.* develops in a broader sense; that is, a drama in which we have a man who renounces his changing, empty and vain existence to play the part of a madman, and pretends to believe himself an historical personage, Henry IV. All this might be merely theatrical trickery if it were not seared by a deep anguish, characterising a philosophy which has destroyed all faith in the absolute, in reality, in any fixed limits outside individual personality.

Pirandello's plays have rapidly achieved success throughout Italy and abroad, and have been translated into some 15 languages. In 1925 he created an art theatre of his own in Rome, where new Italian and foreign plays are performed, and in the summer of the same year he brought his company on a tour to England to produce his own plays in London (at the New Oxford Theatre), to Paris, Basle and 18 theatres in Germany. Everywhere he met with an enthusiastic reception. (S. D'A.)

PIRENNE, HENRI (1862–), Belgian historian, was born at Verviers Dec. 23 1862. He first lectured at the University of Liége, and in 1886 became professor at the University of Ghent. His most famous work, *Histoire de Belgique*, of which five volumes had appeared in 1925, completely revolutionised the current conceptions of Belgian history and nationality. Starting from the origins, M. Pirenne showed how, from the time of the Germanic invasions, Flemings and Walloons were drawn together by community of tradition and economic interest: the unity achieved in the 15th century under the dukes of Burgundy was not the result of a foreign domination, but of the natural development into a modern nation of the various fiefs, among which Belgium was divided in the Middle Ages. When the Belgian provinces came under foreign rule during the following centuries, their local liberties were jealously preserved by the people, until their complete independence was recognised by the Powers in 1830.

M. Pirenne became chiefly known among historians as a mediaevalist, and his works on mediaeval cities and social conditions include *Les anciennes démocraties des Pays-Bas* (Paris, 1910, Eng. tr. 1915) *Recueil des documents relatifs à l'histoire de l'industrie drapière en Flandre* (with G. Espinas, 4 vol. 1906–24) and *Mediaeval Cities: Their Origins and the Revival of Trade* (Princeton, 1925). M. Pirenne was the first president of the "Union Académique Internationale" (1920–3) and received honorary degrees from the universities of Brussels, Oxford, Manchester, Groningen, Paris, Strasbourg, Bordeaux, Leipzig and Tübingen. (*See* ALBERT, KING OF THE BELGIANS; BELGIUM.)

PISTOL (*see* 21.654).—During the period 1910–26 the automatic pistol has been gradually perfected and adapted to replace the revolver as a military side arm, despite the fact that there are many who maintain that the revolver is the more dependable weapon. The automatic pistol, like all complicated mechanisms, occasionally malfunctions, usually due to a defective magazine or cartridge. This disadvantage is, however, offset by the fact that from the pistol about three times the number of shots per minute may be fired as from a revolver; its magazines are changed instantly, thus giving sustained fire while loaded magazines are at hand. This gives a great advantage to the user of a properly working pistol, as a revolver is often useless at close quarters, such as obtained in trench raids, after its six shots have been fired. In such positions the volume of fire from a group of pistols is much greater than that from an equal number of revolvers even if a pistol is occasionally disabled by a jam.

Owing to its simpler mechanism, the revolver is more reliable for civilian self-defence where more than two or three shots are seldom required; the weapon then being unused and often neglected for long periods. The revolver is also considered superior to the automatic pistol in safety. In the latter, the loaded cartridge automatically inserted in the chamber after each shot is liable to be forgotten and left there when the magazine is taken out. To prevent accidental discharge from this source, some of the newer models have a "magazine safety," which prevents the pistol from being fired when the magazine is out. In addition, a "grip safety," which prevents discharge unless the rear part of the grip is pressed in at the same time the trigger is pulled; and a safety catch, which locks the slide and hammer, are often used. Recent models of revolvers show no improvements of note, and it is probable that with the attention now being given to the design of the automatic pistol, that weapon will eventually be made as reliable, safe and quick to get into action as a good revolver.

In European armies previous to the World War, the pistol was used almost exclusively as an officer's side arm. Their weapons were of small calibre, ranging from 7·63 mm. to 9 mm., and lacked stopping power. During the War the use of the pistol and revolver was extended to include many branches of the service not armed with rifles, particularly by the United States, British and German armies. The large calibre weapons of the former armies gave them a great advantage in pistol fighting, and their use confirmed previous opinions that a large calibre heavy bullet of short range and low velocity is more effective in a pistol than a high velocity, small calibre bullet. The principal and best known systems of automatic pistols, most of which are manufactured in several calibres, include the following: Colt, Browning, Webley, Savage, Remington, Luger, Mauser, Mannlicher and Steyr.

Automatic pistols have now been adopted by the armies of the United States, Belgium, Spain, Italy, Denmark, Portugal, Switzerland, Germany and Austria. The British Navy has adopted the Webley automatic pistol.

Automatic Pistols and Their Cartridges

Cartridge	Barrel Length, Inches	Weight of Bullet, Grains	Muzzle Velocity, Ft. Seconds	Energy of Bullet, Ft. Lb.
·22 Long rifle rim fire	..	..	..	..
·22 Colt Auto. target model	6½	40	765	51·8
·25 Auto. Colt, Webley & Scott, Harrington & Richardson (also interchangeable with 6·35 mm. Browning (Fabrique Nationale), Mauser, Pieper, Clement, Steyr, Victoria)	3⅛	50	733	59·7
7·63 mm. Mauser, Borchardt	5½	86	1,397	373
7·65 Luger	4⅝	93	1,173·5	284·3
·32 Auto. Colt, Webley & Scott, Savage, Harrington & Richardson (also interchangeable with 7·65 mm. Browning (Fabrique Nationale, Bayard, Mauser, Pieper, Schwartzlose, Clement, Steyr, Frommer)	4	74	964	152·
·35 Smith and Wesson	3½	76	809	110·5
9 mm. Luger	4	125	1,039·2	299·8
·38 Auto. Colt, Bayard	5¾	130	1,146·3	379·4
·380 Colt Auto., Savage, Webley, Browning 9 mm. (Short), Remington, Bayard	3¾	95	887	116
·45 Colt Auto.	5	200	910·2	368
·45 Colt Auto., U.S. Govt.	5	230	809	335
·445 Webley Naval Automatic	..	220	710	..
·455 Colt Automatic	..	..	..	..

(H. O'L.)

PITCH: *see* COAL TAR PRODUCTS.

PITTSBURGH, PA. (*see* 21.678), had (U.S. Census, 1920) a population of 588,343, increased in 1925 to 631,563. The increase over 1910 was 54,288 or 10·2%. After the 1920 census was taken, St. Clair borough and parts of Chartiers, Reserve and Lower St. Clair townships were annexed. Within the metropolitan district of a 10-m. radius, but outside the city limits proper, there was a further population equal in number to that within the municipality itself, and within a radius of 30 m. the total population was 1,800,000. In Allegheny co., of which Pittsburgh is the county seat and business centre, there were in 1920 1,184,832 persons (1,252,344 in 1925), 13·6% of the total population of Pennsylvania.

Recent Developments.—The 50th anniversary of Pittsburgh, elaborately observed in 1908, marked the beginning of a new period of corporate, educational, social and material development. By legislative enactment (1911) the former common and select councils gave way to a small council of nine members, elected by general vote of the entire city. The mayor continued to appoint the heads of departments (safety, works, health, charities, supplies, property, water, treasury). The comptroller also was elected as formerly by popular vote. The expansion of public business in the city and county exceeding the capacity of the city hall and the court-house led to the erection by joint action of a new city-county building, a fine structure of nine storeys. The county in 1923 completed a twin tunnel—each tube 25 ft. wide and 5,889 ft. long at a cost of $6,000,000—under Mt. Washington to connect the southern hill district with the city by a high-level bridge over the Monongahela river bringing that district within 15 minutes' transit of the centre of the city. Two new bridges across the Allegheny were completed in 1925, and two others under construction were expected to reach completion in 1926, thus providing the city with 16 bridges across the two magnificent rivers.

The value of Pittsburgh products in 1923 was $1,883,447,400, being 21·8% of those for the entire state. In 1924 the city held fifth place in bank clearings ($8,036,969,343) and first place in the following manufactured products: iron, steel, glass, electrical machinery, steel cars, tin plate, air brakes, fire-brick, white lead, pickles and preserves, corks, aluminum, railway signals and safety devices, vanadium, bituminous coal and coke.

In 1911 the Legislature adopted a new school code for the entire commonwealth, coming into operation on Nov. 11 1911. Under this code a Board of Education consisting of 15 members appointed by the Common Pleas judges took control. Separate school districts were abolished; a new city superintendent with associate superintendents were appointed; the scattered and unrelated school agencies were consolidated: new high schools and junior high schools established. New ward schools were erected. Between 1920 and 1925 eight new high schools were built and eight grade schools. The public-school system was supplemented by parochial schools. In addition to the high schools there are a number of academies and other schools, 77 in all, on private foundation. The recent development of higher education has been notable. The University of Pittsburgh raised $7,000,000 toward the erection of a 52-storey Cathedral of Learning; completed the Stadium and in 1921–3 added 32 ac. to the campus. The Carnegie Institute continued its service to the community through its central library. In the Institute is held each year an international exhibition of contemporaneous paintings. Pittsburgh has altogether 20 hospitals, modern in construction and equipment, with 4,500 beds. There are 196 clubs, 511 churches, 263 social and welfare agencies, 50 playgrounds and 28 parks.

A city planning commission and board of appeals control the height and character of all buildings. A bureau of traffic relief and a traffic commission were created in 1924 and, in the following year, a dept. of city transit charged with the regulation of traffic conditions and with the matter of recommending subways and a comprehensive system of rapid-transit lines for the entire city. (S. B. McC.)

PIUS X. (1835–1914).—Although the pontificate of Pius X. (*see* 21.690) lasted only 11 years (Aug. 4 1903–Aug. 20 1914), it has been said that his work for the Church, reconstructive and reformative, surpassed that of any of his predecessors since the days of Sixtus V., who died in 1590. In the defence of the faith, his condemnation of the 65 propositions of Modernism in 1907 will rank as a parallel to the condemnation of the 68 propositions of Molinism by Innocent XI. in 1637 or the 101 propositions of Jansenism condemned by Clement XI. in 1713.

The activity of the pontificate may be judged by the fact that its output of papal Bulls and greater official papal documents (counting only those published) exceeded 3,322. These bear upon undertakings and reforms of the first importance—the codification of canon law; the protection of the liberty of the conclave by the abolition of the exclusiva; the simplification and security of the conditions of marriage by the *ne temere* legislation; the restoration of the Rota as the supreme court of appeal; the regulation of the triennial or quinquennial visits of bishops to Rome; the legislation as to church music; and the decree as to first communion, and the encouragement of international eucharistic congresses; the reform of the Roman breviary; the founding of the biblical institute for the work of Scriptural research; the regulation of studies in the seminaries; the creation of the commission for the great work of editing the true text of the Vulgate; the reconstruction of the official machinery of the Roman curia; the transfer of the English-speaking countries from the propaganda or missionary régime to the normal government of the Church. To these may be added in the domain of discipline the unflinching vindication by Pius X. of the Church's right to depose delinquent bishops, carried out even at the cost of rupture of diplomatic relations with France; an apostolic visitation rigorously carried out through the dioceses of Italy, resulting in four bishops being made to resign on account of neglect or inefficiency; a further regulation by which no one can be proposed for a bishopric unless his promotion receives the visa of the Holy Office, which means that his past life has been free from ecclesiastical censure or reproach.

The well-known personal characteristics of Pius X. were his piety, charity, deep humility, simplicity, pastoral zeal, combined with great charm of manner to all who approached him. For war he had nothing but horror and it was the shock of the outbreak of the World War that hastened his death, which took place in Rome Aug. 20 1914. It is said that one of his last acts was to refuse the request of the Austrian Emperor to bless his cause, saying, "I do not bless war: I bless peace." (J. Mo.*)

PIUS XI. (1857–), Pope since 1922, was born on May 31 1857 at Desio, a small town north of Monza, in the environs of Milan, on the road to Como, and was named Ambrose Damien Achille. His father was Francesco Ratti, the manager of one of the great silk factories of Desio, and partner in the firm of Gadda. Achille was educated at the seminaries of San Pietro Martire and of Monza, and at the college of St. Charles at Milan, where he graduated. Feeling that he was called to the priesthood, he studied for two years in the greater seminary. His life at this time was profoundly influenced by his spending his vacation months with his uncle, Don Rodolpho, the venerable and exemplary parish priest and provost of Asso, a village in the promontory of the Bellagio. From his windows he could see Lake Como and the Alps, of which later on he was so strongly to feel the lure. It was also here that he came under the personal notice of the Archbishop of Milan, Mgr. Nazario di Calebiana, who was staying as the guest of Count de Herra, and was a frequent visitor at his uncle's presbytery. The Archbishop was much struck by the future Pope's earnestness and maturity of judgment, and was wont to call him his "young old man." Ever afterwards he took a deep interest in his career. He sent him to the college of St. Martin and then to Rome to study at the Lombard College and attend the lectures at the Gregorian University. Here Achille Ratti took with distinction the degrees of doctor of philosophy, of theology and canon law. He was ordained priest on Dec. 20 1879.

At the Lombard College his fellow student and closest friend was Alessandro Lualdi, later Cardinal Archbishop of Palermo. These two were mentioned to the Pope by Professor Liberatore as the most brilliant of his students. They were the first to win the doctorate at the Angelico, the new Thomistic College founded by Leo XIII. at Rome. The Pope sent for the two students and while passing through the Clementine Hall, from his chair in which he was being carried to the Vatican gardens he delivered to them an impressive lecture upon the vital importance of a sound philosophy and of their mission in promoting it in the years which lay before them. In 1882 Dr. Ratti returned to Milan and was appointed for some months to a curacy at the village of Barni.

Following up the intentions of Leo XIII., the Archbishop transferred him to the Great Seminary, where he filled for five years the post of professor of dogmatic theology. In 1888 he was admitted as a member of the college of doctors at the great Ambrosian Library. This appointment gave a new direction to his scholarship. In this task, Dr. Ratti found a congenial field of labour under the guidance of the prefect of the college, the learned Abbate Cerriani. He became an expert, especially in Latin palaeography and published several studies, and contributed numerous articles to the learned reviews. In 1907 he succeeded Cerriani as prefect of the library. He was made domestic prelate by Pius X. and canon of the Milan Cathedral by Cardinal Ferrari. During the years 1905–7 he undertook and carried out a reclassification of the library upon modern methods so as to facilitate the work of consultation and research. His success in this enterprise was recognised by the King of Italy, who bestowed on him the knighthood of the Order of Saints Maurice and Lazarus.

From 1888 onwards he was chaplain and director to the nuns of the Cenacle, an order specially devoted to the work of arranging spiritual retreats or conferences for all classes of women.

At their convent he was brought into contact with all that was most distinguished and zealous among the laity of Milan and became an active organiser of their manifold works of charity. At the same time, he spent the hours that he could spare from his library in teaching the catechism to numbers of poor children, including the little chimney sweeps that annually come down from the Tirol. He clung to this work during the 30 years that he remained in Milan.

He more than once visited England. In June 1900 he stayed for a time with his intimate friend, Bishop Casartelli, at Manchester. He studied at the Bodleian in Oxford and at the British Museum and said Mass in Westminster Cathedral. In his summer vacations it was his custom to make climbing excursions in the Alps. The *Bolletino* of the Italian Alpine Club relates how, in 1889, he discovered a new way of ascent by the eastern slope to Monte Rosa, and how on one occasion by his courage and promptitude he saved the life of his guide. The ascent is commemorated by a monument erected by the club at Macugnaga. In 1908, during the riots at Milan, he was active in pacifying the turbulent elements and intervened successfully to save the Capucine convent from destruction during the bombardment.

Cardinal Ferrari had made him his trusted counsellor in the government of the diocese and in 1909 appointed him to a canonry in the cathedral. In 1912 Pius X. called him to Rome, made him vice-prefect of the Vatican library (where he served under Cardinal Gasquet) and at the same time promoted him to a canonry of St. Peter's. On the succession of Benedict XV. he became the familiar friend of the new Pope, who, with a keen appreciation of his qualities singled him out for the diplomatic service and entrusted him with the delicate mission of Apostolic Visitor to the new republic of Poland. Here his clear judgment and tact and his fluent knowledge of German and Polish enabled him to achieve a marked success in dealing with the complicated claims of the various nationalities in Poland and the bordering Russian territories. It is related that he himself had shrunk from this task and pleaded for a whole hour with the Pope to be excused from it. Benedict XV. only listened in silence and simply asked at the end " How soon can you start? " and Mgr. Ratti's only reply was simply " Tomorrow."

In June 1919 Ratti was made Nuncio Apostolic in Poland and titular Archbishop of Lepanto and on July 3 was consecrated in Warsaw by the Archbishop, Mgr. Katowski. It was a mark of the confidence reposed in him by all classes that he was chosen by the Interallied Commission to act as high ecclesiastical commissioner for the plebiscite of Upper Silesia by agreement of both the Polish and German Governments. During the Bolshevik invasion, when most of the embassies withdrew from Warsaw, the Nuncio remained and carried on his work of conciliation and of succour for the poor in devastated regions. Pope Benedict XV. sent him the pallium, the Polish Govt. decorated him with the Order of the White Eagle and the university enrolled him amongst its doctors. On the death of Cardinal Ferrari, Benedict XV., in June 1921, appointed him Archbishop of Milan, and made him a Cardinal under the title of S.S. Silvestro and Martino ai Monti. On Sept. 2 he returned from a pilgrimage to Lourdes and on the following day was solemnly enthroned. Milan gave him an enthusiastic reception. His carriage was drawn by the people and was accompanied by the civic authorities and the military and clergy. The vast procession was enhanced by the novel feature of an escort of aeroplanes encircling above it along the route to the Cathedral.

Pope Benedict XV. died on Jan. 22 1922. On Feb. 2 the Cardinals entered into conclave and on Feb. 6 Cardinal Ratti was elected Pope. He chose the name of Pius XI. and was proclaimed from the balcony of St. Peter's. He received the triple obedience of the Cardinals and on Feb. 11 was crowned in the presence of an enormous concourse in the Basilica. Since then the life of Pius XI. may be summed up as one of constant activity, in which his encouragement of all high ideals and good works has been marked by staunchness in matters of principle and the spirit of pacification and conciliation in administration. During 1925, the year of the jubilee, he was brought, perhaps more than any other pontiff, into personal contact with his spiritual subjects by receiving more than 1,250,000 pilgrims from all parts of the Catholic world. By all he is revered for his learning, his charity, piety and width of sympathy, his courtesy, tact and charm of deportment and, most of all, for his untiring devotion to the duties of his exalted pastorate.

BIBLIOGRAPHY.—He has published *Climbs on Alpine Peaks*, transl. by J. E. C. Eaton, with introd. by Bishop L. C. Casartelli and a foreword by Douglas W. Freshfield. See also *Annuaire Catholique* (1923), ed. by Mgr. A. Baudrillart; *Acta Apostolicae Sedis. Commentarium Officiale* (1919–25); and *Documentation Catholique* (1922–6).
(J. Mo.*)

PLAGUE (*see* 21.693).—The investigations of the Indian plague commission working in conjunction with the advisory committee showed that bubonic and septicaemic plague are transmitted by the agency of fleas. Highly susceptible animals are not infected by their plague-stricken fellows so long as fleas are excluded from the cages, but with the introduction of these ectoparasites the disease forthwith spreads from the sick to the healthy. Subsequent experience has confirmed the main findings of the commission, and outbreaks of human plague are unquestionably mere extensions of preceding or concurrent plague affecting animals. Rats (*Rattus rattus*) are of outstanding importance as reservoirs of infection through their close association with man, but marmots (*Arctomys bobac*), gerbilles (*Tatera lovengulae*) and ground squirrels (*Citellus beecheyi*) have been responsible for epidemic outbreaks in China, South Africa and California respectively.

Mode of Infection.—The plague commission concluded that the disease can be transmitted by the faeces of infected fleas, but did not state that this is the usual method of spread. Bacot and Martin later demonstrated that the entrance to the flea's stomach becomes obstructed by a mass of plague bacilli. Such fleas in their persistent efforts to feed merely succeed in distending the gullet with blood, which, now contaminated, regurgitates on to the skin of the host. The organisms then enter the body either through the flea's bite or through some abrasion of the skin.

Fleas as Vectors.—The flea most commonly incriminated as a plague-vector is *Xenopsylla cheopis*, but several other species of rat fleas (*Ceratophyllus fasciatus, Stivalius ahalae*), the common mouse flea (*Leptopsylla musculi*), the dog flea (*Ctenocephalus canis*), a marmot flea (*Ceratophyllus silantievi*) and the human flea (*Pulex irritans*), amongst others, are proven carriers of plague that are known to bite man. When the plague commission made their investigations only one species of *Xenopsylla* (*X. cheopis*) had been recognised, and they were unaware that two other species of this genus commonly infest Indian rats. One of these, *X. astia*, is incapable of conveying plague in circumstances where transmission by *X. cheopis* is readily effected. *X. astia* is the predominating species infesting rats in parts of India which have remained free from plague, or where plague when introduced has not spread. The inhospitality of *X. astia* to the plague bacillus may be the responsible factor in such immunity, as was first suggested by Hirst in 1914.

Epidemiology.—Laborious studies on the biology of fleas have added to our knowledge of the epidemiology of plague. These insects cannot withstand desiccation, and their survival apart from their host is proportional to the rate at which they lose moisture. Bacot and Martin (1924) found the water content of fleas to be 80% of their weight, and death occurred before the loss of water had reached 60% of their weight. This goes far to explain the observation that plague does not maintain itself in epidemic form when the temperature rises above 80° F., accompanied by a saturation deficiency of over ·30 of an inch; whereas Bacot (1914) demonstrated that starved rat fleas (*C. fasciatus*) infected with plague may remain alive, and infective, for one or two months in cool weather. He also showed that the larval and pupal stages may be prolonged by natural agencies, and in consequence active adult fleas may be found, in favourable

situations, where there have been no hosts for long periods—10 months in the case of *X. cheopis*, and 22 months in that of *C. fasciatus*. The seasonal variations in the prevalence of plague have been recognised for many centuries. In temperate countries epidemics attain their maximum in the summer months, whereas in tropical climates the onset of hot, dry weather brings an existing epidemic to an end. In each case, the peak of the plague curve coincides with meteorological conditions most favourable to the activity and longevity of fleas. In contradistinction to the foregoing, pneumonic plague, once established, spreads independently of animals and fleas. In outbreaks of ordinary plague, a secondary involvement of the lungs supervenes in a small proportion of cases, and if atmospheric and environmental conditions favour the survival and transmission of the bacilli an epidemic of pneumonic plague may result, the virus being transmitted from the cougher to the victim up to a range of about three feet.

Treatment.—Unfortunately, there is no plague specific. Serum, to be really effective, must be given before the symptoms of the disease are manifest, an impossible procedure in most cases. Still, when available, serum should be administered intravenously in doses of 80–100 c.c.'s, and repeated. Some advocate injection of tincture of iodine (7–10 minims), or other antiseptics, intravenously, and also into the buboes. These measures are of doubtful benefit. Buboes showing signs of suppuration should be incised. Otherwise, treatment is on general lines, and cardiac stimulants should be administered early.

Prophylaxis.—So long as members of a community are content to live in association with rats and fleas correlative plague is a likely result. Meanwhile, plague prophylaxis consists mainly of warfare against rats, in the hope of ultimately banishing them from human habitations and from contact with man. Any general elimination of these pests over wide areas is a slow, costly and usually impracticable affair, and all that can be achieved in most cases is some degree of palliation by rat-proofing of grain stores, wharves and other places which serve as centres for the dissemination of plague. Destruction of rats by trapping and poisoning is a commendable procedure, but of itself will never eradicate endemic plague, for the losses in the rat population are quickly made good if survivors are provided with food and harbourage. An important measure of personal prophylaxis is inoculation with anti-plague vaccine, which affords a good degree of protection. Persons entering plague-infected houses should wear gaiters, and otherwise render their clothing as flea-proof as possible; if there is any suspicion of pneumonic plague, goggles, and masks made of several layers of fine gauze, should be worn without fail.

BIBLIOGRAPHY.—*Journal of Hygiene, Plague Supplements* (1912–7); League of Nations Report, ch. 130, *Prevalence of Epidemic Disease in the Far East* (Geneva, 1923); Ministry of Health, Report 19, *Hydrogen Cyanide for Fumigation Purposes* (1923).

PLANCK, MAX (1858–), German physicist, was born at Kiel April 23 1858. He studied at the universities of Munich and Berlin, became an assistant in Munich University, and was subsequently appointed a professor in Kiel (1885) and in Berlin (1889). Planck devoted himself to the study of theoretical physics, and in particular to that of thermodynamics. His lectures on this subject appeared in book form and were translated into English, French and Russian. He gained international fame by his *Law of Radiation* (1901), which asserts that the energy of radiation is emitted and absorbed in integral multiples of certain indivisible " quanta " of energy, which depend on the frequency of oscillation of the electrons. In 1912 Planck extended this " quantum theory " to all kinds of energy and added the assumption that only emission proceeds discontinuously, in quanta, while absorption is continuous. In 1913 he somewhat altered his theory, but subsequently reinstated the old conception. Although several physical phenomena, such as the properties of the specific heats of solids, the kinetic theory of gases, confirm Planck's theory, it is still warmly disputed. In 1918 he was awarded the Nobel Prize for physics. Planck became editor of the *Annalen der Physik*.

Among his works are: *Die Entstehung und bisherige Entwickelung der Quantentheorie* (1920), transl. by H. T. Clarke and L. Silberstein (1922); *Vorlesungen über die Theorie der Wärmestrahlung* (1921); *Physikalische Rundblicke* (1922), transl. by R. Jones and D. H. Williams (1925); *Einführung in die Theorie der Elektrizität und des Magnetismus* (1922); and *Die Ableitung des Strahlungsgesetzes* (1923).

PLANQUETTE, ROBERT (1850–1903), French musical composer (*see* 21.725), died in Paris Jan. 28 1903.

PLANT PATHOLOGY.—The progress made in the theoretical and practical study of plant pathological problems during the early part of the century consisted not of any very outstanding discovery in any particular part of the subject, but of a general and considerable advance in all departments. There was first of all a much quickened interest in the subject of plant diseases on the part of the departments of agriculture in all the more progressive countries of the world. More funds became available for the investigation of disease problems, and the number of workers in this branch of botanical science correspondingly increased. (*See* also BOTANY; ECOLOGY.)

In this respect the United States of America, with its varied and as yet somewhat experimental system of agriculture, still occupies the leading place, but Britain is following in the same direction, especially in connection with the development of her tropical colonies and dependencies. As a consequence of this increased activity, the period under consideration produced a vast accumulation of scientific literature; many diseases new to science and of greater or less importance have been described; more detailed knowledge on the subject of the older and better known diseases has been obtained; and as regards the purely practical aspect of the problem improved methods of dealing with plant diseases have been developed. The latter include more efficient methods of spraying, dusting, etc., for the purpose of checking the onset of disease, and, what is of perhaps greater economic importance, the breeding of varieties of economic plants which are immune or at least resistant to certain diseases.

Virus Diseases.—What are now known as the " virus " diseases of plants were formerly considered as physiological diseases, *i.e.*, as being due to certain disturbances of function not correlated with the presence of a parasite. The recognition of their infectious or contagious nature, either by direct inoculation or by grafting, was a great step in advance. The general view now held is that they are due to a " virus " which is ultramicroscopic and which will pass through the pores of certain filters. As to the nature of the virus, whether it is a kind of very small bacterium, or an enzyme, or an organism *sui generis* (Twort), no definite decision can at present be given. (*See* FILTER-PASSING MICROBES.)

A large and ever increasing number of economic plants prove to be susceptible to diseases of the virus type. To mention some of the better known: the various forms of virus disease of the potato (mosaic, leaf-roll, crinkle, etc.), the mosaic diseases of tomato, tobacco, cucumber, hops, sugar-cane, various beans, clover, raspberry, dahlia, etc.; the " curly top " disease of sugar beet, a number of peach diseases and the phenomenon known as " infectious chlorosis." To the same category probably belong the well-known " reversion " of black currants which is troublesome in England, and the " spike disease " of sandalwood in South India.

In Britain the most important virus diseases from the economic point of view are those occurring on the potato. These are widespread, especially in the warmer and drier parts of the country. Researches have shown that virus disease is the chief cause of the deterioration, *i.e.*, of the loss of cropping power which potato stocks suffer in the warmer parts of Britain. The view held formerly was that this deterioration was due to climate *per se*, the potato being considered to be a plant of cold climates and therefore not maturing its " seed " properly under warmer conditions. According to the latter view, deterioration is thus inevitable, the only way to keep up the cropping power of the potato being to import more vigorous " seed " from farther north. Those who hold the " virus " theory, on the other hand, point out that the effect of climate is only indirect, in that it encourages the multiplication of insects (aphides) which are

the natural agents for spreading the disease in the field. Prevention of deterioration is thus possible, either by control of the insects concerned, or, failing that, by the provision of disease-free stock in the first instance and avoidance of subsequent contamination. The prompt recognition of diseased plants and their removal (" rogueing ") before the disease has been carried to neighbouring plants is the practical method of controlling virus diseases of the potato and virus disease in general.

Carriers.—Apart from their economic importance, great scientific interest attaches to diseases of the virus type. The nature of the active principle has been the subject of numerous researches (Allard, Doolittle and others). There exist definite " carriers " of the disease—that is, plants which on inoculation show no symptoms of disease in themselves, but are able to transmit the disease to susceptible plants. This feature affords an interesting parallel to what is met with in certain animal diseases, *e.g.*, typhoid fever. In fact, the virus diseases of plants are in general very similar to the corresponding diseases in animals, and serve as a kind of common ground for the sciences of plant and animal pathology—two sciences which in the main are very different.

Diseases Due to Fungi.—As regards plant diseases of a purely fungoid type, the expansion of world agriculture, and especially the agricultural development of the tropics, proceeds apace, and thus economic crops are brought into contact with new environments where they are liable to attack by parasites unknown in their old habitat. Furthermore, the plantation method of cultivating tropical tree crops as opposed to the sporadic occurrence of these plants under natural conditions brings with it greater dangers from parasites, as the mass formation of a plantation lends itself readily to the spread of disease once the latter has entered. New fields of investigation are thus constantly being opened up. Even in countries with a stable and long-established system of agriculture such as England, new problems may suddenly arise, as witness the wart disease of potato (*Synchytrium endobioticum*). In the early years of the century this disease was almost unknown, but in the period under consideration it attained serious dimensions, so much so that its presence determined the whole development of the potato industry in England in later years.

Among diseases which have become of considerable importance in England mention may be made of the silver leaf disease (*Stereum purpureum*) of plums and other fruit trees; the American gooseberry mildew (*Sphaerotheca mors-uvae*), which is firmly established and the downy mildew (*Pseudoperonospora humuli*), which is a constant source of danger to hop cultivation. In the United States the bark disease (*Endothia parasitica*) of sweet chestnut, which came in from Japan, and the white pine blister rust (*Chronartium ribicola*), which is native to Europe, have caused great damage. The problems of rusts and smuts in cereals have received a large amount of attention in all grain-growing countries; and the same may be said of a number of fungi which cause foot-rot, leaf stripe or barrenness of ears in various grasses (*Ophiobolus, Helminthosporium, Gibberella*).

In various countries a whole group of " wilt " diseases, due chiefly to a species of *Fusarium*, has come into prominence—wilt of cotton, of banana, of various leguminous and solanaceous plants, etc. Some of these, *e.g.*, the cotton wilt, have been definitely controlled. Banana wilt, on the other hand, is not yet under control, and this fact is of the utmost importance in the banana industry. The establishment of the rubber industry in the East brought in its train a whole literature of fungoid diseases (*Fomes, Corticium*), as well as the somewhat obscure brown bast disease. The rubber plantations in the East have not as yet suffered from a leaf spot disease (*Melanopsammopsis*), which has so far prevented the establishment of rubber plantations on the South American continent, the natural home of the *Hevea* rubber tree. An interesting internal boll disease (*Nematospora*) has been described from the West Indies. In this case the active transmitting agents are biting insects. From present indications it is not unlikely that this disease will prove to be an obstacle in the way of cotton cultivation in parts of Africa.

Diseases Due to Bacteria.—Bacterial diseases of plants, which were at one time believed to be non-existent, are now known to be fairly common, and some have proved to be of great economic importance—for example, the angular leaf spot disease (*Bacterium malvacearum*) of cotton, which is especially severe on Sea Island and Egyptian types; the citrus canker (*Pseudomonas citri*), which has caused great damage in Florida, South Africa, etc.; the pear blight (*Bacillus amylovorus*), which is serious in various parts of Canada and the United States; and the wild fire disease of tobacco (*Bacterium tabacum*), which is now one of the most important diseases of tobacco in the United States and South Africa. The crowngall organism (*B. tumefaciens*) has been much studied with special reference to its supposed resemblance to human cancer, but this analogy has been called in question. (*See* BACTERIOLOGY.)

Breeding of Immune or Resistant Varieties.—With regard to methods of prevention or treatment of plant diseases, the period under consideration shows considerable advances. Much is now known on the subject of the inheritance of immunity or susceptibility to plant disease, and as the practical result of breeding work varieties immune or highly resistant to disease have been developed. In England many high-class varieties of potato have been developed which are entirely immune to wart-disease. Wheats highly resistant to rust (and with other good commercial qualities) have been established (Biffen, Nilsson-Ehle), varieties of hops immune to mildew (Salmon), of asparagus resistant to rust (Norton), of beans resistant to anthracnose (Barrus, Burkholder), and so on. By simple selection of resistant individuals in the field, strains of cotton and cowpea have been isolated which are highly resistant to wilt (Orton, Watson). Similar success has been obtained in the same way with the tobacco root rot (Garner).

Strains of Parasitic Fungi.—The problem of breeding immune or resistant varieties has been complicated by the discovery that many parasitic fungi exist in a number (sometimes a large number) of " biologic forms " or races, each of which has a different host range. Hence a plant which is immune in one area may be susceptible in another, the strain of the parasite being different in the two areas. This feature of parasitism, which has been made out in very striking form in connection with the black-stem rust of cereals (Stakman and co-workers), leads to the practical conclusion that breeding for disease resistance must be a regional problem. The first step in the solution of the problem must be the determination of the strain of fungus prevalent in the given area, and hence the value of the plant disease surveys which have been taken up by the agricultural departments of various countries. Stakman's work, however, while indicating unexpected difficulties in the way of obtaining immune varieties, has led to a simplification in another direction. The old view of a " bridging species," according to which a fungus is able to pass from a susceptible plant to one which is otherwise immune (Ward, Salmon, Pole-Evans), has been considerably discredited, so that there are now strong grounds for thinking that once an immune variety has been obtained it will remain so as long as it does not come into contact with a fungus of different parasitic power.

Prevention by Sprays, etc.—Many advances in detail with regard to the chemical control of disease by the use of sprays and washes have been made. These have been made possible to a large extent by the increased knowledge of the life-history of the various pests, so that more exact information with regard to the best time for spraying can now be given. This item makes all the difference between success and failure in spraying. The technique of preparing spray fluids has received much attention, with a view to obtaining the maximum fungicidal efficiency with the least damage to the plant. Improvements have taken the form of presenting the active chemical in a finer state of division, in the perfecting of spreading reagents (soap, casein preparations) and in the use of new fungicidal chemicals, such as " Uspulum." Dusting has been much advocated in place of spraying as being more practicable, and in many cases as being equally effective. The latest development along these lines is

the use of aeroplanes for dusting, as in the campaign against the cotton boll weevil in the southern United States. (*See* COTTON.) The same methods may be applied to rust control in wheat-growing regions.

Control by Eradication.—The control of certain diseases in which the parasite passes a part of its life-history on an alternate host is illustrated by the "Barberry Eradication" campaign in the northern part of the wheat belt in the United States and Canada, the barberry being the alternate host of the black stem-rust of wheat. A similar campaign to eradicate species of ribes, which are alternate hosts to the rust of the Weymouth pine, is in progress in the eastern United States. The control of internal boll disease of cotton in the West Indies by the cutting down of certain Malvaceous trees, on which the transmitting insects lived during the period when the cotton was not on the land, is a striking example of the same method.

Biological Methods of Control.—A method of control which refers particularly to diseases of insect origin is the introduction and acclimatisation of enemies (parasites or "predators") of the injurious insect. It frequently happens that in trying to establish a new crop in a country some insect pest by-and-by gets in, and that the latter in the absence of its natural enemies flourishes exceedingly and becomes a serious menace to the crop. By investigations in the original home of the crop it has been found possible in many cases to determine the natural enemies of the insect pest, either parasitic or predatory insects, or in a few cases bacteria or fungi, and to establish these in the new country. Many of these efforts have resulted in failure, due to faulty methods of procedure or to the intrinsic difficulty of the problem. In some cases, however, brilliant success has been achieved, as in the control of the sugar-cane leaf hopper in Hawaii. Strenuous attempts are made by the United States Department of Agriculture to control the ravages of the corn borer insect by the introduction of its natural enemies in Europe, its original home. Research along these lines appears to be one of the most promising outlets for entomological science for the future.

Legislation.—A marked feature in recent years is the increasing amount of governmental control which is coming into being in connection with plant diseases. This development is to a certain extent the outcome of the increased transportation of plant products incidental to commerce generally and to the establishment of new crops in new countries. Control methods are in many cases useless unless carried out thoroughly and simultaneously and in a specified manner over the whole area concerned. As between nations governmental control takes the form of inspection at the port of entry, of quarantine and in certain cases of actual exclusion. Thus the import of gooseberry stock into England from the United States is forbidden on account of the mildew, and conversely the import of English potatoes into the United States is forbidden on account of wart disease. Considerable controversy has arisen as to the efficacy of these measures, as in many cases they are applied too late. Irritation is also caused by the fact that, while such regulations were primarily intended for the express purpose of excluding certain pests, they are capable of being used for the furtherance of economic profit.

Governmental control within the limits of any particular country takes the form of compulsory notification of certain diseases, of the prohibition of growing particular varieties in certain "scheduled" areas, of the inspection and certification of seed and stock plants and of the enforced clearing up of plant material which constitutes a source of danger to succeeding crops. The control of wart disease and of silver leaf disease in England is a good illustration of these methods, and in the former case at any rate very considerable success has been achieved. An interesting experiment along the same lines is in progress in British West Africa, where a universal clearing up of cocoa diseases is being attempted.

Scientific Developments.—Developments in the more scientific aspects of plant pathology have dealt mainly with the physiological study of the interrelation between host and parasite and with the effect of external factors on the incidence of parasitism. In the latter connection temperature and humidity have received most attention, *e.g.*, the relation between parasitic attack and soil temperature (Jones and co-workers), and the effect of low temperatures on fungal growth and parasitism (Brooks, Cooley). These investigations have a practical outlook, especially with regard to the transportation and cold storage of fruit, a subject to which great attention is paid (Stevens, Hawkins, Kidd, West). Another direction in which advance has taken place is the discovery of "saltation" or mutation in fungal organisms (Crabill, Stevens, Brown and others). The occurrence of this phenomenon has probably a direct bearing on the existence of the many strains of pathogenic organisms already alluded to.

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PLANT PHYSIOLOGY (*see* 21.744).—This branch of botany has made such great advances and it touches physics and chemistry so closely that it has almost become a separate subject. Progress has been made over such a wide field that only a few important developments are referred to.

Photoperiodism.—It is a familiar fact that, at least in temperate climates, many plants flower at certain periods of the year only. There are so-called spring flowers, autumn flowers and plants which flower in the summer. This marked seasonal effect must be due to some varying external condition or set of conditions. It has often been supposed that temperature plays a large part in the development of flowers, and a certain degree of warmth is essential for growth, yet altering the temperature alone will not markedly alter a plant's flowering period. Asters and chrysanthemums cannot be made to flower in summer by lowering the temperature nor irises in winter by putting them in a greenhouse. Apart from temperature there is one regular cyclical change associated with the march of the seasons and that is the change in the length of the day and night, the day in the latitude of London varying from 16½ hours in June to a little under eight hours in December.

It has been shown by Garner and Allard (1) that in the case of many plants it is the length of the day which is the decisive factor in fixing the season of flowering. The discovery was made in the United States, where the behaviour of a valuable variety of tobacco known as *Maryland Mammoth* was being studied. It had been found impossible to obtain seeds from this variety since it went on growing steadily through the season, sometimes reaching a height of 12 ft., being eventually cut down by frost before it had formed flowers. One autumn a specimen was transplanted to a greenhouse, where it promptly flowered and set seed. This was at first thought to be an effect of temperature, but further investigation showed that it was impossible to cause the plants to flower in the summer. It was soon found that the dominating factor was length of day; if growth conditions were favourable it would flower in the short days of late autumn or winter but not in the long days of summer. By artificially shortening the day to 12 hours by placing the *Maryland Mammoth* plants in the dark during some of the dayligh hours, flowering could be brought about at any time of the year

Following up this discovery of the behaviour of the variety of tobacco, Garner and Allard investigated at Washington the behaviour of a large number of plants. These were grown in pots which were borne upon light trucks running on tram-lines so that the pots could be run in and out of sheds and thus be illuminated for various fractions of the daylight period. Many plants, such as the tobacco variety mentioned above, soya beans, asters, chrysanthemums, poinsettia, were found to be "short day" plants, and would only flower when the period of daylight was reduced to 12 hours or less. If the time of illumination is suit-

ably adjusted the plants will flower and fruit when they are quite diminutive, while other individuals exposed to full daylight grow to a large size without any trace of flower production. Other plants such as grasses have been shown to be " long day " plants which require a long daily period of illumination for the initiation of flowering (2).

Phototropism.—In the physiological field of irritability of plants the question which has perhaps been most discussed of recent years has been that of the nature of the response of plant organs to light from one side. It is known that many stems when exposed to unilateral light grow toward the light. The earliest view was that this reaction was a response to the greater intensity of illumination on the near side as compared with that on the far side. When, however, it was found that many transparent organs such as root hairs and fungal hyphae would respond to light, the view that the plant organ was sensitive to the direction of the incident light came to the front. Blaauw (3) was the first to put forward against this view a simple theory of the phototropic response. He showed that simple unicellular structures like the sporangiophore of *Phycomyces* and the hypotocotyl of *Helianthus* exhibited a very definite " light-growth reaction " when illuminated all round, the rate of growth being increased in *Phycomyces* and reduced in *Helianthus*. Light, apart from direction, has thus an acceleration effect in the one case and an inhibiting effect in the other. The turning of the hypotocotyl of the sunflower toward the light is explained by the relatively greater retardation of growth on the side turned toward the light. It would seem that the sporangiophore of *Phycomyces* should turn away from the light, but it was shown that this glass-like cylindrical structure acts as a lens, the light being focussed on the *further* side which is thus the more intensely illuminated of the two.

Later, it was shown by Buder (4) that if the sporangiophore is placed in liquid paraffin and exposed to unilateral light the focussing effect is no longer produced, and the nearer side is the more highly illuminated, with the result that the organ now grows away from the light. As a result of his work Blaauw put forward the view that phototropism is simply a growth response to the different intensities of illumination of the two sides of the plant organ. The light probably acts in some photochemical way and this affects the cell processes. Buder's (5) experiment, in which one half of the coleoptile of the oat was illuminated by a pencil of light coming directly from above, and also that in which the hollow coleoptile was illuminated on one side by a pencil of rays coming from the inside outwards, speak strongly in favour of the theory that the response of orthotropous organs is to differences of light intensity and not to light direction.

Conduction of the Phototropic and the Geotropic Stimulus.—Interesting results have recently been obtained by studies on the conduction of the phototropic and geotropic stimulus. If the apex only of the coleoptile of oat be illuminated, the stimulus is conducted to the lower part which becomes curved. It was first shown by Boyson-Jensen, and later more fully by Pâal and by Stark, that if the tip is cut off and stuck on again by means of a thin film of gelatine, illumination of the tip while the lower part is kept darkened will still bring about curvature. The conduction takes place through the layer of gelatine, and it will also pass through a thin sheet of cane covered with gelatine; but if a thin sheet of mica or of metal be used there is no transmission of the stimulus. This indicates that the agent responsible for the conduction is some diffusible material and not an electric current. It has also been shown by Snow (6) that a similar phenomenon is to be observed in connection with the geotropic stimulus. He finds that if the primary roots of the broad bean (*Vicia Foba*) are decapitated and the tips are stuck on again with a film of gelatine the roots become again capable of curving under the action of gravity. The conduction in this case also appears to be due to the diffusion of some soluble substance. The diffusion from the tip of a substance important in growth reactions is not confined to organs which are phototropically and geotropically stimulated. If the tip of a coleoptile kept vertical is removed the rate of growth of the coleoptile is slowed down but the replacement of the tip increases again the rate. A growth promoting substance seems thus to be continually passing downwards from the apex.

Permeability.—There have been many investigations dealing with the permeability of the plant cell but the nature of the plasma membrane, which largely controls the entry of substances, and the forces which lead to the accumulation of substances in the cell are still very obscure. The whole subject has been reviewed by Stiles (7). A clearer picture, however, has now been obtained of the water relations of the cell. The plant cell usually exhibits an osmotic pressure which ranges from about 11 to 40 atmospheres and may reach over 150 atmospheres. In addition to this outwardly directed osmotic pressure (P) there is in turgid or partially turgid cells an inwardly directed pressure, the wall pressure (T). In a fully turgid cell, *i.e.*, one which is fully imbibed with water, the wall pressure is equal to the osmotic pressure, *i.e.*, P = T. In a partially turgid cell the wall pressure is less than the osmotic pressure: the difference (P − T) between these two pressures is the suction pressure (S). If the cell is lying in water this suction pressure is a measure of the pressure forcing water into the cell. The " water absorbing power " of a cell, as it used to be called, is thus determined not by the osmotic pressure of the cell but by its suction pressure. Whether one cell will absorb water from another depends not on their relative osmotic pressures but on their relative suction pressures; a slightly turgid cell with a low osmotic pressure can take water from a fully turgid cell of much higher osmotic pressure. When the cell is plasmolysed the suction pressure is at its highest, and is equal to the osmotic pressure of the cell sap; when the cell is fully turgid the suction pressure is zero.

Respiration.—The work of Neuberg and his collaborators (8) has placed our knowledge of the chemistry of the related process of alcoholic fermentation on a firm basis. The probability is very great that pyruvic acid is an intermediate product in the conversion of a hexose sugar into alcohol and carbon dioxide. Normal respiration follows rather different lines; in essentials it is the exact opposite to photosynthesis (carbon assimilation). In that process sugar is built up from water and carbon dioxide with the aid of the energy of light. In respiration, sugar is oxidised to carbon dioxide and water with the liberation of heat. It may be represented thus:—

$C_6H_{12}O_6 + 6O_2 = 6H_2O + 6CO_2 + 674{,}800$ calories. Other substances may be oxidised in the process of respiration but sugar appears to be commonly used. There are various theories as to the mechanism of respiration, one being that oxidation is due to a peroxide and an enzyme (peroxidase). Such oxidising enzymes, although they will oxidise a number of aromatic substances present in the plant, will not act on the materials such as sugars which are used in respiration. Of late years the view of Wieland has been very much to the fore. In this view the process of physiological oxidation is really a process of combination with water, followed later (probably under the action of an enzyme) by a process of *dehydrogenation* in which hydrogen is split off, the material being finally reduced to carbon dioxide. The hydrogen formed, which is in an active state, combines with the oxygen in the air to form water. Wieland has shown that, in the absence of oxygen, respiratory material such as glucose can produce carbon dioxide at ordinary temperatures when in the presence of water and some catalyst (such as palladium black) provided that some " acceptor," as it is called, of hydrogen is available. Methylene blue or hydroquinone can act as such an acceptor. In the view of Warburg (9) the process of respiration is essentially a *surface* reaction. It has been shown that if blood corpuscles be reduced to an emulsion by freezing and thawing, respiration will go on, but it is confined to the solid portions of the emulsion, *i.e.*, to the cell fragments. The same applies to broken-up egg cells. Warburg has shown that various substances, such as oxalic acid, amino acids (leucin and cystine) and even sugars, when adsorbed on the surface of animal charcoal, are oxidised with considerable rapidity. As a result of these oxidations the same substances are produced as arise when these materials are respired in the living organism.

This view of oxidation at a surface receives support from the fact that narcotics not only retard the process of respiration but also the oxidation of substances by animal charcoal. Furthermore, the narcotics are the more effective the greater their degree of adsorption by the charcoal; by their active adsorption they displace the material from the surface. It is found that hydrogen cyanide (HCN) has a far greater effect in solution than can be explained by its adsorption. Warburg is thus led to the view that iron plays a very important part in the process, the oxidation only occurring on those parts of the surface (of the charcoal or the cell) in which iron is present. The hydrogen cyanide is peculiarly active because it alters the iron chemically so that it is no longer active as a catalyst. In Nathansohn's (10) view the physiological oxidations characteristic of respiration are essentially electro-chemical. Small membrane potentials in the cells may lead to the electrolytic dissociation of water, the nascent hydrogen being removed by the same "acceptor" and the active oxygen bringing about the oxidation of respiratory materials.

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(V. H. B.)

PLATA, RIO DE LA, or RIVER PLATE (*see* 21.786), the great estuary on the east side of South America, between the republics of Argentina and Uruguay, into which flow the rivers Paraná and Uruguay with their tributaries. During the 20 years ending in 1926 many of the ports, cities and towns located on the Plata-Paraná-Paraguay river system have made marked progress. Millions of dollars have been spent in extending and improving shipping facilities by Montevideo, La Plata, Buenos Aires, Rosario—all of them ports of call for ocean-going steamships. Many of the smaller ports like Santa Fé, Paraná, Corrientes, Posados and Asunción, have also improved their facilities, and have increased their exports of grain, hides, meat, quebracho wood and extract, maté and lumber. A decided impetus has been given to river shipments by the development in the lumber and cattle and meat canning industries, following on the purchase by North American interests, in 1915–6, of nearly 2,000,000 ac. of land, several hundred miles north of Asunción, Paraguay.

Communications.—The completion, in 1916, of a 37 m. railway around the Falls of Guayra, on the Alto Paraná river, opened a new river and rail gateway to the heart of Brazil, the principal outward shipments being yerba-maté and dried beef. A new hotel at Iguazu River Falls and a motor-car service from Puerto Aguirre to the Falls, 10 m. distant, provide modern accommodation, and, aided by better steamboat service on the Alto Paraná have brought more tourists to the cataracts. The Rondon, the Roosevelt (1913–4) and other expeditions of recent years; the colonisation schemes of European and American companies in Paraguay and Bolivia; the completion of a Brazilian railway from São Paulo nearly to the Paraguay; petroleum investigations in eastern Bolivia; larger areas planted with cotton in Argentina and Paraguay have combined to arouse wider interest in the vast region watered by the Plata river system. On the Uruguay river the cities of Mercedes, Paysandú and Salta have new water systems, improved streets and extended sanitation. A packing plant at Fray Bentos has increased operations there. The Argentine Navigation Co., the Lloyd Brazileiro and local steamboat lines operate La Plata services to Corumbá, Brazil, 1,800 m. from the Atlantic. Deep-draft vessels ascend as far as Rosario, 200 m. above Buenos Aires. Throughout the Plata region the gradual introduction of modern agricultural implements has increased output, and, consequently, river traffic.

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(W. A. R.)

PLATT, CHARLES ADAMS (1861–), American architect and sculptor, was born in New York City Oct. 16 1861. His education in art was acquired in the National Academy of Design, New York City, after which he went to Paris in 1882 and studied under Boulanger and Lefebvre, returning to the United States in 1887. His intention had been to become a painter and etcher, but the outcome of a visit to Italy was a book, *Italian Gardens* (1892), which showed that he had been captivated by the architectural spirit of the Italian Renaissance. As a consequence he turned to architecture, in which his work showed the marked influence of Italian form. He designed a large number of private houses and gardens in addition to public buildings, among the latter being the Maxwell Memorial Library, Rockville, Conn. (1917); The Freer Gallery of Art, Washington, D.C. (1918); the Library, Connecticut College for Women, New London (1922); the Agricultural building, University of Illinois, Urbana, Ill. (1923); and the Lowell Memorial Fountain, New York City. See *Monograph of the Work of Charles A. Platt*, with an introduction by Royal Cortissoz (1913).

PLAYER PIANO: *see* MUSICAL INSTRUMENTS.

PLAYFAIR, NIGEL (1874–), British actor and theatrical manager, was born in London July 1 1874. Educated at Harrow and at University College, Oxford, it was at Oxford that he gained his first theatrical experience with the Oxford University Dramatic Society and other amateur acting societies. For some time he practised as a barrister, and it was not until July 30 1902 that he made his first appearance as a professional actor at the Garrick Theatre, London, in "A Pair of Knickerbockers." He afterwards played many other parts, but was chiefly associated with the Lyric Theatre, Hammersmith, London, the management of which he assumed in 1919. Among his most famous productions at this theatre were John Drinkwater's *Abraham Lincoln* (1919) and the revival of Gay's *Beggar's Opera* (1920) which ran for over three years. He published a number of volumes, including *The Story of the Lyric Theatre, Hammersmith* (1925), and contributed verses to London periodicals.

PLEBISCITE (*see* 21.834), politically a method of ascertaining the general desire of the inhabitants of a given territory or area. As a means of settling the destination of populations and territories the method of the plebiscite is comparatively new. It was first used in the French Revolution to defend the wholesale annexations of territory made by the conquering French Republic, and subsequently by Napoleon I. It was revived by Napoleon III. and applied (successfully for him) in the case of Nice and Savoy, and (successfully for Victor Emmanuel) in the duchies of north Italy during the years 1859–60. These cases were comparatively simple, for the area in each instance was historic and defined and the question was—Did such area want to remain as it was or become absorbed in a larger unit?

The Peace Conference of 1919 decreed plebiscites without much discrimination, in cases where it seemed desirable to soften the blow to a defeated enemy or to get over a difficult diplomatic crisis. They were not generally conceded as a matter of principle, but resorted to as an expedient.

Plebiscites After the War.—In connection with the Peace Conference of 1919 17 plebiscites were proposed, and of these only eight were actually held. Of these the Turkish plebiscite in Transcaucasia was a farce. Those of Allenstein Marienwerder (*q.v.*) retroceded territory disputed between the Germans and Poles to the former. That of Oedenburg returned part of west Hungary from Austria to Hungary (*see* BURGENLAND). That of Klagenfurt (*see* AUSTRIA) returned the whole Klagenfurt basin (which was claimed by the Yugoslavs) to Austria. None of

these five was of great importance, but the remaining three did decide questions which could not have been equally settled by other means. Two plebiscites were held in Luxembourg. The first, a political one held after the deposition of the Grand Duchess, elected her younger sister in her place by a great majority. The second, an economic plebiscite, decided by a large majority for an economic union not with Luxembourg's neighbour Belgium, but with France. But these, though held under the influence of were not actually directed by the principal Allies.

Solid and permanent results, like those obtained in Luxembourg, were likewise reached in Schleswig (*q.v.*). Bismarck had given a promise in 1866 to take a plebiscite in the northern or Danish area of this territory which he had not carried out. The Peace Conference of 1919 put into practice this project by a plebiscite which was a model of fairness. The net result was to cede the southern or Flensburg zone to Germany and the northern area to Denmark, a division satisfactory on every ground and giving indications of permanence.

The plebiscite in Upper Silesia (*see* SILESIA) was the most gravely contested of all such popular votes. Intimidation by Polish volunteers under Korfanty and the hardly disguised Polish sympathy of General La Rond, the French president of the plebiscite commission, caused much difficulty. Finally, after the vote had been taken, arrangements for partitioning the territory between Poland and Germany were sharply contested between Great Britain and France. It was finally settled in Oct. 1921 by an appeal to the League, which laid down a frontier considered by independent critics as unduly favourable to Polish claims.

The net result of the Peace Conference was to discredit rather than to advance the method of decision by plebiscite. Much clearly depends on the method of taking a plebiscite or the previous condition of the country, and on the size of the electoral areas in which the vote is taken. And it is plain that these difficulties were not successfully surmounted in most of the plebiscites taken at the bidding of the Peace Conference at Paris in 1919.

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PLEKHANOV, GEORGY VALENTINOVICH (1857–1918), Russian Socialist, was born Nov. 26 1857 in the province of Tambov, of an old noble family. His father wished him to enter the army, but while a student he joined the Narodnist (populist) revolutionary movement. At the age of 20 he led the first great popular demonstration at St. Petersburg (Leningrad) in the Kazansky square (Dec. 18 1876). When the Majority section of the Narodnists adopted terrorist methods in 1879, Plekhanov seceded, and later with Deutsch, Axelrod and Vera Sassulich, created the Marxian Russian Social Democrat party (1884). He spent 40 years in exile, chiefly at Geneva and later at San Remo. He was associated with Jules Guesde, Liebknecht and Clara Zetkin (who translated his book on Tchernichevsky), was Russian delegate to the Socialist International congresses held in Paris (1889) and in Copenhagen (1910). He was the recognised leader and philosophic exponent of Russian Marxism, his most famous book being *The Materialistic Conception of History*, and wrote also a remarkable booklet directed against anarchism.

Up to the split between the Bolsheviks, or Left Wing, led by Lenin, and the Mensheviks, or Right Wing, led by Martov, in 1907 he was the leader of the Social Democrat party. At first neutral in his attitude, desirous of re-establishing unity, he became a strong opponent of Lenin's "anarcho-syndicalism" and of his conception of the dictatorship of the proletariat. In the World War Plekhanov advocated resistance of German militarism and attacked Lenin's extreme anti-war tactics. When the Russian revolution came, he returned to Russia in spite of illness and was triumphantly received at Petrograd (Leningrad) (March 31 1917), and was invited to join Kerensky's Government. He refused, but supported Kerensky against the Bolsheviks in the bitter Press campaign which followed, and was brutally handled by riotous Red Guards during the Bolshevik revolution (Nov. 1917). He died in Finland May 30 1918. The Soviet Govt. has erected several statues to his memory and published an official edition of his works.

PLENER, ERNST, FREIHERR VON (1841–1923), Austrian politician, was born on Oct. 18 1841 at Cheb in Bohemia, the son of the Austrian statesman Ignaz von Plener (1810–1908). He began his diplomatic career in 1865, and served in the Paris and London embassies until 1873. In the latter year he was elected by the chamber of commerce of his native place to the Chamber of Deputies of the Reichsrat, where he was soon reckoned among the most conspicuous members of the constitutional party. In the Taaffe period (1870–93) he was one of the leaders, and from 1888 the acknowledged head of the German-Liberals in their struggles against the Slav-Conservative majority in the Chamber. Consequently he represented Germanism on the nationalities question, but was not averse to concessions compatible with the maintenance throughout the whole monarchy of the position due to the German Austrians. He sought to compromise the quarrel between Germans and Czechs, and the so-called "points" of 1890, a summary of the bases for a German-Czech understanding, were essentially his work. In the Windischgrätz Coalition Ministry (1893–5), Plener took over the portfolio of Finance. Soon after his retirement from the Finance Ministry, Plener was appointed president of the Supreme Audit Department (*Oberster Rechnungshof*). He became a member of the Upper House in 1900, and died May 1 1923 in Vienna.

Plener wrote a series of economic and political works, among others *Die Englische Fabriksgesetzgebung* (1871); *Englische Baugenossenschaften* (1873). His speeches were published by his friends in 1911. He himself published *Erinnerungen*, 3 vol. (1911–21).

PLIEKŠANS, JĀN (1865–), Latvian poet and dramatist, was born Sept. 12 1865 at Tadenava in the district of Illukst, Courland. He adopted the pen name of Jozsef Rajnis. He was educated at the Riga gymnasium, and from 1884 to 1888 studied law at St. Petersburg (Leningrad). He later practised as a barrister at Mitau, Courland. From 1891 to 1895 he edited in Riga a democratic Latvian paper, *Dienas Lapa* (Daily Paper). He was arrested by the Russian Govt. on political grounds and deported first to Pskov and then to Viatka returning thence in 1903. He may be considered the chief exponent of democracy in Latvian poetry. He invented a special form of sonnet, shorter than the ordinary sonnet and well constructed. As a dramatist he achieved distinction, not only as a translator of Shakespeare, Goethe and Schiller, but also by his own tragedies written in the Lettish language. His principal historical tragedies are *Uguns un nakts* (*Fire and night*), *Pūt vējini* (*Blow breeze*) and *Daugava* (*The Dvina*). *The Sons of Jacob* has been translated into English, and was produced May 22 1925, at the New Scala Theatre, London, by the International Theatre Society. For several years he was director of the Latvian National Theatre, and in 1920 became a member of the Latvian Saeima (parliament).

PLOUGH: *see* TRACTOR.

PLUMER, HERBERT CHARLES ONSLOW PLUMER, 1ST BARON (1857–), British soldier, was born March 13 1857, and entered the army in 1876. He served on the Red Sea littoral in 1884, and in 1896 commanded a mounted regiment in the Matabele Campaign. Before the outbreak of the South African War in 1899 he raised the Rhodesian field force, which he commanded during the early months of the contest. He was promoted major-general on the conclusion of hostilities.

In May 1915 Sir Herbert Plumer was selected to lead the II. Army on the Western Front. His army was not very actively engaged during the remainder of 1915, nor yet in 1916, but on June 7 1917 Plumer gained a signal victory at Messines. (*See* YPRES, THIRD BATTLE OF.) In Nov. he was selected to take charge of the British troops that were being sent to the basin of the Po after the Italian defeat at Caporetto. He commanded them until March but he was then summoned back to

Flanders to resume the leadership of the II. Army just before the great German offensive started. When the general advance of the Allies began in August, his army took a prominent part in the operations by which Belgian Flanders was recovered from the invaders. For his services in the War he was raised to the peerage as Baron Plumer of Messines and of Bilton, was promoted field marshal, and received a grant of £30,000. He subsequently commanded the British forces on the Rhine for a short time. From 1919 to 1925 he was governor of Malta and in 1925 became high commissioner for Palestine.

PLUNKETT, SIR HORACE CURZON (1854–), Irish politician (*see* 21.857), after his retirement in 1907 from the vice-presidency of the Irish Agricultural Department took no prominent part in politics till the crucial year, 1914. In the spring of that year he made abortive suggestions for an agreed settlement of the Irish question; and then in July, just before the outbreak of the World War, he announced his conversion to Home Rule and appealed to Ulster to give Home Rule a chance. In 1917, a year after the Dublin rebellion, he took the lead in a further attempt at a solution of the problem. When Mr. Lloyd George set up a comprehensive convention of Irishmen to consider the matter, there was great difficulty in finding a suitable chairman; but the first meeting unanimously chose Sir Horace for the post. He was himself sanguine, and worked at his task with singular devotion; but the absence of Sinn Fein from the gathering, the impossibility of reconciling the views of the Ulstermen and those of the Southern Unionists, and the occurrence of a number of tragic events in Ireland, prevented the adoption of any report with colourable unanimity. In 1920–1 he was a prominent advocate of "Dominion Home Rule," and saw it adopted in the Irish Treaty. He served as a Senator of the Irish Free State in 1922–3. (*See* IRELAND: *Agriculture.*)

PLYMOUTH, England (*see* 21.861), which has included Devonport and Stonehouse since 1914, had a population in 1921 of 209, 857 and an area of 5,711 ac. in the borough. Morice Town, to the north of Devonport and Stoke, is a rapidly growing district. Plymouth has returned three members to Parliament, from the Drake, Devonport and Sutton divisions, since 1918. Lady Astor, the first woman to sit in the House of Commons, was returned in 1919. By the municipal reorganisation of 1914 the town was divided into 14 wards, and has now a mayor, 20 aldermen and 60 councillors. The municipal museum and art gallery were finished in 1910, and a free library has been opened in Tavistock Road. The church of St. Gabriel, Compton Gifford, was built and made into a parish in 1910, and that of St. Boniface, St. Budeaux, was built in 1913, and made a parish in 1916. A parish was formed from that of Sutton-on-Plym in 1911. A memorial to men of the Royal Marine Light Infantry was unveiled on the Hoe in 1924, a naval memorial in 1924, and one to Capt. Scott and his comrades in 1925. Milbay Pier in the harbour has been extended to give further accommodation for mail steamers.

PNEUMONIA: *see* RESPIRATORY SYSTEM, DISEASES OF THE.

PNEUMOTHORAX.—The lungs are elastic organs kept in a condition of extension by their attachment to the walls of the bony thorax. This attachment is not direct, but is effected through the intervention of a smooth-walled empty sac, the pleura, which on the one hand covers the lung, and on the other forms a lining to the thoracic wall. The surfaces of this sac are held in contact by the weight of the atmosphere, and glide over one another during movements of respiration. If gas or air gain entry, whether from without or within, the lung is released from its condition of extension, and on account of its elasticity tends to collapse and empty itself of air. This is the condition known as Pneumothorax, and according to the means of its production is spoken of as Spontaneous or Artificial.

Spontaneous Pneumothorax.—This is generally due to the rupture of an air-containing lung into the pleural sac, commonly caused by softening of a tuberculous nodule. According to the size and nature of the rupture the pneumothorax is formed gradually, with slow development of symptoms or suddenly with immediate and urgent distress. A rapid and complete collapse of one lung, accompanied, as commonly happens, by encroachment of the chest contents on the other lung, is a condition that leads to severe breathlessness. Where, however, the collapsed organ was extensively diseased its loss may be less urgently felt and occasionally its collapse may be actually beneficial. It was largely the benefit arising from certain of these cases that directed attention to the idea of inducing collapse artificially. In most cases of spontaneous pneumothorax the pleura becomes inflamed, and fluid, whether thin or purulent, transforms the condition into a hydro- or pyro-pneumothorax.

Artificial Pneumothorax.—Otherwise known as pneumothorax treatment, or as collapse-therapy, artificial pneumothorax was first urged on theoretical grounds in 1821 by an Irishman, James Carson of Liverpool. His views were supported by clinical observations on Spontaneous Pneumothorax (Houghton, 1832; Stokes, 1837), but not till 50 years later did Potain (1884) put air into a spontaneous pneumothorax, and Cayley (1885) treat a case of haemoptysis by this method. The treatment on its modern lines may be said to originate with Forlanini, who reported his first cases in 1894–5.

The aim of this treatment is the collapse of a diseased lung, where disease does not respond to other measures, and where the other lung is sufficiently sound. Its main field has been pulmonary tuberculosis, but it has also been used in lung abscess and bronchiectasis, in the diagnosis of obscure lung conditions, especially tumours, and to assist the surgeon in certain chest operations. The gases used are commonly air, nitrogen or oxygen, according to the requirements of the case.

The gas is delivered from a "gas bottle" connected with a "pressure bottle" containing fluid, and enters the chest through a special needle attached to a water manometer to control the pressure. It is introduced in small quantities at first and collapse brought about slowly. As it collapses the lung squeezes out the diseased secretions it contains, and these are brought up as sputum. In a favourable case the sputum then ceases, the temperature becomes normal and the patient regains his lost health. Gas is given every few weeks, and treatment is carried on till disease is judged to be healed. The lung is then allowed to expand and does so to a varying extent. The main impediment to pneumothorax treatment is the occurrence, in a large proportion of cases, of adhesions between the surfaces of the pleura. The main source of failure during its course is the development of fresh disease in the functioning lung. The success of pneumothorax treatment in severe tuberculous disease has been very notable, at least 50% being improved, arrested or cured.

See Medical Research Council, *Special Report* No. 67, *Report on Artificial Pneumothorax* (Stationery Office, 1922). (C. Ri.*)

POELZIG, HANS (1869–), German architect, was born in Berlin April 30 1869. He studied architecture at the technical high school in Berlin from 1888 to 1893, in 1900 he was appointed a lecturer in the Breslau Academy of Arts, of which he was subsequently director from 1903 to 1916. He was architect to the city of Dresden from 1916 to 1920 and also professor at the technical high school there. In 1920 he started an advanced studio for applied arts at the Academy of Arts in Berlin. He became professor of the architectural section of the Technische Hochschule in Berlin in 1924. Poelzig was also a member of the Academies of Arts at Dresden and Berlin and president of the Deutscher Werkbund. Among his buildings may be mentioned the dam in the Klingenberg Valley; the Centenary Exhibition in Berlin (gardens and buildings); the reconstruction of the Schauspielhaus, Berlin; the water tower at Posen; the "Capitol" Cinema, Berlin; the Reick gas works, Dresden; and the alterations in the Breslau concert hall.

POINCARÉ, JULES HENRI (1854–1912), French physicist, was born at Nancy April 29 1854. He studied at the École Polytechnique, devoting himself to scientific mining, and took his degree in 1879. He was lecturer at Caen and then was transferred to the University of Paris in 1881, lecturing first on physical mechanics, then on mathematical physics, and ultimately on astronomical mechanics. In 1887 he became a member of the Académie des Sciences. Among the discoveries made

by him is that of the "Fuchsian functions," an order of functions more general than those of the ellipse, which he applied to the non-Euclidian geometry founded by Lobatchevski, and that of the theory concerning the rings of Saturn, by which they are supposed to be formed of a multitude of small and solid satellites. He also worked on the electro-magnetic theory of light and on electric oscillations. Poincaré died in Paris July 17 1912. His works include *Cours de physique mathématique*, 10 vol. (1889 etc.); *Leçons de la mécanique céleste* (1905 etc.); *Théorie de Maxwell et les oscillations hertziennes* (1907); *La théorie du potentiel newtonien* (1899); *Science et hypothèse* (1903); *La valeur de la science* (1904); *Science et méthode* (1908).

POINCARÉ, RAYMOND (1860–), French statesman (*see* 21.892). In March 1906 M. Poincaré became Minister of Finance in the Sarrien Govt., but he gave up his portfolio to M. Caillaux in Oct. of the same year, when M. Sarrien was succeeded by M. Clemenceau as Prime Minister. During the next five years, though he still continued to exercise a powerful influence in the Senate, M. Poincaré devoted himself mainly to his legal career. In 1909 he was elected a member of the French Academy. In Jan. 1912, M. Caillaux, who had been Prime Minister since the beginning of the previous year, resigned, whereupon M. Poincaré formed a government in which he himself held the portfolio of Foreign Affairs. His most notable colleagues were M. Millerand, M. Briand and M. Delcassé, Ministers of War, Justice and Marine respectively.

M. Poincaré's Cabinet constituted an *entente nationale*, and his first aim was to pursue a more definite foreign policy. In home affairs the problem which presented the greatest difficulties was that of electoral reform. M. Poincaré induced the Chamber to pass a proportional representation bill. But above all diplomatic affairs claimed his constant attention; for during the negotiations with Germany which took place in consequence of the dispatch of a gun-boat by that country to Agadir, certain incidents had occurred during the Caillaux administration which had produced a feeling of disquietude in regard to foreign policy. M. Poincaré therefore sought to re-establish a continuity of policy; and though he maintained courteous relations with Germany his main endeavour was to prove that France would remain faithful to both friends and allies. The ratification by the Senate of the Franco-German Treaty of Nov. 4 1911 was followed by France's definite establishment in Morocco and on March 30 1912 M. Poincaré obtained the signature of the Sultan Mulai-Hafid to a treaty recognising the French protectorate. On Nov. 27 he further concluded a treaty with Spain which settled the boundaries of France and Spain in Morocco.

Almost immediately after the establishment of the Poincaré Govt., an incident had occurred, which temporarily obscured the friendly relations between France and Italy. The Italians, who at that moment were at war with the Turks, seized two French mail-steamers, the "Carthage" and the "Manouba," which were on their way to Tunis, on Jan. 16 and 18 1912. But M. Poincaré, by his calmness and resolution, succeeded in re-establishing amicable relations between the two countries. By the end of Oct. Italian sovereignty in Libya was recognised, and by a mutual declaration of the two Governments, full liberty of action was granted to France in Morocco and to Italy in Libya. When in the autumn of 1912 the Balkan War broke out, M. Poincaré made every effort possible to prevent the conflagration from spreading. Nevertheless the succession of European crises combined with the ever-increasing menace from Germany and Austria-Hungary, rendered it necessary to take precautions; and with this object in view, M. Poincaré exercised constant watchfulness over army organisation. He induced Parliament to vote a programme of naval construction; and through the strengthening of Franco-British relations it became possible to concentrate the whole of the French fleet in the Mediterranean while Great Britain disposed her naval forces in the North.

At the beginning of Jan. 1913, M. Poincaré made known his intention of standing as a candidate for the presidency of the republic in the place of M. Fallières. A rival candidate appeared in the person of M. Pams, the Minister of Agriculture, who was supported by the Radicals and Socialists. The contest between the two was spirited, but on Jan. 17 the National Assembly elected M. Poincaré President of the Republic by 483 votes, as against 296 votes for M. Pams. M. Poincaré on being elected resigned the premiership, and was replaced by M. Briand. On Feb. 18, the date when M. Fallières' term of office expired, the new president took up his residence at the Elysée. Two days later he addressed a message to Parliament, reminding them among other things that "the will of one power alone was not enough to maintain peace," and "any nation that wished to give proof of its pacifist attitude must be ready at all times to meet and repulse any military attack which might be made against it." This allusion to the danger of war showed that the new president was fully alive to its possibility; and that this fear was well grounded events were soon to justify. Seeing that the menace from without continued to increase, M. Poincaré felt that while adhering strictly to the limits imposed upon his powers by the French constitution, his first duty must be to back up all those who were endeavouring to strengthen the defensive organisation of the country. Never once did he exceed his functions in this respect, and the men to whom he entrusted the government were always those who had the support of Parliament.

Always apprehensive, and with reason, of the terrible events which he saw were looming ahead, M. Poincaré endeavoured to cement the friendships and strengthen the alliances of France. At a later stage, his adversaries abroad as well as those at home criticised him severely for this policy; yet it is hardly reasonable because a man is sufficiently far-seeing to apprehend a storm and make preparations for it, to accuse him of wishing to hasten it. He claimed that he did his utmost to avert war holding that the way to prevent the conflict was for those powers against whom the menace was directed to present a powerful and united front, and thus make it seem imprudent to attempt any act of aggression. He also felt that if in spite of everything France was attacked, it was essential for her to be able to make a successful resistance. This belief he consistently adhered to, both in deed and word, as well as in his writings; and though it impelled him to be constantly on his guard, he never departed from a strictly pacifist attitude.

In July 1914 M. Poincaré went to Russia on a visit which had been planned for some time past. He was on his way home, having arranged to visit the three Scandinavian capitals, when the news of the Austrian ultimatum to Serbia reached him. After a short stay in Stockholm he returned hastily to Paris; and in a letter to King George V. he pleaded for a clear declaration that the entente cordiale, if necessary, would prove its strength on the battlefield, pointing out that such a statement would have a restraining effect on the policy of Vienna and Berlin. Throughout the War he continued to perform his duty with the same energy and discretion as before; though sometimes he visited the front, he never placed any obstacle whatever in the way either of the Government or of the army. In Nov. 1917 he gave proof of his vision and disregard of self by placing in power M. Clemenceau, who, though undoubtedly the man of the moment, was one with whom he had little sympathy. During the critical months of 1918, M. Poincaré revealed an inflexible resolution and a supreme confidence in the ultimate victory. After the Armistice, Parliament by a resolution testified to the services he had rendered to his country.

During the peace negotiations divergence of views again became apparent between M. Poincaré and M. Clemenceau. On more than one occasion the president found it necessary to write to the Prime Minister pointing out the errors which, from his point of view, were being committed. His counsels, however, were not followed, and at the beginning of 1920, after having completed seven years as president, he left the Elysée and was shortly after re-elected senator for the department of the Meuse. In Jan. 1922, the Briand Cabinet having resigned, M. Poincaré once more became Prime Minister and Minister for Foreign Affairs. He made it his chief aim to insist on the fulfilment by Germany of her obligations in regard to reparations. During

the first year of his new Government he failed to arrive at any agreement on this subject with the British Cabinet, whose views differed so widely from his own. The Inter-Allied Conference in London in Aug. and Dec. 1922 produced no result. A further conference took place in Paris on Jan. 2 and 5 1923. But M. Poincaré rejected the proposals drawn up by Mr. Bonar Law, and all that was done was to put on record, in friendly terms, the complete disagreement of the two Governments.

At this moment, the Reparations Commission, with Britain dissenting, having declared that Germany had failed to fulfil her obligations in regard to the delivery of coal and coke, M. Poincaré, in agreement with Belgium, undertook the occupation of the Ruhr. At first this measure involved merely a method of control, but gradually, owing to the passive resistance of the Germans, it became necessary to exploit the railways and to some extent also the mines by means of Franco-British supervision. By the autumn the passive resistance had ceased, and M. Poincaré awaited the German proposals which never came. He then accepted the American suggestion that a group of experts should be given the task of finding the solution of the reparation problem; this resulted in the adoption of the Dawes Plan. But M. Poincaré had made up his mind not to withdraw from the Ruhr until he was satisfied that this plan was being carried out.

During the first three months of 1924 M. Poincaré had to face a financial crisis due to the state of the exchange. Not without difficulty he induced Parliament to vote new taxes and succeeded in saving the situation. But from now onwards he had to withstand strenuous opposition from the parties of the Left consisting of the Radicals and Socialists. The policy of these groups met with a marked success at the general elections of May 11 1924 and resulted in a majority for the Left which now formed a coalition under the name of the Cartel des Gauches. Immediately the results were announced, M. Poincaré stated that he would retire on the day when the new Chamber was to assemble, which took place on June 1 1924. Thenceforward he took his place in the Senate, intervening only rarely in political debates. In addition to various articles on legal, political and literary subjects, Poincaré undertook the publication of an important work in 10 volumes, entitled: *Au service de la France; neuf années de souvenirs*, the plan of which is to describe the sequence of events from 1911 to 1920 and the rôle which he himself played in them. Two of these volumes appeared in 1926 under the titles of *Le lendemain d'Agadir* and *Les Balkans en feu*.[1]

See H. Girard, *Raymond Poincaré* (1913); E. Charton, *L'Angleterre et M. Poincaré* (1923); S. Huddleston, *Poincaré* (1924). (P. B.)

POISON GAS: *see* CHEMICAL WARFARE.

POISONING: *see* FOOD POISONING.

POLAND (*see* 21.902), an independent Republic of Central Europe (Rzeczpospolita Polska) and a member of the League of Nations. Its area is 149,895 sq. m., and the population (1925) 28,896,000.

I. POLITICAL HISTORY

Poland After the Partitions.—The Congress of Vienna (1815) set the seal on the three partitions of Poland. The smouldering discontent of the Poles broke out in revolution in 1830, 1846 and 1863; but the bloody repression of the last revolt closed the period of active rebellion. From this date until 1914 the Poles of Prussia, Galicia and Congress (Russian) Poland developed along widely different lines so that from a practical standpoint the differences between them became almost as important as the ideal unity of their memory and dreams.

The Poles in Prussia.—Each acquired some characteristics of the Empire with which its lot was cast. The Prussian Govt. especially under Bismarck, had attacked the Polish problem with its usual efficiency. In the 'thirties the administration in Prussian Poland had become purely German; the Polish officials assisting this process by quitting the State service. In 1872 the "Kulturkampf" began; the Polish language was gradually eliminated from school and pulpit. In 1886 a commission began to buy up Polish estates and settle German peasants on them. In 1894 the "Ostmark" organisation was founded, with the aim of ensuring German cultural and mercantile predominance in the East. In 1902 the so-called "Wrzesnia" case aroused a painful scandal when it was admitted in the German Reichstag that Polish children had been beaten for refusing to say the Lord's Prayer in German (*see* POSEN, 22.170). In 1908 a compulsory Appropriation bill was passed, and the use of Polish at public meetings forbidden. The resistance of the Poles was stubborn, but in view of the strength of Germany, not mainly political. The leaders looked to Russian Poland for assistance; but their strength at home lay in the network of co-operatives and peasants' associations, led by the Catholic priests, who put up a solid resistance in the economic field. The result of the Prussian occupation was to create a sturdy class of peasants and small bourgeoisie, disciplined and economically and culturally advanced, whose political programme was essentially defensive.

The Poles in Austria.—In Austria, on the other hand, the Poles were almost a dominant nationality. The numerical strength of the Parliamentary "Polenklub," which always united against all outsiders, was such that no Austrian Govt. could be formed without it. In 1867 the Poles of Galicia were granted a special Minister for Galicia (Galizischer Landsmannminister) as the price of their consent to the "Ausgleich" with Hungary. The Governor, or Statthalter, of Galicia was invariably a rich Polish aristocrat; and these two officials were able to defy any centralising efforts of the Vienna bureaucracy and establish a *de facto* independent Polish State within Austria, with a purely Polish administration, which extended over non-Polish East Galicia. Galicia, unlike Prussian or Congress Poland, thus retained an active interest in politics, and the nobles developed into a large administrative class; but while preserving the tradition of the "Szlachta" they paid little attention to material development; and Galicia remained economically backward in every respect. Even the development of the Galician oil-fields, when it came, was due almost entirely to Jewish houses, who made enormous fortunes out of it. *De jure* autonomy within the monarchy for Galicia was constantly urged by the German nationalists of Austria; but would have been most unwelcome to the Poles, politically, because it would have vastly weakened their position against the Ruthenes of East Galicia (*see* GALICIA, EAST) who were almost as numerous as themselves; financially even more, because it would have meant the end of the very heavy annual subsidies which this province received from the Imperial Exchequer.

The Poles in Russia.—Nor was the desire for a free and united Poland so unresting in Warsaw as is generally supposed. All self-government in Congress Poland was suppressed in 1863; all education was Russified in 1869, justice in 1873. On the other hand, the abolition in 1851 of the customs frontier between Russia and Poland had laid the foundation for an extraordinary industrial expansion in this district. Russian Poland became the chief industrial region for all Russia. Its vast market in agricultural Russia was protected against Western competition by high tariffs; the Russian Govt. took every possible measure (such as the introduction of specially favourable railway tariffs) to assist this expansion. The Poles of Russia refused on principle to enter the Russian State service. This could only be welcome to Russia; and its result was that the Poles busied themselves with productive occupations—industry, trade and agriculture, and the upper and middle classes achieved a well-being far superior to anything enjoyed by their cousins in Galicia. A second and important result of this expansion was the growth in Congress Poland of a large and radical proletariat which dissociated itself from its Polish exploiters and made common cause with the Russian Social Democratic movement. The divisions between the upper and lower classes in Poland were accentuated by the agrarian policy of the Russian Govt. in Poland. The emancipation of the peasants was effected by

[1] In June, 1926 when the fall of the Briand Government created great confusion in France, Poincaré declined to join Briand in a reconstructed cabinet. However, after the brief administration of Herriot, he became head of a coalition government, undertaking himself the onerous duties of minister of finance.

the ukases of 1861. Each peasant, whatever his tenure had been, and the mass of the landless proletariat, became freeholders. The landlords received compensation in the form of Russian Treasury Bonds. Village affairs were placed in the hands of the peasants' communes, which quickly fell under the influence of Russian bureaucracy. Nevertheless, contrary to the hopes of the Russian Govt., these communes served as centres for the spread of education and for the revival of the idea of Polish nationality.

The Russian revolution of 1905 was a turning point in Polish history. The measures of repression which followed it aroused the deep hatred of a large section of Poles among whom the most prominent was Piłsudski, leader of the "right" or patriotic wing of the Socialist party, who was obliged to flee to Galicia and now began to organise active resistance to Russia from that base. Yet the revolution was followed by the grant of a Russian Constitution, and the Liberals in the Duma were not averse to the idea of granting Poland a large measure of autonomy within Russia. The Polish and the Russian bourgeoisie found a bond of union, even as had the Polish and Russian proletariat. Moreover, the brighter prospects in Russia contrasted strongly with the renewed severity of the régime which Bülow introduced in Prussia. And in East Galicia and the Ukraine alike the Ukrainian (Ruthenian) nationalist movement —much more prominent in Austria since the grant of general suffrage in 1907—was exceedingly unwelcome to both the Poles and the Russians.

Russia, defeated in the Far East, had again begun, after an interval of nearly 30 years, to propagate Pan-Slav ideas and to work actively among the Slavs of Europe. The Neo-Slav move-

ment, unlike most earlier forms of Pan-Slavism, was prepared to drop the racial and religious feud with the Poles. The idea of uniting all Poles with autonomy within the Russian Empire was widely preached; its realisation seemed near at hand. It became the programme of the National Democratic (All-Polish) party, founded in Congress Poland in 1897 under Roman Dmowski, which gained a considerable following, even in Austria. The Slav Congresses of 1908 and 1910 really did much —thanks largely to the efforts of the Young Czech leader, Dr. Kramař, to reconcile the Polish and Russian nations. This reconciliation, was not, indeed, more than partial. It was rudely shaken in 1912, when Russia separated the Govt. of Cholm from the rest of the Kingdom of Poland. Poles in general, nevertheless, now looked on Prussia as their chief enemy and the sympathies of the Poles of Galicia had become divided.

Poland During the World War.—The outbreak of War in Aug. 1914 thus found the Poles of Germany, Austria and Russia to a great extent estranged from one another, their sympathies divided, and a united national policy lacking. Piłsudski, the "activist," crossed the frontier from Galicia with a few hundreds of his armed band and engaged the Russian Empire in battle as forerunner of the army of an independent and united Poland. But the Polish National Committee, formed in Cracow on Aug. 16, aimed at uniting Galicia and Congress Poland as a third party in the Dual Monarchy and required the Polish Legion to take the oath to the Emperor. In Warsaw another Polish Committee under Dmowski denied the right of the Cracow Committee to speak in the name of the Polish nation; protested loyalty to the Tsar; and attempted to form a Polish Legion on the side of Russia. Meanwhile the Grand Duke Nikolai Nikolaievich issued a proclamation (Aug. 14) in which he promised to unite the three parts of Poland in an autonomous state with the Russian Empire. When the Russian Army occupied a great part of Galicia the Russophil party in Galicia (the National Democrats) openly adhered to this programme. The "Austrian Solution" retired into the background.

In the summer of 1915, however, the Central Powers conquered all Congress Poland. After the fall of Warsaw on Aug. 5 1915, governments were set up on behalf of Germany at Warsaw, and Austria-Hungary at Lublin. It was now the Russian solution that was platonic. But fresh difficulties confronted the Austrian solution. The Polish Socialist Party (P.S.P.) under Piłsudski declared that no recruiting should take place for Polish legions until an autonomous Polish Govt. had been formed to conduct it. The P.S.P., the Peasants' Party and the National Democrats united on this programme. Meanwhile Tisza, the Hungarian Minister President, had vetoed the Austrian trialist scheme, which was also opposed by Germany. Vienna, again, rejected the plans put forward by Germany, of annexing Congress Poland to Germany, or of forming an independent Polish buffer state in economic military and political alliance with the Central Powers.

Formation of a Polish State.—In Aug. 1916, however, after the defeat of the Austro-Hungarian troops at Łuck, the German Supreme Command acquired complete control of policy on the Eastern Front. Ludendorff believed it possible to gain a large Polish Army if his ideas were adopted. Germany and Austria-Hungary issued a proclamation on Nov. 5 1916, holding out a prospect of the restoration of an independent Congress Poland as a hereditary constitutional monarchy closely attached to the Central Powers. Francis Joseph promised Galicia increased autonomy within Austria-Hungary. The discussion of details was shelved; the military governments at Warsaw and Lublin continued to administer the country. The German Governor, General von Beseler, arranged for the election of a Diet with fairly extensive powers in local administration, education and justice. Meanwhile, by decree dated Nov. 26 1916, a Provisional Council of State was appointed, which was solemnly opened on Jan. 14 1917; but the National Democrats were excluded from it, the Minister of Political Affairs was allowed to hold relations with the Central Powers only, and the decisions of the Diet could be overruled by Von Beseler. Piłsudski, who had long been in conflict with the German Supreme Command on the degree of independence which the Polish troops should enjoy, resigned his command, entered the Diet and began to work out the plans for a national Polish Army. He refused, however, to raise it for German use; and actually the German plan of raising a Polish Army failed completely.

In March 1917 the Russian dynasty fell. On March 30 the new Russian Govt. recognised Poland's right to self-determination and promised Poland its support in the creation of a new Polish State. These events altered the attitude of the Allies towards Poland, particularly as they were now reinforced by the entry of the United States into the War. The answer of the Entente Powers to the peace proposals of the Central Powers issued on Jan. 10 1917 had already declared their adhesion to the Tsar's manifesto to his armies (Dec. 25 1916) which had spoken of "the formation of a free Poland in all parts into which it is at present divided."

Paderewski was working tirelessly in America. In Nov. 1916 a great Polish National Department in Chicago had united all the organisations of the 4,000,000 Poles in America; and under Paderewski's influence, President Wilson on Jan. 22 1917 alluded to a "united, independent and autonomous Poland." The danger threatening Poland from Russia vanished with the breakdown of Brusilov's offensive (July 1917). The Central Powers were now the only enemy. The Poles of Galicia were discontented with Austria's failure to introduce the promised self-government; the Left was stimulated by the example of Russia, and when the Austrian Reichsrat met in May 1917, its Polish members demanded "an independent united Poland with an outlet to the sea," and declared that the Polish case was one for "international consideration." The Council of State in Warsaw demanded wider powers on May 1, but the chiefs of the Provisional Governments in their answers of May 15 and June 8 did not give immediate effect to these demands.

After a conflict, some members of the Council accepted the German demands to make a recruiting appeal, and take an oath of loyalty to the German and Austro-Hungarian armies and to their Allies, for the present War, swearing by their "Fatherland, the Kingdom of Poland and the future King of Poland." Piłsudski resigned from the Diet with his adherents, and set about turning his secret military organisation against Germany. Polish legions were formed in France under General Haller and in Russia under General Dowbor-Musuicki. Polish volunteers from America were trained in Canada. On July 22 Polish discontent was increased by the arrest of Piłsudski. On Aug. 25 the Diet, now discredited with the people, resigned. On Sept. 12 Germany and Austria-Hungary introduced a new project of a regency of three, a Cabinet and Premier and Council of State, chosen by the regency, and enjoying limited powers, the German and Austrian military governments retaining the right of veto. The regency was appointed on Oct. 15; it consisted of the Archbishop of Warsaw, Dr. Kakowski, Prince Lubomirski and Josef Ritter von Ostrowski, a large landowner. The first Minister President, Jan v. Kucharzewski, was appointed on Nov. 26 and formed his first Ministry on Dec. 7.

The final collapse of the Russian Army in the autumn was the signal for the Central Powers to work out fresh combinations, according to which the future of Poland was determined in the most various ways. But although Germany was still strong, Austria had now lost all real authority over the Poles of Galicia, who were in a position to dictate terms as they pleased. The proposals of the Russian delegates who arrived at Brest-Litovsk in Dec. 1917 amounted to a recognition of Poland's independence; and the thirteenth of President Wilson's Fourteen Points (Jan. 8 1918) declared that a Polish State should be erected which should include the territories inhabited by indisputably Polish populations "with an outlet to the sea and an international guarantee of its independence and integrity. The Polish National Committee, founded at Lausanne in Aug. 1917 and since established in Paris, was gaining increasing influence in the councils of the Allies, largely through Paderewski, who represented it in

Washington. Between Sept. 20 and Dec. 1 1917 France, Great Britain, Italy and the United States had recognised it as the official representative of the Polish people. Polish delegates were not admitted to the deliberations at Brest-Litovsk.

By treaty (March 3) Russia renounced all claims over Poland; but the treaty signed Feb. 9 1918 between the Central Powers and the Ukraine allotted the Ukraine the disputed province of Chełm, while Austria-Hungary further pledged herself in a secret clause to form East Galicia and the Bukovina into a separate Crownland. These clauses became known; Polish opinion was infuriated beyond measure; the Polish Cabinet resigned; the Polish Club in the Austrian Reichsrat went over to the Opposition; the remnant of Piłsudski's legions still fighting for the Central Powers mutinied. Some were interned, some fought their way to the coast and joined Haller's legions in France. In April the Polish delegates to the Congress of Rome declared their aim to be " reunion into one independent State of all the Polish lands, including those which the Central Empires are refusing to restore to Poland and those which they are bestowing as largesse on their vassals." The elections for the Council of State in Poland were held in the same month; and it was opened in Warsaw on June 22. Little interest was taken in the elections, and general feeling in Poland tended to ignore this body in favour of the National Committee in Paris. After the breakdown of the German offensive in July 1918, a last effort was made. The Poles were offered their choice between rival schemes of a Poland attached to Austria in the " Mitteleuropa " plan, or a State formed according to German wishes, though under an Austrian Archduke. But the Poles were now strong enough to ignore all suggestions from this quarter, especially as the Prime Ministers of Great Britain, France and Italy had declared in favour of an independent and united Poland at Versailles on June 3 1918, and Wilson insisted on the Fourteen Points as a basis for peace.

The Declaration of Independence.—On Oct. 6 the Polish Regency Council and Minister President published a manifesto to the Polish nation declaring its intention of dissolving the Council of State, forming a representative national government and summoning a Diet for a " free and united Poland." On Oct. 15 the Polish representatives of the Reichsrat declared themselves to be " subjects and citizens of a free and re-united Polish State." On the same day the Council of Regency in Warsaw summoned the Galician Poles to Warsaw to take part in forming the new Polish Government. A Cabinet, consisting for the most part of Russophil National Democrats, was hurriedly formed on Oct. 22. On Oct. 28 a Commission of Austrian Poles met in Cracow to wind up relations with Austria. Assuming its authority to extend throughout Galicia, it appointed its next meeting for Nov. 2 in Lemberg, where a Ruthenian Govt. had already formed, thus early coming into collision with its neighbours (*see* GALICIA: EAST). On Nov. 3 the Cabinet proclaimed the Polish Republic, and declared its intention of forming a Government with the Left. In fact, owing to the hostility of the Left, the Cabinet resigned on Nov. 4, and a provisional Cabinet of officials carried on. On Nov. 10 Piłsudski, who had been released from imprisonment on Oct. 7, arrived in Warsaw. The German troops of occupation were disarmed and expelled, and the Poles assumed the executive power in Warsaw on Nov. 11. The Council of Regency declared on Nov. 12 that it appointed Piłsudski to the supreme command of all Polish troops; while Piłsudski proclaimed himself head of the National Government. On the 18th he notified all belligerent and neutral States of the formation of an independent State of Poland.

Post-War Position.—Of all the new or resurrected states of Europe, Poland was in many respects in the most difficult position. The territory of Congress Poland and Galicia had been devastated in the War. Most of the factories were closed for lack of raw material, where they had not been actually dismantled. The fields of the peasants had been laid waste, their live stock slaughtered, their farms burnt. Many districts were actually famine-stricken, others swept by epidemics. Communications were disorganised, rolling stock in a deplorable state. Marks, roubles and kronen circulated freely, but their value was low and uncertain, and public and private finances were chaotic. Owing to the past policy of the Prussian and Russian Poles, a national bureaucracy only existed in Galicia. At one time there were only six officials in the Ministry of Finance. Thirty thousand German troops were still in the country. On the East, Bolshevik Russia was in a highly unsettled state. The ideas prevalent in Russia had unsettled the peasants, who pressed for a redistribution of land from the large estates, and the workmen, who were suffering under unemployment, were in a state of unrest. The century of foreign rule had been an ill training for constructive political thought, and political parties were as numerous as they were, in the main, futile.

But above all, the problem of Poland's frontiers assumed an immediate and lasting importance. Only in the Carpathians could Poland be said to possess a natural frontier. Over the vast and formless eastern plains, nation merged into nation, and there were vast areas where the very language of the inhabitants was only a doubtful dialect. In others, enclaves of Polish and non-Polish territory were inextricably mixed. In others, and these among the richest, the land-owning nobility was Polish, the peasants Ukrainian or White Russian. Poland's historical frontiers had at one time extended, over large non-Polish populations, from the Baltic to the Black Sea. At the time of the Partitions of Poland, they had embraced nearly twice as much territory as was ethnographically Polish. The Poles themselves had learned to think in wide spaces, with more force than restraint. With powerful neighbours to East and West, each far more numerous than themselves and each at the moment highly unpopular with the victors in the War, the Poles little needed the encouragement which they received to make enormous territorial claims. Much of their history for the next four years was to consist in disputes with their neighbours involving the young State in excessive expenditure and entailing grievous neglect of internal problems.

Piłsudski, the old revolutionary, had begun by appointing a Cabinet of the Left, composed mainly of Galician socialists and peasants' representatives. This was formed on Nov. 18 after the Social leader, Daszynski, had attempted unsuccessfully to form a ministry four days previously. The programme of M. Moraczewski, the Premier, was " consolidation and social construction." But his rule was short. The propertied classes refused him their support, and his attempt to float an internal loan met with little response. The friends of the Entente and the National Democrats resented the Galician rule; and when M. Paderewski, the second man in Poland enjoying almost unlimited prestige, arrived in the country in Dec., he composed his differences with Piłsudski and became Premier on Jan. 17. Prussian Poland had come under complete control of its Polish inhabitants by Jan. 9. West Galicia was incorporated; East Galicia was occupied by Polish troops, which had entered Lemberg on Nov. 22. It was possible to hold elections for a Constituent Assembly on Jan. 26 1919. The Constituent Seym met on Feb. 10. Out of the 337 deputies, only 32 were Socialists. The National Democrats numbered 107. The majority of the House consisted of peasants, politically extremely ignorant, sympathising with the Left against the landowners, with the Right against Socialism. The Seym passed a vote of confidence in Paderewski's Cabinet, and confirmed Piłsudski in his position as head of the State without, however, exactly defining his position.

Piłsudski and Paderewski were chiefly interested in foreign affairs. On Dec. 13 1918 Poland had broken off diplomatic relations with Russia, on Dec. 15 with Germany. On Jan. 4 1919 all Polish parties had issued a message that Poland was one with the Entente through community of ideas and historical tradition. Paderewski proceeded to Paris to urge Poland's claims; Piłsudski raised an army to defend them. General Haller's troops, returning from France, formed the nucleus of this force. The unemployed were glad to join it and on March 7 six classes were called up. Already Poland had an army of

600,000, which was soon increased to 800,000. On April 2 a state of siege was proclaimed in Congress Poland, and on May 8 an offensive opened in East Galicia against the Soviet Russian and Ukrainian forces.

The Treaty of Versailles and the Frontier Problems.—On June 28 1919 the Polish delegation signed the Treaty of Versailles, under which Poland agreed to accept an agreement with the Principal Allied and Associated Powers for the protection of national minorities in Poland, and for the protection of freedom of transit and equitable treatment of the commerce of other nations. This Minorities Treaty was signed on June 28 1919 between Poland and the Principal Allied and Associated Powers. Under the Treaty of Versailles, Poland received the larger part of Posen and part of West Prussia. A plebiscite was to determine the settlement of Masuria and Upper Silesia. Danzig was to be a free city under the protection of the League of Nations. This city was to be included within the Polish customs frontiers and its foreign relations and the protection of its citizens abroad were to be entrusted to Poland, who also received other economic rights in this territory. The actual details were to be settled later by a treaty between Poland and the free city. Art. 87 of the Treaty assigned to the Allied and Associated Powers the duty of fixing Poland's eastern frontier. A provisional boundary was laid down between Poland and Russia, roughly corresponding to the course of the Vistula. As a signatory to the Treaty of Versailles, Poland was an original member of the League of Nations. The treaty was not popular in Poland but the Seym ratified it on July 30–31 by 285 votes to 41. During the next three years, however, Poland was almost exclusively occupied on questions arising directly or indirectly out of it, which it will be convenient to take in order.

The industrial district of Teschen (*q.v.*), with important coal mines, was claimed by both Poles and Czechoslovaks. Each nation attempted to assume practical control and there was some fighting. A plebiscite commission arrived in the district on Jan. 30 1920, but on July 28 1920 the Supreme Council fixed a line of demarcation through this district, cutting the town in two, and through the neighbouring districts of Zips and Orava. In East and West Prussia (*see* ALLENSTEIN-MARIENWERDER) the plebiscites were held on July 11 1920. The bulk of the districts were allotted to Germany on the basis of the vote.

Upper Silesia was the scene of grave troubles (*see* SILESIA, UPPER). Art. 88 of the Treaty of Versailles provided that the inhabitants of this area, except in its purely German portions, should vote by plebiscite for adherence to Germany or Poland. Allied troops occupied the districts in the meantime, and a commission consisting of a French, a British and an Italian representative took charge. The plebiscite was fixed for March 20 1921. The Poles put great pressure on the inhabitants. At the polls, 717,422 votes were cast for Germany, 483,514 for Poland. The towns and industrial districts voted German. In consequence of a rumour that only two districts were to be assigned to Poland, Korfanty, a prominent Pole, occupied southeastern Upper Silesia with an armed force, recruited and equipped from Poland, and defied the Allied Powers. A commission of the Council of the League of Nations on Oct. 20 1921 awarded the southeastern districts, including 75% of the aggregate material wealth of the disputed territory, to Poland. A convention signed at Geneva between Poland and Germany May 15 1922 provided guarantees for the continuity of the economic life of the country and the protection of minorities during a transitional period of 15 years.

Danzig (*q.v.*) was proclaimed an independent free city on Nov. 15 1920. A treaty between Danzig and Poland was signed at Paris Oct. 27 1920 and a supplementary convention at Warsaw Oct. 24 1921. Poland's rights in the territory of the free city are exclusively economic and ensure her free access to the sea. The convention regulating the administration of the harbour and waterways was signed on May 23 1923.

Hostilities Against the Ukraine and Russia.—The disturbances on Poland's eastern frontier were on a larger scale. Polish troops, on occupying Lemberg in Nov. 1918, had expelled the East Galician Govt., which took refuge in Vienna. General Petliura, who formed a government in the Ukraine in the same month, proclaimed the union of the Republics of Ukraine and West Ukraine (East Galicia). The East Galician troops placed themselves under his command. Throughout 1919 fighting continued between the Polish and Ukrainian troops, the former remaining in *de facto* possession of the disputed territory. At the same time, Poland was engaged in a somewhat serious war with Soviet Russia

The German troops of occupation had evacuated the White Russian and Little Russian territory in Chełm and Volhynia in such a way that the Bolshevik troops were able to occupy it before the Poles, to whom the inhabitants appealed for aid, could come up. In this year Soviet Russia was engaged in war with most of her neighbours and with various expeditions, such as those of Kolchak or Denikin. The policy of the Allies was extremely uncertain; but in any case it was hostile to Soviet Russia, and there was talk of forming a "sanitary cordon" round that country. The Polish forces, as the largest and most successful of those opposed to Russia, enjoyed considerable support in Western Europe. All the Allies desired a strong Poland; but British statesmen considered that this aim would be best achieved if Poland's frontiers were not excessively extended. In the autumn, Russia suggested an armistice which was declined. The Allied and Associated Powers on May 8 definitely assigned West Galicia to Poland, and on June 21 allowed her to establish a government in East Galicia, which district was, however, to determine its own fate in the future and to preserve its autonomy. On Nov. 20 the Peace Conference reached a decision that East Galicia was to receive autonomy for 25 years under a Polish protectorate, after which period the League of Nations would decide its future.

The "Curzon line" of Dec. 8 attempted to define Poland's eastern frontier. It drew a line roughly following the ethnographical frontier and thus running some way further west than the actual line then occupied by Polish troops. The district of Vilna (Wilno), which the Poles had occupied in April 1919, was assigned to Lithuania.

In the spring of 1920 efforts were made to secure peace with Russia; but as Poland advanced claims on historical grounds to large non-Polish areas, these came to nothing. On April 25, having settled differences with Petliura in the Ukraine by a Treaty dated April 22, Poland opened a strong offensive. On May 8 the Polish troops entered Kiev. The Soviet Army, however, having defeated Kolchak and Denikin, concentrated against Poland and opened a counter-offensive. By July the Polish forces were in a serious position. Poland appealed to the Allies for mediation; and the Allies suggested that Poland should retire to the Curzon line and that representatives of Poland, Russia, Finland, Lithuania and Latvia should meet in London to arrive at a general peace settlement of eastern Europe. Russia refused this offer, but agreed to negotiate directly with Poland. On July 22 Poland asked Russia for an armistice; the Soviet Govt. replied, fixing the opening of negotiations. Russia was procrastinating, apparently believing that the military situation would become more advantageous to herself with delay.

The Allies, however, had been perturbed by the Russian advance, and a French mission under Gen. Weygand had arrived in Warsaw to assist the Polish General Staff. The invasion had also awakened Poland to the need of a supreme effort. The Government issued an appeal to the country, which responded to it nobly. On Aug. 14 Piłsudski opened a counter-offensive, and drove the Russians back in confusion. On Aug. 17 the Polish army retook Nowo-Mińsk and on Aug. 19 Brest-Litovsk. Poland, backed by the Allies, was now able to reject the terms which the Russian delegates at Minsk suggested, which included the formation of a civic militia of the Polish workmen, 200,000 strong. The conference was moved to Riga, where the preliminary treaty of peace was signed on Oct. 12. The final treaty was signed at Riga on March 18 1921 and ratified by the Seym on April 17.

The contracting parties acknowledged each other's independence, and abandoned all claims to territories situated on the other side of the new frontier; Russia also declared her *désintéressement* as regards the territory disputed between Poland and Lithuania. Both parties mutually agreed to recognise the political sovereignty of the other and to refrain from propaganda or from harbouring organisations directed against the other party. They mutually renounced claims to war reparations, while Russia undertook to restore all art collections, libraries, historical documents, etc., removed after 1772, all industrial installation evacuated between Aug. 1 1914 and Oct. 1 1915, and to pay 30,000,000 roubles in gold as Poland's share in the assets of the former Russian Empire. A number of mixed commissions were set up to carry out the terms of this treaty; but, in general, disputes were more common than agreements among them. As regards industrial property, Poland agreed (Aug. 25 1914) to accept a large sum as settlement.

Poland's eastern frontier now ran southeast from the border of Latvia to Dzina (Disna), then south, just east of Dokszyce (Dokshitsi). It passes some 18 m. west of Minsk and, further south, some 70 m. east of Pinsk; then running almost due south and then slightly southwest to Ostróg; for some 25 m. it continues southwest, thence almost due south till reaching the river Zbrucz which it follows till its junction with the Dniester, which separates Poland from Rumania.

Simultaneously, Poland was embroiled with Lithuania on the question of Vilna (*q.v.*). This town and district had been occupied by Poland on April 19 1919 but were assigned to Lithuania by the Curzon line, and Russia recognised Lithuania's claims to them by a treaty dated July 12 1920. During their advance, Polish troops came into conflict with the Lithuanians. An armistice convention of Oct. 7 laid down a line of demarcation, which was to come into force on Oct. 10. On Oct. 9, however, the Polish General Zeligowski took possession of the disputed districts by a *coup de main*. The Polish Govt. disowned the General but made no serious effort to recall him. After prolonged negotiations, the Conference of Ambassadors assigned Wilno and district to Poland on March 14 1923. The Lithuanian Govt. refused to accept this decision as final. On March 14 1923 the Allied Powers through the Conference of Ambassadors recognised Poland's *de facto* northern, eastern and southeastern frontiers, the United States subsequently notifying the Polish Govt. of their acknowledgment of this fact. This decision repealed previous provisions for the future of East Galicia, which thus became an integral part of Poland.

Relations with the Little Entente, France and Rumania and the Baltic States.—Surrounded by so many enemies, Poland could not stand alone. The most important *bloc* in Central Europe formed after the War was that of the Little Entente (*q.v.*). Although Poland had many interests in common with the members of this alliance, she was unable to join it. She had no quarrel with Hungary; indeed, policy, tradition and a similarity of social structure made her sympathetic towards that State. The long drawn out disputes with Czechoslovakia on the Teschen, Zips and Javorzina frontier questions prevented a close alliance with that Power, which also refused to enter any alliance directed against Russia. Furthermore, Czechoslovakia had received a mandate over Carpathian Russia and hoped to establish a direct frontier with Russia. So long as the fate of East Galicia remained in abeyance Czechoslovak and Polish interests were bound to conflict.

On Nov. 6 1921 a Czecho-Polish political convention was indeed signed at Prague. The two parties mutually guaranteed, as far as they were able, the territories in their possession and agreed to act in concert for the application of the treaties which they had signed in common "when occasion arose." Czechoslovakia "disinterested herself" in Eastern Galicia, Poland undertook "analogous obligations" towards Czechoslovakia. Note was taken of Czechoslovakia's conventions with Rumania and Yugoslavia, Poland's with France and Rumania; reference was made to a commercial convention, and provision made for arbitration of differences. Feeling, however, was too unfriendly for the ratification of the treaty, although a commercial agreement was signed (Sept. 20 1921). Poland took part from time to time, as observer, in the periodical conferences of the Little Entente. Poland's relations with Czechoslovakia only became really cordial in 1925.

Of much greater importance were Poland's agreements with France and Rumania, referred to above. From the first, France had designated Poland as the Ally which should take over Russia's rôle on Germany's eastern frontier. The note with which Clemenceau transmitted to M. Paderewski the Polish Minorities Treaty reminded him that Poland would "to a large extent depend for the secure possession" of her territories on the Western Powers. The French Mission helped to save Poland during the Russian advance of 1920. France gave Poland her support in the Silesian and East Galician questions, thus helping her to acquire most valuable coal and oil fields and industrial regions. France assisted Poland to organise and equip her army, lent her instructors and staff officers and made her generous loans for the purchase of war material. On Feb. 19 1921 Piłsudski signed a Franco-Polish Treaty in Paris for the "maintenance of the treaties . . . the peace of Europe, the security of their territories and their common political and military interests." The two Governments undertook to consult each other "in all matters of foreign policy which concerned both States so far as these questions affect the settlement of international relations in the spirit of the treaties and in accordance with the Covenant of the League of Nations"; to conclude a commercial treaty and to take concerted measures "for the defence of their territories and the protection of their legitimate interests" in cases of an unprovoked attack upon either or both.[1]

The Polish Govt. ratified this political treaty on May 30 1922. It was not stated whether any further unpublished military convention had been concluded. Poland signed a commercial agreement with France (Feb. 6 1922) with a bilateral convention dealing with the property and rights of private individuals and an agreement concerning the exploitation of oil in Poland. A new convention was signed in Paris on Dec. 9 1924 on a very wide basis, which again included clauses relating to the French capital invested in Polish oil. Other agreements with France deal with the Polish immigrant workmen in France (Sept. 3 1919 and Oct. 14 1920) and consular and general matters (April 17 1924, Dec. 30 1925, Feb. 20 1926).

In view of the common danger threatening both States from Russia, Poland concluded a defensive alliance with Rumania on March 3 1921 (text printed in vol. 7 of the League of Nations Treaty Series). The treaty provided for mutual assistance in the case of an unprovoked attack on either party on their eastern frontier (defined in the case of Poland as those laid down in the preliminary Treaty of Riga of Oct. 12 1920); common diplomatic action in regard to the two parties' eastern neighbours; and for a military convention to be concluded for the same duration as the treaty, *i.e.*, five years from the date of signature, with the right of denunciation at six months' notice after two years.

A definite alliance between Poland and the Baltic States proved impracticable as, quite apart from the antagonism between Poland and Lithuania, the smaller states could not contemplate anything but a defensive attitude towards Russia, and feared to be entangled in an aggressive policy. In July 1921, however, representatives of Poland, Finland, Latvia and Estonia met at Helsingfors and determined to hold periodical conferences to exchange opinions on matters of policy and discuss the possibility of joint action. Such conferences were held at Riga (Aug.-Sept. 1921), Revel (Dec. 1921), Warsaw (March 1922), Genoa (April 1922), Revel (Sept. 1922), Helsingfors (March 1923), Riga (July 1923), Revel (Oct. 1923), Warsaw (Feb. 1924) and Helsingfors (Jan. 1925). The majority of these dealt only with minor financial and economic problems. At the Warsaw Conference of March 1922, however, a political agreement was suggested defining the outlines of a *rapprochement* between the States concerned on the basis of "benevolent neutrality towards any of the signatory states which might be attached without provocation," and a previous understanding in respect of treaties and agreements entered into. These suggestions could not be ratified owing to the opposition of the Finnish Diet. A conference was held in the same month at Riga, attended also by representatives of Russia, where the establishment of neutral zones as a preliminary to disarmament broke down, as did the disarmament conference in Moscow of Dec. 1922. At the second Helsingfors conference (Jan. 1925) a multilateral arbitration treaty was signed between Poland and the Baltic States. Poland concluded a commercial treaty with Finland (Nov. 1923), a consular convention with Latvia (Jan. 3 1924) and with Estonia (Jan. 11 1924).

[1] The text of this treaty is printed in vol. 18 of the League of Nations Treaty Series.

The Minorities Questions.—The events and treaties shortly mentioned above delimited and to some extent guaranteed Poland's frontiers, although their security left much to be wished in view of the agitation conducted by her neighbours, especially Soviet Russia. It left her, however, with national minorities amounting to 9,000,000 out of a total population of some 27,000,000 (according to the Polish *Handbook*, 1925, 3,883,000 Ruthenians, 2,123,000 Jews, 1,057,000 White Ruthenians, 1,036,000 Germans, 72,000 Lithuanians and 210,000 Russians, Czechs, Tatars, etc.), sufficient, under the system of proportional representation and *scrutin de liste*, to give the bloc of national minorities 89 deputies in the first regular Seym of 444 deputies.

The Polish-Minorities Treaty of June 28 1919 secured to all inhabitants of Poland full protection of life and liberty; it secured that all *bona fide* inhabitants of the districts allotted to Poland be admitted to Polish nationality and citizenship in the fullest sense (except in the case of recent German colonists); guaranteed the minorities the right to use their own language, to maintain their own institutions, to receive primary instruction in their own language, and where the proportion was considerable to receive "an equitable share in the enjoyment and application of public funds." The Jews are included among the "racial, religious or linguistic minorities"; Yiddish is recognised as a language, and the Jews are granted special protection as regards education and the keeping of the Sabbath, but are not recognised as "a separate political community within the Polish State." The guarantee for the execution of this treaty was entrusted to the League of Nations.

The most difficult minorities questions, after the Jews, proved to be those of the Ukrainians. East Galicia was not incorporated within Poland for a considerable period, during which, however, Poland treated it as an integral part of the Polish State. Complaints were numerous, and only grew less after the fate of the district had been decided because they were now unlikely to be heard. On Sept. 26 1922 the Seym passed a general law on provincial self-government which established local bodies (*Dietines*) for dealing with purely local affairs. This law granted a small measure of autonomy to East Galicia, but not enough to prevent complaints; more particularly as the break-up of large estates under the Land Reform Acts was utilised to settle Polish peasants in the non-Polish districts.

Serious disputes arose, not only with the Ukrainians, but also with the German minorities. In 1924 a more conciliatory spirit began to prevail. On July 10 of that year a bill was passed providing for the use of Ukrainian, White Russian and Lithuanian in government offices, law courts and schools in districts where the majority of the population speaks one of those languages. The provisions were not extended to the Yiddish language. M. Thugut, the vice-premier in 1924, however, made persevering efforts to reconcile the minorities. In the summer of 1924 the Government concluded a kind of pact with the Jewish leaders by which the Government promised to promote in every way the religious and educational interests of the Jewish community, while the Jewish leaders pledged themselves to respect the integrity of Poland and to give loyal support to the Polish national Government.

Nevertheless, the racial and especially the religious enthusiasms of the Polish people were such that considerable friction persisted between them and the minorities. The latter were strong enough to form a serious danger to the Polish State in times of unrest, particularly along Poland's eastern frontier, where such unrest was actively fomented by the Soviet Government. This was perhaps the principal reason why relations between Poland and Russia continued unsatisfactory, consisting, indeed, mainly of a continuous series of "incidents" accompanied by mutual insults and threats of an appeal to arms.

Internal Conditions, 1919–24.—For the first years of its existence the history of Poland was dominated by its foreign political situation. Large parts of its area were the theatre of wars; its army absorbed a considerable proportion of its man-power; and military expenses were the main item in its budget. Nor was this purely due to aggressive or imperialistic tendencies. Poland's long and defenceless frontier necessitated the upkeep of a large army, more particularly when her chief neighbour was so unrestful a one as Soviet Russia. Taxation was insufficient to meet these expenses, and Polish national resources—forests, oil-fields, etc.—were heavily mortgaged to foreign capitalists, generally French, in consequence.

The first period of Poland's independent existence bore the marks of its origin, which had been to some extent revolutionary, and during that period much advanced legislation was passed. Whereas the population up to 1918 had enjoyed little political liberty, the franchise system promulgated on Nov. 30 1918 for the elections to the Constituent Seym allowed the often untutored wishes of almost the entire adult population of Poland to find expression. The Constituent Seym was therefore mainly composed of peasants (who form 65% of the population of Poland), while the workmen were also strongly represented. These groups, however, and especially those of the peasants, suffered from a grievous lack of unity.

The Agrarian Question.—Not only were there antagonisms between the representatives from the three portions of the Republic, but their economic status and development were very different. In the west and the east of the country there were numerous large estates; but in the former districts the peasants were well organised and educated, while in the latter they were illiterate and backward. In Galicia there were numerous small estates, especially in the west; in Congress Poland the land reform commenced in 1905 had established a considerable number of small estates, but the reform was still far from completion. In both Galicia and Russian Poland there was a large landless proletariat, and in Galicia especially there were a great many dwarf holdings which were inadequate to support the families cultivating them. The natural desire of the peasants for a reform was increased by the example of events in Russia, and the first agitation contemplated a redistribution of a very radical nature; more especially as large parts of Poland were practically famine areas, and were only partially saved from the most widespread distress by the administration of relief (mainly granted by the American Food Mission) on a large scale.

The land reform bill was introduced in the Seym on July 10 1919, and was passed by a single vote in a House of about 360. It proposed the nationalisation of forests and limited the amount of land to be held by an individual in Poland to from 148 to 248 ac., although in the non-Polish lands a higher limit of 988 ac. was fixed. The land thus available was to be used for increasing "dwarf holdings" to economic small holdings and settling the landless in new small holdings. The reform, however, was not carried through as originally intended. It was impossible in any case to put through expropriation on a large scale, for financial reasons. The bill became a convenient asset in the political bargainings of the over-numerous parties of the Seym. It at last became law at the end of 1925. It now provided for the distribution of about 50,000 ac. a year to a period of 10 years. The maximum which an owner could retain was 148 ac. in the industrial centres, 740 ac. in the border provinces and 435 ac. in other areas. The benefit of the reform was largely enjoyed by the large and medium farmers, who thus came to form a conservative class. In general, however, owing to a series of remarkably good harvests, the agitation for reform largely died away.

The Labour Question.—The workmen in Poland were less fortunate. The industrial boom which almost all Europe enjoyed after the War missed Poland, where so many of the industrial areas had been ravaged and industry disorganised beyond the possibility of speedy repair. The closing of the Russian frontier, moreover, cut off Congress Poland's accustomed and almost sole market. In Galicia, Prussian Poland and Congress Poland, the labour legislation in existence in 1918 was extremely various, while in the last-named area it was very backward. No trade unions, in the modern sense of the word, existed in this, the chief industrial district of Poland; they had been prohibited by the Russian Govt., and the prohibition had been strictly enforced. The Socialist movement in these districts had therefore been of a radical and secret character, while the high proportion of Jews in Polish industry, as employers and workers alike, perhaps accentuated these traits, and certainly diminished the sympathy felt for the movement outside its own ranks.

The period during which Socialism was able actively to influence Polish legislation was short, but while it lasted some important measures were passed. Labour inspection was introduced on Jan. 3 1919, the organisation of the Labour Inspection Bureaux being slowly extended until the whole country was covered in 1923. The duties of labour inspectors include that of arbitration. Working hours were regulated by the Statute of Dec. 8 1919, by an amendment to this statute of Feb. 14 1922 and by various other statutes. The working day, with certain exceptions, is limited to eight hours and the working week to 46 hours. The Decree of Feb. 8 1919 introduced the freedom of coalition and defined the status of trade unions, which after that date grew rapidly in numbers and importance. At a later period, Poland took a very important part in the work of the International Labour Organisation, being among the States to ratify most readily the draft conventions prepared by that office.

Nevertheless, the position of the workmen in the republic was not happy. They were a minority, and their interests conflicted too often with those of the majority. During the period of the Russo-Polish hostilities in 1919–20 their sympathies were often deeply estranged from their country. The Communist element was large, and was actively encouraged by Russian agents, whose activities—carried on in defiance of the provisions of the Treaty of Riga—caused much ill feeling between Poland and Russia. Fear of Bolshevism caused the middle class and peasant parties to adopt an excessive severity towards any socialist organisations. Labour troubles were frequent, and often very grave. They abated when conditions grew more settled and communications improved. One relic of the early socialist influence was the over-staffing of industry and of public services, introduced as a palliative against unemployment; this over-staffing helped to burden the State exchequer and prolong the financial crisis.

Administration and Finance.—A capable civil service might have carried the country through without grave difficulties until conditions had settled down. Unfortunately, the only trained bureaucracy was that of Galicia, and this was not only numerically insufficient to meet the needs of the whole country, but had inherited by no means ideal traditions. The requisite staffs for the ministries were hastily improvised, but as a rule made up in quantity what they lacked in quality. They necessarily acquired experience slowly, and the first years of their administration were inefficient and expensive. Local Government had, indeed, existed before the War, but varied widely in the different parts of Poland. In Prussian Poland the rural commune had usually consisted of no more than 350 persons; in Galicia of about 1,000; and in Russia of some 7,000. District self-government did not exist in Russian Poland before the War. A large apparatus had thus to be improvised, and what was already in existence had to be made uniform. The efforts to introduce a uniform system of administration, as well as a uniform code of justice, largely occupied the first years of Poland's independence, and had not been wholly completed by 1925. These difficult tasks had meanwhile to be accomplished under the worst possible financial conditions. In 1919 the financial situation was chaotic. From 1921 on, Polish agriculture began to recover, and the peasants, the majority of the population, achieved a certain prosperity. The recovery of industry was slower; that of public finance slower still. Until M. Grabski undertook his reforms in Dec. 1923 the whole of Polish life was really dominated by the steady and sometimes extremely rapid fall of the mark, with the familiar accompaniments of inflation; the impoverishment of the middle classes and officials, antagonism between town and country, wage disputes in industry, and uncertainty as to the future.

Parliamentary History.—These difficulties were partly a cause, partly an effect, of an extraordinary political instability. Starting life as a country divided both politically and geographically, Poland achieved a great number of political parties. The Constituent Seym had 13 political parties, as well as two independent members, and it was difficult to ensure a stable Government, especially as the Constitution gave Parliament a preponderating influence in the Government of the country. M. Paderewski resigned in Nov. 1919, following the decision of the Powers to grant East Galicia autonomy. A new Cabinet of the Right and the Conservative peasants was formed on Dec. 13 1919 under M. Skulski. Its most important member was M. Grabski, the Minister of Finance, who succeeded M. Bilinski, a high financial authority from the old Austro-Hungarian service. Grabski, a National Democrat, aroused intense indignation in Galicia by fixing the value of the krone, for exchange purposes, at some 20% below its market value. In May 1920 the Cabinet proposed to requisition the next harvest. Witos, the Galician peasant leader, caused a crisis by his opposition. As Witos himself was unable to form a Cabinet, Grabski formed a non-party Conservative Govt., with Prince Sapieha as Minister of Foreign Affairs. At the height of the Russian offensive in July Grabski resigned and Witos became Premier, introducing Daszynski, the Socialist leader, as Vice-Premier for the purpose of negotiations with Russia. In July 1921 the Socialists and National Democrats left the Government, which carried on as a Government of the Left Centre. On March 17 the Constitution was adopted (*see* below).

In Aug. Witos was violently attacked by the Right in connection with the Upper Silesian dispute, and resigned. A non-party Cabinet under M. Ponikowski was formed on Sept. 27. The most remarkable member was M. Skirmunt, Minister of Foreign Affairs, who had been appointed to that post shortly before, on the resignation of Prince Sapieha. The Minister of Finance, M. Michalski, introduced a capital levy which stabilised the currency for a while. On March 3 1922 Ponikowski resigned owing to difficulties in the Vilna dispute. On March 27 he formed a second Cabinet, but resigned on June 2 owing to a difference of opinion with Piłsudski, who considered that the attitude of the Polish delegation at the Conference of Genoa had been too conciliatory towards Russia. The fall of Ponikowski, whose administration, unhampered by party conflict, had been a marked advance on those preceding it, both in foreign and financial policy, was the signal for an outbreak of party strife between Right and Left. After a prolonged crisis, during which Piłsudski came into hot conflict with the Right, who had selected Korfanty, of Silesian fame, as their leader, a non-party Cabinet under Nowak was formed on July 27. The electoral law was passed on July 28, and the general elections fixed for Nov. 5 for the Seym and Nov. 12 for the Senate.

The elections to the Seym returned 163 members of the Right, six of the Centre, 190 of the Left (41 Socialists, the remainder mostly small peasants), 83 of the National Minorities and two Communists. In the Senate the Right had 52 Deputies out of 111, the National Minorities 21; the other parties were small.

The first business of the two Houses was to elect a President. Marshal Piłsudski refused to stand. The parties of the Left, supported by the National Minorities and the Witos Peasant party, put forward and secured the election of M. Naturowicz, a friend of M. Piłsudski, who had acted as Minister of Foreign affairs in several Cabinets. The defeated candidate of the Right was Count Zamoyski. Polish nationalism was infuriated by the election of a President through the votes of the National Minorities, including the Jews; and on Dec. 16 a fanatic (apparently of unsound mind) assassinated the new president. This act sobered public opinion. The new president was M. Wojciechowski, an old member of the Polish Socialist party and later a leader in the co-operative movement. Gen. Sikorski became Premier.

Financial Collapse and Reforms.—Poland's position in the early part of 1923 was still very unsettled. General uneasiness was felt as to how far the French occupation of the Ruhr, with its possible complications, might affect her position. The visit of Marshal Foch to Warsaw in the summer aroused a fear that Poland might be committing herself to secret military alliance; the French loan of 400,000,000 francs for purchase of material of war in France was regarded with suspicion as pointing in the same direction. The Polish mark was affected by the collapse of the German currency, falling in sympathy with it. M. Grabski was unable to put through the reforms which he desired, and the other Ministers of Finance proved quite unequal to the situation. Relations with Russia remained unsatisfactory, being especially troubled by the Soviet's persecution of Catholic priests. In the spring Witos secured a promise from the Right of more speedy execution of the land reform, and he became Premier on May 27 in alliance with the National Democrats.

The Left and the National Minorities showed considerable discontent, which was shared by Piłsudski, who had now been succeeded as Chief of the General Staff by Gen. Haller. Interest centered in the financial question; the mark sank in the autumn to nearly 1,000,000 to the pound sterling. There was serious industrial unrest in July and again in Oct.; but fortunately the harvests were again excellent. On Oct. 27 the Government took in two strong personalities from the Right, M. Korfanty and

M. Dmowski; but the finances were not reformed, the peasant parties were discontented, and the Government resigned on Dec. 11. On Dec. 19 a non-party Government was formed under M. Grabski, Poland's most able finance minister. The political parties agreed to subordinate all other problems to those of financial reconstruction. M. Grabski, who had received valuable advice from a British financial mission under Mr. Hilton Young, asked for emergency powers, which were granted him on Jan. 3 1924. He was now able in an astonishingly short time to stabilise the currency and balance the budget and the financial problem occupied the chief attention of the country throughout 1924.

The consolidation of the Polish debt to America (Nov. 14 1924) and to Great Britain (Dec. 10 1924) marked a political as well as a financial advance. A commercial treaty with Great Britain had already been concluded (Nov. 26 1923) and one with the United States was concluded provisionally on Feb. 10 1925. Among other agreements concluded by Poland may be mentioned a commercial treaty (May 12 1922), a special commercial agreement (Jan. 21 1923) and an emigration convention (May 1924) with Italy; a convention regarding option and nationality with Germany (Aug. 30 1924).

The Polish Concordat.—An agreement of great interest was the Concordat reached with the Holy See on Feb. 10 1925. It should be remembered that Pope Pius XI. before his ascension of the Holy See, had been Papal Nuncio in Poland. The Concordat differs materially from any other similar arrangement. The Catholic Church is granted an absolute freedom of execution of her authority and jurisdiction in Poland; the assistance and support of the State being assured her in this respect. The States' interests in connection with nominations for the higher ecclesiastical posts are adequately protected. In religious education, the competencies of Church and State are exactly defined. The division of Poland into ecclesiastical provinces is carried out in such a way that no portion of Polish territory remains subject to the jurisdiction of a bishop residing outside the borders of the State. In this connection must be mentioned the establishment of an autocephalic Orthodox church in Poland, which received the blessing of the Synod and of the Oecumenical Patriarchate in Constantinople on Nov. 11 1924. The political importance of the religious question in Poland can hardly be over-estimated. Religious differences have always been far more important than racial in dividing Poles and Russians, Poles and Ruthenes, Poles and Jews, and even Poles and Germans. It was largely owing to the religious bond with clerical circles in Vienna that the lot of Galician Poles in Austria was happy. To some extent Catholic Poland to-day has entered into the succession of the Holy Roman Empire and the Catholic interest is one of her chief supports in her struggle with Russia.

The Problem of Security.—Meanwhile the question of security, in all its forms of guarantee of security, arbitration and limitation of armaments was beginning to succeed that of reparations as the chief European problem, and Poland, whose interest in the latter question had been secondary, found herself one of the parties most directly concerned in the deliberations of the Powers and of the League of Nations. Simultaneously, her position with regard to the League changed. The 29th session of the Council of the League (June 17 1924) was the first at which there was no Polish question on the agenda of the meeting; hitherto Poland had only too regularly occupied the attention of the representatives of the Powers as plaintiff or defendant in wearisome frontier disputes.

Count Skrzynski, who became Poland's Foreign Minister for the second time in Aug. 1924, took an active part in the work of the Fifth Assembly of the League (Sept. 1924). The Polish delegation maintained that the performance of a mutual guarantee pact,which would facilitate the application of Articles 10 and 16 of the Covenant, could alone secure disarmament in accordance with Article 16; and spared no effort to co-ordinate the opposing views and to assist in the drafting of the Geneva Protocol. The Protocol, which embodied all three aspects of the problem of security, was in complete agreement with the Polish thesis.

The rejection of the Geneva Protocol by Great Britain in 1925 alarmed Polish opinion. The original German proposals made to France in the spring of 1925 treated the problems of Germany's western and eastern frontiers separately. In Poland it was feared that a system of regional pacts by which Germany guaranteed her western frontier alone might endanger the integrity of Poland's western frontier. Poland contended that the question of security in Western Europe was inseparably connected with that of the stability of frontiers in the East, and that the conclusion of agreements guaranteeing Germany's western frontiers could not in any case create a state of uncertainty in respect of her Eastern frontiers, as both were established by the Treaty of Versailles and any new agreements would have to be in strict accordance with the Peace Treaties and with the existing alliances. In March the Seym passed a resolution protesting against any tampering with Poland's frontiers. The Slav minorities did not join this protest, although expressing themselves in favour of Poland's present western frontier. They were clearly living in hopes that the question of East Galicia would be reopened at some future date.

Poland's relations with Germany were further troubled, firstly by the breakdown of negotiations for a commercial treaty, followed by a tariff war, secondly by a failure of the arrangements to receive the German natives of Poland who had not opted for Polish nationality, whom the Polish Govt. called upon to leave Poland on or before July 31 1925. The question of Danzig, moreover, was a perennial cause of friction. Its economic importance for Poland, its racial and historical bonds with Germany, were never forgotten by either party. These considerations, as well as the continued friction with Russia, were a prime factor in drawing Poland and Czechoslovakia closer together. On May 6 1924 a Polish-Czechoslovak conference in Cracow had finally regulated the Jaworžna dispute; and on April 23 1925 the two countries signed a treaty of arbitration, a commercial treaty and an agreement which settled certain outstanding points of dispute. Although Poland still remained outside the Little Entente, the position of the Slav bloc along Germany's eastern frontier was greatly strengthened, and it was obvious that in future the countries composing this bloc would act in greater accord than previously.

The Locarno pact (*see* SECURITY) signed on Dec. 1 1925 brought forward a fresh solution to the problem of Poland's security. Poland and Germany signed an arbitration treaty which included in its preamble the recognition of the inviolability of the existing treaties, the recognition of the integrity of each contracting party's rights, and the elimination of war as a means of settlement of disputes and conflicts. In a separate treaty of guarantee between France and Poland, France is referred to as the guarantor of the Polish-German arbitration agreement. France undertook in the case of an unprovoked attack by Germany against Poland to abandon no means of assistance at her disposal and within the limits of the Covenant and of the political agreements with Poland.[1]

Polish opinion was not easily reconciled to the idea of the Locarno pact. The arrangements were accepted, but there was some feeling that Poland was being abandoned by France which even brought about a temporary rapprochement with Soviet Russia. M. Chicherin, the Russian Commissar for Foreign Affairs, visited Warsaw Sept. 26–30 1925, but the visit did not, apparently, result in any concrete revision of the policy of either country. At the same time, Poland was unfortunate in losing

[1] A project for disarmament submitted to the Conference of Poland and the Baltic States held in Moscow on Nov. 30 1922 had already been rejected by these States on the ground that the plan, if adopted would secure Russia a military predominance without providing adequate political or moral guarantees to the other contracting parties. On this occasion the absence of Russia from the Conference created a great difficulty, as the acceptance of the decisions of the Conference by Russia's neighbours would place them at an obvious disadvantage towards Russia who remained free from any international obligations. The Polish delegation accordingly brought forward a clause, which was adopted, exempting the countries referred to from the duty of registering and publishing figures concerning their traffic in arms until Russia had signified her access to the Convention. A further protocol brought forward by the Polish delegation, condemning chemical and bacteriological warfare, was also adopted by the Conference. At a conference held at Riga (July 9–11 1923) the four Baltic States (not including Russia) agreed to support disarmament proposals at Genoa if accompanied by a general treaty of neutral guarantee.

M. Grabski, who resigned on Nov. 13 in consequence of a disagreement with the Bank of Poland. The zloty fell to an alarming degree, and it seemed clear that Poland's financial troubles were, after all, not over. On Nov. 20 M. Skrzynski formed a new coalition Cabinet, but was obliged to admit that the financial and economic state of the country was serious, the treasury was almost empty, the shortage of private capital was very great, and unemployment was increasing rapidly.

The year 1926 opened amid considerable friction between the Right and the Left. The coalition Government maintained itself throughout the winter, but the steady fall of the zloty aroused great dissatisfaction, and controversy arose as to who should bear the brunt of the retrenchments which were obviously indispensable. The Socialists demanded a large programme of public works to relieve unemployment, and a rise in salaries for the lower branches of the civil service, while refusing to admit a reduction in the number of railway employees. They proposed to make their economies on the army budget. The Right desired a reduction of civilian expenditure, while maintaining the army at full strength. This dispute affected the whole life of the country. The Left rallied round Marshal Piłsudski who was still a popular hero in his retirement, and he opened a series of devastating criticisms on the army, its conduct and its influence on national policy.

There was a fresh frontier " affair " with Lithuania in March, which followed closely on a more serious incident in which Germany was concerned, a large German espionage organisation in Poland being discovered. Public opinion in Poland grew more excited and alarmed than ever. On March 2 the Seym ratified the Locarno Treaties, but there was a strong feeling that the security which they afforded Poland was inadequate. This feeling found expression when the League of Nations met later in the month to elect Germany a permanent member of the Council and put the Locarno pact into operation. The Polish delegates insisted on Poland's right to a permanent seat on the Council. They afterwards withdrew their claim, but other countries made similar demands, and the admission of Germany had to be postponed.

There were signs after this that Poland was working to form an Eastern European bloc in conjunction with the Little Entente and possibly Italy. The treaty with Rumania was renewed on March 26 in the altered form of a guarantee pact, each party guaranteeing the political independence and territorial integrity of the other and pledging itself to immediate aid and assistance in case of unprovoked aggression.[1] On April 14 Count Skrzynski, on a visit to Prague, signed an arbitration treaty with Czechoslovakia, the details of which were kept secret, but which was stated by Dr. Benesh to be " much more than an arbitration treaty . . . an expressive symbol of definite politics," while Count Skrzynski declared that " here in Central Europe a Slav bloc has been created." Secondly, a treaty of ratification was signed, which cleared away certain outstanding points of disagreement. From Prague Count Skrzynski proceeded to Vienna, where a new treaty of arbitration was signed(April 15 1926) between Poland and Austria.

Marshal Piłsudski's Coup d'état.—Meanwhile, however, internal dissensions had become acute while the news of the conclusion of the second Russo-German treaty (*see* GERMANY) increased the general nervousness. Gen. Szepticki, chief of the army inspectorate at Cracow, whom Marshal Piłsudski had been attacking with particular vehemence, resigned his post, publishing his reasons for doing so. The adherents and opponents of Pilsudski now formed two definite, opposing camps in the army. The quarrel between the Marshal and the Parties of the Right was of no new date. It was largely owing to fear of Piłsudski's possible excessive influence that the Polish Constitution had been framed to allow the legislature an excessive power by comparison with the executive. Piłsudski had since been gradually edged out of power, and was now in retirement pending his appointment as inspector-general and commander-in-chief in time of war. The Right, however, desired to frame the bill containing this appointment in such a way as to bring the army under the direct control of Parliament, while Piłsudski insisted on independence from the Ministry of War. At the same time the discussions on the budget commenced. The Minister of Finance proved unable to reconcile the opposing claims of the Right and the Left. The Socialist ministers of the Cabinet resigned; on April 21 Count Skrzynski himself resigned in consequence. At the request of the President, Skrzynski resumed power with a rump Cabinet of the Right to pass the monthly budget. Three fruitless weeks were passed in the endeavour to form a reasonable parliamentary majority, till on May 11 M. Witos, the peasant leader, succeeded in forming a ministry.

This solution evoked considerable dissatisfaction. Both sides were weary of the futile parliamentary struggle, and it was rumoured that M. Witos proposed to cut the knot by establishing a dictatorship of the Right, supported by the Polish nationalist circles and Fascist organisations. Above all, Witos proposed to pass through the disputed Army bill, for which Count Skrzynski had been unwilling to assume responsibility. On May 12 Piłsudski, whose following was growing from day to day, suddenly attacked Warsaw at the head of the troops which espoused his cause. The Government prepared to resist, proclaimed Piłsudski a rebel, and summoned its own adherents in the army to Warsaw. Throughout May 13 and 14 there was heavy fighting in the streets of Warsaw, in which at least 200 persons appear to have lost their lives. On May 14 the Social Democratic party proclaimed the general strike in Warsaw and certain other Polish towns. The Government's troops were unable to come up, and by May 15 Pilsudski won a definite victory. The Government and the President of the Republic resigned, and M. Rataj, Marshal of the Seym, became acting head of the State, in accordance with the terms of the Polish constitution. A non-party Cabinet was formed, pending the election of a new President. The troops which had supported M. Witos returned to their garrison, and by May 17 most of the country was quiet. The new Government proclaimed " the moral regeneration of the nation" as against " individual and party sectionalism." Piłsudski was elected President but at the beginning of June 1926 refused the office in favour of his nominee, Professor Ignacz Mosiecki. He remained, however, the dictator of the country. (J. GRA.)

CONSTITUTION

Poland is a Republic. The legislative power is vested in a diet (Seym) and a senate, which are summoned, adjourned and dissolved, but not without their own consent, by the President. The Diet is composed of paid members elected for five years, upon a system of proportional representation. Suffrage is universal, all who enjoy full civic rights and who are over 21 being qualified to vote, but, since voting is personal, soldiers on active service are excluded. Citizens over 25 are eligible for election to the Diet; members of the civil service cannot be elected for the district in which they hold office. The minimum age for voting in senatorial elections is 30, whilst no one under 40 is eligible for election.

Bills go to the Senate after being passed by the Diet and if no objection is raised within 30 days the bill becomes law. Amendments suggested by the Senate are considered and voted on by the Diet, which can override them by a majority of eleven-twentieths. The budget is fixed each year for the following year; taxes and customs duties can be established only by law and a supreme court of control superintends the management of state finance.

The executive power is exercised by the President and a Council of Ministers who are responsible for his official actions. He is elected for seven years by the National Assembly, that is, the Diet and Senate acting together. Laws are to be signed by him and by the President of the Council and the Minister concerned. The President has the supreme power in the army, except in time of war, when the Minister for War is responsible for all military affairs. The President can declare war and make peace only with the consent of the Diet. He has the right of pardon.

[1] Rumania forms the centre of Polish interests in the Balkans, partly because of their common frontier with potential importance of Rumanian ports as an outlet for Polish trade.

For purposes of administration Poland is to be divided into palatinates, districts and urban and rural communes, these forming the units of local government. Economic autonomy is established by means of chambers of agriculture, commerce, industry, etc., which will together form the Supreme Economic Chamber of the Republic, the competence of which required further legislation. The control over the whole administration is vested in Administrative Courts headed by the Supreme Administrative Tribunal. Judges are nominated by the President, whilst justices of the peace are popularly elected. Judges can be removed from office only in certain legal cases and following a judicial decision. A united code for justice, both civil and criminal, had not been fully completed in 1924, and the Russian, German and Austrian codes, together with certain Polish regulations, were still in force in various parts of the country. All citizens are equal in the eyes of the law, protection of life, liberty and property being assured to all inhabitants. State protection is given to labour and insurance for unemployment, illness and accident is guaranteed. Roman Catholicism is the recognised religion of the country but others are allowed provided they are in accordance with the law.

Land must be cultivated from the point of view of public utility. The law is to decide to what extent citizens and independent associations may cultivate the land and exploit its mineral wealth, and in what cases the State may repurchase property to improve the value of its production. (C. A. M.)

BIBLIOGRAPHY.—Dr. J. Grzymala-Grabowiecki of the Polish Foreign Office kindly supplied a detailed and valuable account of Poland's foreign relations since 1919, large portions of which are incorporated in the above article. Literature on modern Poland is extremely scanty. The following may be quoted: Prof. W. A. Phillips, *Poland* (Home University Library, N. D.); L. Bernhard, *Die Polenfrage* (Leipzig, 1910); J. Moraczewski, *Zarys sprawy polskiej w obecnej wojnie* (Lausanne, 1915); J. Rosner, *W krytycznej chwili* (Vienna, 1916); W. Feldman, *Geschichte der politischen Ideen in Polen* (Munich, 1917); I Daszynski, *Cztery lata wojny* (Cracow, 1918); O. Czernin, *Im Weltkriege* (Berlin, 1919); *Constitution de la République de Pologne du 17 mars 1921* (Warsaw, 1921); *Mémoire sur le traité de Riga* (Paris, 1921); B. Winiarski, *Les institutions politiques en Pologne au XIXe siècle* (Paris, 1921); A. Skrzynski, *Poland and Peace* (London, 1923); *The Polish Handbook, 1925* (London, 1925).

II. DEFENCE

Man-Power.—Military service is obligatory for all male subjects of the Polish State between the ages of 21 and 50. On general mobilisation men of 19 and 20 are also liable. The terms of service are: in the active army, two years from 21 to 23; in the reserve, 17 years from 24 to 40; and for the *levée en masse*, 10 years from 41 to 50. Officers and other ranks on the reserve are called out from time to time for refresher training. There is no training for the *levée en masse*.

The annual class is calculated to produce an average of 160,000 conscripts, of whom about 110,000 are fit for general service. The total mobilisable man-power may be summarised as follows: permanent cadre, 50,000; two serving contingents, 220,000; reserves (men up to 40 years of age and men of 19 and 20 who are liable to be called up), 2,155,000; *levée en masse* (10 classes at an average of 80,000 each), 800,000; making a total of 3,225,000. From this total must be deducted all men who would be retained in civilian life on those works that are regarded as of national importance.

Army Organisation.—In peace time the army is organised into the following units: 30 divisions of infantry, of three regiments each; 4 divisions of cavalry, of three brigades of two regiments each; 5 independent cavalry brigades of three regiments each (one brigade has four regiments); 30 regiments of field artillery; 10 regiments of heavy field artillery; 10 divisions of horse artillery; 2 regiments of mountain artillery; 1 regiment of super-heavy artillery; 1 regiment and 10 independent batteries of anti-aircraft artillery; 4 companies of foot artillery; 1 tank regiment; 10 engineer regiments and 6 aviation regiments. There is the normal complement of army and divisional troops. The total establishment of the army is about 270,000 all ranks. In war it is estimated that Poland could mobilise and equip an army of about 1,000,000 men. Of these some 40% would be required for lines of communication troops and services, leaving a field army of 480,000 all ranks.

Recruiting Organisation.—Poland is divided into recruiting areas which are subdivided into recruiting districts. The civil authorities of each recruiting district keep a register, and summon each class annually to appear before a recruiting commission which is a mixed civil and military board. Those passed fit for general service are posted to units but remain on leave until actually ordered to join, usually in Oct. of each year. In each recruiting area a revision commission is set up to deal with appeals against the decision of the recruiting commission in cases where grounds for appeal are shown to exist. Exemptions from service are granted in certain cases, *e.g.*, on religious and compassionate grounds, etc.

Administration.—The country is divided into 10 administrative districts, each under a general officer commanding, who is responsible for the administration and mobilisation arrangements of his district. The 10 districts are grouped into five army inspectorates. Army inspectors are responsible under the Minister of War for the training and efficiency of the troops in their inspectorates. The headquarters of districts are as follows: Warsaw, Lublin, Grodno, Łódź, Cracow, Lwow (Lemberg), Poznan, Toruń, Brześć and Przemysl. The headquarters of inspectorates are as follows: (1) Wilno (Vilna), No. 3 and 9 districts; (2) Warsaw, No. 1 and 10 districts; (3) Toruń, Nos. 7 and 8 districts; (4) Cracow, No. 4 and 5 districts and (5) Lwów, No. 2 and 6 districts.

The Higher Command.—The President of the Republic, as head of the executive, is the supreme chief of the army. He grants commissions, makes appointments to commands from divisional commanders upwards, awards promotion and confirms retirements. For other matters he delegates his authority to the Minister of War. The Great War Council is an advisory council on important military questions. It consists of the members of the Cabinet and the highest military authorities. It is summoned as required, and is presided over by the President of the Republic. The Small War Council sits permanently. It consists of the Minister of War, the army inspectors, the inspectors of artillery and cavalry, the chiefs and sub-chiefs of the general administrative staffs and other members co-opted for special business. It is the executive organ for the preparation of military operations; its decisions on these matters are obligatory on the Minister of War.

The Minister of War is the governing authority in all matters connected with the army, including training, armament, supply, recruiting, etc. Considerable powers are delegated to army inspectors and general officers commanding military districts, who thus act as the executive medium through which is carried out the policy laid down by the Minister of War. The Ministry is divided into three branches: General Staff, Administrative Branch and Army Control Branch (finance). A draft bill for the appointment of an inspector-general was under consideration in 1921. It is intended that this office shall carry the power of practically complete control over military affairs while remaining nominally responsible to the Minister of War. In time of war the inspector-general would become commander-in-chief. The general staff is organised in five bureaux: organisation, intelligence, instruction, communication, personnel.

Armament.—The armament of the army is not yet homogeneous, though a scheme for introducing similarity of weapons is being carried out gradually.

As regards rifles, the French Lebel, Austrian Mannlicher and German Mauser are in use. The latter is being adopted as the universal pattern and its manufacture has been started locally.

The light machine-guns are the French Chauchat, German Bergmann and the Lewis gun. These types are to be replaced by a Browning automatic rifle firing Mauser ammunition. The manufacture of this gun is to be undertaken in Poland. Heavy machine-guns in use are the Maxim, Hotchkiss and Schwarzlos. The Hotchkiss firing Mauser ammunition is to be generally adopted and manufactured locally. The field-gun is the French 75 mm.; the field howitzer, the 100 mm. Skoda. The horse-artillery gun is a 3-inch Russian field-gun, but it is proposed to reline this weapon to take the same ammunition as the 75 mm. gun. The mountain gun is the French 67 millimeter. The heavy field artillery is armed with a 105 mm. gun and the 155 mm. Schneider howitzer. The heaviest field artillery has a 120 mm. gun.

The cavalry is armed with sword and carbine, while the front rank of line troops carries a lance. The carbine is to be standardised to take Mauser ammunition.

Frontier Guard.—A somewhat novel body has been created in Poland called the Corps of Frontier Guards. The Corps is organised on a military footing and consists mainly of volunteers from the regular army, the establishments being completed by conscripts when necessary. Its strength is about 25,000 all ranks, organised in 6 brigades subdivided into battalions and squadrons. The headquarters are at Warsaw, and the units distributed along the whole length of the Lithuanian, Latvian and Soviet frontiers. Its duties are the protection of the country from armed raids and banditry, the prevention of smuggling and the closing of the frontier to unauthorised individuals, propaganda, etc.

Navy.—The navy also comes under the orders of the Minister of War. A special department exists in the Ministry supervised by an admiral with a staff of some 30 officers. The total establishment is 2,350 all ranks, of whom 570 are on a long service engagement. The sea-going fleet consists of a division of six torpedo boats; a training division of two gunboats and four mine-laying trawlers; a hydroplane division, and the naval port of Gdynia, including the land defences. A programme of naval expansion is under consideration, and will probably be put in hand as soon as the financial situation permits. The river fleet consists of the Vistula Flotilla and the Pinsk Flotilla; there are in all four monitors, six river gunboats, 25 motor boats and some other small craft.

Air Force.—The Polish air force is part of the army, and is under the Ministry of War, a special department being concerned solely with aviation. The strength of the air force is about 700 officers and N.C.O. pilots. The full establishment, which will not be reached before 1928, allows for 12 regiments of aviation with a total of 580 machines. At present six regiments only have been formed. In time of war the regimental organisation is abolished and divisions of aeroplanes are allotted to formations as required.

Discipline and Morale.—Discipline in the army is, generally speaking, good, relations between officers and men being on a satisfactory basis. The tendency of senior officers to dabble in politics and criticise each other in the Press is an adverse factor which should be eradicated in time. As regards morale, the strong points are the intense patriotism of the Poles and the increasing efforts of officers to study the men's welfare and provide recreation. On the other hand the army contains a considerable non-Polish element and barracks are often bad. On the whole the weak points are being attended to and morale is being steadily raised. The lower ranks work hard and apply themselves to learning.

Tactical Efficiency.—Since 1919 the army has had a large French military mission as instructors, with the result that there now exists a considerable number of well trained staff and regimental officers. The Polish Army compares well with any but the highest Western standards. The general obstacle to progress is the lack of money. Until the economic situation improves, the army must continue to suffer from shortage of material, curtailed programmes of training and inferior barrack accommodation. (A. P. W.)

III. ECONOMIC AND FINANCIAL HISTORY

Population and Resources.—The area of Polish territory after the final determination of the frontiers is 149,895 sq. m., with a population numbered at 27,192,674 on Sept. 30 1921, and estimated at 28,896,000 on Jan. 1 1925. Sixty-five per cent of the population live on the land, and the wonderful soil, the vigour of the peasantry and the proximity of big industrial markets offer the certainty of prosperity on the condition of good management.

But the economic organisation of this territory by a political unit was kept in suspense after 1918 until some definite basis could be created both for external and internal relations. In foreign affairs the essential preliminary of defined frontiers was not obtained until the defeat of the Bolshevik armies in Aug. 1920 had been crowned by the peace of Riga (March 1921), and not put beyond question until Polish Upper Silesia was taken over in July 1922.

At home a constitution and administration had to be created in the midst of the war with the Bolsheviks and the damages of the World War repaired. Practically, Poland started her career nearly three years after her neighbours, handicapped by a scarcity of able men, a mediocre administration and the inherited hostility of her people to all governments.

Agriculture, Forestry and Related Industries.—The devastation and dislocation of the War delayed the recovery of agricultural production until 1922–3. In 1919 considerable quantities of cereals were imported. Even in 1920 the crops (except potatoes) averaged only about 30% of a good pre-War year. The industry and thrift of the Polish farmer brought about a progressive improvement by 1921–2. Imports of fertilisers, implements and machinery rapidly increased, the worst ravages of the War were repaired, and co-operative marketing made considerable progress. Both area under cultivation and yield per acre show a marked advance. The excellent harvest of 1923 enabled Poland to export cereals, out of crops which are given as:—

	Production in Metric Tons	Area in Hectares
Rye	5,962,000	4,644,768
Wheat	1,354,000	1,017,365
Barley	1,656,000	1,199,457
Oats	3,522,000	2,515,076
Potatoes	26,494,000	2,279,219
Beet	2,081,000	108,729

The most immediately advantageous crop has been sugar beet, exports rising from 40,000 tons of sugar in 1921–2 to 190,000 tons in 1924–5. This industry is highly organised, both in labour (the men work in the fields in the summer and in the factories in winter), in supplying and in marketing. At an early date it established connections in London and obtained credits, exporting sugar and importing fertilisers and machinery. It has steadily consolidated its reputation and increased its operations.

In 1919 some damage had been done to the forests by foreign Governments, machinery was lacking and in many areas the methods of exploitation were primitive. The chief difficulty was inadequate transport. The forests were nationalised in 1919. About one-third are worked by the State and the rest are State-controlled. Exports are chiefly and increasingly boards, sleepers and other half-finished articles.

Mining and Metallurgy.—Petroleum mining in Galicia had been encouraged by the Germans during the War, but the difficulties of production have increased as it is now necessary in many cases to sink wells to low levels. Petrol production is under Government control, intended to ensure cheap oil for the population, but disadvantageous to the mines. The Government's practice of paying for oil many months after it was piped caused serious financial and labour difficulties during the inflation period. Lack of capital for exploiting the deeper mines and restrictions on export have been additional causes of difficulty. Production remains round about half the pre-War level. Exports of petroleum products are growing at the expense of home consumption.

Other industries of importance, depending on minerals, are cement, glass and salt (Government-owned). Efforts are being made to develop the construction of locomotives, aeroplanes and machines of all kinds, largely by customs protection aimed at increasing Poland's metallurgical development for both economic and military motives. These efforts have met with but moderate success.

The coal-mines of Dombrowa, Cracow and Teschen were favoured from the beginning by the Polish Govt., which facilitated the renovation of damaged plant and purchase of new equipment. The mines had an abundant supply of inexpensive labour, and thus made rapid progress. It is claimed that their output had passed the pre-War level by the end of 1922. The Upper Silesian area, added in that year, surpasses the rest in

area and quality. Poland now ranks after Germany and Great Britain as the third coal-producing country of Europe. Lignite is of little importance. The Ruhr occupation increased the German demand for Polish coal in 1923, but in 1924 the "stabilisation crisis" and the world-wide shrinkage in the demand for coal began to restrict production, which by the middle of 1925 had fallen to about 75% of the pre-War figures.

Industry.—Apart from the industries already mentioned, and the important textile manufactures, the industries are not large and work chiefly for the home market. There is a general shortage of both working and fixed capital, due to a century of poverty and foreign exploitation, to the financial troubles of the last few years, and to the inability of Poland to attract foreign capital in large amounts. Labour, more particularly clerical labour, is not of very high quality. The bulk of the clerks still count on the *abacus*. The reserve of skilled artisans capable of producing highly finished articles is small. As the industries produce little for export they are dependent on the home market, where the standard of living of the bulk of the population is low and the demand liable to fluctuation according to the harvests.

The textile industries are distinguished from other Polish manufactures by their size, and by the vigour and ability of their leadership. In 1919 the mills found themselves despoiled of the great bulk of their machinery, equipment and raw materials, in debt for pre-War supplies, and deprived of the Russian market which had taken 75% of their output before 1914. Making arrangements for their pre-War debts, they were able to obtain certain credits for the purchase of machinery and cotton. Wool came from the British Govt., financed out of relief credits. The remaining machinery was reassembled, and manufacture was thus able to make an early start. It found a great demand in the home market, depleted by eight years of war, and made rapid progress. Russia, officially closed, took fair quantities surreptitiously. Other foreign markets, notably Rumania, presented themselves. By 1921 production of cotton stood at 60% of the pre-War figure, and by the end of 1922 the pre-War figure was passed. In the home market Lódz sold at prices generally above the level of prices abroad (partly to provide insurance against depreciation of currency). From an early date the textile industry had direct access to the state bank for its credits, and individual firms were thus able to protect themselves to some extent against fluctuations of the exchanges. In the last stages of inflation in 1923 considerable depression set in, and this was intensified by the financial reform of 1924. Foreign credits revived the cotton and woollen industries in the autumn of that year, but the acute credit crisis of 1925 brought the industries into difficulties.

Communications.—From her own resources Poland could do little to equip her railways, as the repairing shops in the Russian provinces were almost completely destroyed. Her greatest deficiency—rolling stock—was largely made good by considerable allocations from Germany and Austria. A large quantity still had to be purchased abroad; repairing works had to be constructed, shunting stations installed. Works for manufacturing locomotives and railway coaches were created, and the immense damage in the eastern districts to bridges, stations, warehouses, etc., has been made good in large measure. The former Russian lines have been adapted to the narrower gauge.

The greatest technical problem was the adaptation to the new directions of trade. From being strategic lines and channels of exploitation leading to St. Petersburg, Vienna and the German centres, the systems had now to provide abundant communication with Danzig and (later) Upper Silesia. Equally serious were the difficulties of administration—first in replacing the German employees in the former German areas, and then the more enduring difficulty of training a personnel. The superabundance of untrained hands introduced, under Socialist influence, the eight-hour day, the special passes for Government employees augmented at the same time the working difficulties and the deficit. But great and rapid progress was made. The American railway mission gave valuable advice, and enabled Poland to avoid many of the mistakes made by other European countries. By the end of 1923 the technical condition of the railways would compare most favourably with that of almost any European system. But the charges, in consequence of depreciation of the mark, were too low, and the deficit on the railways was one of the chief causes of the deficit in the budget. Early in 1924 the railways were made autonomous. A gold loan, guaranteed on the receipts of the Galician railways, provided them with some working capital. Fares and rates were increased, and economies on the administration finally enabled the railways to show a surplus even in 1924, which has been maintained.

The long and numerous waterways are the natural means of transport for much of Polish traffic, but repairs to the banks, dredging and other work is sorely needed. Capital and organisation have been lacking, however, and little has been done.

Labour and Social Questions.—Social questions in Poland cannot be measured by the standards applied in countries further west. The differences in the standards of life and in the habits of the people (*e.g.*, in the part played by religion) makes statistics peculiarly hard to interpret. This is notably the case for figures of industrial unemployment. Most of the 30% of the population who are not employed in or about agriculture still retain family connections with the land and are accustomed to return there in any time of stress. In consequence there is an unusual "elasticity of supply" in Polish industrial labour. Since the War this situation is seriously complicated by the great increase of the population. Poland is now deprived of her two great *débouchés*—the United States, which absorbed 100,000 workers yearly; and German agriculture, which took as many as 1,000,000 persons in the season. The population has been increased by expulsions from Russia, whilst the rate of annual growth is perhaps the highest in Europe.

Under Socialist influence, room has been found for much unskilled labour in the railways and other Government services, thereby hampering the efficiency of these young administrations and increasing the deficit in the state budget. Trade union policy has maintained the extremely large number of public holidays, extended the practice of the eight-hour day, and increased the number of men on the pay-roll of industry. The ability of Polish industry to compete with foreign, and especially German, industry has been very much restricted, and Polish finances have suffered. Other factors depress the standard of comfort, notably the housing shortage, which with Poland's expanding population is perhaps more intense than anywhere in Europe. The repair of about 60% of the War damage has done something to relieve the agricultural areas (until 1921 hundreds of thousands of people lived in holes in the ground), but in the towns no family may by law retain for its own use more rooms than its own number plus one.

As a political force Communism is spent, killed by Polish patriotism and the Bolshevik war. But Socialism of the Marxian type is important both in politics and in trade unionism. In the latter it has combined with economic forces to restrict output and promote unrest and strikes, which have been very frequent. In 1925, however, in many industries, notably in Upper Silesia, under the stress of "stabilisation" and German competition, the hours and efficiency of labour have been increased. A number of statutes for the protection of the workers against accident, illness, old age and unemployment have been passed. In this, as in some other fields, there is a difference between Polish law and Polish practice.

Trade in Poland is conspicuous for the large proportion of middlemen, some of whom fulfil no economic purpose. Of them a large number are Jews, who form 10% of the populace of Poland and 30% in Warsaw. They arouse much popular prejudice, and are one of many causes which give to economic and social affairs a more emotional and less calculable quality than is common further west.

Foreign Trade Relations.—The political framework of Poland's foreign trade has been but recently shaped and is not yet complete. Though commercial agreements with Czechoslovakia and Rumania were made in 1921, and with Austria, Yugoslavia, Switzerland, France, Italy and Japan in 1922, this list excludes both Poland's chief customer and her largest neighbour, and the agreements themselves were of a primitive kind. During the period of inflation, prohibitions both of export and import were common, but with the stabilisation of the currency and some years of experience the way was open for the introduction of a new customs tariff which was instituted in 1924. In it the needs of the national finances, which had hitherto been almost

completely neglected, also obtained some recognition, although in a country so predominantly agricultural as Poland the customs duties must be one of the foundations of the national revenue. Poland suffers from exceptional difficulties in the administration of her customs revenue, due to the length of her frontiers and their lack of natural protection. Danzig is now included in the Polish customs tariff and organisation. The attempts to make a commercial agreement with Germany led in 1925 to profound disagreement, the reimposition of the system of prohibitions and an overturning of Poland's trade balance.

Too much reliance cannot be placed on statistics of foreign trade, especially during the inflation period. The years 1920–1 were disastrous ones. Devastation, disorganisation and the Bolshevik war reduced exports to perhaps 10% of the value of imports, which included large amounts of American grain financed by the Allies out of relief credits. By 1922 the worst was over. By June of that year, excluding trade with Russia and through Danzig, exports were estimated at 50% of imports, and in 1923 that exports of commodities probably equalled imports in value, while the total foreign trade increased by a fair amount. In addition, considerable sums were received annually in remittances from Poles in America and small amounts from Poles working in the devastated regions of France, the total probably averaging about $32,000,000 per annum, or 12% of the total imports.

Political changes have not greatly affected the main currents of Poland's foreign trade. Estimates of percentages differ, but about half of both exports and imports are German, and important amounts (*e.g.*, of American cotton) come through Germany. The bulk of the remainder is with Poland's neighbours, notably Rumania and Austria. Great Britain takes about 7% of both imports and exports. The part played by Russia is much less than pre-War. Nor has the nature of the trade undergone much change. The exports are chiefly (*a*) cereals, dairy produce, timber, sugar and flax; (*b*) coal, iron, steel, petrol and chemicals from the mining areas; and (*c*) textiles. The imports are (*a*) fertilisers and agricultural machinery and equipment; (*b*) machinery and raw materials for the industrial areas; and (*c*) fish, cocoa, fats and other foodstuffs not produced at home.

Thus by the end of 1923 Poland was settling down to a somewhat badly organised foreign trade with a value of about £50,000,000 a year, vulnerable especially on the German side. The reform of 1924 administered a serious shock to foreign trade. Exports were rapidly surpassed in value by imports, though their total value did not diminish. But the bad harvest of 1924–5, the coal crisis and difficulties with Germany gravely aggravated the situation. Some recovery, however, appears in the autumn figures, and much was expected from the good harvest of 1925–6.

Banking and Credit.—At an early date the Polish banks (which had not been very strong before the War) locked up their resources in industry to a very great extent. Weakened alike by this immobilisation, by the continual decrease in the gold value of deposits resulting from inflation and by their lack of co-operation, they failed to exercise on the Government's financial policy the influence which they should have brought to bear. Such an influence was all the more necessary because of the frequent changes in the Ministry of Finance. The shaping of policy thus fell to far too great an extent into the hands of the State Loan Bank, the officials and the politicians. By 1924 the State Loan Bank had taken to itself the bulk of the business of discounting bills which would under normal conditions be transacted by commercial banks.

With the stabilisation of the currency the banks resumed something of their true importance. Some of the weaker banks disappeared. Some Government banks were amalgamated. In general, deposits increased continuously and with them discounts and advances. But interest and charges were heavy; the much-needed reforms of administration and co-operation made slow progress, and the banking system was not fully able to meet the strain of 1925. In that year it became increasingly difficult to collect inland bills, nor had the banks enough foreign resources to face the exchange difficulties without shrinking.

Currency and Exchange.—Much agricultural business was done by various forms of barter. Considerable quantities (for Poland) of foreign currencies were in use, especially dollar bills, which the Polish emigrant had familiarised in the remotest villages, but no satisfactory estimates of the amount are available.

Figures of the issue of notes are as follows:—

Date	Circulation in millions of marks	Equivalent in thousands of dollars	Equivalent per head of population in dollars
Dec. 31 1918	1,024	113,812	4·38
Dec. 31 1919	5,316	48,275	1·45
Dec. 31 1920	49,361	83,664	3·11
Dec. 31 1921	229,538	78,542	2·87
Dec. 31 1922	793,437	44,575	1·60
Dec. 31 1923	125,371,955	19,666	0·69
Apr. 27 1924	570,697,550	61,697	2·13

These mark notes were issued by the Polska Krajowy Kasa Poscyczkowa, or P.K.K.P. (the state loan bank), a Government institution, whose dominant position in commercial banking was the special feature of Polish inflation. For its facilities it charged 7% per annum till 1923, although money generally commanded as much as 60% per annum. Its exchange regulations, though imperfectly administered, probably delayed the flight from the mark. This bank was subsequently merged in the National Bank.

Public Finance.—The rise in the tide of inflation overtook the Polish Treasury before it had learned to swim. Before Poland had even equipped herself with a constitution the mark had fallen to 800 to the dollar. No budget ever received the final approval of Parliament until the end of 1923, and a parliamentary system of national finance had still (1926) to be constructed.

The excessive instability of Poland's early Cabinets was a chief cause (after the war with the Bolsheviks) of her financial troubles. Another potent cause was the defective administration of the public services already mentioned. The direct financial losses from this cause were considerable.

The chief item in the expenditure was the army, which in 1921–2–3 required about one-half of the estimated or about the whole of the actual receipts from taxation, viz.: about 400,000,000 to 450,000,000 gold francs per annum (or about 12s. 6d. per head of population). This is not a large sum for a country with Poland's long, undefended land frontiers, on the morrow of invasion by Russia, and was not the true cause of the fall of the mark. A budget overbalanced by such an item is too small a budget, and in fact Polish taxation yielded far too little. The responsibility for this must be divided between the constantly changing governments, the weak administration and the citizens' century-old tradition of evading taxation.

In the autumn of 1921 M. Michalski succeeded in arresting the downward course of the mark and balancing the public accounts for a period of several months. His chief resource for this purpose was the *Danina* or extraordinary capital levy, and, skilfully employing the proceeds of this levy to maintain the exchanges steady, he was able to collect a large proportion of his taxes without their being frittered away by currency depreciation. From the Danina alone he collected 90% of its estimated yield.

The next event of importance in the succession of finance ministers was the Ministry of M. Grabski, who became Prime Minister and Minister of Finance in Dec. 1923.

The Financial Reform of 1924–5.—Grabski has claims to rank with Rasin as one of the great financial statesmen of the Continent since the War. The weakness which has lately overtaken the złoty should not obscure the great importance and high quality of his reforms, the credit for which must go in the main to Grabski himself and his immediate assistants.

Grabski's strategy may be summarised as: no foreign control, no parliamentary interference, the immediate "pegging" of the exchange, the introduction of a new currency on a gold exchange standard, and (concurrently if possible but, if not, then later) the balancing of the budget and, finally, the obtaining of certain resources abroad on the credit of the reforms thus executed. From the outset Grabski concentrated on the exchange problem, and within three weeks of receiving his full powers from Parliament he had completely arrested the decline of the mark. He achieved this result by arresting the printing press and declaring his readiness to sell exchange freely, risking the whole gold reserve of the Treasury, which amounted to only $2,500,000. This respite allowed progress to be made with the institution of the National Bank, and especially with the national budget.

The budget problems had been a little simplified at the end of the previous administration by the "valorisation" of the taxes on Jan. 1 1924 and by the institution of monthly estimates and accounts. The immediate necessity was more cash, and Grabski, like Michalski, had to take money where he could find it. The immediate balancing of the 1924 budget was secured essentially from two sources—by the anticipation of certain taxes, and by the reimposition of a Danina. This property tax, intended to produce 1,000 million gold fr. by three equal annual instalments, served its chief purpose by producing some 200 million fr. in 1924 and over 94 million fr. in the first four months. The other leading feature of the budget reform was the turning of the railways into a practically autonomous institution.

Some gold loans were floated on the home market with moderate success. A loan of 400,000,000 lire was obtained from Italian sources on the security of the tobacco monopoly.

By these means, before the summer of 1924, the budget was rendered independent of the printing press and the major part of Poland's immediate problem was solved. But the new budget stood at the high figure of over 1,600 million złoty, and even so would have failed to balance by 160,000,000 but for extraordinary revenue such as the Italian loan. This figure is too high for Poland's resources, just as the revenue of 1922–3, estimated at about 420,000,000 złoty for each, was too low for her needs. The figure of 1,000 million suggested by Commander Hilton Young appears to be about the true figure. The expenditure of the Ministry of War increased with the increased budget, and economies in the civil administration were not carried out as vigorously as was necessary.

Meantime, the Bank Polski, the National Bank of Poland, was created by charter as a limited liability company, with a capital of 100,000,000 złoty. It has the sole right of issue of bank-notes until Dec. 31 1944. The main features of the charter resemble those adopted in Austria. Notably, the Government credit is limited to 50,000,000 złoty. When circumstances permit, the currency is to be placed on a full gold standard, but for the present is restricted to a gold exchange standard. The gold value of the currency is not fixed in the charter or by other law. The whole capital was subscribed by the public, but the Government appoints the president and approves the directors.

The first balance sheet of the bank, of May 10 1924, showed (in round millions of złoty) bank notes in circulation 111, current accounts, etc. 230; against gold 70, foreign balances 207, bills 118 and other assets 46.

This strong position resulted from the utilisation of all available reserves and the restriction of the circulation below the country's needs. But for some 12 months the bank was able to sell dollars freely at 5·185 złoty per dollar and still maintain a cover of between 50 and 70% against a minimum of 30% required by the charter.

At the end of 1924 Poland funded her chief external debts, viz., to U.S.A., Great Britain and for relief credits. The total amount of Poland's foreign debts at the end of 1925 was about £70,000,000. The first annual instalment on these debts was punctually paid at the end of 1925.

The economic consequences of stabilisation began to appear in the summer and autumn of 1924, and are still working themselves out. They were greatly accentuated by two extraneous events—the very disappointing harvest of 1924, which in itself was enough to turn the foreign trade balance against Poland, and the worldwide coal crisis. By the irony of circumstances Upper Silesia, whose detachment from Germany was much criticised in some British circles, has thus become a liability which has now to be borne by Poland instead of Germany. These two events destroyed the foreign trade surplus, which was one of the foundation stones of the reform. The other foundation stone, the balanced budget with its consequent great burden of taxation, has pressed increasingly heavily on the economic life of Poland. The gross budget for 1925 was no less than 2,176,000,000 złoty, and the net figure 1,658,000,000.

Great restriction of trade after the stabilisation was to be expected, and Austria's experience showed that it might be prolonged, but in Poland things go to greater extremes than elsewhere. The centre of the difficulties, as of the reform, has been the national bank. Its resolute maintenance of free transactions in exchange threw the burden of defending monetary stability upon its credit policy. The official rate of discount at the end of the inflation period was 48% per annum, and in practice 60% was usually payable. The Bank Polski fixed its discount rate at 12%, which was reduced to 10% in Nov. 1924, and required banks not to charge more than double the official bank rate, but the demand for credits grew without ceasing. Those given by the Union of Banks rose from 83,000,000 złoty in April 1924 to 376,000,000 at the end of March 1925, and during the same time credits granted direct to industry by the Bank Polski increased by 221,000,000. Credit was nevertheless extremely scarce, and the repayment of loans increasingly difficult to secure. The real rates paid in private trade often considerably exceeded 2% a month. When the stimulus of inflation was removed the traditional habits of the Polish people showed themselves in these long credits. The resulting slow pace of circulation of money makes a correspondingly larger note-issue essential. In 1925 the Bank Polski rigorously curtailed credit and reduced its note issue from 551 to 369,000,000; but during the same period the Treasury issue of notes and small coins (purely fiduciary) rose to over 400,000,000, or more than the total note issue of the Bank Polski, at the end of 1925.

Prices had increased by practically 20% between June and Dec. 1924, and production fell off very seriously. Early in 1925 more stability was achieved, but the evil results of the bad harvest then began to appear. Poland was compelled to import foodstuffs for some £13,000,000, and the exchanges began to be in danger. The expiry on June 15 1925 of a coal agreement with Germany, under which Poland had been able to export some 500,000 tons a month, brought relations with Germany to a crisis, and tore the złoty away from its gold anchorage. Through the autumn the exchanges sagged lower, some of the greatest banks came into serious difficulties, and certain of them had to be granted a moratorium by the Government. Discontent increased and Grabski resigned early in Nov. 1925. A new Cabinet under Count Skrzynski was formed, with M. Zdziechowski as Finance Minister, which endeavoured to effect considerable economies in the budget and to secure loans abroad.

The initial successes of Grabski's reform have not properly been consolidated. Their permanence required them to be followed by the application of principles adopted in other European countries whose finances have been overhauled. Even more than those countries Poland requires a moderate increase of her working capital. Her pre-War history, the War and post-War inflation have prevented her from accumulating this fund from her own resources. But it would have been easier to attract it from abroad if improvements in her banking and public administration had been carried out more vigorously. A further effort at financial consolidation, if necessary with foreign help, is required if Poland is to achieve that economic strength which is indispensable to her prosperity as an independent State.

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POLAR EXPLORATION (*see* 24.938).— During the period under review (1910–26) much exploration work has been done around both the North and the South Poles. In this article a section is devoted to each of these fields. (*See* also ANTARCTICA; ARCTIC REGIONS.)

I. THE NORTH POLE

As to the distribution of land and water in the northern regions, we now know the limits towards the north of all continental land surface both in the old and in the new world. The last problem in this respect was the northern extension of Greenland, the northernmost end of which was reached by Peary, while its northern coasts have been mapped by the Danish travellers: Mylius Ericksen, Knud Rasmussen, Lauge Koch and others. There seems now to be no possibility left of any great, continuous land-surface within the still unknown tracts in the North; but this does not mean that there may not be greater or smaller islands, which may possibly form a kind of continuation of the groups of islands known.

Canadian Arctic Archipelago.—The northern extension of the Canadian Arctic Archipelago is still an open question. Capt. Otto Sverdrup in 1900, found the great new islands, Axel Heiberg Island, the Island of Ellef and Amund Ringnes and King Christian Island, an area of more than 200,000 square kilometres. In 1916 Vilhjalmur Stefansson completed these discoveries with some smaller islands: Brock Island, Borden Island and Meighen Island, on the western and northwestern side of Sverdrup's islands. It seems hardly probable that the islands now known should form the northern boundary of this extensive archipelago; but how far it may still extend northwest and northwards will be for future exploration to decide.

Croker Land.—Farther east, north of Grant Land (Grinnell Land) Mac Millan has looked in vain for the land, Croker Land, which Peary thought he had seen in the distance. It may therefore be probable that there is no more land in that direction as also north of Greenland, where Peary has travelled across the drifting ice, and where there obviously is a deep sea.

Spitsbergen.—The extension of the island group of Spitsbergen (or Svalbard as this group is now called) is known, and as there is a deep sea to the north there is no probability of any new land of importance in that direction.

Franz Josef Land.—The extension of the island group called Franz Josef Land, has been explored by the Jackson-Harmsworth expedition (1895–7), the sledge journey of Johansen and Fridtjof Nansen (1895), the expedition of the Duke of the Abruzzi (1900) and by the Ziegler expedition (1902). The extension of this island group towards the east is uncertain; but the drift of the tragic Brusilov expedition in the " St. Anna " in 1912–3 east of these islands, and northwards, approximately along the meridian of 70° E., in fairly deep sea (more than 600 metres), without seeing land, limited the possibilities of this extension.

Russian Exploration.—By far the most important discovery in this part of the Arctic for a long time was made by the Russian expedition on board the ice breakers the " Taimir " and the " Vaigach," commanded by Vilkitski, on Sept. 3 1913, when they found the great new land or island group, called " Nicholas II. Land," to the north-northwest of the northernmost point of the old world, Cape Chelyuskin. The eastern coast of this land was found to extend towards north-northwest as a continuation of the eastern coasts of the Taimir Peninsula and the Chelyuskin Peninsula, and was tracked northwards as far as 81° N. Lat. where the ships were stopped by impenetrable ice. Only the eastern and southern coasts of this island group were observed. The group forms obviously a northern continuation of the groups of islands, Fearnley Islands and Axel Heiberg Islands, discovered during the " Fram " expedition in 1893. This new land has an extension from south to north of 350 km., or more than three degrees of latitude. How far it extends farther towards north and towards west is unknown. A limit for the possible maximum of its extension is set in the north by the drift of the " Fram " in 84° and 85° N. Lat., or about 400 km. north of the northernmost point of the known land—and in the west by the drift of the " St. Anna " at a distance of about 500 kilometres. An exploration of this island group in its full extension will be a feat of great value.

Siberian Islands.—Farther east are the New Siberian Islands. To the northeast of this great island group some small islands have been found in a very shallow sea: Jeannette Island, Henriette Island and Bennett Island were discovered by the " Jeannette " expedition under de Long in 1881. The last mentioned island was at the time supposed to have a great northward extension, but Eduard von Toll found in 1902, at the cost of his valuable life, that it is only a small islet of less than 200 square kilometres. In 1913 and 1914 the Russian expedition on board the " Taimir " and the " Vaigach " discovered two new small islands: General Vilkitski Island and Jokhov Island, southeast of Bennett Island. As the sea is very shallow in this region, mostly less than 50 metres deep, there may easily be more unknown islands in the north.

Farther east Wrangel Island and the tiny Herald Island are the only known islands in the shallow sea north of the Siberian coast, not counting the islands near the land. There may possibly be more islands to the west of Wrangel Island and also in the north, north of the drift-routes of the " Jeannette " (1879–81) and the " Maud " (1922–4).

North of Alaska a deep sea has been found, and it is hardly probable that there is any new land in that region.

The extension of the Continental Land-masses and the Deep Sea.—To discover and map the possible islands and lands in the unknown North will be an important task for future explorers, but it will be much more important, from a scientific point of view, to define the northward extension of the continental land-masses over and under the sea-surface, and to determine in its chief features the extension of the North Polar deep sea.

The Continental Shelf.—The boundaries of the great continental land-masses are not defined by the coasts of the land visible above the sea, but by the edge of the *continental shelf*, which, at a comparatively small depth, generally less than 100 to 200 metres, under the sea-surface extends often very far out from the coasts, and is actually an important part of the continent. At the edge of this shelf, generally at a depth of 100 to 200 metres, the sea-bottom falls, as a rule, abruptly and comparatively steeply towards the deep floor of the ocean at depths of several thousand metres or more.

North of Siberia this continental shelf has a very wide extension of many hundred kilometres. Its surface is extremely level, and situated at a shallow depth of a large area less than 50 metres under the sea-surface. It was over this remarkably shallow continental shelf that both the " Jeannette " (1879–81) and the " Maud " (1922–4) drifted along their crooked drift-routes. The edge of this shelf has been determined only at one place, viz.: along the drift-route of the " Fram " in 1893, north of the New Siberian Islands, in about 79° N. Lat. and more than 600 kilometres north of the Siberian coast. At another place, about midway between the New Siberian Islands and Cape Chelyuskin, in about 77° 24′ N. Lat., the Russian expedition on board the " Taimir " and the " Vaigach " in 1913, made a sounding of 402 metres without reaching the bottom, and here they were probably at the edge of the continental shelf. Off Nicholas II. Land the shelf seems to be comparatively narrow, and its surface is uneven and traversed by submarine valleys and fjords. But further west, towards the Kara Sea and Novaya Zemlya, the shelf is again very broad and has very shallow depths.

North of Europe this continental shelf extends far north beyond Franz Josef Land and Spitsbergen, and these island groups are situated on it. In the Barents Sea the shelf is traversed by a system of submarine valleys with depths of as much as 400 metres or more. North of Canada the continental shelf has a wide extension, comprising the whole Arctic Archipelago, but how far it extends farther north is unknown. North of Alaska, off the coast eastwards from Point Barrow, the edge of the continental shelf approaches near to the land. During the drift with the ice of Stefansson's ship the " Karluk " in 1913, and during the ice-journey of the Norwegian " Storkerson " in 1918, depths of more than 1,000 and 2,000 metres were found at distances less than 100 kilometres from land, and there seems to be an extensive deep sea.

Sea-basins.—During the Norwegian " Fram " expedition in 1893–6 a great and deep sea-basin with depths of 3,000 to 3,850 metres was found in the North Polar region. It extends as a continuation of the deep Norwegian Sea far north of Spitsbergen and Franz Josef Land and eastwards to the longitude of the New Siberian Islands, and probably farther eastwards.

This sea-basin forms the northern termination of a series of sea-basins which extend northward from the eastern side of the North Atlantic, through the Norwegian Sea—between Norway-Spitsbergen on the one side and Iceland-Greenland on the other. This series of deep basins separates the two great continental land masses of the earth: Eurasia on the one side, and Greenland, North America on the other. The different basins of this continuous sea are separated from each other by submarine

ridges such as: the Scotland-Faeroes-Iceland-Greenland Ridge, the low ridge between Jan Mayen and Bear Island and a probable ridge between northwestern Spitsbergen and northeastern Greenland.

How far the deep North Polar sea-basin extends eastwards towards Bering Straits and Alaska is still unknown. Nansen assumed that it actually extends to a short distance from the north coast of Alaska. The soundings made by the "Karluk" and "Storkerson," with depths of more than 3,000 metres confirm this assumpton. But the extension of the deep sea in this region beyond 74° N. Lat., or 400 kilometres north of the Alaskan coast, is unknown, and we cannot decide at present whether it is continuous with the deep sea north of the New Siberian Islands or whether it may be separated from it by some submarine ridge. A single sample of the water from depths greater than 1,000 metres north of Alaska would have settled this question.

That there is an open communication in the upper water-layers between the sea north of Alaska and the sea between Spitsbergen and Greenland is proved by the drift of several objects, and there is obviously a constant, though slow, drift of the ice across the sea near the North Pole from the sea north of Bering Straits and into the Norwegian Sea where the ice drifts southwards along the east coast of Greenland. But whether this North Polar Sea is chiefly a deep sea, or whether it to a great extent is shallow, is still uncertain. By computations of the tidal observations made at several places along the Arctic coast the American hydrographer, Harris, came to the conclusion that a continuous great land probably extends from the region north of Alaska and northwest of Banks Land, to the North Pole on the one side and to a certain distance north of the New Siberian Islands on the other side. Later observations, and especially the many tidal observations and current measurements made by Dr. Sverdrup during the drift of the "Maud" (1922–5) seem to prove definitely that Harris was mistaken, and there is probably no such land to the north of the "Maud's" drift-route.

North Polar Sea.—The most important geographical problem of the unknown North Polar regions is consequently the extension of the deep North Polar sea. When the edge of the continental shelf has been determined all the way round it is hardly probable that there should be isolated islands farther out rising from the deep oceanic floor, unless there be volcanic islands, like Jan Mayen in the Norwegian Sea. There may, however, be submarine ridges across the North Polar basin, and they may in places rise above the sea-surface and form islands.

Meteorological Problems (*see* METEOROLOGY).—In order to master some of the most difficult meteorological problems of our atmosphere, it is necessary to study the physical conditions of the polar regions. The circulation of the atmosphere is essentially due to the heating of the air by the solar radiation in the warmer regions of the earth, and to the cooling of the air by the radiation of heat in the colder, especially the polar, regions. To try to find the laws for the atmospheric circulation without knowing the physical conditions of the extensive polar regions, would therefore be somewhat similar to trying to compute the circulation of heat in the pipes of a central heating apparatus without knowing the radiators where the heat is given off. In modern meteorology it is therefore more and more acknowledged that the meteorological conditions of the Arctic regions have a predominating influence upon the weather in our latitudes, and that therefore a thorough study of the different layers of the atmosphere—both near the earth's surface and at great heights—in all parts of the North Polar regions is essential for the understanding of the complicated laws regulating the weather.

Oceanographic Problems.—A methodic study of the physical conditions of the North Polar sea in the different parts of the unknown region, will be of much interest for oceanography (*q.v.*). From the drifting ice the movements of the sea, the horizontal currents as well as the vertical oscillations of the water-layers, may be continually and carefully studied at all depths, in an ideal manner which is not possible in any other part of the ocean; and many of the greatest problems of Oceanography may thus be solved. A careful study of the relation between the directions and velocities of the drift of the ice, the sea-currents and the wind in different parts of the North Polar regions will also be of much value.

Terrestrial Magnetism (*q.v.*).—Investigation of the phenomena of terrestrial magnetism in the still unknown polar regions and determinations of its various elements: declination, inclination, intensity, etc., is very important and has to be attempted sooner or later.

Problems of Gravitation.—The floating thick ice-floes of the North Polar Sea offer possibilities of making exact measurements of the earth's gravitation over a deep ocean as well as over the continental shelf, which can be found nowhere else. Pendulum-observations of this kind made by S. Scott-Hansen during the "Fram" expedition (1893–6), gave unexpected results; but with modern instruments results of very great importance for the understanding of the physics of the earth and its crust may certainly be obtained (*see* GEODESY).

Biological Problems.—There are naturally also biological problems of interest in the unknown polar regions, although they may seem to be of minor importance. The North Polar sea, covered in its interior by an almost continuous layer of thick ice, is extremely poor in plant as well as animal life. The sun light is absorbed by the thick ice, and extremely little light penetrates to the water underneath. Hardly any plant-life can therefore be developed in this water, there is only just a little—chiefly in the water lanes between the floes in the summer; and without plant life, no animal life. The interior, continuously ice-covered North Polar sea may therefore be considered as a desert in the ocean, where the "Fram" expedition (1893–6)—"found comparatively many species of small crustaceans, but the fauna was so extremely poor in number of specimens that the tow-nets might hang out for several days, and although we drifted along at a good speed there was extremely little in them when we hauled them up." These conditions have a peculiar effect. The substances in the sea-water generally used to sustain the plants and animal life of the sea, are thus used only to an extremely small extent in the ice-covered North Polar sea, and the result obviously is that these substances are to a great extent stored in the sea-water of that region. But as soon as this water with these accumulated riches is freed of the ice, near the outskirts of the polar sea, and is exposed to the sunlight in the spring and summer, an unusually rich plant and animal life (plankton) is developed and flourishes. It would certainly be of great importance for the understanding of the biology of the ocean in general to study in detail the biological conditions in the North Polar regions.

Methods of Exploration.—The most important problems of the unknown North Polar regions have been mentioned above. We have hitherto had chiefly three means for locomotion for the exploration of the polar regions, viz.: sailing in a ship, sledge-travelling with or without dogs (or reindeer or horses) and drift with the ice. The use of the first of these methods is limited by the impenetrable ice preventing the advance of the ship. The second method has a limited radius of action, owing to the difficulty of transporting a sufficient equipment and the accommodation necessary for the desirable scientific research. The third method of locomotion is very slow and has the drawback that the traveller cannot decide the direction in which the ice will carry him. But if the expedition drifts in a well-equipped ship, this method has the great advantage of offering the best possible opportunities of making methodic and valuable scientific investigations even of the most subtle kind.

In recent times we have, however, acquired two new means of locomotion which may become of great importance for the unknown or little known regions of the earth; the aeroplane and the airship.

Owing to the difficulty of landing on the uneven North Polar ice, the use of the aeroplane with its present development has obviously its limitations in the North Polar regions, as is proved

by Amundsen's remarkable flight to nearly 88° N. latitude. But it can hardly be doubted that when it is further developed it will become of importance for the exploration of these regions.

The airship on the other hand, may be used not only for solving the geographical problems of the unknown North Polar regions, by flying across them; but it may also render possible more continuous investigations in the unknown regions as, with the considerable carrying capacity of a big airship, parties of men with full equipment may be dropped at any place either on land or on the drifting ice in the unknown regions, and may be fetched again at any fixed time when they have fulfilled their work. (F. N.)

Air Expeditions to the Pole.—No less than six air expeditions were organised to fly to the North Pole in 1926. Particulars of each are given below.

1. The Amundsen-Ellsworth-Spitsbergen-Alaska, 1926, expedition used the Italian semi-rigid dirigible airship type N. 1, named "Norge," and carried 17 passengers, including Amundsen, Ellsworth and Col. Huberto Nobile, who commanded the airship. The "Norge" cruised to Spitsbergen in March and April, by way of Rome, Marseilles, Paris, Pulham, Leningrad (or Oslo), Vardoe, Kings Bay. Starting from Spitsbergen May 11, the "Norge" flew to the Pole, which it circled twice, thence across the unexplored Arctic basin to Point Barrow, Alaska, and landed at Teller, on Behring Sea. The total distance traversed was 2,700 m. and the time occupied 71 hours.

2. The expedition organised by Lieut.-Commander Richard E. Byrd, U.S.N., to which John D. Rockefeller, Henry Ford and three others have subscribed $20,000 each, for the scientific purpose of exploring the area from the Arctic edge of the North American continent to the Pole. Commander Byrd left Spitsbergen at 12:50 A.M. on May 9 1926 and returned there after a 15½ hours flight in the course of which he reached the North Pole.

3. The Detroit Arctic Expedition, commanded by Capt. George H. Wilkins, the Australian aviator-explorer, who will fly from Point Barrow to Spitsbergen, using two Fokker aeroplanes, which will be transported by railroad to Fairbanks, where the railroad ends, and then flown to Point Barrow. The Alaskan mail pilot, Ben Eilson, will be in charge of the planes.

4. The Norwegian expedition organised by Lieuts. Ellassen and Gross of the Norwegian Navy, who propose to fly a seaplane from Novaya Zemlya to Alaska, a distance of 3,000 kilometres, which they expect to cover in 30 hours.

5. The American expedition organised by Lieut. Leigh Wade and H. H. Ogden, U.S. Army, who distinguished themselves in the round-the-world flight, who leave the army to organise this expedition. With them are associated Robert Anderson Pope, who conceived the expedition, Norman H. Read, veteran pilot, who was one of the first Americans to join the Royal Air Force, Lowell Thomas, writer and photographer, Harry Ehler, mining engineer, and L. L. Jackson, radio expert, geologist and meteorologist on the staff of the Museum of Natural History.

6. The Harrison Williams expedition in charge of Capt. Robert A. Bartlett. (X.)

II. THE SOUTH POLE

Amundsen 1910–1.—Captain Roald Amundsen set out in the "Fram" for a north polar voyage in the autumn of 1910, but changed his plans and established a base called Framheim, on the Antarctic ice barrier near the Bay of Whales in Ross Sea (78° S.). Before winter he had laid out food depots in 80°, 81° and 82° S. and after winter, on Oct. 20 1911, he set out with four companions on ski and 52 dogs dragging three sledges. They crossed the barrier southward to the Queen Maud mountains and found a way to the Plateau by the Axel Heiberg glacier in 85° South. In 88° S. the surface was 11,000 ft. above the sea and thence a gentle descent brought the party to the Pole on Dec. 14 1911. Two days were spent in fixing the exact position. The outward journey occupied 49 days, the return to Framheim only 38, the dogs working well throughout. The party at the base had meanwhile visited King Edward Land where they reached a height of 1,700 feet.

Scott 1910–2.—Captain Robert Scott organised a private British expedition in 1910, and landed from the "Terra Nova" at Cape Evans on Ross Island (77½° S.) on Jan. 4 1911. He built a hut for his land-party of 24 which included a highly efficient scientific staff, and sent the "Terra Nova" with a party under Commander Victor Campbell to occupy a base in King Edward Land. This party met Amundsen, returned to Cape Evans with news of the Norwegian expedition, and proceeded to Cape Adare where they wintered in the hut of Borchgrevink's expedition of 1899–1900. They were compelled to make a hazardous land journey of 300 m. back to Cape Evans along the coast of Victoria Land, wintering on the way with improvised equipment. On this journey Mr. R. E. Priestley made valuable geological surveys. In 1911 and 1912 Griffith-Taylor and Debenham surveyed the west coast of MacMurdo Sound. A very remarkable winter journey to Cape Crozier was carried out by Dr. E. A. Wilson, Lieutenant Bowers and Mr. Cherry-Garrard in conditions of unprecedented severity, and unique specimens of the eggs of the emperor penguin were secured.

The main effort of the expedition was a journey to the Pole. Depots were laid out on the barrier, but only as far as 79° 29′ S., in Jan. and Feb. 1911. The expedition started from Cape Evans on Oct. 24 1911 in three divisions using respectively motor-sledges, ponies and dogs. The motors broke down before the journey was well begun, the last of the ponies was shot before reaching 83° 30′ S., here also the dog-teams were sent back to the base, and on Dec. 10 Scott with 11 others began the ascent of the Beardmore glacier, following Shackleton's route of 1909, with three man-hauled sledges. On Dec. 21 four men with one sledge were sent back from 85° 7′ S.; and on the 31st the last supporting party of three under Lieut. E. R. G. R. Evans returned from 86° 56′ S. and reached the base after narrowly escaping death from scurvy.

The Polar party—Scott, Wilson, Bowers, Captain Oates and Petty-Officer Edgar Evans—with one sledge and equipment originally designed for four men, reached the Pole on Jan. 18 1912 where they found a tent left by Amundsen. All were tired out by their 69 days' march and bitterly disappointed to find that they had been forestalled. The weather on the return journey was worse than had ever been known before, and disasters followed one another. Edgar Evans broke down on the Beardmore glacier and after delaying the march died on Feb. 17. Oates, at the end of his strength, and resolved not to be a burden, sacrificed himself on March 17 in 79° 50′ S., by walking out into the blizzard. The supply of fuel oil at the last depot had been deficient and 20 m. remained, to reach the next. The three survivors struggled on heroically for 10 m., raised their tent for the last time and, being without fuel, nothing remained but to await death with quiet fortitude. Lieutenant Evans, the second in command, had been invalided home on the "Terra Nova," and the search parties sent out to meet Scott had been unfortunate, so that it was not until after another winter that Dr. Atkinson, then in command at the base, found the tent with the frozen bodies on Nov. 12 1912.

Douglas Mawson.—Dr. Douglas Mawson organised the Australian Antarctic Expedition which set out in the "Aurora" in Dec. 1911. A party was landed on Macquarie Island to set up an intermediate wireless station and the ship went on to Adelie Land where the main base was established and a wireless mast erected. Here Mawson with 17 companions built a hut on the shore of Commonwealth Bay (67° S., 142° 4′ E.) while the ship under the command of Capt. J. K. Davis proceeded 1,500 m. to the westward where Queen Mary Land was discovered and Mr. Frank Wild landed with a party of seven men and a hut to form the Western base in 66° S., 94° East. Adelie Land was found to be a region of almost continuous blizzard, the wind-force averaging 50 m.p.h. for the whole year, and velocities of over 100 m.p.h. frequently occurring. Sledge parties started from the main base in Nov. 1912, diverging to explore inland towards the magnetic pole and eastward and westward near the coast. The land sloped steeply from the sea to the high plateau and was entirely buried in heavily-crevassed glacier ice

and snow, yet the sledge parties made their way for 300 m. or more from the base. All got back without disaster except the leader, whose two companions, B. B. S. Ninnis and X. Mertz, perished, leaving him with scant stores 100 m. from Commonwealth bay. He reached the hut on Feb. 10 1913 by an effort of almost superhuman endurance and found that the "Aurora" had just sailed to relieve Wild, leaving a volunteer rescue party with whom he awaited the return of the ship in Dec. 1913.

Filchner 1911-2.—Lieut. W. Filchner got up an expedition in Germany and sailed from South Georgia in the "Deutschland" in Dec. 1911. He made his way into the Weddell Sea on the meridian of 30° W. and found a new coast, which he named Luitpold Land in 77° 48′ S. on Feb. 2 1912. An attempt to erect a winter hut in Vahsel Bay was frustrated by ice movements, and after seeking vainly for safe winter quarters Filchner decided to return to South Georgia on March 4. The ship was caught in the floe and drifted slowly northward and eastward for 264 days until the floe broke up and set her free in 63° 40′ S., on Nov. 27 1912. Good meteorological work was done, especially by kites in the upper air, and the drift threw light on the currents of the Weddell Sea, and proved the non-existence of Morrell Land.

Shackleton 1914-6.—Sir Ernest Shackleton planned the Imperial Trans-Antarctic Expedition in 1914, intending to cross the Antarctic continent from the Weddell Sea to the Ross Sea by way of the South Pole. On board the "Endurance" he entered the ice-pack in the Weddell Sea early in Dec. 1914 and worked his way in adverse climatic conditions southward between 15° and 20° West. He discovered the Caird coast between Coats Land and Luitpold Land on Jan. 11 1915, but he found no landing place, so the fine teams of Hudson Bay dogs and several new types of motor sledges and tractors were useless. The ship, beset in the ice on Jan. 18, was drifted northward parallel to the track of the "Deutschland" but about 10° farther west. She was crushed in a terrific ice pressure and abandoned on Oct. 27, in 69° 5′ S., and the 28 men camped on the ice-floe, which continued to move northward until April 9 1916 when the floe broke up in 62° S., 54° W. after a drift of 457 days. The party took to their three small boats and landed six days later after extraordinary hardships on Elephant Island where they camped on a narrow beach below vertical ice cliffs. Shackleton with five men succeeded in reaching South Georgia, 750 m. distant, in a 22-ft. boat and after three unsuccessful attempts to return to Elephant Island through the ice-floes he succeeded with the Chilean trawler "Yelcho" in rescuing all his men on Aug. 30 1916.

Shackleton's Ross Sea Party, 1914-7.—The Ross Sea party who were to meet Shackleton after crossing the continent reached Cape Evans in the "Aurora" on Jan. 16 1915 and Captain Mackintosh with five men carried out his task of laying a depot at the foot of the Beardmore Glacier in Jan. 1916. Meanwhile the "Aurora" trying to winter frozen in the ice at Cape Evans was blown out to sea fast in a floe in May 1915 and drifted northward for 315 days. Though much damaged when the ice broke up near the Balleny Islands she got to New Zealand, was repaired and in Jan. 1917 returned to Cape Evans under the command of J. K. Davis with Shackleton on board. The vessel rescued the survivors of the Ross Sea party; three of them had already perished, one on the march, from scurvy and two by taking undue risks on the sea-ice.

Shackleton's Last Voyage, 1921-2.—Sir Ernest Shackleton's last expedition sailed on the "Quest," a small and defective vessel, in Sept. 1921 to explore the Enderby quadrant of the Antarctic (0° to 90° East). The leader died at South Georgia on Jan. 4 1922, but Frank Wild, second in command, carried on the voyage as far as the lateness of the season permitted. He reached 69° 17′ S. in 17° E., in spite of great difficulties, and got important soundings in a little-known area.

Whaling on a large scale is now carried on in Antarctic waters from South Georgia and Australia, but no geographical discoveries have resulted. The Royal Research ship "Discovery" was commissioned in 1925 by the Colonial Office with funds supplied by the Falkland Islands Govt. to study the life history of whales with the view of regulating and perpetuating the industry in sub-Antarctic waters (*see* WHALING).

Scientific Results.—Results of exploration since 1910 have been the attainment of the South Pole, the discovery of the general configuration of the Antarctic continent and the perfecting of methods of polar travel and residence. The geology, glaciology and biology of large areas have been studied in some detail. The most valuable work has been done in meteorology, the combined observations of all the expeditions having thrown much light not only on Antarctic weather, but on the general circulation of the atmosphere which affects all countries. The full results of the Australian expedition and of Shackleton's two last expeditions had not been published up to 1926. It has been established that the blizzards of Adelie Land and MacMurdo Sound are outrushes of air chilled by the intense cold of the great plateau and pouring down the slopes by gravity. The even greater cold found at sea-level at the Bay of Whales is accompanied by a remarkably still atmosphere.

Part of the funds raised for a memorial to Scott has gone to endow the Scott Memorial Institute for Polar Research in the University of Cambridge where polar problems may be studied, and exploration promoted.

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POLISH LITERATURE (*see* 21.023).—During the last decade of the last century there came to the fore a whole group of young exuberant talents. Dissatisfied with the utilitarian character of art and poetry of the preceding period, they organised themselves into an independent body with the view of working out a new theory of art. This group, soon known as "The Young Poland," rejected all accepted and conventional views of art and literature as a national function, and demanded an absolute freedom in form and matter. True to their principles of unfettered individuality, practically everyone tried his best to find his own way of expression.

A Group of Poets.—The first among these young poets to gain fame and renown was Kazimierz Tetmajer (b. 1865), whose love lyrics are comparable to the best work of French Parnassists. The modern poetry of France and Belgium found a gifted and congenial interpreter in the person of Zenon Przesmycki (b. 1861). The most forceful individuality of this group was Stanislaw Przybyszewski (b. 1868) who, having spent several years among the young Scandinavian and German writers, came back to Poland in 1898 and became at once the leader of the group and the editor of their organ, a weekly called *Życie* (Life). His dramas, full of fatalistic terror, and his prose poems, dealing with the mystical and tragic side of love and death, became the fashion of the day.

The art editor of the said weekly was Stanislaw Wyspiański (1869–1907), a painter of great originality, who became also the leading Polish dramatist; in fact, an artist and a man of the theatre who contributed not a little to the development of the art of the theatre. His leading idea was to unite in the theatre the arts of painting, of architecture and of drama, in which poetry and music should have their due share. The study of the Greek tragedy inspired him to works like *Meleager* and *Protesilas I Laodamia*. His next experiment was to apply the form of Greek tragedy to the setting of a Polish village in the two

tragedies *Klatwa* (The Curse) and *Sedziowe* (The Judges). But gradually his attention turned to national subjects, and especially to the problem of national strength and weakness, which is the root of the three dramas based upon the history of the Rebellion of 1831, *Warszawianka* (The Song of Warsaw), *Lelewel* and *Noc Listopadowa* (The November Night). *The Legion* (1900)—a play of which the tragedy of Mickiewicz as the leader of Polish romanticism is the subject-matter—constitutes the link between the past and the present day. The present day problem was to Wyspiański that of national existence, which he dealt with in three powerful dramas—*Wesele* (The Wedding) (1901), *Wyzwolenie* (The Deliverance) and *Akropolis* (1904).

Jan Kasprowicz (1860) is no doubt the greatest contemporary Polish poet. With him, not unlike Thomas Hardy, the problem of evil and human suffering is the predominant subject. From the first small volume of poetry, published as far back as 1889, this problem, inseparable from that of God and religion, finds expression growing more and more powerful in *Chrystus* (Christ) (1904), *Na Wzgórzu Śmierci* (On the Hill of Death) and finally in the cycle of hymns dedicated *Ginącemu Swiatu* (To the Perishing World) (1899–1901). Here the poet reaches the simplicity and the heights of Job or Aeschylus. The echoes of the Promethean struggle of man are heard in many of his works, until at length the poet attains the wisdom of a resigned sage, which speaks from every line of his last work called *Księga Ubogich* (The Book of the Poor) (1916). The mood of spiritual calm is also the dominant tone of Leopold Staff (1878) who started his poetical career with *Sny O Potędze* (Dreams of Might). A cruel death at the hands of Russian Bolsheviks brought to an untimely end the life of Tadeusz Micińki (1873–1919), a poet endowed with extraordinary imagination, and a visionary of a deeply religious nature.

The Work of Żeromski.—Brought up in the atmosphere of the most stupid Russian oppression and persecution, Stefan Żeromski (1864–1925) at that time one of the leading Polish novelists of his time, introduced the painful and profound pessimism of a modern mind tormented by the endless sight of wrong done by man to his fellowman, and of the apparent triumph of evil. This pessimism underlies the conception of his many novels depicting the utter futility of individual effort and self-sacrifice. The most typical among them are *Ludzie Bezdomni* (The Homeless) (1900) and *Walka z Szatanem* (The Fight with Satan), a trilogy published at intervals during the War.

One of his outstanding artistic achievements is a great historical novel dealing with the Napoleonic period, *Popioty* (The Ashes) (1904). The stately classic prose of Sienkiewicz is here displaced by a new literary language able to reproduce a new mood and full of rhythm. But the difference between Sienkiewicz and Żeromski goes a step further. While the former was anxious to rouse the national feeling by his artistic calling to life of past glories, Żeromski, as if by contrast, does not shrink from the analysis of the most painful social and national ills. His last novel *Przedwiosnie* (Before the Springtime) comes as a timely warning against the dangers threatening the social fabric of Poland. The ideal of independent Poland was with him as sacred as with Wyspiański.

Reymont.—In popularity second to none, and in his standing surpassed only by Żeromski, is the fortunate winner of the Nobel Prize for literature (1924), Wladyslaw Stanislas Reymont (1868–1925), whose artistic point of view, however, altogether differs from that of Żeromski. He is mainly concerned with life as it is. His joy and delight is to be one of the mass, a particle in the eternal movement. His acute sense of observation and his strong, almost brutal directness in execution manifested itself in his short stories which deal with the life of peasantry. But his early ambition was to make a picture of life in a big industrial town. With this end in view he went to Łódź, the main centre of Polish textile industry, and having spent there a few months, he produced his famous novel called *Ziemia Obiecana* (The Promised Land) which brought him, on the part of the critics, the title of "Polish Zola." It was the apparently simple and monotonous, yet rich, complex, and varied life on the land, the life of the peasant, that became his main subject. Having once set his mind and heart on this theme, Reymont devoted to it five years of hard and incessant work until his great tetralogy called *Chtopa* (1904–9) was finished, Eng. tr., *The Peasants* (1925). This is a great epic novel, an achievement unique of its kind in the annals of modern literature. Although the psychology of the people remains faithfully Polish, the work attains a universal importance by its fullness and completeness of treatment.

Reymont's *The Peasants* was to a certain degree the crowning achievement of the movement which aimed at an artistic introduction of the popular element into art and literature. As far as literature was concerned, this aim was partially and locally realised in some of the plays of Wyspianski, and even more effectively in a series of short stories of Tetmajer published under the title of *Na Skalnem Podhalu* (On the Polish Rockies), in which the author succeeded in re-creating the vanishing primitive life of the natives of the Polish Highlands. These stories led him finally to a long novel called *Legenda Tatr* (The Tatra Saga). The interest in the life and manners of Polish Highlanders soon became fashionable, and a whole group of poets and prose writers followed his example. Among them the strongest individuality is that of Władysław Orkan who, like Tetmajer, was born and brought up in these parts of Poland.

Other Writers.—The most talented representative of exoticism in Polish literature is Wacław Sieroszewski (1858), whose works deal mostly with life in Northern Siberia and the Far East, which he got to know when banished thither by the Russian authorities for a political offence. His prolonged stay among the native tribes of Northern and Eastern Siberia resulted in a series of most fascinating and interesting short stories, in which the hard lot of primitive life of these Siberian tribes is presented objectively, yet not without humanity and understanding. His novels on life in Japan and China possess the same humanitarian qualities.

An artist of rare subtlety and perfect artistic skill is Wacław Berent (1873). Among his few novels the most important are: *Próchno* (Rot) and *Ozimina* (Winter-Sowing), containing a most subtle analysis of life at the end of the 19th century: his later work, *Żywe Kamienie* (Living Stones) (1918), an amazingly rich and interesting picture of mediaeval life, revealed a new and unexpected aspect of his talent. Among the novelists who chose to follow the path made safe by the genius of Sienkiewicz's contemporary novels the most talented is Jozef Weyssenhof (1860), while of the novelists who belong to the school of Żeromski the most conspicuous are Gustaw Daniłowski, Andrzej Strug and Madame Rygier-Natkowska. The element of satirical humour is represented in the works of Kornel Makuszynski, Jan Lemanski, Adolf Nowaczynaki and Wiodrimierz Perzynski.

The Influence of the World War.—These are the most important writers of the older generation. With the normal conditions of spiritual and intellectual development restored, Polish literature must resign a good deal of its former position as one of the guiding forces in national life. At the close of this period a great new movement, although necessarily of a somewhat chaotic and transitional character was making itself felt. The most distinct and definite advance is to be found in poetry. We may trace its origin to the War. Already during the World War which for the Polish youth was the war of emancipation and freedom, there came into being two notable groups of young poets, one in Poznan, the capital city of the Western provinces of Poland, another in Warsaw. The latter soon surpassed the former and from 1920 onward became the centre of the new poetic movement which was at first characterised by a boldly aggressive and joyous view of life. Among these young poets the most promising are Juljan Tuwim, Kazimierz Wierzyński, Jan Lechoń, Antoni Słonimski and Jarosław Iwaszkiewicz. There are others who, like Emil Zegadlowiz, look for their inspiration to the quietness and retirement of a country life, seeking rather solitude and loneliness than the distracting crowd.

War experiences found expression in some notable works of such writers as Madame Kossak-Szczuka, Eugenjusz Konoin-Malaszewski: Madame Dunin-Kozicka and above all Juljusz

Kaden-Bandrowski. The scattering of the Polish exiles over the vast territories of European and Asiatic Russia called into being at least one writer of unsurpassed energy and imagination in the person of Ferdinand Goetel. An enormous popularity in Poland, as well as abroad, was won by a writer of amazing experiences, Ferdinand Ossendowski; his books were quite a revelation to the minds of American and Western European readers.

The immediate post-War Polish problems, reflecting the social and political changes brought about by the collapse of the pre-War systems prevailing in Germany and Russia attracted soon a great deal of attention on the part of several writers of the older generation, notably of Zygmunt Bartkiewicz and Adam Grzymala-Siedlecki. The historical novel which played such an important part in the literature of the last century appeared to be on the decline; the call of the present with its new problems was too urgent to leave much time for brooding over the past.

See Roman Dyboski, *Periods of Polish Literary History* (1923) and *Modern Polish Literature* (1924). (L. P.)

POLITICAL ECONOMY: *see* ECONOMICS.

POLIVKA, JIRI (1858–), Czech philologist, studied at the universities of Prague and Zagreb. In 1885 he became a lecturer, and in 1895 was appointed professor of Slavonic philology in the Charles University at Prague. He travelled on several occasions in Russia and in Yugoslav countries for the purposes of research. His writings, which are contained mainly in Czech and foreign philological and Slavistic periodicals, deal with many questions relating to grammar, literary history and folklore. His chief works are "Palaeographische, grammatische und kritische Eigenthümlichkeiten in dem Makedonischen Praxapostolus," *Archiv, für Slav. Phil.* X., pp. 106–132 and 417–483 (1887); "Novéjši hypothese o původu pisem Slovanských," *Listy filologicke* XII., pp. 92–120 (1885) and *Drobné příspevky literárněhistoricke* (Prague, 1891). Prof. Polivka made a special study of popular literature and analysed several collections of popular legends, especially those of the Slavonic races. His chief work of this character is "O Srovnávacím studiu tradio lidových," *Národopisny Sbornik Československ* II. pp. 1–49 (1898). For a list of his works see J. Horák, *Sborník Prací věnovaných Prof. Dr. J. Polivkovi* (Prague, 1918).

POLO (*see* 22.11).—The years 1910 and 1911 witnessed a great transformation in English polo. In 1910 the handicapping of individual players was introduced and in 1911 offside was abolished. These changes were to a large extent in consequence of the sensational defeat of England by America in 1909.

As regards offside it was realised that the drawback of curtailing the liberty of one of the four players in a team by making him adapt his movements to those of his chief opponent, *i.e.*, the back on the opposite side, was an unfair one. The position of No. 1 under offside conditions was very unpopular; the youngest and most inexperienced player was, as a rule, chosen for this unenviable position, being often used simply to clear the way for his No. 2 by riding off the back, and being ordered to leave the ball alone, with the result that he very frequently spoilt his ponies and failed to improve his own play. Offside slowed up the game, and it was realised that the wonderful form shown by the great American team (No. 1 L. Waterbury, No. 2 M. Waterbury, No. 3 H. Whitney, back D. Milburn) had been developed by playing the game at a greater pace under no offside conditions. Lastly, with the offside rule in force, umpiring was extraordinarily difficult.

Handicapping.—The individual handicapping of players must not only tend toward closer and harder matches, and consequently more interesting games, but must also give the stronger side more practice in goal hitting than under offside conditions; and in all tournaments, with the exception of open cups, the stronger teams would be obliged to give a start to weaker combinations instead of playing on the level, as was the case under the "recent form list" which had been in force since 1903. The "recent form list" was a list of first-class players and in ordinary tournaments only one or two such players might play in the same team. On the whole, the abolition of offside and the introduction of the system of handicapping improved the game all over the British Empire, for India and the Dominions followed Hurlingham's lead. Matches were closer and combination was not lost.

Polo Ponies.—Up to 1914 the height of ponies was limited to 14·3, official measurers being appointed in England and Ireland. The height measurements were unsatisfactory for many reasons. Cruelty was practised, big ponies with low withers were passed, smaller ones with high withers failed to get through and much expense was entailed. Further, big ponies that failed to pass were promptly sold in the United States, where no measurement rules were in force and in some instances were played in international matches against England.

When the War was over measurement of polo ponies was entirely abandoned. Owing to the losses of thousands of ponies in the War, the cessation of breeding and the consequent difficulty of finding sufficient 14·3 ponies, it was decided that animals of any height might be played. A craze at first rose for big ponies, but it was soon found that the game deteriorated owing to various causes, the chief of which was that what the big ponies gained in pace they lost in handiness. Owing to the scarcity of English ponies, England has become more and more dependent on the Argentine supply, the pony from that country having marvellously improved in quality.

International Polo.—Till 1909 it was not really believed that there was any team in the world that could possibly beat the best English players and the great interest taken now in international polo may be said to have then started. International polo matches have turned polo from what it used to be, more or less a private club game, into a great popular spectacle. The zenith of English polo was reached in 1914 when the Championship Cup, lost in 1909, was brought back to England by Lord Wimborne's soldier team (Captain Leslie Chase, H. A. Tomkinson, F. W. Barrett and V. N. Lockett). In 1911 and 1913 attempts were made to recover the cup, which was only lost by the narrowest of margins and in 1914 victory crowned the efforts of the English team. Then came the War in which many of the best English players lost their lives and during which the training of the young players in polo, and of the boys in riding, ceased for about five years. When it was resumed, the expenses of the game had increased to such an extent that few young civilians could afford to take up the game at all. In England the standard of play had deteriorated, and English teams suffered heavy defeats by America in 1921 at Hurlingham and in 1924 in America. In 1922 an excellent Argentine team visited England, and in 1925 the Jodhpur team came from India. Both of these teams succeeded in winning the Championship Cup, the former going on to America to annex the U.S.A. championship. In 1923 the British Army team was defeated by the American Army in the United States, and in 1925 was again defeated by the American Army in England.

During 1926 perhaps the most hopeful sign for the future of the game in England was the great interest taken by the general public and the tremendous keenness of the players themselves. This is undoubtedly due to the international matches, the visits to England of Argentine, Jodhpur and U.S.A. Army teams and to the fact that the public has been able to witness good matches at Hurlingham, Rugby, Minehead, Cirencester and elsewhere.

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United States.—Polo as played in the United States is a highly scientific, hard-working, out-to-win game. English polo in comparison is slow because so much play is concentrated on the principal fields, in consequence of this the turf and top dressing are badly cut and therefore slow; whereas in the United States there are many exceedingly fast fields on which important matches are played. On these fast fields the slow-field player is confused. Within half an hour's motor ride of the Meadow Brook Club, near New York City, are ten or twelve fast fields, two of

which are conserved to keep them in perfect condition; in the corresponding fields around London two and sometimes three matches are played at each day's gathering. Then, in England, of recent years high-goal men play much with lower-goal men, while in the United States high-goal men play with their handicap peers to a much greater extent, thus continually holding themselves to their highest point of excellence. There is a difference also in method employed in the game. The seat in the saddle is deemed in America as important as the stance at golf; American players hit standing in the stirrups, hit from the heel to the shoulder, whereas Englishmen mainly hit from a seat in the saddle. In the United States novices and even schoolboys are encouraged to take up the game; in a number of places polo is played through the winter by these youngsters under the enthusiastic supervision of crack players from important clubs, who willingly give time and experience to train properly the next generation in this great outdoor game. (W. P. P.*)

POLYTECHNICS: *see* TECHNICAL EDUCATION.

POMARE, SIR MAUI, Maori statesman, was born at Pahou, Taranaki, New Zealand, his father being chief of the Atiawa tribe and his mother a chieftainess of the Ngalitoa tribe. He was educated at a private school at Christchurch and the Te Aute College, Hawkes Bay, and studied medicine at a medical college in Chicago, gaining a doctor's degree. He was appointed chief health officer to the Maoris, was knighted in 1922 and in the following year became Minister for Health. He was also appointed minister for the Cook and other islands and minister representing the Maori race.

PONTOPPIDAN, HENRIK (1857–), Danish author (*see* 22.69), completed *Lykke Per* in 1904. In 1912–6 appeared his trilogy *De Dodes Rige*, dealing with the first decade of the 20th century. In 1917 he received the Nobel Prize for literature, together with K. Gjellerup.

POOR LAW (*see* 22.74a).—Ever since the exposures made by the royal commission on the Poor Laws in 1909, the whole British system of boards of guardians and parish relief has been, so to speak, under sentence of death. Mr. John Burns, President of the Local Government Board at that date, tried to save it by administrative reforms. But those reforms left the fundamental defects of the Poor Law untouched, and they did little to restore it to popular favour. The World War brought a temporary reprieve; the volume of pauperism diminished, and in any case drastic reform would have been impossible under war conditions. (*See* also INSURANCE, SOCIAL.)

Recommendations of 1917.—In 1917, however, a committee, appointed by the Ministry of Reconstruction and presided over by Sir Donald Maclean, re-examined the problem. Its report confirmed the sentence passed by the royal commission eight years before, and made detailed recommendations for the break-up of the Poor Law. It proposed:—

1. The transfer of all the functions of the boards of guardians to the councils of counties, county boroughs and boroughs or urban districts with populations exceeding 50,000.
2. Provision for all the sick and infirm (including the aged requiring institutional care, and maternity cases and infants) should be made by these authorities under the Public Health Acts suitably extended.
3. The Ministry of Health should have power to put any borough with a population over 10,000, or any urban district with over 20,000, in the position of an autonomous health authority, with such reservations as might be desirable.
4. The children should be dealt with by the local education authorities, the mentally deficient by the local lunacy authorities.
5. Every county or county borough (or borough or urban district council with a population over 50,000) should set up: (1) a prevention of unemployment and training committee (on the lines of the education committee, and including representatives of employers and trade unions); (2) a home assistance committee (on the lines of the education committee) to enquire into the economic circumstances of all applicants for public assistance, to supervise them, to administer all relief given in the home, to recover expenses of maintenance, treatment, etc., and to keep a private register of all such applicants and their families and of the assistance given.
6. County councils should appoint committees for districts or combinations of districts, to which various functions of the home assistance committee and the prevention of unemployment committee would be delegated. Such district committees would consist of: (*a*) members of the county council; (*b*) borough or district councillors; (*c*) persons experienced in the work to be done.
7. London should have a special scheme, in which the functions would be divided between the L.C.C. and the metropolitan borough councils. The borough councils would appoint home assistance committees, and would also be responsible for vaccination and registration of births and deaths. The L.C.C. would, through its appropriate committees, exercise the rest of the functions transferred. It would also appoint a central assistance committee, which would lay down a policy and rules of local administration for the home assistance committees in the metropolitan boroughs.
8. Poor Law officials should be transferred to the local authorities (provided both they and the local authorities agreed), and compensated for any pecuniary loss incurred by the change.
9. The cost of all functions transferred should fall on the new authority (the county, county borough, borough or urban district and in London mainly on the county, but partly on the metropolitan borough).

Scotland was outside the committee's terms of reference. But the matter was referred for consideration to the Scottish consultative council on local health administration. The council issued majority and minority reports, the majority declaring in favour of a Scottish scheme on the general lines of the Maclean report.

The Recommendations Examined.—These reforms were not advocated on the ground that the boards of guardians were corrupt or incompetent or remiss in their duty. Broadly speaking, the guardians were recognised to be doing devoted service. But it was the service of an out-of-date principle; relief of the poor by an *ad hoc* destitution authority, employing—and obliged by law to employ—deterrent methods, could not be squared with modern views either of scientific treatment or of efficient administration. And, indeed, it was this very fact which had caused an all-round encroachment on the guardians by other public bodies, better equipped for dealing with the needs of this or that class of the poor. As the Maclean committee put it: "For the last decade Parliament has been unwilling to entrust the boards of guardians with new functions, and the provision for new services has had to be made by other local authorities—in some cases new local authorities—often to the increase of confusion." Thus, with the reversal in 1911 of the "pauper disqualification" clause in the Old Age Pensions Act of 1908 many thousands of the destitute aged became entitled to old-age pensions, and so passed out of the Poor Law. Similarly the National Health Insurance Act took a vast number of patients, or potential patients, from the Poor Law medical service, while later Acts, empowering the local health authorities to set up maternity and infant clinics, to provide midwifery service, to supply milk to expectant and nursing mothers, to treat venereal disease or tuberculosis, still further diminished the scope of the Poor Law.

All this served to reinforce more and more strongly one of the principal charges made by the royal commission in 1909. For it meant in practically every department an increase of administrative disorder—overlapping, multiplication of machinery and waste. In the case of every class of the pauper host, infants, children of school age, the sick, the feeble-minded, the aged, the able-bodied, there was at least one, and generally more than one, other authority set up as a rival to the board of guardians. There was little, if any, co-ordination between the work of the medley of public bodies engaged in giving various forms of assistance out of the rates and taxes. They were in many cases dealing on different lines, and for different reasons, with different members of the same family. So far as the Poor Law guardians were concerned, it was often a mere matter of chance whether it was they or the local health or lunacy or education authority who became responsible for a sick or feeble-minded person or a schoolchild. And as regards the aged, it was found that at the beginning of 1920, out of a total of 46,846 paupers over 70 in England and Wales, no less than 9,345 were old-age pensioners, two-thirds of them receiving outdoor relief and the other third in institutions.

The argument of the Maclean committee, therefore, like that of the royal commission, was based on administrative as well as on humanitarian grounds. The abolition of the Poor Law was

demanded in the interests both of the poor and of the public. The Maclean scheme was approved by the Govt. of the day, and by their successors. Pledges were given, and repeated, that a bill would be brought in so soon as the opportunity could be found. But the opportunity was remarkably elusive, and before long the moribund Poor Law had received an unexpected fillip.

The industrial depression, which began in 1920, led to an appalling increase of unemployment. The Unemployment Insurance Act and such relief works as were instituted soon proved inadequate to meet the situation, and armies of unemployed workers and their dependents had recourse to the guardians for money or the necessaries of life. In Dec. 1920 the total number of persons in receipt of poor relief in England and Wales was 567,900. In the following Oct. it had risen to 1,494,000, and it went on rising till June 1922, when it reached the record of 1,837,980, or one in 21 of the whole population. Thereafter there was a gradual fall, but in June 1923 the figure was still over 1,250,000. Nor, of course, was this burden spread evenly over the 600 odd Unions; it fell heaviest on the most necessitous industrial areas. No less than 30 Poor Law Unions had one in 10, and Poplar and certain others one in five of their population in receipt of parish relief. The poor rates mounted to alarming heights, and in some districts the ratepayers were unable to meet the strain; the guardians had to borrow and thus saddle the rates with a heavy future load.

Two opposite views could be taken of this rush for relief. Defenders of the Poor Law urged that it proved the folly of the abolition policy. It was only the Poor Law, they said, that had enabled us to meet the crisis, and the Minister of Health spoke approvingly of the boards of guardians as "the sheet anchor of the nation." Others, however, passed a very different judgment. They did not blame the guardians; indeed, there was no question of blame, for the guardians were only performing their duty in preventing starvation. But they insisted that the Poor Law was never intended for such a task. Wholesale out-relief to the able-bodied was not among the objects of the Act of 1834; nor could even the most resolute opponent of reform honestly pretend that a board of guardians was a satisfactory unemployment authority, crisis or no crisis. And there was much criticism of the Govt., which, having failed to make proper provision for meeting the exceptional distress, had then, as it was alleged, deliberately encouraged this recourse to the Poor Law in order to divert the cost as far as possible from the taxes to the rates.

But the rising tide of unemployment led also to another startling development in the shape of a struggle between the Poplar board of guardians and the Ministry of Health over what was known as "Poplarism." The Poplar board, dominated by a Socialist majority, had long favoured the policy of giving what it regarded as adequate, and its critics as extravagant, outdoor relief. But in the circumstances of 1919 this policy meant an intolerable burden on the ratepayers. Efforts were made to get the Minister of Health to devise means for mitigating this burden in the poorer parishes, but in vain. The Poplar Borough Council then refused to collect the rates for the L.C.C. and certain other central bodies. Legal proceedings were taken, and the High Court ordered the collection of the rates. The Borough Council ignored the order, and 29 of its members were imprisoned for contempt of court. Following upon this a concession was made to the Poplar claim by the passage of the Local Authorities (Financial Provisions) Act, 1921, which provided for a large measure of equalisation in London, and in particular laid down that the cost of outdoor relief should be borne by the Metropolitan Common Poor Fund within the limits of a scale to be fixed by the minister.

The "Mond" scale, so called because Sir Alfred Mond was then Minister of Health, was issued in Jan. 1922. It did not satisfy the Poplar guardians, who now pressed for a loan to tide them over their immediate difficulties. A special inquiry was then instituted by the minister into the circumstances of Poplar. The report was unfavourable to the guardians, condemning their policy and declaring that by more economical methods they could save £100,000 a year. As they refused to abandon their claim to administer relief at their discretion, the minister issued a peremptory Order, applying to the Poplar Union alone, and providing that no relief in excess of the "Mond" scale to an able-bodied person or any member of his family should be legal unless specially sanctioned by the minister. This order the Poplar guardians continued to defy, and so laid themselves open to surcharge. A curious complication was presently introduced by the Local Authorities (Emergency Provisions) Act, 1923, which apparently revoked automatically the "Mond scale," but left the special Poplar Order intact, though the two had been closely bound up together. This anomaly lasted till Feb. 1924, when the Poplar Order was rescinded. The Poplar guardians meanwhile were regularly surcharged by the auditor, but successive Ministers of Health ignored the surcharges, until at length, in Feb. 1924, Mr. Wheatley announced that he would take no action to enforce surcharges in respect of "illegal relief" given before the rescission of the Poplar Order. That was the end of this particular struggle, though it was not the end of the policy of high relief scales. Other boards of guardians continued to favour "Poplarism," and came into conflict from time to time with the Ministry of Health.

The history of the Poplar case illustrates some of the worst features of the Poor Law system—the problem of "necessitous areas," for example, the unsatisfactory relations between the central and the local authorities, and above all the unsuitability of the guardians to deal with unemployment. This indeed was recognised by the Poplar Board as well as by its critics, and drastic legislation was expected from the Labour Government. The Labour Govt., however, fell before it could prepare a bill, and the task of breaking up the Poor Law was left to its successors.

Towards the end of 1925 Mr. Neville Chamberlain, Minister of Health in the Conservative Govt., issued his "proposals for Poor Law reform," after successfully piloting through Parliament a Rating and Valuation bill which prepared the way for the abolition of the guardians. Under this statute the parish disappears as the valuation area, the board of guardians no longer appoints the assessment committee, and all the rating functions of the overseers of the poor are transferred to the town and district councils. The Act comes into force on April 1 1927.

The main points of Mr. Chamberlain's Poor Law scheme are:—

(1) Boards of guardians to be abolished.

(2) Registration of births, deaths and marriages to be transferred to electoral registration officers acting for counties and county boroughs.

(3) The rest of their functions, and their property (including institutions), liabilities and staffs to be transferred to the county and county borough councils.

(4) County borough councils to provide at their own discretion for the carrying out of the transferred duties.

(5) The county council to be the supervising and controlling authority for all health purposes and to have complete responsibility for "home assistance" throughout the administrative county. The transferred duties to be carried out "through existing or new committees of the council, assisted where necessary by local sub-committees consisting of county councillors, or partly of county councillors and partly of representatives of the borough and district councils of the localities" (or of the metropolitan borough councils in London). But delegation to be allowed to borough and district councils (or metropolitan borough councils in London) of "any transferred service identical in kind with a service already administered by the borough or district council" (*e.g.*, care of infancy and expectant or nursing mothers).

(6) Relief to able-bodied persons to be limited and correlated with unemployment insurance.

(7) The assigned revenue system to be abolished. Block grants fixed for a term of years to be paid in aid of transferred and existing health services and distributed to county and county borough councils on a basis of population qualified by a factor representing low ability to pay. The cost of delegated services to be borne by the borough or district councils to which they are delegated.

This scheme, it will be seen, is based in principle on the Maclean report. But it has certain differences of detail, some of them important. In particular, it gives a greater power to the counties, allowing no such autonomy as the Maclean report recommended to the larger non-county boroughs and urban districts. It also contemplates some special system of dealing with the able-bodied unemployed, though what that system is to be cannot be

discovered from the brief and obscure statement (see 6, ante) in which it is adumbrated. The whole scheme, however, was stated by the minister to be provisional; it was issued primarily for consideration and criticism by the local authorities and others concerned. There was no likelihood of a bill being passed before the session of 1927.

The number of persons in receipt of poor relief in England and Wales at the end of Dec. 1925 was 1,324,314 (222,494 in institutions and 1,101,820 relieved at home). This figure does not include lunatics in asylums, casuals or persons receiving medical relief only, who together amounted to about 119,000. The totals in previous years were:—

1913	632,242	1922	1,406,028
1919	483,148	1923	1,240,723
1920	567,909	1924	1,071,945
1921	1,375,982		

(See Ministry of Health "Statement showing the Number of Persons in receipt of Poor Law Relief in England and Wales in the Quarter ending in Dec. 1925," 1926.)

The following table shows the total expenditure (other than out of loans) on all Poor Law services in England and Wales in the post-War period.

Year ending March 31:—

	£		£
1919	18,424,000	1922	42,272,555
1920	23,501,000	1923	42,020,000
1921	31,925,000	1924	37,883,000
		1925	36,500,000

Of the 1925 total of £36,500,000 about £31,000,000 was borne by the rates, as compared with £32,571,000 in 1923–4, £38,537,000 in 1922–3 and £12,078,000 in the year before the World War.

In Scotland, in May 1924, the total number of legal poor of all classes, including dependents, was 229,019. The great majority were on outdoor relief; 17,486 were insane, maintained in asylums, poorhouse wards or private dwellings. Of the sane, 11,091 (including nearly 1,000 children) were in the poorhouses, and the destitute able-bodied unemployed numbered 30,000. Scottish Poor Law expenditure for 1923–4 amounted to £4,370,609, as compared with £4,538,127 in 1922–3, £2,093,523 in 1919–20, and £1,609,538 in 1913–4. These totals include the amounts spent on relief of able-bodied unemployment, which were £1,286,654 in 1923–4 and £1,466,891 in 1922-3.

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POPE, JOHN RUSSELL (1874–), American architect, was born in New York City April 24 1874. He was educated at the College of the City of New York, and graduated at the School of Mines, Columbia University, in 1894. In 1895 he was fellow of the American Academy at Rome and in 1896–7 held the Schermerhorn travelling fellowship in architecture. In 1900 he attended the Ecole des Beaux Arts in Paris, and in the same year commenced practice in New York City. In addition to many private residences he designed the Scottish Rite Temple, Washington, D. C.; Plattsburg (N. Y.) City Hall; the Terminal Station, Richmond, Va.; the McDonough Memorial at Plattsburg; and the Lincoln Memorial at Hodgenville, Kentucky. He was chosen architect for the Roosevelt Memorial in Washington, D. C., and the Roosevelt Memorial in New York City.

POPE, SIR WILLIAM JACKSON (1870–), British chemist, was born in London March 31 1870, and was educated at Finsbury technical college, and the central technical college, London. From 1897 to 1901 he was head of the chemistry department at the Goldsmith's Institute, and in 1901 he became professor of chemistry at the municipal school of technology at Manchester, occupying the chair of chemistry in the university there from 1905 to 1908. In 1908 he was appointed professor of chemistry at Cambridge, where he was later elected a fellow of Sydney Sussex College. Pope carried out much valuable research work on organic chemistry and crystallography, with particular reference to optical activity, and, conjointly with Barlow, on the relation between crystalline form and chemical constitution. During the World War he served on Lord Fisher's Admiralty Inventions Board (1915), and was conspicuous for his work on poison gases, and for the active assistance he gave to chemical industries. He was knighted in 1919, and was in addition the recipient of many British and foreign awards, including the Davy Medal of the Royal Society, to which he was elected, in 1914. His numerous scientific papers appear in various learned journals.

POPPER, DAVID (1846–1913), Bohemian violoncellist (*see* 22.91), died Aug. 7 1913.

POPULATION (*see* 22.92).—About two-thirds of the inhabitants of the world are now periodically enumerated by means of a census. Whenever a census is taken questions are asked regarding some or all of the following matters: age, sex, occupation, place of residence, religion and others. Thus, regarding two-thirds of the inhabitants of the world there is a considerable volume of information of a fair degree of accuracy. The questions asked vary considerably from country to country. Since information is nearly always required regarding age, sex and marital condition, the inhabitants of different countries, the population of which is periodically enumerated, can be compared in respect to these matters.

But with regard to the asking of questions concerning other matters much variation exists, and comparisons are often rendered impossible. There is no question regarding religion in the English census, for example, and comparisons in this respect between England and other countries where such information is collected are therefore not possible. For information regarding the remaining third of the world population it is necessary to rely upon estimates. No great degree of confidence can be placed upon these estimates, and a wide margin of error must be allowed for. Furthermore, estimates can only be made for the total population. It is impossible to estimate the distribution of the population in respect to age or sex, and as to this, therefore, for the remaining third of the world population there is no information at all.

The first step is to analyse and tabulate this information so as to throw light upon such points as it is desirable to investigate. The information contained in recent enumerations can be compared with that contained in former enumerations. The next step is to enquire how the population of any area comes to be what it is and how the changes found to have taken place between one enumeration and another have been brought about. This involves an examination of the facts regarding marriages, births, deaths and migration which are generally recorded annually for those areas in which a census is taken. From these registration statistics it is possible, for example, to throw light upon the proportion between the sexes as disclosed by the census figures. It can be shown that there is a certain proportion of male to female births and that the death-rate differs for males and females in each age period. In this manner an explanation is provided of the facts given by the enumeration. The attempt can then be made to push the explanation further back. The problem as to the cause of the difference in the proportion of male to female births can for instance be investigated. But such enquiries pass beyond the field of what is usually included in the study of the population problem, and attention in this article is confined to the study of the facts as disclosed by censuses and estimates and to the immediate explanations of these facts as far as registration statistics throw light upon them.

I. WORLD POPULATION AND ITS DISTRIBUTION

Geographical Distribution.—Of the many estimates of the population of the world that have been made the best known are those of MM. Levasseur and Bodio for the years 1880 and 1900 and of M. Bunle for 1920. Since the census figures and estimates used

in making these calculations were those available nearest the years 1880, 1900 and 1920 the totals given below should be read as estimates of the population "about" 1880, 1900 and 1920 respectively. Thus the British figures included in the 1920 estimate are those given in the census of 1921.

TABLE I. *Estimated Area and Population of the World*

Region	Area in thousands of square miles	Population in millions in			Density per square mile in 1920
		1880	1900	1920	
Europe	3,899	347	401	451	116·5
Africa	11,766	197	135	132	11·0
Asia	16,173	789	850	956	59·6
N. America	9,891 [1]	80	107	144	14·5
S. America	7,096	32	43	67	9·3
Oceania	4,231	38	52	69	16·3
Totals	53,056	1,483	1,588	1,819	...

[1] Including approximately 3,222,000 sq. m. of arctic and sub-arctic territories.

In compiling these estimates the Malay Islands have been included in Oceania, whereas in other estimates they are sometimes included in Asia. To what extent can these estimates be relied upon? No very high degree of accuracy can be attributed to the totals of the earlier estimates. As M. Bunle points out, while the areas of the continents given in the above table may be taken as approximately accurate, the 1920 figures for Africa and Asia and to a lesser extent for the other continents, with the exception of Europe, differ from those given by MM. Levasseur and Bodio when making the earlier estimates. The areas have of course not in fact changed, and the differences are due to more accurate recent measurements. It is evident that if the areas were not even known with accuracy when the earlier estimates of population were made, these latter estimates are likely to have exhibited a much larger margin of error. That the estimated population given in the above table for 1920, however, is not likely to be seriously in error may be deduced from the fact that it agrees fairly closely with other independent estimates. Thus the International Institute of Agriculture at Rome gives the estimated population of the world as 1,820 millions for 1921 and the Institut International de Statistique 1,791 millions for 1920 and 1,895 millions for 1924.

The Various Continents.—Considering the continents in turn, the figures for Europe and North America may be accepted as approximately accurate, though some doubt arises concerning the figures for Russia and Mexico. It is thus seen that whereas the population of Europe has increased by about 50,000,000 in each of the periods 1880–1900 and 1900–20, the population of North America has increased by about 25,000,000 in the first period and by about 37,000,000 in the second period. The difference between the two continents in this respect in the later period is partly to be explained by migration from the former to the latter and partly by the effects of the World War. The figures for Oceania are probably more accurate than those given for any of the other remaining areas. In twenty years the population appears to have increased about 30%, which is approximately the rate of growth found for the population of North America. While very considerable progress has been made during recent years in the enumeration of the inhabitants of certain South American countries, especially of Brazil, Argentina, Chili and Uruguay, there remains a large measure of doubt as to the present population of the continent. The figures for the earlier years are still more open to suspicion. There is no question but that the population of this continent has increased largely since 1906; it may be doubted, however, whether it has increased to the extent which these figures show.

The figures for Asia are still less trustworthy. For some areas of that continent, India and Japan for example, there are reliable figures. But for other areas, China in particular, the estimates vary widely. M. Bunle accepts the estimate of 445,000,000 for China, Manchuria and the Chinese dependencies made in connection with the Chinese postal administration for 1921. This estimate is among the highest, but it agrees closely with those of the Chinese Maritime Customs for 1922 and of the China Continuation Committee for 1918. There are estimates as low as the 318,000,000 given by current books of reference. These low estimates have apparently been influenced by the census of 1910, which was a census of households and not of persons. Furthermore, the households were multiplied by different factors in different parts of the country to get the total number of persons —an obviously unsatisfactory method. Given this uncertainty

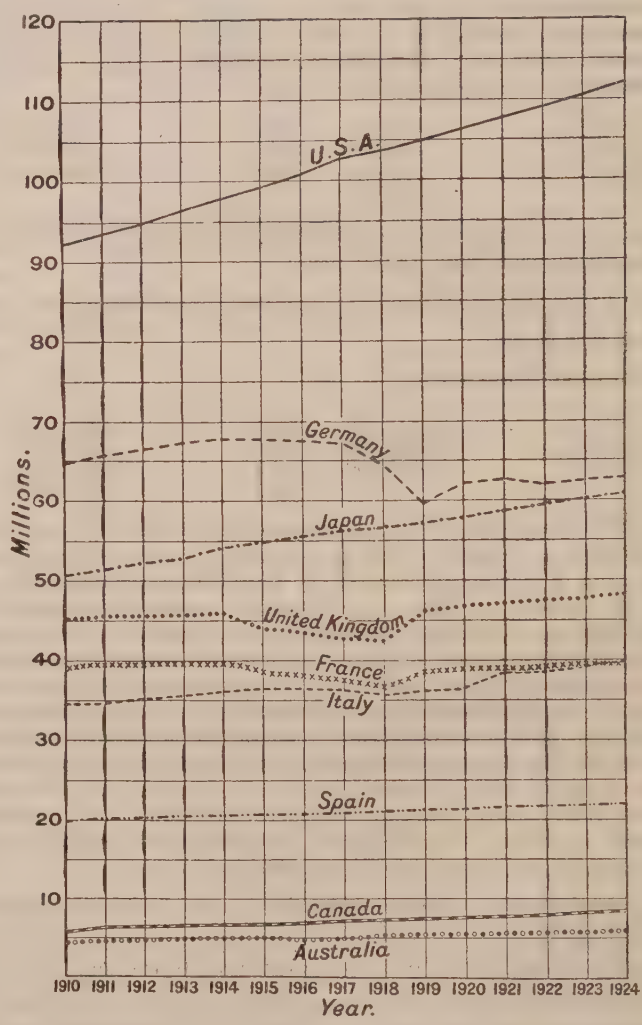

FIG. 1.—Chart showing the changes in the populations of certain selected countries from 1910 to 1924. The most marked features are the effect of the war upon the populations of the United Kingdom (which includes the area now called the Irish Free State), Germany, France and Italy; and the rapid increase in the populations of the United States and Japan.

regarding the population of China, it is evident, especially in view of the tendency to accept a higher estimate, that no reliance whatever can be placed upon the apparent growth in the population of Asia shown in the table as taking place between 1900 and 1920. The difference between the estimate for the population of Asia for these dates is less than the difference between the estimates of the population of China at the present day. Similarly, no confidence can be placed upon the apparent decrease in the population of Africa between 1880 and 1920. Estimates for the population of the Belgian Congo vary from 8,000,000 to 30,000,000. In large part the difference between the figures is due to the acceptance of lower estimates for the negro population. At the same time, parts of the continent have been ravaged by sleeping sickness and other diseases in late years and it is at least unlikely that there has been any increase in the population.

While it is not possible to obtain any accurate measurement of the proportion of the world population represented by the populations of the different continents at various dates and thus

to record the relative advance of the populations of some continents compared with others, it is possible to obtain a fairly accurate measurement of the changing proportion of the total population of Europe shown by various European countries. A similar calculation can be made for North and South America, though it would be misleading to take the figures back to so early a date as in Europe, since it is only of late years that the data have attained a reasonable degree of accuracy. The following table therefore shows the proportion which the population of the principal countries of Europe contributed to the total population in 1880, 1910 and 1920, and the proportion contributed by the principal countries of North and South America in 1910 and 1920.

TABLE II. *The Proportion of the Total Population of Europe (=100) and of America (=100) Contributed by Certain European and American Countries at Various Dates*

Europe				North and South America		
Country	1880	1910	1920	Country	1910	1920
England & Wales	7·77	8·06	8·38	Argentina	3·93	4·14
Scotland	1·12	1·06	1·08	Brazil	12·98	14·73
Ireland	1·55	·98	·98	Canada	3·99	4·23
France	11·20	8·76	8·67	Chili	1·80	1·81
Germany	13·54	14·52	13·24	Colombia	2·83	2·81
Austria	6·63	6·38	1·42	Cuba	1·19	1·39
Belgium	1·65	1·66	1·65	Mexico	8·40	6·68
Hungary	4·71	4·67	1·77	Peru	2·49	2·40
Italy	8·52	7·75	8·59	United States	50·98	50·84
Russia	25·82	29·13	22·50	Venezuela	1·48	1·16
All other countries	17·49	17·03	31·72	All other countries	9·93	9·81

Between 1880 and 1910 there were no changes in the frontiers of European countries, and the alterations in the relative positions of the various countries are due to varying rates of increase. The notable features are the decline in the position of France and the advance in the position of Russia. Between 1910 and 1920 there were large losses and large gains of territory in many countries. In addition, all European countries experienced an increased death-rate. Thus, in the case of the 1920 figures the changes due to varying rates of increase are overshadowed by the effects of the War. These effects have been remarkable. It is noticeable that France, in spite of an increase in territory, has not quite maintained her position, and that Germany, in spite of a large decrease in territory, has suffered comparatively little. Austria and Hungary now contribute less than 2% each to the population of Europe. The figures for North and South America are interesting in that they show that the various countries tend to maintain their relative position.

Racial Distribution.—It is necessary to exercise the greatest caution in the use of the term "race." If by racial groups are meant groups of men exhibiting in common certain inherited character differences, then we may legitimately employ the term. There are groups of men exhibiting in common certain inherited characteristics in respect of hair, pigmentation and other physical features, and it may be asked what proportion of the population of the world falls into each of the larger groups. To this question no satisfactory answer can be returned. Not only in South America, for example, is the total population not accurately known but trustworthy data as to the proportion which each racial group, Caucasian, Negroid and Amerindian, contributes respectively to the estimated total are wholly lacking. The same applies to Asia and Africa. An estimate has been made by Sir Leo Chiozza Money of the total numbers of the so-called "white race," an element of the Caucasian group formerly more or less confined to Europe. He finds that out of an estimated world population of 1,852 millions in 1921, there were 603,000,000 belonging to this white element, that is to say, rather less than a third of the total world population. He also finds that of the 603,000,000 about 117,000,000, or less than a fifth, are of British stock. If these 600,000,000 whites are subtracted from the total world population, leaving some 1,250 millions to be distributed among the remaining racial groups, then it may be very roughly estimated that about half this number belong to the Mongoloid racial group, while two-thirds of the balance belong to the non-White branch of the Caucasian group and one-third to the Negroid racial group.

It thus appears that the white branch of the Caucasian racial group and the Mongoloid group between them account for about two-thirds of the population of the world. In the absence of accurate information as to the constitution of the population of the world to-day it is clearly impossible to discover whether the different racial groups are maintaining their relative positions or whether one or more groups have improved their relative positions since 1900 or 1880. It can only be said that the white element of the Caucasian group, which was during the greater part of the last century considerably improving its position, is in any case not now doing so in the same ratio if indeed it is improving it at all.

II. ECONOMIC DISTRIBUTION

Density.—In Table I. is shown the density per sq. m. of the population of each continent. The average density of population for the whole land area included in the table is 34 per sq. mile. From this table the uninhabited continent of Antarctica is excluded. It should be noted that no deduction has been made on account of the barren and almost uninhabitable areas which are included within every other continent. The inclusion of these areas tells least against Europe and most against North America. Thus Greenland, Alaska, the Northwest territories of Canada, Labrador and the Arctic Islands, cover an area of approximately 3,222,000 sq. m., and contain a population amounting only to about 113,000. If these areas are excluded the average density of population in the rest of North America rises from about 14 to about 22 per sq. m. and in the world as a whole to about 36. Taking the figures as they are, it appears that Europe and Asia are the most crowded continents, Europe being about twice as densely peopled as Asia. The remaining continents are, relatively speaking, empty.

Among countries and areas which are regarded as distinct units from the point of view of political organisation, Barbados is the most densely populated, having (in 1921) 952 per sq. m., while Java comes next with (in 1920) 689 per sq. mile. Belgium is the most densely populated among European countries with 635 per sq. m. (in 1920), while Great Britain has 482 per sq. m. (in 1921). It is worthy of notice that England and Wales have a density of 649 per sq. m. (in 1921) and are therefore more densely peopled than Belgium. Such comparisons can be widely extended and up to a point are informative. It should be remembered that they may also be very misleading. The area of Egypt is, for example, 383,000 sq. m., and the total population amounts to 12,750,000, giving an average density of 33 per sq. mile. But the population of Egypt is almost wholly confined to the valley and delta of the Nile, the areas of which contain 12,023 sq. m., giving a density of 1,061 per sq. m. of the inhabited area. So, too, the figure of 1·83 per sq. m. for the continent of Australia misrepresents the facts. A considerable proportion of the continent is uninhabitable, and if this part was excluded from the calculation the density per sq. m. would be appreciably raised.

The figures for density given above fail to bring out certain important facts. An examination of the map of the world showing density of population without regard to political boundaries makes it at once apparent that there are three densely populated regions of no great size. The first region is that part of Europe which lies south of the parallel 60° north latitude. The second is that made up of the greater part of India and Ceylon; the third includes Japan, the greater part of Manchuria and China and a strip along the coast of Tonking. It may be roughly estimated that the population of these regions amounts to 440,000,000, 480,000,000 and 300,000,000 and the areas to 2,900,000, 2,000,000 and 1,200,000 sq. m. respectively. We thus find over 1,200 million people living on about 6,000,000 sq. m., or in other words about two-thirds of the world population living on about one-eighth of the habitable area. There are four other very much smaller regions which are densely peopled, the New England area of the United States, the Nile valley and delta, the tip of the Malay Peninsula and Java.

Urbanisation.—As seen above, figures for average density may be misleading if within the area of a country or region there

are large barren tracts. But even if they are not misleading, or if calculations are made to correct the misleading impression otherwise given, such figures fail in themselves to provide an adequate picture of the conditions under which the inhabitants of an area are living unless they are supplemented by facts throwing light upon the degree of urbanisation.

It is not an easy matter to obtain a measure of urbanisation. The census returns of most countries classify the population into urban and rural, but while these figures are useful for comparing changes in the same country between two dates, they are of little use when comparing two countries. This is so because the classification is based upon very different methods in different countries. Thus, owing to differences in local government between England and Scotland, the figures giving the percentages of urban dwellers out of the total populations are not comparable. Again, those officially classed as urban dwellers often live under what to most people would appear as rural conditions. English urban dwellers include, for instance, according to the official classification, those who live in the areas of urban district councils and, as is well known, to live in such an area is often regarded as having escaped from a town. The best method is perhaps to note, in the table below, the percentage of the total population living in towns having a population of 100,000 and over.

TABLE III. *Density of Population and Urbanisation: 1920*

Country	Population per square mile	Percentage of population living in towns having 100,000 inhabitants and over
Egypt (cultivated area only)	1,061	9·9
England and Wales	649	38·8
Japan	484	12·1
Italy	329	13·7
Germany	319	23·7
China	274	2·2
France	184	15·0
India	177	2·6
Russia (in Europe)	57	4·0
United States	35	25·7
Canada (excluding North West territories)	3	18·9
Australia	1·83	41·3

This table must be interpreted with caution. The method of calculating urbanisation here adopted is not perfect. The urbanisation of Australia, for example, is exaggerated. The urban population of Australia is concentrated in five large towns and there are few towns of relatively small size. If 50,000 instead of 100,000 was taken as the lower limit, Australia would come out as relatively less urbanised than under the present method of calculating urbanisation. Allowing for its defects, the table does show that there is little association between density of population and urbanisation. Densely populated countries may or may not have a high degree of urbanisation; Australia is an example of a sparsely peopled country with a high degree of urbanisation. Further examination of the table shows that urbanisation goes with industrialisation rather than with density. In other words, a high degree of density without industrialisation does not lead to urbanisation, whereas urbanisation can go a long way where industrialisation prevails, even though the population is sparse. The countries which have a high degree of density without urbanisation are those such as China, India and Egypt, where intensive agriculture is practised. Density thus accompanies intensive agriculture and may also be attained under industrial condition.

There were, in 1920, 16 towns with a population of over 1,000,000 apiece. Of them six were in Europe, five in Asia, three in North America and two in South America. One remarkable result of the War has been the decline in the population of certain great towns. Thus between 1910 and 1920 Moscow decreased from 1,481 to 1,028, Leningrad from 1,907 to 706 and Vienna from 2,030 to 1,841 millions.

TABLE IV. *Proportion of the Sexes Living and at Birth About 1910 and 1920, in Certain European Countries*

Country	No. of females to 1,000 males		No. of male births to 1,000 female births about 1920		
	about 1910	about 1920	Born living	Born dead	Total
Germany	1026	1091	1072	1260	1077
Austria	1036	1089	1073	1327	1080
Belgium	1016	1032	1060	1287	1069
Bulgaria	961	1002	1068	1378	1069
Denmark	1060	1053	1044	1231	1049
Spain	1056	1062	1099	1402	1106
France	1035	..	1059	1395	1073
England	1067	1091	1052	..	..
Scotland	1062	1079	1043	..	..
Ireland	1002	..	..	..	..
Greece	986	..	1163	1511	1167
Italy	1036	..	1060	1276	1069
Norway	1099	1053	1056	1229	1060
Holland	1020	1012	1063	1246	1069
Portugal	1107	1113	1048	1301	1057
Rumania	973	..	1061	..	..
Russia	1038	1224	..	..	..
Serbia	945	..	..	..	..
Sweden	1046	1037	1064	1296	1069
Switzerland	1033	1070	1065	1293	1071

III. DISTRIBUTION BY SEX AND AGE

Sex.—It is a familiar fact that in Great Britain and most European countries females outnumber males. The extent to which this is the case is shown in Tables IV. and IV.-A. The tables show the number of females to 1,000 males in certain European countries about the years 1910 and 1920 and in certain non-European countries about the year 1920.

The European countries include all the larger ones, among them Russia, Germany and France, and most of the smaller ones. The newer countries *e.g.*, Czechoslovakia and Yugoslavia are not included, as in their case there is no information about conditions in 1910. Wales, as usual in such cases, is treated with England, but separate figures are given for Scotland. The non-European countries are the United States, Canada, Australia, India, Japan, South Africa and Egypt, for all of which the necessary statistics are available.

As regards the figures for the European countries for which there is information at both dates, it is seen that in the case of the countries neutral during the War there has been little change on the whole in the proportion between the sexes, whereas in the case of belligerent countries the former considerable excess of females was increased. Belligerent countries are therefore abnormal in respect of the existing large excess of females, and the increased disparity between the sexes is due to deaths of males during the War. The exceptional case of the lately belligerent countries may be thus left out of account, and the proportions about 1910 taken as more normal for European conditions. It next appears that most European countries are strongly contrasted with those extra-European countries for which figures are given. The latter show a deficiency of females.

TABLE IV.-A. *Proportion of the Sexes Living and at Birth in Certain Non-European Countries about 1920*

Country	No. of females to 1,000 males about 1920	No. of male births to 1,000 female births about 1920		
		Born living	Born dead	Total
U.S.A.	960	..	..	..
Canada	940	1065	1402	1075
Egypt	997	1093	1512	1097
South Africa[1]	943	1076	..	..
Japan	979	1045	1176	1053
India	928	..	..	..
Australia	968	1062	..	..

[1] Excluding coloured population.

TABLE V. *Death-rate among Males Expressed as a Percentage of the Death-rate among Females at Different Age Periods*

Country	under 1	Age Periods 1–4	5–9	10–14	15–19	20–24	25–34	35–44	45–54	55–64	65–74	75 and over
England and Wales 1911–5	119	103	95	115	125	125	125	128	130	125	116	111
U.S.A. Registration Area 1911–5	120	114	110	115	118	116	112	127	120	114	106	

Country	Age Periods under 1	1–19	20–39	40–60	60 and over
Japan 1918	125	88	81	118	97

The next step is to examine the sex ratio at birth. The differences noted might be due to an excess of female births in some countries and of male births in others. The figures in the table show that this is not so. For all countries for which figures are given there is an excess of living male births. Accepting this as a fact, how, it may be asked, is the excess of females in Europe and the deficiency of females in other countries arrived at? Table V. shows that in England and Wales and in the United States registration area during the years 1911–5 females in every age group experienced a lower death-rate than males with the one exception of the age group 10–15 in England and Wales, where the males have the lower death-rate.

It thus comes about that, although in the earliest age groups males outnumber females because more boys are born than girls, females soon come to outnumber males and in fact preponderate in the age group 15–20 in England and Wales and in all succeeding age groups. Thus, taking the population as a whole, females outnumber males. It may then be asked why females have this more favourable experience. There are two reasons which account for this fact. The female sex is more hardy than the male sex, and on the whole resists disease and the wear and tear of daily existence better than does the other sex. Again, females are less exposed to accidents than males. Thus, industrial accidents, as exemplified by mining disasters and explosions, fall more heavily upon the latter than upon the former. Men, in fact, lead a more hazardous existence, and more often lose their lives at work or at play than do females. The outbreak of war is only a special case of the extra exposure of males to risk.

There are, however, countries where males predominate. This is so in the United States, for instance, and since Table V. shows that the male death-rate there exceeds the female death-rate to nearly the same extent that it does in England some explanation is clearly required to account for the difference between the United States and England in this respect. The explanation is to be found in the fact that large numbers of emigrants from Europe have entered the United States during recent years, and that among these emigrants males preponderate. This tendency for males to migrate more than females accounts also in some degree for the deficiency of males in those European countries from which movement takes place. The excess of males in the United States is found chiefly among the foreign-born whites and not amongst the native-born whites and negroes. Again, in the densely settled regions of that country females outnumber males. The same factor explains the excess of males in the British Dominions. This factor cannot, however, be invoked to explain the position in India, Japan and Egypt. Table V. shows that in Japan the female sex experiences a higher mortality than the male sex between the ages of 1 and 40. This higher mortality is clearly the cause of the excess of males in that country.

It is outside the scope of this article to discuss the determination of sex. The figures in Table IV., however, carry us somewhat further back. So far, reference has only been made to the figures for living births, which show that more males are born alive than females. Reference may now be made to the figures for still births, and it will be observed that males bear a higher proportion to females among still births than they do among living births in every country for which figures are available. Males thus suffer a high mortality at birth, and the original disproportion between the sexes must be higher than the statistics for living births show. Evidence derived from observations upon miscarriages and from other sources goes to show that males suffer a disproportionately heavy mortality at a still earlier stage during pre-natal life. It thus follows that the proportion of males to females must be very much higher at conception than it is at birth. It may be observed that modern investigations into the determination of sex have shown that sex is determined at conception and cannot be influenced by any method now known. Nor is any method of so doing likely to be discovered.

Distribution by Age.—It is in theory possible to have a population distributed in almost any fashion according to age. Thus, an uninhabited island might be peopled by boys or girls or by persons 60 years of age and over. When the populations of different countries are examined it is found that there are remarkable differences in respect to age distribution. Thus, one country may have a relatively large number of young persons and another a relatively large number of old persons. These differences are of interest from two points of view. First, the proportion of persons of working age is important because upon their efforts depend the rest of the non-working population, both young and old. Again, only when the age distribution is known can the figures for birth-rates and death-rates be interpreted. It may be known that there are a certain number of births per 1,000 of the population and a certain number of deaths per 1,000 of the population in a certain area during a certain year, but, unless it is also known how many wives of child-bearing age and how many old persons there are in every 1,000 of the population, this information is of little use in enabling comparisons to be undertaken between one country and another or between one town and another. Thus, old people might retire in large numbers to a healthy town and live there until their death, thus causing a high death-rate and giving the appearance of bad conditions in what was in fact a healthy town.

Table VI. gives some information as to the age distribution in certain countries:—

Figures such as these are not of a very high order of accuracy. Ignorance and mis-statement vitiate the data to some extent. There seems to be a tendency for persons below a certain age to understate their age and for persons above a certain age to overstate their age. This may be in general attributed to vanity, the young being proud of their youth and wishing to appear even younger and the aged being proud of their advanced years and wishing to appear even older. Nevertheless, the figures are of sufficient accuracy to bring out some remarkable differences in age distribution as between different countries.

The influence of the decline of the birth-rate is best seen in the case of England and Scotland when the age distribution of 1911 is compared with that of 1921. The number of those under five years of age has decreased, while there has been a marked increase in the number of those over 45. If the number of those of 65 years and over

TABLE VI. *Number of Persons at Different Ages per 1,000 of the Total Population about 1911 and 1920*

Ages	England and Wales		Scotland		U.S.A.		Australia		France	Germany	Prussia	Japan	England & Wales
	1911	1920	1911	1920	1911	1920	1911	1920	1911	1911	1920	1920	1881
Under 5	107	88	112	97	116	110	119	116	89	120	74	129	136
5–15	199	189	210	198	205	209	199	206	169	220	221	222	229
15–25	182	176	185	186	197	177	202	167	160	183	194	179	188
25–45	299	293	282	276	292	296	288	298	291	273	284	261	259
45 and over	213	254	211	243	190	208	192	213	291	204	227	209	188
All ages	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

is considered, it is found that there were in every thousand of the population 52 in this age group in 1911 and 60 in 1921. Since persons of these ages are for the most part dependent upon others for their support, it will be seen how the burden increases which a declining birth-rate places upon the producing section of the community. There is a close similarity between the figures for the United States and Australia. Both countries have experienced the influence of immigration and of a declining birth-rate. The figures for France and Germany are pre-War figures. The birth-rate of France has long been steady, and it is towards some such age distribution as that now seen in France that the age distribution in England is tending. Figures for the whole of Germany since the War are not available but, in so far as Prussia is representative of German conditions, the influence of the decline of the birth-rate upon the age distribution can also be seen in Germany. In the last two lines of the table the figures for Japan in 1918 and for England in 1881 have been set out, and it is evident that the present constitution of the Japanese population in respect to age closely resembles that of the population of England and Wales 40 years ago.

How do these differences arise? If the birth-rate and the death-rate remained constant in a country over a period of years and if there was no migration, the population would become and remain distributed according to age in a certain fashion. It is because the birth-rate, death-rate and migration rate change in the same country as between one period and another and because they do not change similarly in different countries that there are differences in age distribution as between the population of the same country at different times and between different countries at the same time. The case of England and Wales may be taken as an example. During the last century the death-rate declined, and principally as a result of this the population rapidly increased. The population of England and Wales in 1861 was 20,066,224, and in 1921 was 37,886,699, and in consequence persons of 60 years of age and over are the remnant of a population little more than half as large as the existing population.

But the birth-rate has been decreasing for half a century. It can be calculated that, if the birth-rate remains at about its present level and if the death-rate does not change significantly, the population will cease to increase within two decades, and will remain approximately stable. Under these circumstances the age distribution would become stabilised. This example explains the differences between the age distribution in France and England, since in the former country there has been little change for some years, with the result that there is a larger proportion of old persons than in this country. Migration largely explains the high proportion of younger persons in the Dominions, and similarly explains the deficiency of such persons in Ireland.

IV. MARRIAGE, BIRTH AND DEATH RATES

Marriage.—The age distribution of the population is given in the census returns, but the attempt to interpret changes in the age distribution leads to the employment of data regarding birth-rates and death-rates which are obtained from registration statistics. Similarly, certain data regarding marriage can be obtained from the census returns, but for the interpretation of these figures recourse must be had to registration statistics of marriage. One method of representing the facts is to give the number of married persons per 1,000 of the population. This method is open to the objection that, since the age distribution in the same country at different times and in different countries at the same time is not the same, figures are not comparable. Another method is to give the number of married persons per 10,000 of the marriageable population. The marriageable population is defined as consisting of all males 18 years of age and over and of all females of 15 years of age and over, excluding only those of either sex who are married. This latter method is to be preferred, though it is applicable only to countries with European standards and habits. It fails to represent, for instance, the true condition of things in India, where in 1921 there were 110,684 boys and 218,463 girls married under five years of age and 757,405 boys and 2,016,687 girls married between the ages of five and 10. Further, there were over 2,000,000 boys and 6,000,000 girls married between the ages of 10 and 14.

The table brings out the fact that the different countries vary in a striking manner in respect of the marriage rate thus calculated. There is a group of Western European countries where the rate tends to exceed 500, and a group of Eastern European countries where it approaches or exceeds 1,000. The rate has not tended to vary widely in each country during the period to which the figures apply. Generally speaking, countries that had a high rate around 1876 have maintained that rate, and countries with a low rate have maintained a low rate. It has long been known that the marriage rate in England tends to vary in the same direction as the price of wheat, the value of exports, and such indices of prosperity as the amount cleared at the Bankers' Clearing House per head of population. But these variations are not large, being in the same direction but not in the same degree as the changes in the indices of national prosperity.

Another matter of considerable importance is the mean age at marriage. In giving figures for the mean age at marriage it is best to omit marriages of widowed and divorced persons. It is the age at marriage of bachelors and spinsters that is of importance, and the facts as to the age at marriage of these persons are obscured if other marriages are taken into account. The mean age at marriage is of course not the same as the most usual age at marriage. Thus, the mean age at marriage in England and Wales in 1920 was not far from 28 for bachelors and 26 for spinsters, whereas the most common ages at marriage in the same year were 24 for men and 21 for women.

TABLE VII. *Mean Age at Marriage of Those not Previously Married*

Country	1876–85		1886–95		1896–1905		1906–10		1911–15	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
England and Wales	25·9	24·4	26·4	24·9	26·8	25·3	27·2	25·6	27·4	25·7
France	28·0	23·9	27·9	23·4	27·9	23·6	28·0	23·7	..	..
Germany	..	..	..	..	..	..	..	..	27·4	24·7
Holland	28·3	26·5	28·0	26·1	27·9	25·9	27·7	25·9	27·6	25·8
Italy	..	..	..	..	27·4	23·9	27·1	23·6	27·2	23·6
Scotland	..	..	..	..	27·6	25·6	27·8	25·8	27·8	25·8
Sweden	28·7	27·1	28·7	27·0	28·6	26·6	28·7	26·3	28·8	26·4
Switzerland	..	..	28·5	26·1	28·4	26·0	28·3	25·8	..	..

The table shows that the mean age at marriage is very similar in all countries for which figures are given. The age for men is a little over 27, while that for women varies from 23–26. Furthermore, there has been but little change in the mean age for fifty years: in France it has remained practically the same; in England and Wales there has been a tendency towards postponement; whereas in Holland the tendency has been the other way.

Births, Deaths and Natural Increase.—The census provides no information as to births and deaths. We are here dependent upon registration statistics. The most usual method of recording the birth-rate and death-rate is to give the number of births and the number of deaths per 1,000 of the population in any year. For certain purposes this method is open to objection. Unless the age distribution is known and allowed for, it is clear that these crude rates are no measure of the true fertility of married women or of the health and vitality of the population. But these crude rates serve a useful purpose. The difference between the rates represents the natural increase or decrease per 1,000 of the population as the case may be. This natural increase or decrease is an important fact in gauging the actual position of any country, though further analysis is required in order to throw light upon the manner in which the natural increase or decrease is brought about.

The crude birth-rates varied from 40·3 in Bulgaria to 19·19 in Switzerland during the period under review. The crude death-rates varied from 33·6 in Greenland to 9·1 in New Zealand. The highest natural increase was in Bulgaria and the lowest in France. While it so happens that Bulgaria had the highest crude birth-rate and the highest natural increase, a glance at the table will show that there is in general no correspondence between a high birth-rate and a large natural increase. Thus Greenland, with a birth-rate nearly as high as Bulgaria, had, next to France and Austria, the lowest natural increase. The table shows that countries with a high birth-rate often have a high death-rate and thus do not exhibit a large natural

TABLE VIII. *Mean Annual Number of Marriages per 10,000 Marriageable Persons*

Country	Period	Proportion	Period	Proportion
Austria	1908–14	536	1876–85	551
Belgium	..	537	1876–85	437
Bulgaria	1910–11	1223	1896–1905	1,111
Denmark	1908–14	515	1885–94	540
England and Wales	..	501	1876–85	568
France	..	540	1875–86	496
Holland	..	522	1875–84	536
Hungary	..	844	1876–85	1,038
Ireland	..	253	1876–85	260
Italy	..	578	1877–86	545
Norway	..	416	1881–85	458
Prussia	..	588	1876–85	578
Rumania	1912–13	990	1896–1903	873
Scotland	1908–14	409	1876–85	445
Serbia	1909–12	1194	1896–1905	1,386
Spain	..	526	1900–1	652
Sweden	..	367	1876–85	417
Switzerland	..	451	1878–85	432

increase. The association of a high birth-rate with a high death-rate has been much discussed. What the precise nature of the association may be is not clear; to some extent, no doubt, a high birth-rate renders the care of children by the mother more difficult, and to this extent a high birth-rate may be said to cause a high death-rate. At the same time, however, a high death-rate tends to call forth the birth of more children to fill the vacant places, and to this extent the relation is reversed and a high death-rate is the cause of a high birth-rate. It is worthy of note that, as a comparison of Table VIII. with Table IX. shows, those countries with a high birth-rate are in general also those with a high marriage rate.

But the most interesting and important fact which emerges from Table IX. is that the same natural increase is found in countries which have widely divergent birth and death-rates. Thus, the United States and Japan had both the same natural increase for the periods under review, but, whereas the former had relatively low birth and death-rates, the latter had high rates. The contrast is even more striking between New Zealand, with its low rates and natural increase and such a country as Ceylon, with a death-rate nearly as high as its high birth-rate and in consequence a low natural increase. Apart from the question whether increase is desirable and if so to what extent, it is clear that, if there is to be increase at all in any country, those conditions are to be preferred by which it is attained by a margin between a low birth-rate and a low death-rate rather than between a high birth-rate and a high death-rate.

TABLE IX. *Birth-rates, Death-rates and Natural Increase*

Country	Period	Crude birth-rate	Crude death-rate	Natural increase
Australia	1919–24	24·6	10·4	14·2
Austria	1919–23	21·9	17·9	4·0
Belgium	1919–24	20·5	14·0	6·5
Bulgaria	1920–1	40·3	21·7	18·6
Canada	1920–4	25·3	10·9	14·4
Ceylon	1919–23	38·6	31·6	7·0
Chili	1919–24	39·7	32·6	7·1
Denmark	1919–24	22·9	11·8	11·1
England and Wales	1919–24	21·0	12·5	8·5
Egypt	1919–23	41·6	26·6	15·0
France	1920–4	20·0	17·4	2·6
Germany	1919–24	23·5	14·8	8·7
Greenland	1919–22	38·7	33·6	5·1
Holland	1919–24	26·6	11·4	15·2
Hungary	1919–24	29·9	20·9	9·0
Italy	1919–23	27·3	17·0	10·3
Japan	1919–22	34·7	23·6	11·1
New Zealand	1919–24	23·0	9·1	13·9
Norway	1919–24	23·7	12·2	11·5
Philippines	1921–3	32·8	19·0	13·8
Rumania	1919–22	32·9	22·9	10·0
Scotland	1919–24	23·9	14·4	9·5
South Africa	1919–24	27·5	10·4	17·1
Spain	1919–23	29·8	21·8	8·0
Sweden	1919–24	20·3	12·8	7·5
Switzerland	1919–23	19·9	13·2	6·7
U.S.A.	1919–23	23·8	12·7	11·1
Uruguay	1919–23	26·6	12·2	14·4

While natural increase is an important fact, it should not be taken at its face value. It should not be assumed, for example, that a given rate of natural increase will continue in any country, even if the true fertility of married women and true mortality of the population remain at their existing strengths. This is so because the crude rates are imperfect measures of fertility and mortality. The crude birth-rate is the number born in any year per 1,000 of the population. In order to get a measure of true fertility it is clearly necessary to relate the births to the wives of child-bearing age in the population. In this manner the crude birth-rate can be "corrected." Newsholme gives the following example of using this method of correction. In Ireland, the crude birth-rate was 24·5 in 1881 as compared with 33·9 in England and Wales, and 23·1 in 1901 as compared with 28·4. When these crude rates are corrected they become for Ireland 35·2 in 1881 and 36·1 in 1901, and for England and Wales 34·7 in 1881 and 28·4 in 1901. Thus, the true fertility in Ireland was in fact as high as that in England and Wales in 1881 and much higher in 1901. The explanation of the remarkable differences between the two countries lies in the fact that, whereas in England in 1901 the number of females aged 15 to 45 per 1,000 of the total population was 250 and in Ireland 235, the wives at ages 15 to 45 in England formed 46·8% and in Ireland only 32·5% of the females at the same age. In addition to the importance which these corrections have as throwing light upon the true fertility of a population, they are also relevant to the problem of natural increase.

Let us take the case of England and Wales as an example of this fact. The figures show that there is still a considerable natural increase. It is, of course, true that, if the crude birth and death-rates remain unchanged, the population will continue to increase. It is popularly supposed that these rates represent the true fertility and mortality of the population. As shown above, this is not so. The true fertility and mortality of the population can be calculated, and it can be shown that, if the true fertility and mortality of the population remain as they now are, the crude rates will change until there is no gap between them. In other words, the true fertility and mortality of the population remaining as they now are, natural increase will become negligible in two decades and will later disappear.

The explanation of this paradoxical result is as follows: The age distribution in England and Wales is peculiar in that there is a relatively small number of persons in the older age groups. As a result of the decline in the birth-rate, the relative number of these older persons will increase and in consequence the death-rate will increase though the true mortality remains the same. The considerable natural increase now shown is, therefore, illusory, and will disappear unless there is a marked decrease in the true mortality or an increase in the true fertility. Should there continue to be a decrease in the true fertility as is in progress at present, then there will be a cessation of natural increase at a still earlier date.

The Decline in the English Birth-rate.—The crude birth-rate in England and Wales was 33·5 for the period 1871–5 and has declined to 18·8 in 1924. The decline has been in evidence in most European countries and in countries peopled by persons of European descent, though it usually began later than in England. Enough has been said above to show that these crude rates require interpretation. The decline in the crude birth-rate might be due to a decrease in the number of marriages, to a decrease in the proportion of women of child-bearing age, or to a decrease in the number of children born to married women of child-bearing age. A reference to Table VIII. shows that, while there are notable differences between different countries as regards frequency of marriage, there has been for 50 years little change in this respect in different countries. In other words, the decline in the birth-rate is not explained by a decline in the frequency of marriage.

Table VII. shows that in some countries there has been a tendency towards postponement of marriage, notably in England, but not in others. Now since the decline in the crude birth-rate is almost equally well marked in countries where there has been no postponement, the inference is that some factor or factors other than postponement of marriage must have played the principal part. But in England postponement has not been a negligible factor. It has had the effect not so much of decreasing the proportion of married women who are of child-bearing age as of decreasing the proportion of married women who are of the most reproductive ages. Thus of 1,000 wives under 45 there were in 1901, 593 under 35 and in 1921, 535 under 35. Nevertheless, in England, as elsewhere, the chief cause of the decline has been

the fewer number of children born to women of child-bearing age after making allowances for the smaller proportion among them of women of the most reproductive ages.

The problem is thus shifted to an inquiry into the reason for this declining fertility of married women of reproductive ages. Many suggested explanations can be shown to be inadmissible. In particular, it has been suggested that there has been a decline in reproductive capacity. Now reproductive capacity is a biological characteristic, and there are no biological grounds for suspecting any such change. Further, had any such change taken place it is only reasonable to imagine that it would have affected all sections of the population alike. But it is well known that it has not equally affected all sections, the birth-rate of the so-called upper classes having declined to a far greater extent than that of the so-called lower classes. By a process of exclusion the position is reached that the cause of the decline is to be sought in a change of habits. There is naturally but little direct evidence of such a change but there is an overwhelming amount of evidence that a change of habits has been advocated in the shape of the adoption of birth control methods. It is only reasonable to suppose that as a result of this propaganda birth control (*q.v.*) has been put into practice on a wide scale in many countries and that the decline of the birth-rate finds here its chief explanation. (A. M. C.-S.)

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PORT ELIZABETH, S. Africa (*see* 22.112), had a population (1911) of 37,063, and (1921) of 46,834, of whom 23,935 were whites, mostly of British descent. It is the third port of the Union, a centre for the wool and ostrich feather trade, and imports general merchandise for a wide area. Among modern buildings are the Provincial Hospital, the Grey Institute Boys' High School, and the Grand Theatre, the last in Main street. A breakwater intended to be 8,500 ft. long, part of a scheme to provide a completely sheltered harbour, was in 1925 under construction at the Dom Pedro jetty. In 1913 the tonnage of ships entering the port was 2,064,000. There was a marked fall thereafter which reached its lowest point (445,000 tonnage) in 1918. By 1923 the standard of 1913 had been, however, surpassed, the tonnage being 2,143,000. In that year the cargo handled at the port was 421,000 tons. The average value of imports, 1910–4, was £8,856,000, of exports £3,679,000. In 1923 the figures were, imports £12,519,000; exports £6,381,000.

PORT ENGINEERING (*see* Harbour, 12.935; Dock, 8.353; Breakwater, 4.475; Jetty, 15.359; Pier, 20.588; River and Canal Engineering).—Since 1910 important developments have taken place in many parts of the world to keep pace with the advance of engineering science, and particularly with the increase in the dimensions of shipping which was so marked in the 10 years preceding the World War.

The Dimensions of Shipping

In 1910 the largest merchant ship afloat was the "Mauretania," of 30,696 gross tons, 762 ft. in length between perpendiculars, and 88 ft. beam; but, excluding transatlantic liners, the largest cargo-carrying ship did not exceed 13,000 tons. In 1914 merchant ships far exceeding the dimensions of the "Mauretania" were either afloat or under construction. Harbour authorities, not only of those ports which accommodated the great transatlantic liners but in many other parts of the world, were engaged in increasing their facilities to serve shipping of far larger dimensions than any which had hitherto used their navigable waters. During the War period harbour development throughout the world was arrested and confined largely to works of a nature essential to the objects of the belligerents.

Since 1914 no ships of greater dimensions than those built or building at that date have been laid down and it is unlikely that there will be any marked increase in the maximum dimensions of transatlantic liners; the dimensions of the "Majestic" (ex. "Bismarck"), claimed to be the largest now (1926) afloat, and completed in 1921, being 56,551 gross tons, 915½ ft. length between perpendiculars, and 100·1 ft. beam. This vessel, when fully loaded, had a draught of 38·9 feet. On the other hand, a considerable increase seems likely in the number of cargo-carrying ships of large capacity. In 1910 general cargo vessels of over 10,000 gross tons were rare. Ships of this class up to 600 ft. in length, 72 ft. beam and 18,000 to 20,000 tons gross were not uncommon in 1926.

Depth of Water.—The deepening and widening of the Suez Canal enabled ships of the largest class to trade with Eastern ports. The canal has now been deepened throughout to 12 metres, and ships drawing 33 ft. pass through it. It is intended to provide for a draught of 35 feet. Concurrently with the deepening and widening of the Suez Canal, the more important ports of the Far East have been developed with the object of accommodating the largest ship capable of passing through it. The opening in 1914 of the Panama Canal, having a navigable depth of 40 ft., also had an important bearing on the development of harbours in the Far East and on the Pacific coasts of America. The general result is that whereas in 1910 a navigable depth of 30 ft. was considered ample for practically all requirements, a depth of 35 ft. is regarded essential in harbours of the first class, and in special cases even greater depths are aimed at.

Effect of Depth on Cost.—The cost of constructing port works in general shows an increase approximately proportional to the ratios of the cubes of the draughts of the largest ships for which they are designed.[1] The provision of port accommodation for shipping of the largest class is important from the point of view of finance and may become one of balance between the relative economy of ships of large draught and cargo capacity and the capital cost of port construction.

Materials and Equipment

Materials of Construction.—There has been no radical change in the nature of the materials used for the construction of port works since 1910, although reinforced concrete (*see* Ferro-Concrete) has been increasingly used in building jetties, wharves and other sea works. Rapid-setting aluminous cement was introduced on the Continent during the period under review, and its employment in Great Britain is extending, but its suitability for use in sea water had not been fully tested by the lapse of time. The use of Portland cement concrete for all kinds of port construction, quay walls, docks, breakwaters, etc., became universal, and its cheapness in comparison with the cost of dressed stone in the large majority of situations restricted the employment of the latter for such purposes as copings, sills, altar courses, etc. As an example of this change in practice the Rosyth dockyard may be mentioned. Practically all British Admiralty docks built prior to 1910 are faced throughout, or at any rate on all important surfaces, with dressed stone, usually granite. In the case of Rosyth, however, the quay and dock walls are faced with granolithic concrete, dressed granite being used only for copings, quoins, sills and in similar positions. The use of greenheart for the construction of dock gates gave place to mild steel, largely owing to the high cost of suitable timber in comparison with steel work.

Mechanical Equipment of Docks.—The most marked change in port engineering, apart from the increase in dimensions, is in connection with the mechanical equipment of docks and the provision of storage and traffic facilities. The use of electric power for cranes and other mechanical appliances is almost universal, and even in ports where hydraulic power is available electric appliances are installed side by side with hydraulic equipment. Hydraulic power presents undoubted advantages for operating gate-opening machinery, coal hoists and some other forms of dock equipment, but the adaptability and flexibility of electric power led to its general adoption. The mechanical handling of cargoes has made enormous strides. Elaborate and costly plants for storing, loading and discharging grain, chilled meat, coal, ores and oil in bulk have been established at ports in all parts of the world where such cargoes are dealt with in considerable quantities. The equipment of warehouses and transit sheds with electrically operated cranes, run-ways, loaders, conveyers and hoists is general, and high-speed electric cargo cranes are provided on a large scale at most European and North American ports, although in the Far East cargo is largely discharged by means of ship's derricks. Floating and fixed cranes of great capacity for lifting exceptional loads are common. Many floating cranes, lifting 250 tons, are in use; and one at least in America, a fixed crane at the Philadelphia Navy Yard, was capable of lifting 350 tons.

Breakwaters and Harbours

Breakwaters.—In 1910 the greatest depth of water in which a breakwater structure had been founded was probably at Naples, where the outer portion of the San Vincenzo breakwater was constructed at a depth of about 120 ft. below mean sea-level. The outer portions of the Valparaiso breakwater,[2] built 1912–21, were founded at

[1] See L. H. Saville, *XIIIth International Congress on Navigation* (London, 1923).

[2] *Proc. Inst. of C. E.*, vol. 214 (1921–2).

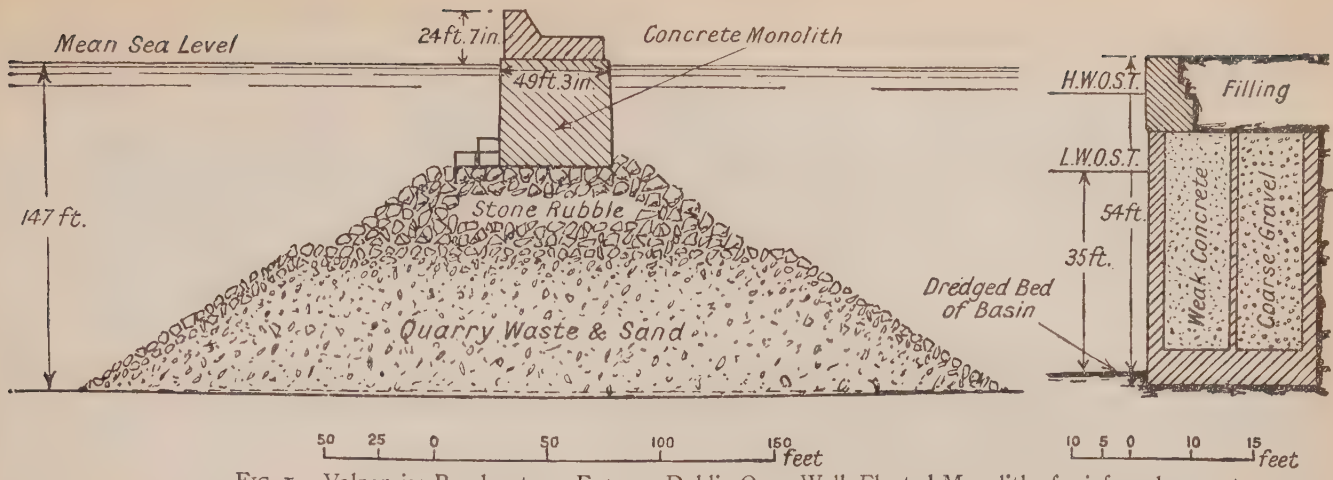

FIG. 1.—Valparaiso Breakwater. FIG. 2.—Dublin Quay Wall. Floated Monolith of reinforced concrete.

a depth of 147 ft. below mean sea-level, and an extension 2,300 ft. in length, was to have its termination in a depth of about 180 feet. The breakwater is of composite construction, the inner portion consisting of concrete blocks set on a submerged rubble stone mound, and the outer portion (fig. 1) of reinforced concrete caisson monoliths, which were floated over and sunk upon a rubble mound (with sand core), the surface of which is at a level of 46 ft. below mean sea-level. These monoliths are the largest which had been hitherto constructed in such a situation, each measuring 20 metres long by 16 metres wide and 15 metres in height, and were, after sinking, filled in with mass concrete. The monoliths are surmounted by a mass concrete superstructure carried to a height of 7·5 metres above mean sea-level. The use of concrete monoliths in breakwater and pier construction has become general. Reinforced concrete caissons, floated into position and filled in after sinking with mass concrete, have been utilised both for the construction of superstructures resting on rubble mounds and, less frequently, as monoliths resting on the sea bed. Other examples of the former are the Galleira mole at Genoa and the extensions of the breakwater at Naples. The latter system was employed in the construction of some of the Heligoland moles demolished after the War.

The breakwater at Fishguard, constructed by the Great Western Railway Co. between 1900 and 1918, is an interesting example of a composite breakwater of modern construction which, in spite of weaknesses inherent in the original design, has been made suitable to the exposed situation in which it is placed. Originally designed as a rubble mound carried up to about the height of high water with concrete superstructure and parapet, the wastage of rubble on its sea face was found to be so serious that in the year 1913 it was decided to protect the rubble by the deposit of 40-ton concrete blocks placed " pell mell " over the whole of the seaward face of the mound above the level of L.W.O.S.T. Previous to this, the quantity of stone rubble deposited annually for maintenance purposes on the sea face averaged 85,000 tons for several years. The total length of the breakwater is half a mile.

The harbour breakwaters at Madras, in a position of extreme exposure, have suffered severe sea damage on many occasions, and large portions have been rebuilt and strengthened from time to time. The original harbour entrance on the east side between the ends of the two curved breakwaters was closed in 1910 on account of the serious " range " in the harbour, due to the position of the entrance and the rapid silting which was taking place. A new entrance was constructed on the north side of the harbour protected by a sheltering arm.[1] This arm, as well as the new portion of the breakwater closing the old entrance, is of sloping block work on a rubble foundation protected by 30-ton wave breaker blocks on the sea face. The outer portion of the sheltering arm was destroyed during a cyclone in Nov. 1916, and has since been reconstructed. The sloping or sliced block system of construction is to an increasing extent adopted both for breakwater and quay construction, particularly on foundations which are liable to settlement.

Harbours.—The bulk of new construction in connection with already existing harbours is in the direction of providing increased depth of water to meet the growing demands of shipping. In many cases of coastal harbours, existing breakwaters, moles or piers have been extended seaward, thus adding to the sheltered area water space of increased depth. In other cases entirely new breakwaters, or other means of shelter, have been constructed and in some already existing channels or sheltered areas have been deepened. Important harbour works, particularly in Africa, South America and the East, were undertaken in positions where no artificial protection previously existed, *e.g.*, the African ports of Casa Blanca, Takoradi and Killindine and Antofagasta in Chili.

The Mersey Bar.—The formation and maintenance of a deeper channel through the Mersey bar have been for many years problems of difficulty. Dredging by means of powerful sand pump dredgers is carried on almost continuously and the quantity of material removed in recent years from the bar channels and the river approaches averages about 20,000,000 tons annually. Since 1907 rubble stone training walls or revetments have been constructed on the east side of the Crosby channel and more recently the west side has been similarly treated, but in spite of these training works and intensive dredging the minimum depth of water in the Mersey approach channels has not been increased beyond the 26 ft. or 27 ft. at low water ordinary spring tide (L.W.O.S.T.) available in 1907.

Dock Construction in Various Ports

In Great Britain, the principal developments in dock construction after 1910 took place in the Port of London, at Liverpool and at Southampton. Important works have also been carried out, or were (1926) in progress of construction, at Glasgow, Avonmouth, Immingham, Hull, Newport and elsewhere. On the continent of Europe perhaps the most important extensions have been made at Antwerp and Rotterdam, and the docks and basins of Havre, Marseilles, Dunkirk, Rouen and several Italian ports have also been extended. In the East large developments have taken place at Calcutta, Karachi and Bombay, as well as in many of the ports of Australasia and Japan.

Port of London.—Since the Port of London Authority was constituted in 1909 to take over the docks of the previously existing dock companies and the tidal portion of the Thames Conservancy jurisdiction, £12,000,000 had been spent up to 1926 on improvements in the port. The King George V. Dock, an extension of the Royal Albert Dock, is the most important addition. Commenced in 1912, it was opened for traffic in July 1921. The wet dock has an area of about 64 ac., a depth of water of 38 ft., and a total length of quayage of just over two miles. It is connected with the Royal Albert Dock by a passage 100 ft. wide. An entrance lock, 800 ft. long by 100 ft. wide, with a depth of water over the sills of 45 ft. at Trinity high water, gives access from the River Thames. A dry dock entered from the wet dock is 750 ft. long and 100 ft. wide, with a depth of 35 ft. over the keel blocks. An interesting feature of the wet dock is the provision of seven reinforced concrete jetties arranged in a line parallel with the south quay at a distance of 32 ft. therefrom. Each jetty carries six three-ton cranes. River barges lie between the jetty and the quay wall, and the cranes upon the jetties can deal with goods on the quay or in the ship or barges. The quay walls of this dock are of concrete with vertical faces. The water level of the dock is maintained permanently at a level of 2 ft. 6 in. above Trinity high water by means of impounding pumps. This system of raising the dock water level has been adopted since 1910 in the case of most of the London docks with the object of increasing the available depth in the berths alongside the quay walls.

At Tilbury a new branch dock was constructed as an extension of the old Tilbury dock, adding approximately 17 ac. to its water area. A portion of the quay walls of this dock consists of built-up concrete well monoliths, sunk from a level a little below the original ground

[1] *Proc. Inst. C. E.*, vol. 190 (1911-2).

surface, with mass concrete superstructure, and affords a typical example of modern practice in quay construction in comparatively bad ground.[1]

A river cargo jetty of reinforced concrete sited alongside the deep water channel of the river at Tilbury in 30 ft. of water at L.W.O.S.T. (low water ordinary spring tide) was completed in 1921. This jetty, a novel feature in the Port of London, 1,000 ft. in length and 50 ft. wide, is connected with the shore by means of an approach viaduct carrying a railway which extends over the roof of the storage sheds, forming a double-decked superstructure. Electric cranes placed on the upper deck unload cargo from ships alongside either into railway wagons or into the transit shed underneath or into barges in the waterway behind.

Among other improvements carried out by the Authority are extensions at the Surrey docks and new quays at most of the docks; storage and transit sheds have been modernised and extended, mechanical equipment has been installed for handling such imports as grain and frozen meat, and the river channel has been deepened successively until in 1925 a minimum depth of 27 ft. at low water ordinary spring tide was available from the sea up to the King George V. Dock. Oil wharves, constructed by private enterprise, have been built in the lower reaches of the river for dealing with the import of oil in bulk. Private enterprise is also responsible for improved facilities in the port for handling seaborne coal imports.

Liverpool.—The Gladstone dock extensions were commenced by the Mersey Docks and Harbour Board at Liverpool in 1910. These new docks at the north or seaward end of the dock estate constitute the most important addition to the commercial docks of Great Britain made during the present century. The Gladstone dry dock, opened in 1913, was the largest in the kingdom, and at the time of its completion the largest in the world. It is 1,050 ft. long and 120 ft. wide at the entrance, which is closed by a sliding caisson. The depth over the sill is 44 ft. at H.W.O.S.T. (high water ordinary spring tide). Originally it was entered direct from the river, but was closed in 1922 during the building of the Gladstone wet docks, from whose water area the dry dock would ultimately be entered. The dry dock was constructed so as to be available for use as a berthing dock when not required for dry docking purposes, and its side walls are equipped as quays with cargo cranes and transit sheds. The new wet docks, having a total water area of over 60 ac. are entered from the Mersey through a lock 1,070 ft. long and 130 ft. wide, sited so that its centre line is at a small angle with the frontage line of the Liverpool docks. At high water ordinary spring tide there is a depth of 48 ft. 9 in. over the sill, and at low water ordinary spring tide 21 ft. 8 inches. The lock is closed by steel gates and is provided with an intermediate pair of gates subdividing it into two sections. The new docks contain $2\frac{3}{4}$ m. of quayage, to have at maximum high water a depth alongside of 54 feet. Treble storey transit sheds with flat roofs are provided on all quays and are equipped with electric cranes both on the quay frontage and on the roofs of the buildings. A new lock 90 ft. wide connects the Gladstone system of docks with the adjoining Hornby dock. It was expected that the new docks would be completed about the end of the year 1926. Concurrently with these extensions several of the older docks at Liverpool have been improved or enlarged since 1910, and a new 80 ft. entrance lock has been made at the Alfred dock, Birkenhead.

Southampton.—The port of Southampton was for many years one of the two principal ports of Great Britain accommodating the largest class of transatlantic liners, and after the World War the largest of these vessels used Southampton in preference to Liverpool. As an indication of the provision which port authorities regard as necessary for traffic of this description, the scheme of dock extensions approved by the Southern Railway Co. in 1924 may be briefly mentioned. Preliminary work on this scheme was put in progress. All the ship berths at Southampton are tidal, and there are no closed wet docks at the port. The extensions were to be constructed on the north side of the river Test, to cover a frontage of about two miles. Deep water jetties, each 1,000 ft. in length, mainly of reinforced concrete with a depth of 35 ft. at low water alongside, to be increased by dredging to 45 ft., were to be constructed, graving docks larger than any existing to be built, and a square mile of foreshore reclaimed from the sea. The cost of the work was estimated to be about £13,000,000.

Since 1910 the Trafalgar dry dock at Southampton has been enlarged, and is 912 ft. long internally, 100 ft. wide at the entrance, closed by a sliding caisson, and has 35 ft. of water over the sill at high water. The Ocean dock, opened in 1912, is an open basin of 16 ac., having a depth of water alongside the quays of 40 ft. at low water ordinary spring tide, the walls being designed for a depth of 45 ft., which can be attained by further dredging. The berths in the Ocean dock accommodate the largest transatlantic liners, such as the "Majestic." The approaches to Southampton are dredged to give a minimum depth in the navigable channel of 35 ft. at low water.

Dublin Quay Wall.—A quay wall constructed in the Port of Dublin, 1923–4, is an example of a form of monolith construction which differs from that described above in the case of the Tilbury dock walls. Reinforced concrete cellular caisson monoliths 40 ft. long, 41 ft. high and 28 ft. wide were floated into position and sunk in a trench previously dredged to and prepared at the correct level for the foundations. The cells of the monoliths, each of which weighed about 1,200 tons, were afterwards filled in with concrete and gravel and surmounted by a mass concrete superstructure wall (fig. 2). The berth in front of the quay, 35 ft. deep at low water, was subsequently dredged to the required depth.

Antwerp.—The enlargement and modernising of the port of Antwerp on a large scale was undertaken in 1913, but at the commencement of the World War a small part only of the new works had been constructed. Operations were resumed in 1921. A *bassin canal*, which is in effect a series of enclosed docks, extending from Kruisschans, on the Scheldt seven miles below the city to the old dock system higher up the river at Antwerp was put in course of construction. The lock at Kruisschans is 886 ft. long, 115 ft. wide and has a depth over the sill of 46 ft. at high water. For the construction of these works caisson and concrete monolith foundations have been extensively employed.

India.—The construction of the King George Docks at Calcutta, commenced in 1920, when completed in 1927, were to provide ample accommodation for the trade of that port for years to come. One hundred and ninety ac. of water surface and 25,000 lineal ft. of deep water quay frontage would be available in the new wet docks. Here again well monoliths of large dimensions, sunk through the alluvial material of the Ganges delta, were employed for the construction of the quay walls and other works. At Bombay, a wet dock of 50 ac., commenced in 1905, was opened in 1914. The entrance lock, 750 ft. long and 100 ft. wide, has a depth over the entrance sill of 41 ft. 3 in. at high water ordinary spring tide. The Hughes dry dock at Bombay, constructed about the same time as the wet dock, is 1,000 ft. long with an entrance 100 ft. in width. At Karachi, additional accommodation on a large scale has been made by the construction of deep water tidal wharves, and a similar course has been adopted at Rangoon.

South Africa.—In South Africa, the port of Durban has been improved by the dredging of the bar, entrance channel and harbour, the normal depth available at low water being now 31 feet. Berths alongside the principal open tidal wharves have depths up to 38 ft. 6 in. at low water. At Cape Town the Victoria basin, 67 ac. in extent, provides sheltered berths alongside quays with 36 ft. to 40 ft. water at low water ordinary spring tide, and the breakwater is now (1926) extended.

At Port Elizabeth, breakwaters which will enclose a harbour of 87 ac. were in course of construction in 1926, the available depth in the harbour at low water being 36 feet. Both at Cape Town and Durban facilities for the shipment of grain on a large scale have been provided.

Australia and New Zealand.—In the principal ports of Australia where the tidal range is small, open wharves and jetties have been constructed to keep pace with the demands of shipping. At Sydney, Adelaide and Hobart, depths of 35 ft. or more are provided alongside the open quays or jetties. Berths having 37 ft. depth at low water are provided at Melbourne. In New Zealand, Auckland and Wellington provide for 35 ft. and 36 ft. depth respectively.

North America.—On the Atlantic and Pacific coasts of North America, where the tidal range is usually small and the majority of the larger ports are in situations possessing ample natural protection, *e.g.*, New York and San Francisco, the necessary additional accommodation has been provided by the construction of long and wide jetties or wharves projecting from the shore into deep water alongside which vessels berth. Many of these jetties, or "docks" as they are termed in New York, have berths upwards of 1,000 ft. in length with 35 ft. to 45 ft. depth of water at low water. Timber and reinforced concrete piles are commonly employed for these structures, but sometimes reinforced concrete cylinders are used in place of piles for carrying the superstructure of the jetty. The Ballantyne Pier at Vancouver (fig. 3), completed in 1923, is a good example of recent construction. It is 1,200 ft. in length, 341 ft. wide, with a depth of water in the berths of 45 ft. at low water. The heart of the pier is formed of sand and gravel filling; the outer rows of columns carrying the reinforced concrete superstructure consist of 7 ft. diameter reinforced concrete cylinders, and the inner rows are carried on clusters of piles. Two-storey transit sheds, railways and cranes are carried upon the superstructure.[2]

Naval Dockyards

The naval dockyard at Rosyth, on the north side of the Firth of Forth, was in course of construction when the World War broke out. The works had been commenced in 1909 and, although a large part of the accommodation was available for the fleet during the War, construction continued until 1921. The Rosyth dockyard occupies a site on the foreshore of the Firth above the Forth bridge, and comprises a closed basin of 54 ac., open wharves, an entrance lock 850 ft. long, 100 ft. wide at sill level, and having a depth of 54 ft. over the sill at high water. There are three dry docks having dimensions approximating to those of the lock and depths of 40 ft. over the sills. The lock itself can be used as a dry dock if necessary. In addition to the lock there is a tidal entrance to the basin 115 ft. wide at sill level. Concrete well monoliths were used extensively in constructing the basin and other walls. H. M. Govt. decided in 1925 to

[1] *Proc. Inst. C. E.*, vol. 215 (1922–3).

[2] *Inst. C. E. Selected Papers* No. 27 (1925).

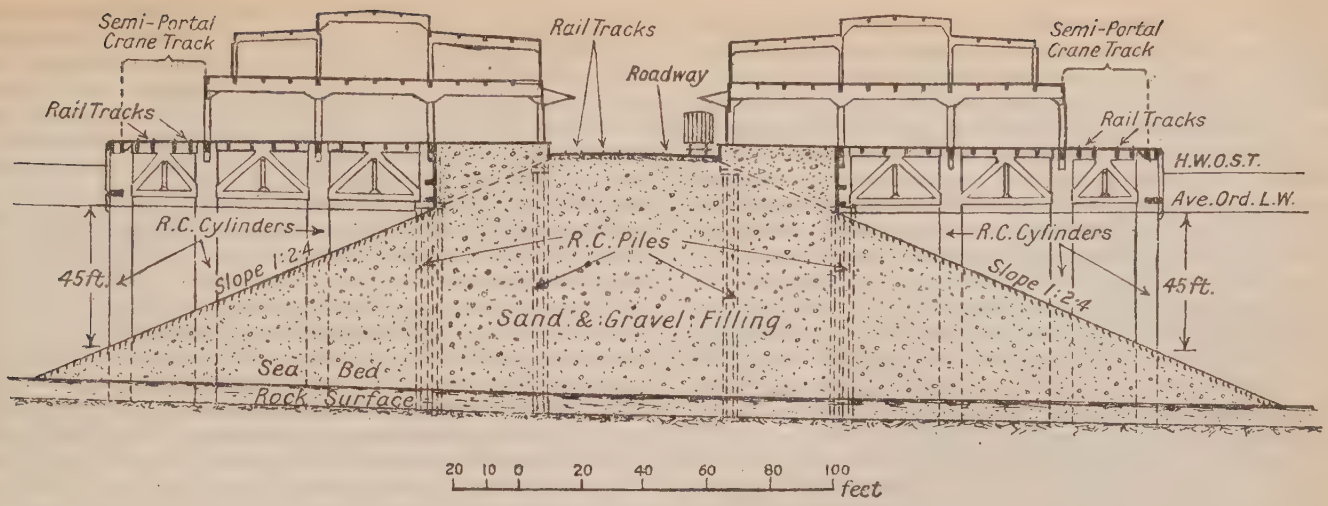

FIG. 2.—Ballantyne Pier Vancouver. Outer Berths.

reduce the dockyards at Rosyth and Pembroke to a care and maintenance basis, and to concentrate all Admiralty home dockyard work at the remaining yards at Portsmouth, Devonport, Chatham and Sheerness. To meet the growing needs of the navy, new locks and a dry dock were constructed at Portsmouth and completed shortly before the War, the dimensions of which are practically identical with those at Rosyth. The largest of the Devonport locks and dry docks are of somewhat smaller dimensions. In 1922 the Admiralty initiated a scheme for the construction of a great naval dockyard at Singapore. The preparatory work which was already in hand was cancelled by the Government early in 1924, but with the advent of a new Ministry work was resumed at the end of that year.

The navy departments of other nations, particularly the United States and Japan, have carried out the construction of new docks to meet the growing requirements of their fleets. The German naval dockyards at Wilhelmshaven, Kiel and Brunsbüttel, the construction or improvement of which had been actively carried on in the years immediately preceding the War, were partially dismantled conformably with the peace conditions, and the naval harbour works at Heligoland were demolished under the supervision of the Allies (1920–2).

DRY AND FLOATING DOCKS

Dry Docks.—In addition to the dry docks which are mentioned in the foregoing paragraphs, large dry docks were completed in the years immediately preceding or following the War in many parts of the world. At Esquimalt, Victoria, B.C., a dock completed in 1925 has an entrance 125 ft. in width with a depth of water of 40 ft. over the sill. This dock is 1,150 ft. in length. The Congella dry dock at Durban, opened by the Prince of Wales in 1925, is 110 ft. in width at entrance and 1,150 ft. long; the depth over the sill is 35 ft. at low water ordinary spring tide. At Havre a dry dock commenced in 1911 was nearing completion in 1926. A novel method was adopted for its construction on a foundation of sand and silt. The entire dock structure is built in and upon a huge steel caisson framework 1,132 ft. by 197 ft., which was floated into position over the site of the dock previously dredged to the required depth and there sunk in place. The dock is 1,023 ft. long internally, 125 ft. wide at the entrance, with a depth over the sill of 52 ft. 6 in. at high water ordinary spring tide. The Balboa dry dock at the Pacific end of the Panama Canal, opened in 1916, is 1,110 ft. long, 110 ft. wide, with 41 ft.5 in. over the blocks at mean high water. Other large dry docks are the Boston U.S. Navy dock, 1,170 ft. by 114 ft., and that at St. John, New Brunswick, 1,165 ft. by 125 feet.

Floating Docks.—The largest floating dock in the world, that at Southampton, was opened by the Prince of Wales on June 27 1924. Designed to accommodate the largest ship afloat, it has an overall length of 960 ft., a clear width of 130 ft. 8 in. and a total lifting power of 60,000 tons. The dock can be submerged to take in ships drawing 38 ft., and the berth where it is moored is dredged to a depth of 61 ft. at low water ordinary spring tide. This dock is of the self-docking type, and is constructed in seven separate sections.

Dock and Lock Entrances.—For closing the entrances of large dry docks steel caissons are used in most modern instances either of the sliding type, as at Rosyth and Durban, or the floating pattern, of which examples are found at the Hughes dock, Bombay, Havre and the Calcutta dock. Sliding caissons, although more costly than floating caissons, have the advantage of being more easily and rapidly moved, and, moreover, they are more convenient for the provision of railway tracks and roadways over them. Steel gates are generally preferred for closing the entrances to large locks and wet docks, although sliding or ship caissons have been adopted in the case of Admiralty wet dock entrances, including Rosyth and Portsmouth, and at the King George docks, Calcutta. The majority of modern steel gates are of the semi-buoyant type provided with buoyancy chambers, which relieve the anchorage at the head of the heel post of a great part of the horizontal stress due to the weight of the gate. In such cases the use of rollers and roller paths under the mitre posts is commonly dispensed with.

A feature of the design of all modern dry docks, locks and wet docks is the construction of entrances rectangular in form, thus approximating to the box shape of the hulls of modern steamships. For operating sliding caissons both electric and hydraulic power have been employed. For gate opening, machinery of the largest type hydraulic power is preferred in Great Britain, but electric machinery is employed generally on the continent of Europe and in America, as, for instance, for the gates of the Panama Canal locks.

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PORTER, HORACE (1837–1921), American diplomatist and soldier (*see* 22.116), died in New York City May 29 1921.

PORTER, WILLIAM SYDNEY: *see* HENRY, O.

PORTLAND, Ore., U.S.A. (*see* 22.120), the financial, industrial and distributing centre of the vast Columbia river basin, increased 24·6% in the decade after 1910, to a population of 258,288 in 1920, of whom 3,771 were Chinese, Japanese and Indians, 1,556 negroes and 49,778 foreign-born (white and coloured). The census bureau estimate for 1925 was 282,383; the local estimate for the metropolitan area 460,000. Annexations of territory increased the area to 63·2 square miles.

By the expenditure of $16,000,000 by the Federal Govt., and $4,500,000 by the city, the entrance to the harbour was improved, deepened and protected by two rock jetties, and the river channel was deepened to accommodate vessels of 30-ft. draft at zero stage, from the mouth of the river to Portland. By 1925, 54 steamship lines were giving regular service to the principal ports of the world. The harbour (fresh water, with a frontage of 29 m. within the city limits) had berthing space for 100 vessels, 65 ac. of cargo space, 6·5 m. of docks, 50 piers, 4 municipal terminals and many private docks, especially for lumber, grain and flour. During the first five years after the close of the World War, the foreign commerce of the port increased by 196% in tonnage, to 1,506,210 tons (1924); and local trade by 114% to 2,872,147 tons. Outbound shipments (by rail and water) consisted chiefly of lumber, apples, flour, wheat,

paper, prunes, barley, canned fruits, salmon (gradually decreasing), cascara, copper, hides and wool, doors, ready-made houses (largely to Japan), furniture and other articles of woodwork. Building permits in the five years following the War amounted to 77,545, representing a value of $116,355,966. The output of the manufacturing establishments within the city limits was valued at $46,861,000 in 1909; $196,380,000 in 1919; and $154,414,779 in 1923. The commission form of government was adopted in 1913; a permanent zoning commission was established in 1918; and a housing scheme was adopted in 1919. A system of main streets, park roads and boulevards was laid out and grade crossings were eliminated.

PORTO RICO (*see* 22.124).—Porto Rico has an area of 3,435 sq. m., and the census of 1922 gave the population as 1,346,623 or 392·14 per square mile. In consequence of this continued growth, education and health remain grave problems. The total enrolment in all schools supported by public funds was 227,267 in 1924: but the percentage of illiteracy in the island is large. The death rate for 1924 was 18·7 per 1,000 inhabitants as compared with 24·97 in 1911. But in 1920 tuberculosis, malaria and uncinariasis (hookworm), together with infant mortality, still accounted for 60% of the total death rate, and even in 1924, deaths among children under five years of age constituted 45·3% of the general mortality. Important preventive work has been carried on by the insular board of health, including an intensive campaign for the control of uncinariasis, in co-operation with the Rockefeller Foundation.

But the influence of basic economic and social conditions is still felt. "Our population is one of the densest on earth," the insular commissioner of health, himself a distinguished Porto Rican, wrote in 1920. "More than 70% are in the country, badly housed and fed, ill in health and ignorant of the first principles of hygiene. Until the people have learned to preserve and protect their health and have more ample means to provide themselves with better houses and food, so as to reduce their miseries, no positive result, no recompense for all our efforts can be obtained."

Political History.—Important developments in the affairs of Porto Rico—political, economic, social—took place in the period 1910–25. Politically, the organic law was first amended and later materially changed. Economically, the agriculture and commerce of the island showed notable increase. Social progress was shown in the improvement of living conditions, the spread of elementary education and the reduction of poverty and disease. The Foraker Act, approved by Congress April 12 1900, under which the island had been administered for the first decade of its existence under the American flag, was amended by the Olmsted Act, approved by Congress July 15 1909, which placed the supervision of Porto Rican affairs in the jurisdiction of an executive department to be designated by the President. The President subsequently designated the War Department. To prevent recurrent deadlocks over the insular budget, provision was made that if the Legislature failed to pass the Appropriation bill for an ensuing fiscal year, the sums authorised for the current year should be deemed to have been appropriated and might be lawfully expended.

Constitutional Changes.—Far more thorough-going were the changes affected by the passage of the Jones Act, approved by Congress March 2 1917, which provided that citizens of Porto Rico should be deemed and held to be citizens of the United States. Six executive departments were constituted: Justice, Finance, Interior, Education, Agriculture, Labour and Health. The governor, the attorney-general and the commissioner of education are appointed by the President of the United States, subject to the approval of the U.S. Senate; the heads of the remaining departments by the governor of Porto Rico, subject to the approval of the Porto Rican Senate. The law-making power is vested in a Legislature consisting of a Senate of 19 members and a House of Representatives of 39 members, all elected by manhood suffrage for a term of four years. Acts of the Legislature may be vetoed by the governor; but his veto may be overridden by a two-thirds vote. The President of the United States may nevertheless interpose a final veto. Matters relating to franchises and concessions are vested in a public service commission consisting of the heads of the executive departments, the auditor and two elected commissioners. A resident commissioner to the United States, paid by the Federal Govt., is elected by popular vote for a term of four years; he represents the island in the U.S. House of Representatives, with a voice but without vote, and is recognised by all departments in Washington.

Industry and Trade.—The economic experience of the years 1910–25 was the increased and more profitable production of sugar, tobacco, coffee and fruits, consequent in the first instance upon duty-free access to the American market, and aided by the completion of irrigation projects. The increase of exports was accompanied by larger imports, by a reversal of the island's adverse trade balance, and by an appreciable, though unequal, diffusion of gain among the island's population, the growers of sugar and tobacco being specially benefited. The commerce of the island more than doubled in the period, the combined value of imports and exports rising from $78,705,364 in 1911 to $176,456,497 in 1924.

This amazing growth was uneven. The activity of 1911–2 was followed by reaction in 1913, accentuated by the dislocations consequent upon the outbreak of the World War. War demand for the island's principal articles of commerce made itself sharply felt in 1916–7 but slackened in 1918–9. In 1920 came remarkable developments, exports rising from $79,496,040 in the preceding year to $150,811,449 and imports from $62,400,360 to $96,388,534. The factor directly responsible was the world boom in sugar, and to a less degree in tobacco and coffee. Sugar exports in tonnage were actually less in 1920 than in 1916 and in 1917, the price per ton rising from $75.81 in 1911 to $136.77 in 1919 and to $235.88 in 1920. The "bubble" burst in 1921; but the succeeding years brought notable recovery, so that in 1924 both imports ($89,369,624) and exports ($87,086,873) were much beyond those obtained during the World War period. The visible trade balance in favour of the island rose from a previous maximum of $27,636,780 (1916) to $54,422,915 in 1920, and later became more normal at $10,627,820 (1923). The great bulk of this trade, 91% in 1924, was with the United States.

There was marked improvement during the period in the island's material equipment. New schools were erected and additional roads and bridges constructed. Even the remoter towns of the interior had in 1925 waterworks and electric lighting plants which had been made possible by loans from the Treasury. The increase in private wealth was reflected in the erection of many fine residences, while the development of commerce and agriculture stimulated the extension of banking and transport facilities.

Finance.—The basis of the insular revenue system remained that put into operation with the establishment of civil government under the American flag by the Hollander law, later modified and adapted to meet changing conditions. Ordinary expenditures for the fiscal year 1924 were $12,431,724 as compared with $3,685,613 in 1911. The total assessed valuation of all property for purposes of taxation in 1924 was $312,384,305 as compared with $133,817,931 in 1911.

The governors were George R. Colton, 1909–13; Arthur Yager, 1913–21; E. Mont Reily, 1921–3; Horace M. Towner, 1923– .

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PORTSMOUTH, England (*see* 22.132), with a population of 247,284 in 1921, and an area of 7,964 ac. (including 87 of water, 522 of tidal water and 1,377 of foreshore), was made a city in 1926. Cosham was included in the borough in 1920. The parliamentary borough was divided into central, north and south divisions in 1918, each returning one member to Parliament.

In 1924 the foundation of a new diocese of Portsmouth and the Isle of Wight, taken from that of Winchester, was approved; a commission of inquiry recommended that the old parish church of Portsmouth, St. Thomas', should be the pro-cathedral. New

churches include St. Alban's, Copnor Road; St. Saviour's, Landport (1914); St. John's (Winchester College Mission) and St. Cuthbert's, Copnor (1916); and a Roman Catholic church at Copnor (1911). The large church of St. Matthew, which had been in process of erection for 22 years, was finished in 1924. A church has been built and a parish and cemetery made at Milton. The Portsmouth war memorial has taken the form of new wards, an administrative block and a gateway, at the Royal Portsmouth hospital, and a cenotaph in the Town Hall Square. Large sums have been spent by the municipality on drainage schemes and esplanades, and Southsea Common has been taken over from the War Office and laid out as a public pleasure-ground. The fine castle of Porchester, with remains from Roman down to medieval times, came into the custody of H.M. Office of Works, as an "ancient monument," in 1926. Portsmouth, besides being an important naval establishment and arsenal, has a considerable coastal trade, and a new industry, the refitting of liners, has been started. The historic "Victory" was in dock for repairs in 1925.

PORT TALBOT, GLAMORGANSHIRE, with a population (1921) of 40,039 and an area of 25,645 acres, was formed into a borough by the amalgamation in 1921 of the parishes of Aberavon, Margam, Michaelston Lower, Cwmavon Lower and part of Baglan Lower. The borough, with three outlying parishes, forms the Aberavon parliamentary division, returning one member. New municipal buildings and a public library were opened in 1915, and a general hospital in 1916. The church of St. Agnes was built in 1910, and that of St. John in 1912. In 1925 Lord Jersey gave 12 acres of land to be made into a seaside park, in order to provide work for the unemployed. The harbour has an area of about 250 ac., with 90 ac. of dock-space.

PORTUGAL (*see* 22.134) has been a Republic since Oct. 1910. Its area, including the Azores and Madeira, is 35,490 sq. miles, and the population, 6,399,355 (1920 census).

I. POLITICAL HISTORY

The political history of Portugal from the revolution of 1910, when the monarchy was overthrown, is a record of short-lived ministries and of revolutionary outbreaks during which the only stable periods where those associated with the control exercised by President Paes, assassinated in Dec. 1918, and with the Ministry of Senhor da Silva, which lasted for 21 months. Royalist invasions, the activities of the Carbonarios, mutinies, strikes and outrages in Lisbon and other towns, rendered the authority of successive administrations precarious in the extreme, and their difficulties were increased by the conflicts between Church and State, the rise in prices, and the general unrest created by the War.

The effects of the revolution fell most heavily on the poor of the country districts and, in consequence, emigration increased to an unprecedented extent, rising from 6·83 per 1,000 in 1910 to 14·85 per 1,000 in 1912. In the towns, discontent with the working of the republic was prevalent; lavish promises had aroused impossible hopes among the people, and by many the republic was regarded as but a first step towards a more Radical workmen's republic. Socialism and syndicalism developed rapidly. The right to strike at 24 hours' notice, conceded on Dec. 7 1910, was followed by strikes of all kinds, including several serious railway strikes. The disorders culminated in the demonstration against Parliament on Aug. 2 1911, and the general strike at Lisbon on Jan. 31 1912, when the city was placed under martial law and over 1,000 workmen suspected of syndicalism were arrested.

The Provisional Govt. of the republic consisted of Dr. Theophilo Braga (1843–1924), president, Dr. Antonio José de Almeida (Home Affairs), Dr. Alfonso Costa (Justice), Col. Corrêa Barreto (War), Dr. Amaro Azevedo Gomes (Marine), Dr. Bernardino Machado (Foreign Affairs), Dr. Basilio Telles and, later, Dr. José Relvas (Finance). Dr. Antonio Luiz Gomes and, later, Dr. Brito Camacho (Public Works). It lasted till Aug. 24 1911.

The Constitution.—On March 18 1911, the new electoral law came into force. It gave the vote to all Portuguese over 21 years of age who could read or write, including priests and officers of the army or navy, but excluding naturalised Portuguese, officers on the active list and persons proscribed politically. Lisbon and Oporto (voting on the proportional system) were to return 10 deputies each, the other districts four and the colonies one each. By a modification of Jan. 11 1915, Lisbon received 20 deputies, Oporto 10, the remaining constituencies between one and four each. By a decree of March 11 1918, universal suffrage for all citizens over 21 was established, but illiterates (75% of the population) were again disfranchised in 1919. By the law of 1918 the number of deputies was reduced to 155, returned by 51 constituencies, of which Lisbon returned 14, Oporto 6. The representation in the Senate, consisting of 77 members, was made regional and professional. By a decree of April 26 1918, soldiers and sailors on active service were allowed to vote. In the elections held on May 28 1911 many of the candidates were nominated by the authorities without opposition and, even where there was an election, the government candidates were returned without difficulty, no Royalists offering themselves.

The Constitutional Assembly was opened on June 19 1911, and a decree was passed declaring the monarchy abolished and the House of Braganza forever banished. On Aug. 20 the new constitution was voted. It provided for two Chambers, that of the Deputies, consisting of 163 members to be elected every three years, and the Senate, consisting of 71 members. The president of the republic was to be elected by both chambers for four years and could not be re-elected. His salary was fixed at £3,600, with £1,200 for expenses. On Feb. 19 1920, he was given the right to dissolve Parliament, after consulting a special council appointed for this purpose.

The first president under the new constitution was Dr. Manuel de Arriaga (born in 1840, at Horta, in the Azores), who, on Aug. 24 defeated the Radical candidate, Dr. Bernardino Machado, the Conservative candidate, Senhor Braamcamp Freire, having withdrawn. Dr. João Chagas (d. 1925) was Premier and Minister of Home Affairs in the first Constitutional Ministry. One of the first measures was to vote the payment to each deputy of 17s. for each sitting of the assembly. Congress in Feb. 1926, approved a proposal for the revision of the constitution.

Church and State.—The anti-clerical policy of the Provisional Govt. had entailed serious difficulties. The bishops signed a pastoral letter of protest and on March 8 1911, the Bishop of Oporto was removed from his see. The religious orders had been expelled by the decree of Oct. 8 1910, their property confiscated and the convents closed. By that of Oct. 22 the teaching of religion in the primary schools was forbidden. Marriage of priests became legal. The decree of separation between Church and State was drawn up, under the date of April 20 1911, by Dr. Alfonso Costa, then Minister of Justice. The Roman Catholic religion ceased to be that of the State, which recognised all creeds as of equal authority.

This decree contributed towards alienating the north of Portugal from the republic. The Patriarch of Lisbon and the Bishop of Guarda published a pastoral letter forbidding the clergy to accept salaries from the state. For consistent opposition to the law of separation the Bishop of Guarda and the Patriarch of Lisbon were banished from their dioceses for two years.

After the promulgation of the law of separation, the Portuguese Legation at the Vatican was suppressed July 10 1913. The law was extended in Nov. 1913 to the Portuguese colonies, where the discouragement of Portuguese missions later gave rise to serious fears of the denationalisation of the colonies[1] through the activity of foreign missionaries. When Paes subsequently became president, one of his first acts was to redress some of the grievances suffered under the law of separation, and, by a decree of Dec. 22 1917, banishment imposed on the priests was annulled,

[1] Administrative and financial autonomy was given to the Colonies on Aug. 15 1914. Decrees regulating native labour in Portuguese colonies in amplification of a fundamental law of May 27 1911 were promulgated on Oct. 1 1913 and Oct. 14 1914.

and the Cardinal Patriarch returned to Lisbon. Relations with the Vatican were resumed in 1918, and were maintained after President Paes's death.

The Royalist Invasions.—The main event of Senhor Chagas's premiership was the first Royalist invasion, commanded by Capt. Paiva Couceiro. Small Royalist risings had been suppressed during the summer of 1911, but Capt. Couceiro still threatened the northern frontier. Successful representations were made by the Republic to the Spanish Govt., which was itself suffering from the action of Portuguese Republicans in Spain, and steamers were detained and war material seized. Couceiro crossed the frontier on Oct. 3 at the head of about 1,000 men, not a quarter of whom were armed with rifles. He advanced in the direction of Braganza, and took the small town of Vinhaes, but evacuated it on Oct. 6 and, after maintaining himself for a fortnight in the hills, recrossed the frontier. A Royalist rising in Oporto, timed to coincide with this invasion, was brought prematurely to a head by Carbonario agents on Sept. 29.

King Manoel and the pretender Dom Miguel met at Dover on Feb. 6 1912. On July 7 Couceiro again crossed the frontier, with a slightly larger force, but most of his arms and ammunition had been seized in Belgium and Galicia. The Royalists' attacks on Valença and Chaves failed, and within a week they returned to Spain. Royalist risings in the northern provinces were speedily suppressed, and great excitement prevailed in the south, where the Carbonarios discovered a Royalist plot at Torres Vedras. Dr. José de Almeida and other prisoners of war were tried by a court-martial and confined in the Lisbon Penitenciaria.

The Political Trials.—The arrests after the invasions of 1911 and 1912 were very numerous. Special tribunals were set up in Lisbon and Oporto in Jan. 1911, to try cases of political conspiracy, and in July 1912, Parliament voted still more stringent laws of defence. Thousands of persons were summarily arrested without the formulation of any definite charge and were confined for months in subterranean dungeons. The chief instrument of this widespread system of espionage was the organisation of the Carbonarios. This secret society, the *Jov. Port.* (Young Portugal), founded or revived by Arthur Duarte da Luze Almeida, forced through the Revolution of 1910 before the politicians were prepared for it. It assumed the functions of an unofficial police force, and at times proved itself strong enough to attack the Republican Govt. and the army. Its members, who carried arms, were Republicans of the most extreme type, and arrogated to themselves the right of summary arrest. Chagas estimated that on Oct. 23 1911 there were 2,000 political prisoners awaiting trial, of whom 700 were innocent.

Reforms were opposed by the Carbonarios and the Radical Republicans, and some of the worst outrages were committed under the weak Government which succeeded that of Chagas in Nov. 1911, with Dr. Augusto de Vasconcellos as Premier, and under the third Coalition Ministry formed by Dr. Duarte Leite in July 1912. Dr. Afonso Costa, the Radical leader, came into power in Jan. 1913, and under the pressure of public opinion, the Minister of Justice introduced a bill modifying the Penitenciaria régime, but the general amnesty was delayed till Feb. 1914. The situation had become one of growing unrest, and strikes were frequent. In April 1913, an attempted ultra-Radical *coup d'état*, in which a portion of the army and navy were implicated, was quelled, and in June the Government decreed the suppression of the Lisbon Syndicalist Club. In July a movement similar to that of April was marked at Lisbon by attacks on the military barracks, and was followed by numerous arrests. Dr. Afonso Costa, who gave much of his attention to finance, resigned on Feb. 9 1914, and Dr. Bernardino Machado became Premier. He was in office when Portugal definitely ranged herself on the side of the Allies during the World War.

The World War.—At a special joint sitting of both Chambers on Aug. 7 1914, Portugal proclaimed her loyalty to the British Alliance, and on Nov. 23 formally committed herself to participation in military operations. She served the cause of the Allies by furnishing munitions, guns and a division of artillery, and acted in close co-operation with Great Britain. On Sept. 11 the first expedition of Portuguese troops left for Africa under the command of Cols. Alves Roçadas and Massano de Amorim, and fresh contingents followed at intervals, 40,000 troops in all being dispatched for the defence of the colonies. Germany had not waited to be at war with Portugal in order to attack them.

As early as Aug. 24 1914, a raid was made on the Portuguese post of Maziwa on the northern frontier of Mozambique. On Oct. 19 the Germans attacked Naulila (on the Angola frontier), where more serious fighting occurred two months later, and on Oct. 30 they stormed the fortress of Kwangar and put the garrison to the sword. On April 11 1916, Portuguese troops occupied Kionga (south of the Rovuma river), which Germany had seized in 1894, and on May 27 they crossed the Rovuma river. They were still co-operating with the British in rounding up the Germans when the War ended. The British Govt. had deprecated any unnecessary intervention of Portugal in the War but agreed to the requisitioning of German ships lying in Portuguese ports, and this was carried into effect in Feb. 1916.

Consequently, Germany retaliated by declaring war on Portugal on March 9 and the declaration of war between Portugal and Austria followed on March 16. German submarines were active off the coast of Portugal during the autumn, many ships being sunk in 1917. By a decree of Jan. 17 1917, Gen. Fernando Tamagnini de Abreu (d. 1924) was given command of the Portuguese Expeditionary Force, and by July there were over 40,000 Portuguese troops on the Western Front, with 20,000 in Portugal ready to reinforce them. On April 9 1918, on the Lys river, the Portuguese contingent were subjected to a formidable attack by the Germans, and subsequently Portuguese troops took part in the entry into Lille.

Political Movements During the War.—On Dec. 13 1914, Dr. Machado was succeeded in the premiership by the democrat, Senhor Victor Hugo de Azevedo Coutinho, president of the Chamber of Deputies, with a view to holding the elections fixed for March 7, but the government's purpose was prevented by a military movement, and President Arriaga appealed to Gen. Pimenta de Castro to constitute a government representative of a wider body of opinion in the country; he formed a ministry on Jan. 28 1915. The action of the new Government was conciliatory and had the support of the moderate Republicans led by Dr. Antonio José de Almeida; foreign policy remained unchanged, but the activity of the Carbonarios was checked, the so-called Committee of Public Safety abolished and the refractory municipal councils dissolved.

The general election was now fixed for June 6 1915. In April an amnesty emptied the prisons. The democrats were, however, able to count on the support of the marines, and on May 14 the sailors mutinied, shot the captains of the "Almirante Reis" and "Vasco da Gama" and bombarded Lisbon, about 100 persons being killed. Pimenta de Castro resigned on May 15 and was arrested next day and transported to the Azores. The revolutionary committee nominated Chagas as Premier, but on May 16 he was shot at and wounded in the train on his way to Lisbon. Chagas died a few days later, and was succeeded by Dr. José de Castro. In a message addressed to Parliament Arriaga resigned the presidency as from May 29 (he died on March 5 1917); and after a short interim presidency under Dr. Theophilo Braga, he was definitely succeeded as president on Aug. 6 1915, by Dr. Bernardino Machado. The Government resigned in June, Castro again becoming premier, but he resigned in Nov. and Dr. Costa returned to office. On Dec. 5 1917, a revolution, directed against the internal policy of Costa and the Democrats, broke out at Lisbon. The rebels entrenched themselves in the Parque Eduardo VII., and their artillery opened fire upon the fleet. After two days' fighting, Gen. Norton de Mattos and Capt. Leotte do Rego took refuge on board a British ship in the Tagus. Dr. Costa and Dr. Soares were arrested; President Machado was placed under arrest, and on the 15th was banished. Vice-Adml. Machado dos Santos was released from prison, and with Maj. Sidonio Paes, the leader of the movement, and Capt. Feliciano Costa, formed

a revolutionary committee. A provisional government was now constituted, Maj. Paes becoming president and Minister for War and Foreign Affairs. The Radical sailors mutinied on Jan. 8 1918, and bombarded Lisbon, but the movement was easily quelled, and several hundreds were deported to Africa.

In March 1918, Paes reconstructed his Ministry, and the elections, on an enlarged franchise, were held on April 28. On the same day Paes was elected president, and was proclaimed president on May 9, the Powers recognising the new régime. Under a new system established in Oct. the president became also premier and ministers were called secretaries of state.

The first anniversary of the revolution was celebrated with national rejoicings on Dec. 5–8 1918, but on Dec. 14 President Paes was shot at the Rocio station by José Julio da Costa and died a few minutes later. On Dec. 16 Adml. João de Canto e Castro was provisionally elected president, and in Jan. 1919, Senhor Tamagnini Barbosa formed a Ministry, reviving the office of Premier. The Radical and Carbonario elements, which had hoped to benefit by the murder of President Paes, rapidly became impatient, and a democrat rising now broke out at Santarem, but the town was besieged by government troops and the rebels surrendered. The Royalists, too, were active, but the main result of their ill-timed risings was to fill the prisons and bring the Radicals into power. Dr. Egas Moniz (later replaced by Dr. Afonso Costa) was appointed to represent Portugal at the Peace Conference, and in Jan. 1919, at the instance of Great Britain, the number of delegates to the conference was increased to two. Portugal came out of the War with a crushing debt, but her colonies were assured to her and her economic future was promising. The Peace Treaty was ratified on March 30 1920. At the Spa Conference in July 1920, Portugal secured 0·75% as her share of the indemnity from Germany, and also received Kionga.

On June 1, Adml. Canto e Castro announced his intention of resigning the presidency, the democratic candidate, Dr. Antonio José de Almeida, being elected president on Aug. 6. There followed a succession of short-lived ministries and on March 2 1921, a new coalition Ministry, composed of off-shoots of the original republican democrat party, was formed, under the premiership of Dr. Bernardino Machado. A military pronunciamento on May 20 caused the resignation of Dr. Machado. He was succeeded by a Liberal Ministry under Dr. Barros Queiroz, who dissolved Parliament and held a general election on July 10. Dr. Barros Queiroz was succeeded in the premiership by Dr. Antonio Granjo.

A solemn pledge had been taken to punish all who had supported the moderate republican, President Paes; in Oct. 1921, the barbarities culminated in the murder in cold blood of the Premier, Dr. Granjo, the founder of the Republic, Adml. Machado Santos, and other prominent persons. The appearance of foreign battleships in the Tagus made an impression, and brought the assassins to their senses for a time. Capt. Cunha Leal formed a short-lived Ministry and was succeeded in Feb. 1922, by Sr. Antonio Maria da Silva, who, despite many difficulties and several revolutionary movements, remained in office for 21 months. A number of Ministries, lasting two or three weeks apiece, followed his resignation, political instability being further increased by divisions in the Democrat party.

In the general election of Jan. 1922, the most striking feature was the Lisbon poll, the monarchist candidate, Sr. Carvalho da Silva, obtaining 3,903 votes, only 470 less than the successful democrat candidate, Dr. Afonso Costa. Each succeeding year saw one or more revolutionary movements, which had become a regular political weapon and were attended by little loss of life. Those of April and July 1925, were of a more conservative character and showed an inclination on the part of the army to expel the politicians from power. In Aug. 1923, Sr. Teixeira Gomes, Portuguese Minister in London, had been elected president of the republic in succession to Dr. Almeida, the first president to serve his full term of four years.

The absence of a firm guiding hand had been especially felt after the murder of President Paes, and successive governments seemed to lose control over the finances. No government was strong enough to raise an internal loan, to revise the system of taxation, or levy a war-profits tax, and, while the taxes were paid in worthless paper money, the Govt. had to buy wheat and pay the service on the debt in gold. Social unrest was chronic; in March 1920, there was a general strike of civil and post and telegraph servants; a railway strike which began on Oct. 1 1920, lasted 70 days; and a newspaper strike in 1921 for over two months. The royalists showed themselves willing to exchange revolutionary for constitutional opposition, and King Manoel had constantly deprecated any revolutionary movement. The death of his uncle, the Duke of Oporto, in 1920, left King Manoel without an heir to the throne. Don Miguel, Duke of Viseu, and his father Don Miguel, Duke of Braganza, renounced their right to the throne of Portugal in favour of Don Duarte Nuno, the younger son of the latter, who was born Sept. 23 1907.

(A. F. G. B.)

The elections of Nov. 8 1925 gave a clear majority to the Democrats, who numbered 82 against 66 for all other parties, and it seemed at last that Portugal might achieve a comparatively stable government. The resignation of the President had long been expected, and when it took effect (Dec. 10) the election of his successor, Dr. Machado, took place without incident. The new Democrat Ministry formed on Dec. 16 consisted of experienced politicians, with Sr. Antonio da Silva once more as Premier. But on Feb. 2 1926 a military revolt broke out in Lisbon. It was rapidly quelled and the leaders deported. On May 30 a more serious revolutionary attempt was made. The new movement was in fact a continuation of the two abortive revolts of April 18 and July 19 of 1925, and Commander Mendes Cabecadas, leader of the July revolt, was one of the leaders. The other, General Gomez da Costa, had also been implicated in former risings. The outbreak of May 30 was a revolution led by the Army and provoked by the corruption and inefficiency of successive governments. On June 1 the whole country was in the hands of the revolutionaries, the President resigned, and Com. Cabecadas formed a provisional government with Gen. Gomez da Costa as Minister of War. The May revolution was the 18th *pronunciamento* since the foundation of the Republic and Sr. da Silva's Cabinet was the 40th to be overthrown in the same brief period.

(Ed. *E.B.*)

Education.—By the decree of March 29 1911, primary education became neutral, laic and compulsory. Each parish was to have at least one boys' and one girls' school, the cost to be shared between the state and the town councils. In the two following years 991 new schools were decreed, but in March 1913, 556 were still non-existent. The sum of £40,000, destined in 1913 for the building of primary schools, was apportioned among 180 schools. By a decree of Sept. 11 1913, in order to encourage industrial education and relieve the lyceums of Lisbon, Oporto and Coimbra, the number of students admissible to these latter was limited to a total of 4,850. Secondary education was remodelled by decrees of July 14 and Sept. 8 1918. In May 1914, a military school of aeronautics was created.

Defence.—On Jan. 19 1911, a commission appointed to reorganise the navy recommended the acquisition from Great Britain of three battleships of the dreadnought type, similar to the "Minas Geraes" of the Brazilian Navy. This recommendation was adopted in the new naval programme submitted by the Minister of Marine in Dec. 1911, which involved the purchase of three battleships of 20,000 tons each, three scouts of 3,000 tons, 12 torpedo-boats of 820 tons, and six submarines. On May 1 1912, a bill was introduced fixing the naval force at 4,500 men, as compared with 5,687 in 1910. On Jan. 27 1913, a commission was appointed for the creation of a naval arsenal on the south bank of the Tagus.

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II. ECONOMIC HISTORY

Population.—The population of continental Portugal, which includes the Azores and Madeira, amounted, in 1920, to 6,399,355 compared with a population of 5,957,985 in 1911. The colonies, which cover a total area of 804,841 sq. m., have a population of 9,675,000. Emigration has tended to keep the population fairly stationary. In 1919, emigrants mainly to the United States and Brazil numbered 31,138, while between 1912 and 1922 the total emigration was estimated at 700,000. According to the 1920 census, the population of the chief towns was as follows: Lisbon, 486,372; Oporto, 203,091; Setubal, 37,074; Braga, 21,970; Coimbra, 20,841; Evora, 16,148; Covilhã, 14,049; Farq, 12,925; Tavira, 11,043; Portalegre, 11,171; Elvas, 11,747; Aveiro, 10,357.

Agriculture.—Portugal is primarily an agricultural country, 60% of the population being engaged in agricultural pursuits. The land is exceedingly fertile owing to its sunny but moist climate; yet more than a third of the whole country still awaits exploitation and, indeed, between 1902 and 1921 there was an increase in the total amount of waste land from 43·1% to 49·1%. The principal handicap to agricultural development is the lack of adequate transport facilities. In many parts of the country, particularly in the south, the roads have deteriorated and the small sum of £8,000 sterling voted for their upkeep in the 1923 Budget is insufficient.

The state railways have also fallen into a serious state of disrepair, and, consequently, it has been found cheaper to import wheat direct from the Argentine than to send supplies to the north of Portugal from the Alemtejo. Lack of fertilisers is another serious handicap; it is estimated that 20,000 tons of additional fertilisers are necessary in the Alemtejo district alone, while other causes which check development are the excessive dependence on hand labour on the farms and, in the frontier districts, the tendency for labourers to cross into Spain, owing to the higher purchasing power of the peseta compared with the escudo. The most valuable crop is wheat, the average yield being six to seven quarters an acre and the harvest averaging 230,000 tons annually. The country, however, is compelled to import between 100,000 to 150,000 tons of wheat annually, despite the efforts of successive governments to encourage wheat growing, and the payment of these imports constitutes a heavy charge on the nation's finances.

Wine is the principal product of Portugal, accounting for 50% of its exports; the vineyards employ 100,000 hands. England alone imports over 6,000,000 gal., valued in 1923 at £2,080,170, despite the fact that the vintage in the port region of the Douro Valley in that year was a poor one. Table wines are produced all over the country, and are exported to Brazil and also to France. With the enforcement of prohibition in the United States, France, however, had no use for the Portuguese red wine which was used for mixing with the Bordeaux wine intended for American consumption, and the French efforts to prohibit the importation of Portuguese wines led to a war of reprisals between the two countries.

Portugal is the third olive producing country in the world, her olive trees occupying an acreage of 750,000 and giving 12,760,000 gals. of oil. Other crops grown on a large scale are maize, rye, oats and barley. About 200,000 tons of potatoes are produced, and there is a large export trade in fruit, mainly to England. Livestock is about equal in number to the population and an important industry is the production of corks which reaches about 70,000 tons annually.

Commerce.—Portuguese trade has been considerably hampered by the political uncertainty and by the fall and instability of the escudo whose value at par is 4s. 5¼d. but which in 1925 was worth about 2½d. The War gave an impetus to the development of home manufactures, more particularly textiles, and, if the hopes of obtaining cheap power are realised, that impetus ought to continue. Great Britain is still Portugal's best customer, buying the greater portion of her port and madeira, her fruit, cork, sardines and mineral ore. After wine, the most important export is canned sardines and tunny fish, the principal customers being Great Britain and the United States. The annual value of these exports amounts to about £1,000,000 annually. Other exports are cork, pitprops, textiles (for Angola) and copper.

Portugal is hampered by the necessity of having to buy abroad foodstuffs, particularly wheat and maize and fish (bought from Newfoundland and Norway). The value of the oil imported now exceeds that of coal which averaged before the War about 1,000,000 to 1,500,000 tons, almost entirely bought from Great Britain. Cotton and woollen goods are also largely imported from Great Britain, agricultural machinery comes mainly from the United States and Germany; and Belgium supplies most of the railway material. As a result of the fall of the escudo, there has been a decline in Anglo-Portuguese trade, Portugal's exports to Great Britain falling from £9,747,000 in 1918 to £4,589,000 in 1922 and in the first nine months of 1923 to £2,890,415. The general fall in foreign trade would have been more noticeable, if it had not been for the large importations of raw materials from Portuguese colonies.

Manufactures.—As already stated, there has been a considerable increase in Portuguese industries since the War, and Dr. Perez Trancoso, a former Finance Minister, has estimated that whereas before 1914 the number of those engaged in Portuguese industries other than agriculture was 60,000 or 1% of the population, 10 years later the number had increased to 500,000 or nearly 10% of the population. The principal manufacturing industry is the production of textiles, employing 45,000 workpeople, half of whom are in the cotton factories of Oporto and district, the remainder being engaged in the wool, silk and linen industries. Other industries are the making of tiles and the embroideries of Madeira, the annual export of which to the United States alone amounts to £2,000,000 annually. Wages have been increased between 20 and 30 times above the pre-War rates, in many cases more rapidly than the cost of living. Most of the labour disputes occurred in overcrowded Lisbon, though there were also troubles in Oporto and Covilhã. Many of these disputes affected shipping. The German mercantile marine is now the second largest carrier of Portuguese overseas trade, and is gradually gaining on British shipping.

Finance.—Portuguese financial difficulties are due to causes which may be summarised as follows: (1) The political and economic uncertainty caused by a series of weak and short-lived governments and by a number of costly strikes; (2) the tendency for the wealthy Portuguese to send their capital abroad, these sums amounting, it is said, to some £75,000,000; (3) the hoarding habits of the peasantry; (4) the large purchases of foodstuffs and raw materials from abroad; (5) foreign liabilities like the debt to Great Britain which, however, is not yet funded; and (6) the increase in the number of civil servants and in their emoluments. The estimated deficit for the fiscal year 1924–5 was 333,023,845 escudos, and the accumulated deficits since the War up to that year had reached 1,000,000 contos (a conto is 1,000 escudos). Financial reforms carried included the raising of port dues and shipping taxes, making the postal and telegraph rates the highest in Europe, and doubling the consular fees payable on all imported merchandise. By a series of prohibitions it was found possible to raise the exchange to about 2⅜d. at which figure it is hoped it may remain. The Bank of Portugal was compelled to issue between Jan. and Nov. 1923, notes to the amount of 238,699 contos, which increased the circulation beyond the legal limits of 1,160,000 contos. That excess was subsequently legalised and the limit increased. The uncertainty and speculation prevailing are further increased by the large number of small banks which cannot confine themselves to legitimate banking business.

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PORTUGUESE EAST AFRICA: *see* MOZAMBIQUE.

PORTUGUESE LITERATURE (*see* 22.155).—Constant political unrest has been prejudicial to letters in a small country without a numerous leisured class, and no distinguished literary figure arose during the years 1910–25, but even before 1910 a reaction had begun against revolutionary methods in politics and laxity, or agnosticism in religion, which may lead to a healthier national life. This movement showed itself in the later works of Eça de Queriroz who had founded the Naturalist school, in the return to the Church of the prose writer Ramalho Ortigão and of the great poet Guerra Junqueiro, whose book, *Poesias dispersas*, dates from 1921, and it is found not only in the writers of the Integralist school (a Portuguese counterpart to the *L' Action française*) but even among men of advanced opinions like the novelist Manuel Ribeiro; most of the leading poets and prose writers are once more declared Catholics and they have gone back to the people for inspiration, with happy results.

Nationalism and regionalism have taken the place of naturalism and symbolism, which were copied from France and never commended themselves to Portuguese feeling as a whole. The prevailing political and economic gloom has driven the *intelligenza* to seek salvation in the spirit of the race, which is essentially Catholic, and has survived in the hearts of the country dwellers, who form the vast majority of the population. The inability of 60% of these to read, saved many of them from losing their ideals and character during the period when a Liberal, destructive and anti-religious atmosphere permeated newspapers and books.

Under the influence of the movement referred to, and perhaps also of the 16th century, the golden age of letters, Eugenio de Castro, the doyen of living poets and once a rather artificial

Symbolist, developed a simple and natural manner in *Canções desta negra vida* (1922) containing the poignant *Song of a Poor Man's Lamp* and the witty *Song of an Old English Clock*, and in *Cravos de papel* (1922), gentle satire runs through short descriptive poems, clearly cut and almost popular in form. His later publications include *A Mantilha de Medronhos* (1923), impressions of Spain, *A Caixinha de cem conchas* (1923), quatrains on the most varied subjects, slightly malicious but true to life, and *Chamas de uma candeia velha* (1925). The titles are happily chosen and suggest the spirit of the contents.

Poets and Poetry.—The most admired of the younger poets of this period, Antonio Correia de Oliveira, continued to draw inspiration from the soil and religion, as in the *Auto das Quatro Estações* (1911) and *Pão nosso, Vinho alegre, Azeite de Candeia* (1922), but his works are marred by repetition and an incapacity for sustained thought. The last defect is avoided in *A Minha terra* (1916) and in *A Criação*, a series of poems in various metres on the genesis of things; some true poetry mingles with much vague rhetoric and the versification shows technical skill. Augusto Gil, a hardly less esteemed poet, published three books, *Sombra de Juno* (1915), *Alba Plena* (1916) hymns of tender devotion on the life of the Blessed Virgin, and *A frauta de Cana* and he had the honour of a volume to himself in the *Anthology* of Agostinho de Campos. Teixeira de Pascoaes, a sincere but nebulous pantheist, the inventor of what is called *saudosismo*, wrote a tragedy in verse on the late King Carlos, devoid of dramatic situations but remarkable for its beautiful lyrics. Not only Portuguese but Spanish critics have hailed him as a great poet and some of his compositions have been compared to those of Wordsworth. Love of nature distinguishes him, but he pays too little attention to form, though his verse has a music of its own. Affonso Lopes Vieira, a writer of exquisite taste and sense of rhythm, translated the traditions of the race and the poetry of the sea in *Ilhas de Bruma* (1918) and produced *refacimentos* of two works of world fame in his *Amadis* and *Diana*, marked by rare artistry and understanding of the originals. The last publication of the Republican politician João de Barros, prolific in verse and prose, is a poem *Sisifo*, in which he treats the classical legend in a novel way.

Prose Writers.—The new manner is seen even more clearly in prose and especially in the novel, though it did not touch the austere Republican and conscientious analyst of middle-class society Teixeira de Queiroz (d. 1919). Following in the steps of Oliveira Martins, Anthero de Figueiredo has sought to combine history and art in *D. Pedro e D. Ines* (1913) and *Leonor Telles* (1916) and above all in *D. Sebastião* (1924), where he revives the figure of the last crusading king, and by the aid of contemporary accounts paints a picture of the times with abundant imagination. It is a frankly nationalistic book, but though the author at the close exhorts his countrymen to educate themselves and work, it is to be feared that his panegyric of the noble but headstrong monarch may have a contrary effect to the one intended. His *Espanha* (1923), *Jornadas em Portugal* (1918) and *Senhora do Amparo* (1920) are regional works, in a glowing style, which in the second suffers from over elaboration.

The lack of a sound classical education is too evident in modern Portuguese prose, and few dare to attempt the straightforward narrative, sparing of adjectives and uncommon words, which is the chief attraction of the classics. Raul Brandão is an exception: his *Pescadores* (1924), dedicated to " my grandfather who died at sea," tells of fisher folk and the tragedy of the ocean with poignant realism, and contains magnificent descriptions of the coast scenery from north to south, ending at Sagres, the town of Prince Henry the Navigator. The book is worthy of the author of *Os Pobres* (1921). The trilogy of Manoel Ribeiro, *A Cathedral*, probably suggested by Huysmans, *O Deserto* and *A Resurreição*, constitute a remarkable performance in subject and atmosphere, without precedent in modern Portuguese, and its popularity is not less remarkable. No better proof could be adduced of the changed times than these " clerical " books by a man of far from clerical ideas. At the close of this period he initiated a new trilogy with *A Colina Sagrada* (1926). The naturalism of Eça de Queiroz found a fresh interpreter in Aquilino Ribeiro, a novelist highly considered throughout the Peninsula, whose works sold by the thousand. Equal as a psychologist to his master and possessed of a rich vocabulary, no one can create characters or picture one side of country life so faithfully as he has done in *A Via Sinuosa* (1918). In 1925 he produced *Filhas de Babilonia*, an unpleasant book, and *Estrada de Santiago*. The voluminous João Grave added *Gente Pobre* (1912), *Parsifal* and *A vida e Paixão da Infanta* to his list of romances. Sousa Costa the novel *Romeu e Julieta*, and a brilliant satire on contemporary political events is to be found in *Saude e Fraternidade* by Campos Monteiro. The *Gente de Palmo e Meio* of Augusto all contain delightful short stories.

The Drama.—The drama is, as ever in Portugal, the weak spot and there are few original plays of merit to record; the theatre continuing to live for the most part on versions from the French. Julio Dantas added to his repertory *O Reposteiro Verde* (1912), a successful piece, and *Mariana*, but they only confirmed and did not increase his reputation. Among other pieces may be mentioned *O herdeiro* and *Entre Giestas* of Carlos Selvagem, a talented prose writer, *D. João e a mascara* (1924) and the lyrical play *Diniz e Isabel* (1919) of Antonio Patricio, *O Gebo e a Sombra* (1923), a tragedy of unrelieved gloom and considerable power by Raul Brandão, and *Egas Moniz* (1918) by Dr. Jaime Cortesão. Augusto de Lacerda, the dramatic critic, also a playwright, his tragic comedy, *O Pastelliro De Madrigal* gaining a prize in 1924.

The veteran Henrique Lopes de Mendonça used his qualities as a dramatist and his knowledge of old Portugal in the composition of five stirring tales, *Lanças n'Africa, Capa e Espada, Fumos da India, Santos de Casa* and *Sangue Portugues* (1921–5). The Conde de Sabugosa, Lord Chamberlain under the monarchy, published five volumes of historical studies between 1912 and 1924. To wide reading, made possible by his richly stocked library, and critical ability, he joined imagination and a sense of humour, a combination not very frequent anywhere. His most substantial work is *A Rainha D. Leonor* (1921). He discovered and edited the *Auto da Festa* of Gil Vicente (1525) and the *Auto da natural Invençam* (1550) (Ed. 1917) of Ribeiro Chiado, two real contributions to letters and scholarship. Another *fidalgo*, the Visconde de Santarem, printed the correspondence and re-issued some of the geographical and historical works of his famous namesake, including the *Historia e Theoria das Cortes Geraes* (1924). The Integralist leader Antonio Sardinha (d. 1925) left among other works *A alliança peninsular*, *Ao ritmo da ampulheta* and *Ao principo era o verbo*, the last containing well documented studies on Gen. Gomes Freire, Grand Master of Masonry, executed for conspiracy in 1817, and the unjustly abused D. Carlota Joaquina, wife of King John VI. They throw fresh light on these subjects and the author's conclusions are likely to stand. Other essays of his were, at this time, being reprinted in the review *Nação Portuguesa*. Hippolito Raposo and Manuel Murias belong to the same school. Dr. M. Gonçalves Cerejeira made his name by a work on the Renaissance with versions of the letters of the humanist Cleynarts; his last volume being *A Igreja e o Pensamento Contemporaneo*.

Historical Works.—Previous to this period there was no complete history of Portugal worthy of the name, for such as existed were neither impartial, nor the work of men with critical ability and learning. A mass of fresh facts and documents were printed in reviews like the *Archivo Historico Portugues* and Prof. Fortunato de Almeida used these to compile his *Historia de Portugal*, the third volume of which, carrying the narrative down to 1580, has appeared. The book marks a great advance on its predecessors, covers a wide field and is well supplied with notes. The same scholar published in four stout volumes a *Historia da Igreja em Portugal* (1910, etc.), equally well documented.

The great historian Gama Barros (d. 1925) issued in 1922 the 4th volume of his monumental *Historia da Administração Publica em Portugal nos seculos 12 a 15* and was engaged on a fifth at his death. J. Lucio d'Azevedo, the authority on Pombal, produced an excellent biography of the 17th-century missionary, preacher and diplomat Antonio Vieira, S.J., and the first volume

of his *Cartas* appeared in 1925. D'Azevedo's most notable book is the *Historia dos Christãos novos portugueses* (1922). Edgar Prestage wrote monographs on various embassies of the Restoration period and in collaboration with Pedro de Azevedo undertook the publication of the correspondence of Francisco de Sousa Coutinho, ambassador at The Hague from 1644 to 1650. Vol. 1 came out in 1920. The same editors were publishing the Lisbon parochial Registers of the 16th century. Those of the Church of Sta. Maria do Castello appeared in 1913, and vol. 1 of those of the cathedral in 1924. The statesman João Franco, last minister of King Carlos, issued a number of autograph letters received by him from the King shortly before his tragic death. His political opponents saw in the book a self defence rather than an attempt to set the King's character in its true light and the publication provoked a controversy which is not ended. Affonso de Dornellas in genealogy and history and Antonio Ferrão in the latter have done considerable work.

The *Revista de Historia*, edited by Fidelino de Figueiredo, which suspended publication after the 11th volume, began again to appear, and three new reviews *Lusitania Portugalia* and *Arquivo de Historia*, contain historical articles, but none attempt to fill the place of the excellent *Archivo Historico*, which came to an end at the 10th volume, on the death of its proprietor and editor Braamcamp Freire. To him we owe an edition of the first part of the *Cronica d'el Rei D. João I* of Fernão Lopes, a portly volume on the life and dramatic works of Gil Vicente and two learned genealogical tomes on the *Brasões de Cintra*. He was joint editor with D. Carolina Michäelis de Vasconcellos (d. 1925) of the works of Bernardim Ribeiro and Christovam Falcão. This great Romance scholar issued the 4th of her illuminating *Notas Vicentinas* in 1924, and among her other publications mention must be made of an edition of the *Tragedia de la insigne Reiña Isabel* by the Constable D. Pedro. Her husband Joaquim de Vasconcellos edited the *De pintura antiga* of Francisco de Hollanda, the friend of Michael Angelo.

The Lisbon Academy of Sciences was also active; it printed the *Livro da Montaria* of King John I., some dramatic works of the 16th century, the writings of King Pedro V. and vol. 6 of the *Cartas de Albuquerque*. It celebrated the 5th centenary of the capture of Ceuta and the 4th of the death of the great Governor of India by a series including *Alguns ascendentes de Albuquerque* by Antonio Baião, *Documentos das chancelarias reais* by Pedro d'Azevedo, *Marrocos e tres mestres da ordem de Christo* by Vieira Guimarães and by editions of three old chronicles, *Historia de la Ciudad de Ceuta* of D. Jeronymo de Mascárenhas, *Anais de Arzila* and the *Cronica da tomada de Ceuta* of Zurara. This and the *Livro da Montaria* were prepared for the press by Col. J. M. Esteves Pereira (d. 1924), better known abroad as an Ethiopic scholar. His transcriptions of Amharic texts are to be found in the *Boletim da Segunda classe* of the Academy.

The Coimbra University Press, under Dr. Joaquim de Carvalho, author of *Leão Hebreu filosofo*, began to issue reprints of the classics and the following had already come out: *Cancioneiro de Resende*, 5 vol. in 1925, *Historia do descobrimento e conquista da India* of Castanheda, *De rebus Emmanuelis gestis* of Osorio and the *Comentarios* of Albuquerque. The useful *Antologia* of Agostinho de Campos now numbers 20 volumes and contains carefully annotated extracts from Fernão Lopes, João de Barros, Camões, Trancoso, Lucena and some modern authors. The critic Fidelino de Figueiredo established his position as the leading literary historian, and his *Torre de Babel* proves that he can excel also as a essayist, while *Sob a cinza de tedio* shows him as a psychologist. Antonio Sergio published some essays and the *Dispersos* of Oliveira Martins and other posthumous publications include *Sol de Inverno* by the poet Antonio Feijó (d. 1917) and *Figuras de destaque* by the critic Fialho de Almeida (d. 1911).

The invaluable *Revista Lusitana* of Dr. J. Leite de Vasconcellos, which reached its 20th vol. in 1917, continues, and to Dr. J. J. Nunes, the philologist, we owe an edition of the *Cronica dos Frades Menores;* he has also one of the *Cantigas d'Amigo* in the press. The *Anais das Bibliotecas e Arquivos*, is equal, if not superior, to any publication of the kind in Europe.

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POSITION FINDER: *see* RANGE FINDER.

POSTAL SERVICES (*see* 22.176).—The Universal Postal Union (1874–1914) was formed by the covenant signed at Berne on Oct. 9 1874 and included at the outset all the European countries, as well as the United States and Egypt. The only non-members of the Union at the end of 1925 were the following countries and territories: In Africa, Nigeria and Northern Rhodesia; in Asia, Afghanistan, Arabia, the Malay States of Johore and Trengganu, the Laccadive and Maldive Islands; and in Oceania, Tonga and the Friendly Islands.

War Work of the Postal Union.—It was decided at the Rome congress of 1906 that the next congress of the International Postal Union should be held at Madrid at the end of 1912 or during 1913. It was, however, postponed until Sept. 1914, and was therefore interrupted by the outbreak of the World War.

The War completely dislocated the international postal service, the international exchange of postal matter of all kinds being either interrupted or completely cut off. As an example of the difficulties encountered may be mentioned the special postmarks and labels of all kinds and colours which bore witness to every phase of the conflict.

Among these may be mentioned: "ouvert par l'autorité militaire" (opened by the military authority); "verificato per censura" (verified by censor); "aus militärischen Gründen verzögert" (delayed for military reasons); "zurück; Keine Beförderungsgelegenheit" (return; no communication possible); "retour à l'envoyeur, lieu de destination envahi" (returned to sender; destination invaded); "zone dangereuse. Non distribuable" (impossible to deliver; dangerous area); "livraison impossible à cause de la guerre" (delivery impossible for war reasons); "renvoi par cause de blocus" (returned; blockade); "incendie wagon-poste" (postal wagon burnt); "naufrage" (shipwreck); "evacué" (evacuated); "repatrié" (repatriated); "tué par l'ennemi" (killed in action); "pays récupéré; non encore distribuable" (liberated area; delivery at present impossible).[1]

During the war years the Union maintained indirect contact between the various belligerent countries. It was at the disposal of all the humanitarian missions undertaken for the relief of distress. The Rome congress, in accordance with a recommendation made by the Hague Peace Conference, had decided that postal correspondence, registered letters, postal orders and pre-paid postal parcels concerning prisoners of war should in future enjoy free entry. From the outbreak of hostilities, neutral countries were requested to serve as intermediaries for the transmission of postal matter to prisoners. This service reached enormous proportions. Thus, from the beginning of war to the end of 1919, the Swiss post transported on this service free of charge 714,500,000 postal packets to and from all countries.[2] Similarly, the Swedish post, which worked the prisoners' postal service between Germany on the one side and Russia, Japan and Great Britain on the other, transported 12,500,000 packages in parcel post from 1914 to 1917, and sent on 1,726,000,000 postal orders between 1914 and 1916, to a total value of 21,000,000 Swedish kroner.[3]

Throughout the War the International Union, in its capacity as a neutral organisation, maintained continual contact between the postal administrations of the belligerent countries. As a matter of courtesy also it did its best to send on the innumerable private letters which it received every day. In these troubled

[1] Stefan Strowski: *Postal Marks of the Great War*, Amiens (1925)

[2] If these postal dispatches had been stamped, it would have meant a revenue for Switzerland of 61·8 million francs, and the transport of them occasioned an expenditure of 2·9 million francs. (*Cf.* the postal service of interned civilians and prisoners of war, in the *Report of the Swiss Federal Council* on its work for 1919: "Postal Administration," pp. 49–55).

[3] After Aug. 1916 the postal order work was entrusted to Switzerland (*Cf.* the Postal Service and the War in Sweden, in the *Postal Union*, 1916–9).

LEIPZIG TRADE FAIR
INTERNATIONAL INDUSTRIES EXHIBITION FROM FEBR 28TH TO MARCH 6TH 1926
TECHNICAL FAIR FROM FEBR 28TH TO MARCH 14TH

CHARACTERISTIC EXAMPLES OF POSTERS

(1) English (2) German (3) American (4) Italian

times the reply-paid system gave excellent results, and was largely used by the public, as will be shown by the following figures:—

Reply-paid Coupons

In 1913	798,444	In 1917	1,371,486
In 1914	854,802	In 1918	1,171,200
In 1915	1,614,457	In 1919	1,116,302
In 1916	1,579,826		

Thus the Union was, above all, an institution for the furtherance of peace, and it was impossible that it should disappear in the storm. On the contrary, it came out of the War stronger than ever.

Postal Developments since the War.—After the Armistice, postal relations were gradually re-established, and the Madrid congress was able to meet in 1920. The congress had to consider 2,248 proposals.[1] The economic systems of all countries had been entirely transformed, and account had to be taken of the new situation. The world currency crisis which followed the War had not yet been settled, and formed a serious obstacle to the proper working of the international post. The Postal Union took the first step in the re-establishment of sound finance by imposing for its own purposes a stable currency on all nations in the form of the gold franc. Further, the old postal rates were now insufficient to cover the costs of the service, and it became necessary not only to give up the idea of adopting a uniform rate of 10 centimes, as had been proposed at Rome by New Zealand, but to acquiesce in a considerable increase in all existing rates. For several years the administrations of the various countries had been experimenting for their inland post with registering machines for stamping correspondence. The use of these machines was, under certain conditions, extended to the international service.

The enormous improvements introduced into aviation during the War made the aeroplane a very valuable ally of the post.[2] The Madrid congress included the aerial services already established between two or more countries in the category of the extraordinary postal services provided for by the Universal Postal Convention, the conditions of transport of which are regulated by private arrangement between the administrations concerned. The old identity card, which dated from the Lisbon congress, was replaced by a simple and practical card, which was also intended to serve as a certificate for postal operations. Finally, a large number of countries signed a new arrangement which allowed any person who had a current post office account in one of the contracting countries to order transfers to be made from his account to a current post office account in any of the countries concerned. The Madrid congress entrusted the necessary revision of the statutes of the Union to a preparatory committee, which held two sessions, one at Zermatt (from July 29 to Aug. 22 1921), and the second at Nice from March 15 to April 14 1922.

The Stockholm Congress.—The Stockholm congress was inaugurated on July 4 1924, and celebrated the jubilee of the Postal Union on Aug. 16. All the members of the Union were represented at the congress except Ecuador, Guatemala, Honduras, Nicaragua and Salvador. The congress was able to reduce transit charges and certain other rates. It authorised the insertion of objects liable to customs duty in packets dispatched at letter rates when the import of such objects by letter is allowed in the country of destination. It made special provisions concerning aerial services, increased the dimensions of postcards and samples and extended the employment of reply-paid coupons. Under specially favourable conditions, which were to be voluntary for the administrations, it facilitated the dispatch of newspapers, periodicals and books by publishers, together with the exchange of literary and scientific publications between learned institutions.

[1] At the Rome congress there had been only 798 proposals.

[2] Attempts at the transport of the post by air had been made in 1909 after the crossing of the Channel by Blériot; but the first regular services would seem to have been established in British India in Feb. 1911, on the occasion of the Allahabad Exhibition of Arts and Crafts; then later, in Sept. 1911, in England, as part of the ceremonies connected with the coronation of George V. (*cf.* Theodore Champion, *Historical and Descriptive Catalogue of Aerial Postage Stamps*, 4th ed. (Paris, 1925); P. G. Heurgren, *The Post in Ancient and Modern Times* (Stockholm, 1925).

TABLE I. *Showing the Progress of the International Postal Service in 1913 and 1924*

Objects Dispatched	Number of Administrations(1)	1913 Number of Objects Dispatched	Number of Administrations[2]	1924 Number of Objects Dispatched
Correspondence[1]	84	2,439,000,000	124	2,678,400,000
Registered letters and packets	57	2,851,000 (value 4,578,000,000 fr.)	85	4,242,000 (value 1,812,300,000 fr.)
Parcel post	77	64,700,000	118	37,500,000
Postal orders	63	33,000,000 (value 2,330,000,000 fr.)	108	15,800,000 (value 2,520,000,000 fr.)
Recouvrements	13	346,000	18	1,319,000,000

[1] *I.e.*, Administrations which supplied information.

[2] Letters, postcards, printed matter, samples of goods and business circulars.

TABLE II. *Showing Some of the Postal Rates in Force in the International Services under the Rome, Madrid and Stockholm Conventions*

Objects Dispatched	Rome Convention (May 26 1906)[1] Centimes	Madrid Convention (Nov. 30 1920)[2] Gold Centimes	Stockholm Convention (Aug. 28 1924) Gold Centimes
Letters: (a) Not exceeding 20 gr.	25[3]	50	20–40
(b) per 20 gr. or fraction of 20 gr. over and above	15	25	12–24
Postcards: (a) ordinary	10	30	10–24
(b) reply paid	20	60	20–48
Printed matter per 50 gr.	5	10	3–8
Braille for the use of the blind	..	5 (per 500 gr.)	4–8 (per 1,000 gr.)
Business circulars	5	10	4–8
Per 50 gr. (minimum)	25	50	20
Samples	5	10	4–8
Per 50 gr. (minimum)	10	20	8
Registration fees	25	50 (maximum)	40 (maximum)
Reply-paid coupons (minimum)	28	50	40

[1] In certain cases the following rates may be collected: (1) a maritime surtax, which may not exceed 25 centimes per delivery for letters, 5 centimes per postcard and 5 centimes per 50 gr. for other objects. (2) an extraordinary surtax.

[2] The Madrid rates could be lowered to the level of those adopted at Rome.

[3] In this case it was possible to maintain the Washington rate, viz., 25 centimes per 15 gr. or fraction of 15 gr.

This article has been prepared from material supplied by the International Bureau of the Universal Postal Union, Berne. See also the sections on communications in the articles on the various countries. See also the 19 vol. of the *Documents of the Congresses and Conferences of the Universal Postal Union* (Berne); and *Universal Postal Convention, Stockholm, Aug. 28 1924* (London, 1925). (*See* GREAT BRITAIN: *Communications.*)

POSTER (*see* 22.196).—The designing and use of posters from 1900 to 1914 became increasingly important commercially and a more definite part of the business of advertising. This was especially so in the United States, where a line of demarcation appeared, dividing the small posters issued by book and magazine publishers from the large outdoor posters used by advertisers of various commodities. A few of the outstanding American artists who represented in their work the best American poster design and technique during this period were Edward Penfield, C. B.

Falls, Louis Fancher, F. N. Abbott, J. C. Leyendecker, Leon Gordon, John E. Sheridan, Adolph Treidler, Robert Wildhack and F. G. Cooper.

Shortly before 1910, and reaching its greatest height immediately before the World War, poster designing in Germany became remarkably active and other countries, especially America, showed for a time considerable readiness to adopt the German poster technique as a predominating one. The principal characteristics of German posters of that period were vigour and massiveness of composition, with correspondingly broad painting and strong masses of colour. Striking and unusual ideas were also characteristic. Of the German poster artists, Ludwig Hohlwein unquestionably occupied the foremost place; other important Germans at that time were Karl Kunst, Bernhard and Gipkens.

In England the poster continued, in a logical development, its earlier types, with, however, no such outstanding names as Pryde and Nicholson ("Beggarstaff Brothers"). Aldin, Hassall and Pears exemplify the most characteristic type of English poster until the appearance of the striking posters issued by the London Underground Railways Company. Among artists commissioned to paint these were F. Gregory Brown, E. A. Cox and E. McKnight Kauffer, the last being a young American painter working in England.

In Italy the designing of posters has long been in the hands of brilliant artists, an extensive group of whom were working consistently and fruitfully throughout the period 1900–14. Foremost of these, and a poster artist as conspicuous in Italy as Chéret in France, was A. Hohenstein, a master draughtsman and brilliant technician, equalled in draughtmanship only, perhaps, by Alphonse Mucha. Some of the most essentially artistic posters ever painted are those of Giuseppi Palanti for Verdi, Mascagni and Wagner operas. Collectors recognise also the posters of G. M. Mataloni, N. Dudovitch, L. Metlicovitz, N. Mauzan, L.Caldanzano, M. Mazza, A. Terzi, D. Cambellotti, A. Magrini and G. Chini, all noteworthy contributors to the poster art of Italy. Many of the most notable of Italian poster designers were trained by the old lithograph firm of G. Ricordi, founded so long ago as 1808. The Ricordi firm still produces most of the posters in Italy. Billboards are under municipal ownership and leased to posting companies. Considerable poster talent has been shown in Switzerland for many years past, with recent designs characterised by a great deal of colour. Cardineaux, Hosch, Giacometti and Lauby are among the names of prominent Swiss designers. Billboards are privately owned in Switzerland, unlike the municipally owned boards of Italy, or those of Austria, where the cities own a half-interest.

Posters in War Time

With the outbreak of the World War in 1914 posters took on a new significance; as the struggle continued and the War needs became increasingly acute, posters multiplied. Artists as a class proved themselves highly patriotic, and the poster was at once recognised as the greatest available vehicle for nation-wide publicity and appeals for the varied activities connected with carrying on a great war. Due to the conscription system, there was no need of posters to stimulate recruiting in Germany, France or Belgium; but recruiting posters appeared first in England and her Dominions and Colonies, and, later, in America. In England posters were issued by the Ministry of Information, which was added to the Parliamentary Recruiting Committee in 1915. Even in the first stages of the War more than 2,500,000 posters, representing the work of over 100 artists, were posted in the British Is. alone. Among the more important men who contributed were Frank Brangwyn, Bernard Partridge, L. Raven-Hill, Guy Lipscombe and G. Spencer-Pryse.

A certain sequence in the successive waves of posters that swept over the combatant countries was observable. First came the recruiting posters, except where conscription existed; next came the battle-cry to the civilian, calling upon him to subscribe to the loans, one loan after another—posters of which the message became increasingly urgent and imperative. Then, as the War continued, came the conservation posters and the posters of appeal to aid various organised enterprises engaged in war work. This group comprised food and coal conservation, ship building, hospitals, milk funds, destitute dependent funds, the Red Cross, the Y.M.C.A. and a number of other agencies, activities and needs brought on by the War.

A French War Loan poster that was striking in its conception showed a French poilu in full equipment going forward, with action in every line. He is looking back as he makes the forward charge, flinging out his arm to lend emphasis to his shout: "On les aura!"—"We'll get 'em!"—to the civilians implored to subscribe their share of the loans to win the War. It was the work of Jules Abel Faivre, and one of the most celebrated of all War posters. Another French Loan poster—the work of Georges Scott—shows the heroic allegorical figure of France holding aloft a sword and a battle-scarred flag. Behind her march the poilus with beating drums and a forest of flags. Overhead airplanes are patrolling a War-wracked sky. Four other French Loan posters that attracted attention because of their effectiveness included "The Loan of the Last Cartridges: one more effort, people of France!" It was the work of an anonymous artist and showed an embattled soldier with his face to the enemy, gun in hand, holding out his hand to receive from a civilian and a small child a box of cartridges and a hand grenade. The second of these four French Loan posters showed two figures in the traditional costumes of Alsace and Lorraine awaiting rescue by France. This poster was the work of Auguste Leroux. The third of these four posters, by Faivre, who designed the "We'll get 'em!" poster, is an appeal to the French people, showing a gigantic French gold piece crushing a German soldier, the Gallic cock leaping from the design of the coin to make the attack more spirited. The appeal is "For France: Pour out your Gold; Gold fights for Victory." The fourth poster of this group is the work of Lucien Jonas and shows the American Expeditionary Force, arriving on the run, with the spirit of victory and determination on their faces. In the foreground are soldiers of the three Allies, Italy, France and England. In addition to these, on the roll of honor of France for poster designs, are the names of Steinlen, Newman, Poulbot and Willette.

When the United States entered the War there was at first considerable confusion in that country in the matter of assigning poster commissions, as had been the case in most of the other countries. In April 1917, however, Charles Dana Gibson formed a committee of the most prominent artists and illustrators in and about New York; this committee was soon recognised by the Government in Washington as officially a part of the Division of Public Information. It then became known officially as the Division of Pictorial Publicity and unofficially as "Gibson's Committee."

The method by which the committee functioned was admirably efficient. The committee met regularly each week, and at each meeting Frank D. Casey reported the requests for posters, cartoons or illustrations received that week from or through the Government as well as from patriotic and charitable organisations throughout the country. Each request was put in charge of a "Captain" who made it his immediate business to see that idea-sketches were received promptly from such artists as were judged best fitted to carry out the assignment. The sketches were then passed through the committee headquarters to Washington, and the finished paintings were made as soon as the sketches were approved. In the course of the committee's work 700 different posters were made for the publicity needs of the Government and for civilian War activities. Among the 187 artists actively enrolled were 33 of the country's most prominent cartoonists. Thirty-seven artists and illustrators devoted their entire work to the needs of the navy, and C. B. Falls specialised almost entirely on the marines. The following names constitute a partial roll of American artists whose work was of special significance in the design of posters during the War: C. D. Gibson, Frank D. Casey, C. B. Falls, Albert Sterner, C. Livingston Bull, Henry Reuterdahl, August Hutaff, E. M. Ashe, Henry Raleigh, Walter Whitehead, Charles Sarka, F. G. Cooper, Crawford

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FRENCH WAR POSTERS

Young, John E. Sheridan, Wallace Morgan, George Illian, A. E. Foringer, Harrison Fisher, Howard Chandler Christy, George Wright, F. Walter Taylor, Gordon Grant, W. T. Benda, Edward Penfield and James Montgomery Flagg.

Since the War the poster has naturally resumed its place throughout the world as an active branch of commercial advertising, with certain characteristics worthy of note in the countries where posters are most extensively used. In England the London Underground Railways Co. has continued to produce posters both artistic and effective, by a variety of artists, and commercial posters in general have shown a logical development of their trend before the interruption by the World War. One of the most important series was one done by G. Spencer-Pryse to commemorate the Exhibition at Wembley—a series showing the peoples and industries of the entire British Empire, with its Dominions and Colonies. The most radical departure from pre-War types of poster is to be seen in the " Expressionist " posters of Germany, which are a part of the general radical art movement that affected painting, stage settings and many other art activities in Germany. Grotesque, bizarre, with virtually illegible lettering and with violent vibrations of line and mass, this type of German poster art has not exerted in other countries the influence that characterised the posters of pre-War Germany.

In the United States great strides have recently been made in the development of the poster as an organised advertising medium. Modern business has discarded the old-fashioned " billboard," with its unkempt appearance and its posters of many sizes. In its place, due to the standards of practice of the Poster Advertising Assn. (now renamed the General Outdoor Advertising Assn. of America) there has come the standard structure, a poster panel 25 ft. long and 12 ft. high which is surrounded by a green moulding as a frame for the poster. The standard commercial poster throughout the United States is the " 24-sheet," whose size is 8 ft. 10 in. in height and 19 ft. 8 in. in length. Members of the Association take great pride in the appearance of their structures. When a poster panel is built on the ground green lattice is used to hide the braces and posts. The location is graded and sometimes planted with grass and shrubs. Many of these structures are illuminated at night.

The standards of practice of the Outdoor Advertising Assn. require that members shall not erect poster panels on strictly residential streets, nor in locations where they will mar natural scenic beauty or prove dangerous to traffic. No poster is permitted which shall offend the moral sense of the public or which induces violation of the Constitution of the United States or any laws or ordinances. The almost universal use of automobiles has given a great impetus to poster advertising, and the 24-sheet poster is now being used extensively in the advertisement of a wide variety of commodities.

Since the War there has also been a marked improvement in the general standard of commercial poster art in America. Among the designers of this type of poster are: Clarence Underwood, F. Nelson Abbott, John E. Sheridan, Harry Morse Meyers, Walter Whitehead, J. C. Leyendecker, Norman Rockwell, William Oberhardt, McClelland Barclay, Neysa McMein, Adolph Treidler and Linn Ball. The death of Edward Penfield in 1925 deprived American poster design of one of its most able, conspicuous and significant artists. In the United States poster art and its industry are represented by a monthly publication in colours—*The Poster* which keeps in touch with all developments of poster advertising and poster art. (M. Pr.)

POTTERY: *see* CERAMICS.

POULSEN, VALDEMAR (1869–), Danish engineer, was born at Copenhagen Nov. 23 1869. He became an assistant in the technical section of the Copenhagen telephone establishment and in 1898 he invented the telegraphone, an electro-magnetic phonograph capable of registering human speech by the alternating magnetisation of a wire. In 1903 Poulsen invented the Poulsen arch, a generator that produces continuous high tension currents, thus solving one of the greatest problems in the science of radio technique. The Poulsen arches are used by numerous radio stations throughout the world.

POUND, ROSCOE (1870–), American jurist and educationist, was born at Lincoln, Neb., Oct. 27 1870. He graduated at the University of Nebraska (A.B., 1888, A.M., 1889), and studied law in the Harvard Law School 1889–90. On his admission to the bar in 1890 he commenced practice in Lincoln, Nebraska. He was assistant professor of law at the University of Nebraska, 1899–1903, and dean of the law faculty, 1903–7; was professor of law at Northwestern University 1907–9, and at the University of Chicago, 1909–10. In 1910 he accepted the Story professorship of law at the Harvard Law School, becoming Carter professor of jurisprudence there in 1913, and dean in 1916.

Pound has written *Phytogeography of Nebraska* (with F. E. Clements, 1898); *Readings on the History and System of the Common Law* (1904); *Readings on Roman Law* (1906); *Lectures on the Philosophy of Free-Masonry* (1915); *The Spirit of the Common Law* (1921); *Criminal Justice in the American City* (1922); *Introduction to the Philosophy of Law* (1922); *Interpretation of Legal History* (1923); and *Law and Morals* (1924).

POWER, SIR WILLIAM TYRONE (1819–1911), British soldier and administrator (*see* 22.224), died July 24 1911.

POYNTER, SIR EDWARD JOHN, Bart. (1836–1919), British painter (*see* 22.239), died in London July 26 1919. In 1919 he was created K.C.V.O.

PRAGMATISM (22.246).—Assuming that the article in the 11th Edition of the *Encyclopædia Britannica* has sufficiently outlined the rise of pragmatism and its history to the end of 1909, it remains to trace its subsequent developments in the years that have since elapsed. In Aug. 1910 the pragmatist movement suffered a great loss by the death of its most effective and persuasive initiator, William James, though for a number of years his works continued to appear or to be re-issued posthumously, from 1911 down to his fascinating *Letters* (2 vol., 1920).

Moreover, the period under review was not in general favourable to the progress of philosophic reflection. For the first few years no doubt philosophic discussion proceeded upon normal lines, with pragmatism attacking absolutism and various sorts of realism assailing idealism, while these stood on the defensive and for the most part entrenched themselves behind their past achievements. At the fourth International Congress of Philosophy at Bologna in 1911 the announcement of Vaihinger's " Philosophy of the As If " brought a valuable reinforcement to pragmatism, because it showed how greatly the use of " fictions " conduced to the making of " truth."

Effects of the War.—But the outbreak of the World War in 1914 soon had a paralysing effect, in philosophy also, on the progress of thought, and substituted propaganda for impartial inquiry, incidentally having some effect in impairing the vogue of German idealism. Philosophically the years of the War are nearly a blank in Europe, though research continued in America while America remained neutral. After the War the chief intellectual sensation, the verification of Einstein's theory of Relativity, was scientific rather than philosophic and though some philosophers intervened in its discussion, it was not a very suitable subject for philosophic acumen. It really arose out of a highly technical problem of physical measurement and established its conclusions by very stiff mathematics. Still the discredit thrown by this successful revolution in physics on the absolutes of measurement and on the familiar abstractions of space and time, could not but dispose men's minds more favourably towards the complete philosophic relativity implied in the pragmatic conception of truth, and proclaimed so long ago in Protagoras's dictum that " man is the measure of all things." In central Europe also the overthrow of so many highly authoritarian social orders had a considerable effect in unsettling rigid ideas and proved conducive to a loss of complacency and to greater open-mindedness in academic circles. On the other hand economic conditions and the state of the book trade put great difficulties in the way of the publication of books that had little or no popular appeal.

On the whole, therefore, it would be absurd to contend that philosophy in general and pragmatism in particular had made any marked progress in the period under review. Still some

progress was made, rather of an unobtrusive sort, under all the four headings under which the influence of pragmatism has made itself felt.

Psychology.—In psychology (*q.v.*) the "boom" in psycho-analysis (*q.v.*) and in psychotherapeutic methods generally, which is directly traceable to the necessity under which many theoretic psychologists found themselves of either finding useful applications of their knowledge or going into the trenches, was a good example of the powerful impetus which scientific practice can give to scientific theory. But otherwise it can hardly be said to have developed or even affected, pragmatic doctrine. Two other movements were more important. In the first place "behaviourism," though it is easily beguiled into explaining away the existence of mind altogether, at any rate makes it quite clear that action rather than speculation is the mind's essential characteristic; so it is no wonder that (in America) many pragmatists, and notably Dewey, have shown themselves decidedly sympathetic towards behaviourism. Secondly, under the leadership of W. MacDougall (*Outline of Psychology*, 1923) there is arising a school of psychologists who stress the biological significance and teleological character of mental life, and so naturally ally themselves with the pragmatic logicians who protest against the ignoring of the purposiveness of thought in the traditional logics. The interdependence of logic and psychology is thus once more attested, as it is by F. C. S. Schiller's study of the psychology of belief, *Problems of Belief* (1924) which is fitted to form a popular introduction to the whole subject.

Logical Aspects.—It is, however, to the logical aspects of their doctrine that the chief pragmatists devoted most attention, and the fruitfulness of their inquiries showed that it was a mistake to take the disparagement of logic indulged in by both James and Bergson as meaning more than a distaste for the futilities of intellectualistic logic (*see* LOGIC.) Dewey on the other hand has a long list of logical works to his credit. *How we think* was a brilliant little introduction to logic and, with *The Influence of Darwin on Philosophy*, came out in 1910. *Essays in Experimental Logic* followed in 1916. *Creative Intelligence* by Dewey and seven of his friends and pupils (1917) was also largely logical in its interest, as were most of his abundant contributions to periodicals. Finally in 1925 Dewey brought out in *Nature and Experience* a full and systematic exposition of his philosophy which, though as a whole it may perhaps be best classed as metaphysical, includes also a magisterial description of the nature and functions of thought. Shortly before (in 1923) C. S. Peirce's early papers (which had long been unprocurable) were collected and brought out under the title *Chance, Love and Logic.*

Alfred Sidgwick continued to hammer away at logic, following up his *Application of Logic* (1910) by an *Elementary Logic* (1914), which treats the traditional logic frankly as just a game with syllogisms. F. C. S. Schiller set himself to elucidate the notions of "error" (which he holds no formal logic can discriminate from "truth") in the Proceedings of the Aristotelian Society 1910–1, and of "relevance" (which he regards as the essential condition of truth rather than all-inclusiveness) in *Mind* (1914), and to show that the possibility of defeating any universal rule by misapplying it to a special case (from which Sidgwick had deduced his fatal objection to the validity of the syllogism owing to the latent ambiguity of the middle term when any syllogism was used) had already been recognised by Aristotle in certain cases. In his *Formal Logic* (1912) he produced a systematic criticism of the traditional logic, and traced all its embarrassments to its abstraction from real meaning, *i.e.*, to its substitution of the meaning of the words for the meaning of the man who used them, so that strictly speaking logic turned out to be a meaningless science, though in practice its doctrines all oscillated between verbalism and psychology. He also emphasised the divergence between logical theory and the actual procedure of the sciences in two contributions to Singer's *Studies in the History and Method of Science* (*Scientific Discovery of Logical Proof*, 1917 and *Hypothesis*, 1921), but has not so far produced the systematic reconstruction of logic on voluntarist lines to which he is pledged.

In face of these criticisms the intellectualist logicians thought it best to wrap themselves in a disdainful silence and to re-state their former doctrines. Thus F. H. Bradley, in the second edition of his *Principles of Logic* (1922) reprinted his original text with annotations and terminal essays, in which he admitted that he had fallen into the errors of the copy-theory of truth, but only to give his adhesion to the coherence view and to represent logic as concerned exclusively with the "all-embracing" judgment and the "self-developing" inference. This doctrine, however, proved difficult to carry through in face of the entanglement of logic with psychology, and he had to admit that "logic, being abstract, has, in order to exist, to take place in a world of psychical irrelevancy" (p. 616), and to relegate to metaphysics the task of how the logical ideal of all-inclusiveness could be rendered compatible with its actual recognition of relevance and the practice of selection. No wonder there remained a final doubt "as to how far in logic the claim of logic is made good" (p. 601). Moreover in his *Essays on Truth and Reality* (1914) which are full of covert polemics against pragmatism, he had been driven to make so many concessions that, as Schiller pointed out (in *Mind*, July 1915), the line separating him from pragmatism had become invisible in many places, while the absolute had been reduced to a merely honorary position.

Ethical Aspects.—In the field of ethics the pragmatists have not been very active. Dewey's *Human Nature and Conduct* (1922) is almost the only notable publication. It is a systematic application of pragmatic principles as conceived by him, to the theory of conduct, and is full of memorable sayings. But L. P. Jack's writings also, though not academic in form and often cast in the form of parable and fiction, and especially his *Alchemy of Thought* (1910), are excellent pragmatism, with a strong moral flavour.

Religion and Pragmatistism.—As regards religion the chief pragmatist writers on the psychology of religion passed away with William James and Theodore Flournoy, and the otherwise very active school of Dewey somewhat conspicuously neglects this branch of pragmatism. On the other hand it can hardly be disputed that pragmatism has shown that up to a point the procedure of the religious consciousness is everywhere pragmatic, and all writers on religion are now much more ready to recognise this fact. As good examples of the religious influence of pragmatism I. King's *The Development of Religion* (1910) and E. S. Waterhouse's *Philosophy of Religious Experience* (1923) may be mentioned.

Conclusion.—In general pragmatism may now be said to have established itself as a definite method and permanent attitude towards the problems of philosophy which, though still resisted and resented in academic circles biased in favour of intellectualism by their mode of life, is never likely to disappear again completely and under some social conditions *e.g.*, in a country, like America, where the academic man is not allowed to seclude himself and to lose touch with life altogether, is even likely to become predominant. It has also made good its claim to be the correct account of a natural and widely prevalent method of knowing, though its opponents do not of course admit that it is the only method, or the best. This is admitted even by the more modern sorts of absolute idealist (Croce, etc.) who, like Bergson, are willing to concede science to pragmatism, though they still maintain that philosophy can attain to absolute truth by "pure" thought. This compromise should perhaps satisfy the pragmatists, in view of the continued success of scientific knowing and its growing control of human activities and of the increasing self-refutation of "pure thought" by the dissensions of its exponents. Controversy has in consequence largely died down, and the accounts of pragmatism given by non-pragmatists are no longer the grotesque caricatures they were, and are becoming quite intelligent and trustworthy.

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Annotated Bibliography of the Writings of William James, edited, like most of the foregoing, by R. B. Perry (1920); *Letters*, edited by his son (1920). (2) Books about W. James—R. B. Perry, "William James" in *Harvard Graduates Magazine* (Dec. 1910); Introduction by H. Bergson to the French translation of *Pragmatism* (1911); E. Boutroux, *William James* (1911), Eng. trans. (1912); T. Flournoy, *La philosophie de William James* (1911), Eng. trans. (1917); J. Royce, *William James and other Essays on the Philosophy of Life* (1911); H. Reverdin, *La notion d'expérience d'après William James* (1913); H. V. Knox, *The Philosophy of William James* (1914). (3) Histories of the Pragmatic Movement—F. B. Muller, *De kennisleer van het Anglo-amerikaansch pragmatisme*, The Hague (1913); E. Leroux, *Le pragmatisme Américain et Anglais*, with an international bibliography (1923); J. Wahl, *The Pluralist Philosophies of England and America*, Eng. tr. (1925). (4) Books by J. Dewey and F. C. S. Schiller:—*a.* by J. Dewey, *Educational Essays* (1910), *German Philosophy and Politics* (1915), *Democracy and Education* (1916), *Reconstruction in Philosophy* (1921); *b.* by F. C. S. Schiller, *Riddles of the Sphinx*, revised ed. (1910); "Why Humanism" in *Contemporary British Philosophy*, vol. I (1924); "Psychology and Logic" in *Psychology and the Sciences*, ed. Dr. W. Brown (1924); *Tantalus* (1924); *Cassandra* (1926); *Eugenics and Politics* (1926). Dewey and Schiller have both written a large number of articles in philosophic periodicals. (5) Books by pragmatists about pragmatism—J. Goldstein, *Wandlungen in der Philosophie der Gegenwart* (1911); A. W. Moore, *Pragmatism and Its Critics* (1911); G. Vailati, *Scritti* (1911); D. L. Murray, *Pragmatism*, with an introduction by Schiller (1912), new ed. (1925); J. E. Russell, *A First Course of Philosophy* (1913); H. M. Kallen, *William James and Henri Bergson* (1914); G. Papini, *Sul Pragmatismo*, 2nd ed. (1920). (6) Criticisms of Pragmatism—Hon. B. A. W. Russell, *Philosophical Essays* (1910); L. J. Walker, *Theories of Knowledge, Absolutism, Pragmatism, Realism* (1910); Vernon Lee, *Vital Lies, Studies on Some Varieties of Recent Obscurantism* (1912); R. B. Perry, *Present Philosophical Tendencies* (1912); W. Caldwell, *Pragmatism and Idealism* (1913); J. T. Driscoll, *Pragmatism and the Problem of the Idea* (1915); W. P. Montague, *The Ways of Knowing* (1925). (F. C. S. S.)

PRAGUE (*see* 22.248), the capital of Czechoslovakia, became the seat of an independent national body in 1918, when the Austrian Emperor's dominions were falling away from him. It is a well-organised modern city, with a population in 1921 of 676,657, largely Czech. The German element, about 5% of the population, and German influence, are much disliked, but the business centres are bilingual, and there are both German and Czech universities and polytechnics. There are also a Czech national museum, an observatory and academy of science. The people evince great pride in the State, and in 1918 an imposing congress was held in the city, at which Czech, Polish, Italian, Rumanian, Slovak and Yugoslav deputies gave pledges of mutual support. The bishop of Prague is Patriarch of the new Czechoslovak church.

Prague has many manufacturing industries. An industrial fair is held twice a year, and a motor exhibition was revived in 1921. The Vltava river was in process of improvement in 1924; it was then navigable for vessels of 1,000 tons to Mělník, and is to be made usable for boats of 700 tons to Štěchovice. A programme for the improvement and extension of the railways was passed by the National Assembly in 1920, the plans include a new central goods depôt, belt lines round the city, and electrification of all lines within a radius of 50 kilometres. The line to Bratislava has been double-tracked. It is also planned to make Prague an aviation centre for Central Europe. A concrete hangar and a lighthouse have been added to the aerodrome at Kbely, near the city.

PRAYER BOOK.—Since 1910 there has been a great movement for the revision of the prayer book in almost all branches of the Anglican Church.

Scotland.—In Scotland some suggestions were made in the Synod of 1911, when a schedule of permissible variations to, and deviations from, the Prayer Book was drawn up, and a revised text of the Scottish liturgy was authorised. In 1919 a more complete revision was undertaken by the consultative council on Church legislation, a body consisting of bishops, clergy and laity sitting together without legislative power. The result of its labours from 1919 to 1924 was contained in a series of reports.

America.—In America revision was inaugurated in 1913 by the appointment of a Revision Commission of the General Convention, consisting of seven bishops, seven presbyters and seven laymen. The work had been going on continuously since then until, in 1925, the last stages were reached. A considerable number of the changes have been already ratified, and, after the ratification of the changes, approved in Oct. 1925, at New Orleans by the General Convention, in 1928 a Prayer Book according to the standard of 1928 will be published.

South Africa.—In South Africa two tentative alternative uses for the Communion Office were put forward. This was followed by the definite issue of an alternative liturgy, which was sanctioned for use in the province at a provincial synod held in 1924, to be used when desired by the priest and people in the parish.

Canada.—In Canada a new Prayer Book has been issued. It carefully avoids making any changes in the Communion Office or any changes involving doctrine, but adds a large number of services adapting the worship of the Church to the needs of the day.

Ireland.—In Ireland a new revision is being undertaken for which a committee was appointed in 1909.

England.—Proposals were made for a revision of the English Prayer Book on the accession of William III. in 1689, but they came to nothing. The subject was much to the fore between 1857 and 1863. There was an association for promoting a revision of the Prayer Book under the chairmanship of Lord Ebury, and many pamphlets were written suggesting revision. All these proposals for revision came from the more Protestant side of the Church of England, for the Tractarians of that day based all their innovations on the Prayer Book and it was desired to remove those features in it which seemed to support their claims. Revision proposals were made in 1879, but came to nothing.

The later movement for revision dates from the Royal Commission which was appointed on April 23, 1904, to inquire into "the alleged prevalence of breaches or neglect of the law relating to the conduct of Divine Service in the Church of England." The commission issued its report on June 21 1906, and recommended that Letters of Business be issued to the Convocations relative to the matters of "ornaments in the Church and the conduct of Divine Service." The Letters of Business, issued on Nov. 10 1906, stated:—

> It is our will and pleasure that you do debate and agree upon the following points, *vide licet*, the desirability and the form and contents of a new rubric regulating the ornaments of the ministers of the Church, and also any modifications of the existing law relating to the conduct of Divine Service and the ornaments and fittings of Churches.

After the question of vestments and the ornaments' rubric had been considered, there were considerable discussions as to the desirability of a general revision of the Prayer Book. It was argued, on the one side, that lack of unanimity was an argument against revision, that the Prayer Book was rooted in the affections of the people and that no other book would hold together such different types of thought. This being so a schedule or supplement only was required. On the other hand, it was argued that the irregularity exercised by nearly all who were responsible for the conduct of Divine Service was a source of danger to the Church. Other parts of the Church in communion with the Church of England had found it necessary to revise; it was a strain on honest men's consciences that they could not obey the law; there was a conflict between the modern intellect and some of the Prayer Book; and there was also an inadequacy for practical needs. However, Convocation proceeded with the revision of the Prayer Book, though it was stated that it is not desirable at present to introduce into the text of the Prayer Book any changes, but they should be embodied in another volume to be sanctioned for optional use for a determined period. The work of revision went on for many years. The whole matter went through the hands of each House of Convocation separately, of the Joint Committee of both Provinces and then of each House again.

The result of this work was taken up by the Church Assembly when it was formed. A committee was appointed and the

report of the Assembly on the revision of the Prayer Book was ultimately published under the auspices of the National Assembly (N.A. 84). But when the moderate and somewhat conservative proposals which had been put forward by Convocation appeared in the fuller light of the Assembly many new factors came into consideration and different groups or parties in the Church took the matter of revision up with great keenness, so there was issued a series of new proposals. These were contained in the Green Book, issued by the English Church Union, the Grey Book, issued by a committee which was supposed to represent the Life and Liberty Movement, the Yellow Book, issued under the auspices of the Alcuin Club, an attempt to embody these suggestions in one book and some white papers, representing a still more extreme view.

Method of Procedure.—The method of procedure which has to be adopted with regard to Prayer Book revision in the Church Assembly is as follows: a committee was appointed consisting of members of all three Houses who have recommended the measure, with the alterations proposed as a schedule, to the Assembly. That measure went before the House for general approval and was passed. It was then referred to the House of Clergy and the House of Laity, sitting separately, for amendment. The measure, with the amendments proposed, then goes before the House of Bishops, who have to put it into the form in which it is to come before the Assembly for acceptance or rejection. No further amendment will be allowed. If it is accepted by the Assembly it must receive the assent, according to the forms arranged, of the two Houses of Parliament. It has also to receive the assent of the Houses of Convocation in order that their spiritual authority may be guarded.

The House of Clergy has suggested a large number of amendments, including two alternative forms of the Communion Office. They have also recommended Reservation of the Sacrament, not only for the Communion of the sick but also for others and the keeping a Festival of Thanksgiving for the Blessed Sacrament and one in honour of St. Joseph.

The House of Laity have contented themselves with far fewer amendments, but have requested the bishops to allow one alternative Communion Service with the optional use of vestments and of Reservation for the sick. They have expressed their disapproval of keeping a festival on the Thursday after Trinity Sunday as a thanksgiving for the institution of the Sacrament. While the House of Clergy desire an alternative book, the House of Laity particularly request that there shall be only one book in which the alterations, omissions and enrichments to the service are printed as notes or emendations to the existing service. In 1926 the House of Bishops was engaged on the work of revision.

Reasons for Revision.—It may be convenient to sum up the reasons for the amendment of the Prayer Book. Speaking generally, they are the desire to adapt a book which dates from 1662 to the needs of the time. In detail they are:—

1. A desire to do away with old-fashioned expressions, phrases unsuitable to the taste of the time, and statements inconsistent with modern thought. On this point there is considerable variation of opinion, many being attached even to the archaisms of the Prayer Book, others finding them difficult or even offensive.
2. A desire to adapt the Prayer Book to the changed usages of the Church which have gradually grown up, to accommodate law to custom.
3. Some desire that the Prayer Book should be revised so as to make the restoration of law and order in the Church possible. It is recognised that the existing Prayer Book cannot reasonably be obeyed in various points. It is proposed that there should be a rule of worship adapted to the present time with a reasonable latitude in the way of variations allowed, and that this should be enforced on the clergy.
4. There is a great desire to adapt the Prayer Book to the far wider religious and social aspirations of the present day. There is a great demand that religious worship should be brought much more closely into touch with the life of the people.
5. A desire felt, particularly by one party in the Church, arising from the great growth among them of sacramental ideas of worship. It is desired to give far greater opportunity for this in the new Prayer Book, and to accommodate it more closely to the traditional liturgical customs of the Church.

It may be noted that some of these desires seem, at any rate, to a certain extent inconsistent with one another. Some desire to reform the Prayer Book in order to bring to an end customs which others desire to make lawful and encourage. The problem presented represents one of considerable difficulty. The revision, which will allow the continued use of the old Prayer Book, must be looked upon as preliminary to a more complete revision when public opinion has become stereotyped. Meanwhile it may, perhaps, be stated that this difficult situation is not one which need arouse serious concern. It arises from the vigorous life and creative power of the Church, which shows itself by developments in various directions. (A. C. H.)

PREFERENCE: *see* IMPERIAL PREFERENCE; TARIFFS.

PRESBYTERIANISM.—Since 1910 the Presbyterian churches have encountered, in common with others, the obstacles and the impetus created by the World War. The gains have outweighed the losses upon the whole. Numerically, to judge from the statistics presented to the general council held at Cardiff in July 1925 the total membership of the Presbyterian churches had increased between 1913 and that date by well over 2,000,000. The precise figures are, for 100 organised churches which it has been possible to reach, 8,670,500 souls; so that, on the usual scale of estimating people under the direct influence of a Church, there are over 40,000,000 who are Presbyterian.

In Continental Europe

Germany.—In Germany the disestablishment of the churches, which followed the Revolution, has moved the Reformed section of the Church, the "Reformierte Bund," to stress its distinctively Presbyterian principles, and as its membership numbers over 600,000 souls, it is destined to exercise a powerful influence in the future reorganisation of the Evangelical churches in that country.

Norway.—In Norway the Evangelical Free Church, though Lutheran, is Presbyterian in temper, but the Lutheran section of the Church in Germany still adheres to its modified Presbyterian government under Consistories (*see* LUTHERANISM).

France.—The vigour shown by the two groups of Presbyterian churches in France, addressing themselves to the task of reconstruction after the War, and the increase due to the fresh membership in Alsace and Lorraine, where the Reformed Church, largely German, numbers about 50,000 members, have helped to vitalise French Presbyterianism. But there is a distressing dearth of ministers; in 1924 there were 148 Reformed parishes vacant. Economic conditions, which have to some extent affected the supply of clergy in most churches, have hitherto operated seriously in France, where Presbyterians do not number quite a half of the total Protestant population (900,000).

Netherlands.—The lack of students for the ministry is also felt in the Netherlands, though less in the smaller Reformed churches than in the Groote Kerk or national Church.

Czechoslovakia.—The rise of the new state of Czechoslovakia in 1918 led to an extraordinary break-away from the Roman Church; the united Evangelical Church of Czech Brethren now numbers over 250,000 adherents, one of its members being President Masaryk.

Ukrainia.—A similar movement is reported from Ukrainia, further east, where over 1,000,000 inhabitants have left the Roman and the Orthodox churches, and are being consolidated in a Presbyterian Church, largely under the mission work of Ukrainians who came back from Canada to carry on the movement.

Transylvania.—In Transylvania, on the other hand, the Presbyterians, like the rest of the religious minorities (*see* LUTHERANISM), have suffered and are still suffering under oppressive legislation at the hands of the Rumanian Government. The Magyar Reformed Church, with 800 ministers and about 720,000 souls under its charge, has to encounter the Rumanian prejudice against Magyars and the Greek Orthodox dislike of Protestants. The rights guaranteed by the Peace Treaty of 1918 to religious minorities are not being observed by the Rumanian Govt. and no remonstrances from outside have yet availed to check the perse-

cution of the Church. Hungarian Presbyterians in Transylvania thus suffer heavy damage by the War-settlement which brought relief and advance to their Bohemian brethren.

Hungary.—In Hungary itself, although the partition of the country brought about untoward religious results, the Reformed Church is still powerful both in numbers and in prestige, with over 1,000 congregations and 1,500,000 adherents. The Magyar racial problem emerges again in the position of the Magyar Reformed Church in Czechoslovakia, where about 40,000 members still keep apart from the larger Church of the country, and in the Reformed Church of Yugoslavia, where the members, two-thirds of whom (in all, about 23,000) are Magyars, lie exposed to hardships like those of their brethren in Transylvania. Possibly the racial prejudices and religious rivalries which make the situation in Transylvania and Yugoslavia so bitter at present may die down in the course of years; meantime the redeeming feature is the tenacity with which the oppressed Presbyterians maintain their faith amid a struggle in which, unfortunately, their outside brethren are unable to afford them very much practical sympathy.

Switzerland.—The four Presbyterian churches in Switzerland have formed a Federation of Evangelical Churches, representing 2,250,000 souls. Switzerland has felt, like most other countries, the call to re-union in organised religion, and the rise of this Federation is a first proof of the Swiss interest in unity. Since 1919 efforts have been made to bring together the Evangelical Church of Neuchatel and the mother church from which it broke away under Godet in 1873, but the local difficulties are still insurmountable.

Belgium.—In Belgium the two small Presbyterian churches, the Union of Reformed Churches and the Missionary Church in Belgium, suffered heavily during the War. Together they now number 50 congregations, with 22,000 members.

Austria.—An even smaller group is the Reformed Helvetic Church in Austria, with its centre at Vienna, which numbers 25,000 souls, out of a total Protestant population of 260,000.

Italy.—The Waldensian Evangelical Church in Italy numbers only 22,633 members in 112 congregations, but its sturdy spirit is unabated; indeed since the War it has asserted itself more definitely than ever in Italian life, actually holding an Evangelical Congress at Rome itself, in 1920. Its theological college is now transferred from Florence to Rome.

Spain.—The Spanish Evangelical Church has but 1,000 members, a tenth of the total Protestant population in Spain, with 26 ministers and 32 congregations.

Denmark and Sweden.—Still fewer, though for no such reasons as in Italy and Spain and Belgium, are the Presbyterians in Denmark and Sweden, with three congregations between them and barely 400 communicants. The history of these countries seems to have marked the Lutheran form of organisation as native to their genus, as is the case with Norway.

Russia.—In Russia the Bolshevik persecution has reduced the Reformed Church from 25 to two congregations, which still survive in Moscow and Odessa.

Poland.—In Poland the Reformed Synod of Warsaw is now reduced to seven congregations, with barely 11,000 people; however, the transfer of Galicia from Austria has added a Reformed Church of three congregations and 7,000 souls.

Lithuania.—In Lithuania, which was mangled by the Peace settlement, the ancient Reformed Church numbers only nine congregations, with 17,527 members, but the land is politically free, and, though it is still predominantly Roman Catholic, the first national Cabinet was half Protestant in its membership.

Greece.—For the sake of completeness this rapid survey must note the Evangelical Church of Greece, with eight congregations and nearly 600 members, making Presbyterianism just visible in that country.

In Great Britain and Ireland

England.—In England the Presbyterian Church, with its 34 ministers and 84,638 communicants, altered the title of its supreme court in 1921 from "Synod" to "Assembly." The Synod of the Scottish Church in England still numbers 10 congregations, with 4,360 communicants, in communion with the Church of Scotland.

Wales.—In Wales the Presbyterian Church has 1,492 congregations and 188,970 communicants, 382 of the congregations being English-speaking. Representatives of the Welsh Church are co-operating with the English, Irish and Scottish churches at present in the preparation of a new Hymnbook which will serve, it is hoped, for Presbyterian churches far and wide.

Scotland.—In Scotland the statistics of the four smaller churches are as follows: 94 ministers and 8,500 members to the Free Church, 15 ministers and 46 congregations to the Free Presbyterian Church, nine congregations and nine ministers to the Reformed Presbyterian Church and 20 congregations with 3,142 members to the United Original Secession Church. Since 1909 the two large churches, the Church of Scotland and the United Free Church, the former numbering now over 760,000 communicants, the latter 535,000, have been moving towards a re-union. The negotiations, interrupted by the War, have been resumed. The leaders of the Church of Scotland have twice gone to Parliament in order to secure Acts which might remove the scruples of the other Church; the first Act (in 1921) ratified a Constitution drawn up by the Church declaring her spiritual freedom, with Nine Articles outlining an acceptable doctrinal basis; the second (in 1925) ratified a financial arrangement between the Church and the heritors, relating to the teinds. At present the proposals for re-union are being considered, with a view to combining in a Church which is at once national and free claiming no legal privilege above any other Church in the land. The net result of preliminary negotiations is the conviction that "the 'main causes of keeping the churches apart' have been removed. The twofold stumbling block, which the state, inadvertently enough, had interposed between them, the state has once for all cleared away."[1] In the near future Scottish Presbyterianism will thus be able to present to the world an object lesson of Christian unity undertaken for the greater good of God's Kingdom at home and beyond the seas.

Ireland.—The political changes in Ireland, as the result of the War, have borne specially on the congregations in the Free State. In the north, the Assembly's College at Belfast has been strengthened. The number of congregations in the Church is now 558, with close on 110,000 communicants, and to this falls to be added the Reformed Presbyterian Church with 43 congregations and 3,427 members.

On the American Continent

Canada.—In Canada the United Church of Canada came formally into existence at Toronto on June 10 1925. This remarkable Union of Congregationalists, Methodists and Presbyterians, is the result of negotiations which have been proceeding since 1908, in order to cope effectively with the religious needs of the Dominion where, especially in the Far West, the ecclesiastical divisions were felt to be more than ever a weakness and a scandal. The best men in the three churches set themselves to devise a basis of union which should conserve the elements of value in the polity of the three churches, and after long, intricate arrangements, the formal bill passed the Canadian Parliament in 1924 by a majority of 110 to 58. The polity of the United Church is admittedly Presbyterian. Of the active members entering it, over 1,800 are Methodist, 1,200 Presbyterian and 89 Congregationalist. When the churches were consulted, less than 14% of the total membership voted against the proposals. Unfortunately a fragment of the Presbyterian Church has declined to follow the lead; 714 out of 4,531 congregations, mainly in Ontario, have preferred at present to remain isolated. Apart from this, the United Church has started under the happiest auspices.

United States.—In the United States, the Presbyterian Church has become more than ever since the War not only the largest but the most liberal Presbyterian Church in the world. She reports 9,903 congregations, with 1,830,928 communicants; in 1924 she raised for Foreign Missions alone the sum of over

[1] A. Martin, *Church Union in Scotland*, p. 48.

$5,000,000 and employs now 1,600 missionaries in 15 different countries. In 1924 it was calculated that there were 2,250,000 Presbyterians in the United States, divided among this and 10 other churches which owe their separate existence to the Civil War strife between North and South, or to sectarian divisions introduced originally from Europe by immigrants, or to internal dissension. It has not yet been possible to re-unite these bodies. Efforts made during the past seven years have achieved little more than a measure of co-operation. Internally the Presbyterian Church has suffered, like most of the other American Churches, from the Fundamentalist Controversy (*see* FUNDAMENTALISM) which is still raging; it is an effort to commit the Church to five "fundamental" points of theology, viz., (*i*) the inerrancy of the Bible; (*ii*) the Virgin Birth; (*iii*) the Atonement as a Sacrifice; (*iv*) the Resurrection of Christ "with the same body with which He suffered;" and (*v*) the reality of the Lord's miracles.

Mexico and South America.—Besides a Presbyterian Church of over 5,000 members in Mexico, the various Presbyterian missions and churches in South America number nearly 30,000 communicants; the Scottish and American Churches are represented in the *West Indies* at present by 151 churches and over 20,000 communicants.

In Australia, Africa, Asia

Australia and New Zealand.—In Australia a movement for re-union similar to the Canadian enterprise has been wrecked in the meantime. Both in Australia and in New Zealand the shortage of ministers is being acutely felt, in face of the increasing number of immigrants and the scattered population. Australasia reckons 127,305 communicants (including the Missionary Synod of Tahiti, New Hebrides, etc.) with 967 ministers, but the latter are insufficient for the needs of the situation.

South Africa.—Another failure of Presbyterianism to unite with other branches of the Church has to be chronicled in South Africa. In 1917 the Presbyterian Church inaugurated a movement for union with the Congregationalists, but the project had to be abandoned in 1921, partly on account of the colour question. Within the Presbyterian Church herself the colour question has had to be solved by the creation of the Bantu Presbyterian Church, composed of purely African natives, independent but allied. On the other hand, the Church of Central Africa came into being on Sept. 17 1924, a very fine example of union between the Church of Scotland's Blantyre Presbytery, the United Free Church's Livingstonia Presbytery and the Dutch Reformed Church's Nyassaland (Missi n) Presbytery. The Dutch Reformed Church in South Africa with a membership embracing 840,000 white adherents, brings up the total of Presbyterians in Africa at present to a large number, proportionately; there are in all 1,768 congregations, including the various missions and 532,085 communicants. A growing spirit of co-operation is also manifest.

India.—In India the South United Church was formed of Presbyterians and Congregationalists in 1908; the community numbers over 240,000, and proposals have even been made for union between this Church and the Southern Indian section of the Church of England. The North United Church, also on a Presbyterian basis, arose in Dec. 1924, from the Presbyterian Church, which had received 53,000 Welsh Calvinistic Methodists from Assam in 1921, and the local Congregationalists.

China.—On a smaller scale the genesis of the United Church of Christ in China resembles that of the Indian and the Canadian communities. It arose in 1921 from the Presbyterians and the Congregationalists, the former numbering 87,332 members, the latter 29,000. This had been rendered possible by a previous reunion among the Presbyterians themselves; in 1918, after 11 years' negotiations, 10 different missions came together to form the Presbyterian Church in China. The combined community is now the largest Protestant Church in China.

Korea.—In Korea the Church, originally founded by American missionaries, has prospered rapidly, and displays a true missionary spirit; it numbers 1,266 congregations, with a Christian community of over 200,000. But when the Japanese made Korea a province, re-naming it "Chosen," they persecuted the Christians harshly, till remonstrances from abroad induced them to adopt more equitable measures.

Japan.—In Japan itself the United Church of Christ, organised in 1877, has grown steadily till it now reckons 399 congregations and nearly 47,000 communicants.

Foreign Missions, etc.

The foreign missions of the Presbyterian churches embrace 660,687 communicants, with 5,308 congregations, and the native agents number 33,191 to 4,587 foreign or white agents. The number and quality of the native agents, who are claiming and exercising more and more responsibility in Church life, have increased in the last 10 years. The Belgians have, since 1921, begun work at Ruanda in Belgian East Africa; the Swiss, Dutch, French and Germans now number 484 white missionaries and 117,153 communicants in their respective fields; the English, Irish, Welsh and Scottish churches report 10,104 native helpers and 765 other agents, educational, evangelistic and industrial, with 171,373 communicants; the Canadian Church's missions include 1,249 agents and 18,000 communicants, while the American churches count no fewer than 2,675 white missionaries and 14,955 native helpers, who supervise about 323,000 communicants. The missions of the Australasian churches in the New Hebrides and elsewhere report close upon 9,000 communicants, and of their 583 agents no less than 454 are natives. Finally, reference may be made to several missions which were taken over from the dispossessed Germans at the close of the War. The heavy responsibilities of carrying them on fell upon the French and Scottish churches. But the action of the British Govt. in 1923, permitting the return of Germans into territory held by the British, has already relieved the situation in East and West Africa, and at the same time made for a renewal of harmonious relations in the mission field. (J. Mt.)

PRESS: *see* CENSORSHIP; NEWSPAPERS; PERIODICALS.

PRESSBURG: *see* BRATISLAVA.

PRESTON, England (*see* 22.307), had a population of 117,406 in 1921 and an area of 3,964 acres. Large sums have been spent by the municipality on acquiring and improving the docks and quays. Industrial establishments have arisen in the neighbourhood of the docks, and land has been bought by the corporation for further development. The number of cotton mills has been further increased, and a large power station on the Ribble was opened in 1925. A chamber of commerce was formed in 1916. Parliamentary powers were obtained before the World War to deepen the channel between Preston and the sea, and a dredging plant was built. The work was postponed, but was finished in 1925. Much attention has been given to the health of the city and to the provision of hospitals, infant welfare centres, etc., and the death rate has fallen to an average of 15 per thousand.

PRETORIA, South Africa, the administrative capital of the Union of South Africa (*see* 22.309). Its population (1921) was 74,052, of whom 45,361 were whites. In 1911 the whites numbered 35,942. Pretoria ranks fourth of the cities of the Union. About a mile from the centre of the town, on a commanding position on the slopes of Meintjes Kop, are the Union Government Buildings, the finest public offices in South Africa. They were built 1910–3, from the designs of Herbert Baker, at a cost of £1,800,000, and consist of a large central semicircular colonnaded building, flanked east and west by rectangular blocks. At the junction of each wing with the central section is a domed tower, 180 ft. high, and at the end of each wing is a projecting pillared pavilion. A feature of the building is the long, low roof, with projecting eaves. The space enclosed by the building is laid out in terraces culminating in an amphitheatre. The buildings are of South African freestone, on a foundation of Transvaal granite. Government House and the residences of ministers are in the suburb of Bryntirion.

PREVENTIVE MEDICINE (*see* 18.59).—The prevention of disease is the true ideal of medicine. Its application is twofold—the preventive medicine of the community, which is generally

termed Public Health or State Medicine, and the prevention of disease or its sequelae in the individual.

Historical Origins.—The practice of preventive medicine had its origin in the ancient world. The Hippocratic writings testify to some great school and tradition of medicine which, sown and watered in a forgotten and unrecorded past, bore ultimately its golden fruit in the master himself, and in those who followed him—Diocles, Aristotle, and the scientific schools of Alexandria. Another harvest is represented in Pythagoras, Alcmaeon and Empedocles. Hippocrates himself was at his zenith in the golden age of Greece. He first systematised the existing knowledge of medicine and classified the causes of disease into those concerned with seasons, climates and external conditions, and those more personal causes such as irregular food, exercise, and habits of the individual. He laid stress upon the hygienic life as the great means of health and the postponement of death. Air, water, sunlight and herbs were his primary therapeutic agents. He wrote also on the "humours" of the body, and laid down the principle that the process of disease consists of its invasion of and disposition in the body combined with the reaction of the body itself in its own defence, a twofold struggle in which nature attempts to overcome disease. Thus Hippocrates taught the healing power of nature, and that the true physician should copy her methods.

Five and a half centuries after him came Galen, the famous Greek physician who lived in Rome in the days of Marcus Aurelius. He gathered up all the medical knowledge of his time, and his books fixed it so firmly that the Galenic tradition lasted through East and West for 1,400 years. It was conserved in the work of Oribasius, and thus became embalmed in Byzantine medicine; it was disguised in Syriac and Arabic translations, though happily it caught a glow from the new light cast upon it by Rhazes and Avicenna; it inspired the Italo-Sicilian school, which left its mark on European practice and education as well as in the "Regimen Sanitatis Salernitanum" (12th century). Haeser says that to every question the Galenic system had an answer, for every problem a solution, "and this spurious air of infallibility led the spirit of man in fetters for centuries, and shattered any hope of progress."

Through the Middle Ages the principles of preventive medicine were ignored, in spite of the scourges of leprosy and plague, nor did the plague tractates or the various ecclesiastical provisions against disease make for advance. Then with the Renaissance came the new learning on the nature both of health and disease, which revolutionised the whole content of medicine and gave it a fresh centre of gravity and a new outlook. At first the revival of learning in the West consisted of the diffusion—by the fall of Constantinople and the invention of printing—of Greek knowledge, and the result might well have been merely an extended presentation of Galenic doctrine had it not been for the new work of the 15th and 16th centuries. Leonardo da Vinci—whose genius suggested some of the great discoveries of modern science—and Vesalius of Padua, were followed in the 17th century by Galileo, Harvey—who discovered the circulation of the blood—Helmont and the experimentalists, and Sydenham and the great practitioners who with their contemporaries observed the relation of the seasons, of telluric conditions, and the contagion in relation to the incidence of disease. This was quickly followed by new knowledge of anatomy, physiology and pathology. Moreover, the early ideas in regard to infection and contagion which had been held by Aristotle and the two Italians Fracastor and Cardan were reinterpreted in the light of the germ theory.

At the end of the first half of the 19th century a beginning had been made in the discovery of specific organisms in diseased tissues, an illustration of which was Pollender's bacillus of anthrax. Then came the immortal work of Louis Pasteur on the causes of fermentation in 1857, on the disease of wine in 1863, on viruses in 1877, and on vaccines in 1880–2. His vision and technique, and that of Robert Koch, with his solid culture media and precise methods of identification, opened the gates of a new kingdom. They had great reward, for in trooped the long line of their successors. From 1870 to 1905 there followed that wonderful succession of discoveries which gave us the bacillus of leprosy (Hansen), the gonococcus (Neisser), the typhoid bacillus (Eberth-Gaffky), the micrococci of suppuration (Ogston), the bacilli of tuberculosis (Koch), of cholera (Koch), of diphtheria (Klebs-Löffler), of tetanus (Nicolaier), and of plague (Kitasato and Yersin), all between 1871 and 1894.

In 1880 Laveran announced the discovery of the *Plasmodium malariae*, and 18 years later Manson and Ross demonstrated its relation to the life history of the mosquito. In 1878 came the trypanosoma of Lewis, to be followed by various members of its genus; in 1883 Friedlander described the pneumococcus, and four years later Weichselbaum the meningococcus and Bruce the micrococcus of Malta Fever. The last to be named in this brief review is Schaudinn's *Spironema pallida* of syphilis, discovered in 1905. These then were the principal pathogenic representatives of that unseen world the existence of which had been long foretold. The discovery of these disease-producing germs was only the first step. In 1888 it was learned that such micro-organisms acted on the body tissues not only by their corporeal presence but by their secretion of toxins, against which the body cells reacted, defending themselves by the production of anti-toxins. (*see* SERUM THERAPY).

Practical Needs.—Concurrently with the growth of medical knowledge there was an empirical movement of practical prevention. Long before the days of Hippocrates men had sought to stem the tides of disease which threatened to overwhelm them. Even in Britain it was the ravages of pestilence in the Middle Ages—of leprosy from the 12th century, of the Black Death from the 14th, of sweating sickness in the 16th, and of cholera and smallpox subsequently—which compelled attention to the conditions which seemed responsible for these scourges. The great monastic orders and some of the historical cities—Rome, Venice and London—provided comfort, refuge and sustenance for the victims, and in 1388 was passed the first Sanitary Act in England, directed to the removal of nuisances. In 1443 came the first plague order recommending quarantine and cleansing; in 1518 was made the first rough attempts at notification of epidemic disease and of isolation of the patient; under Queen Elizabeth scavenging became more stringent; and as time passed men began to see that environment was one of the principal factors in the origin and spread of disease, and thus housing, water supply, drainage, scavenging and quarantine played an increasing part in prevention.

Experimental Method.—At first the new applications of medicine were suggested by medical practitioners. Three centuries ago Harvey indicated for us the true experimental method; he placed the blood in the forefront of physical life, and gave it a new chemical and physiological meaning, and by his demonstration of the circulation he provided a new conception of the method by which the blood carried its nourishment to all parts of the body. Fifty years later, Thomas Sydenham, another practitioner, living in a "generation of the strongest and most active intellects that England has produced," laid the basis of epidemiology by his observation of cases, his power of analysis and comparison, his deduction of laws of prevalence, and his suggestive hypothesis of "epidemic constitutions."

Richard Mead, a successful English practitioner in the first half of the 18th century, left behind him published works on poisons, on the plague and the methods of its prevention, on smallpox, measles and scurvy. Bradley and Rogers deduced from their general practice some of the principles of epidemiology, Fothergill described "putrid sore throat," and Heberman chickenpox. Huxham, of Totnes, became an authority on the treatment of fevers, recommended vegetable dietary in cases of scurvy and defined Devonshire colic, which his medical neighbour, Sir George Baker, traced to lead in the vats and cider presses. Willan made a systematic study of the health conditions of London. Withering, or Shropshire, contributed to our knowledge of the incidence of scarlet fever, analysed water, was a climatologist and used digitalis. Edward Jenner, a practitioner in Gloucestershire, introduced vaccination. James Lind issued the first treatise on scurvy and the health of seamen. Thackrah, who practised in Leeds, explored industrial health problems and described dust diseases and brass-founders' ague, and Michael Taylor of Penrith was the first to elucidate milk-borne epidemics. Indeed, the 18th and 19th centuries furnish a remarkable record of clinical discoveries which prepared the ground for the study of causation and the influence of external environment in relation to communal disease.

Legislative Action.—The applications of state medicine, in the 19th century, found their inspiration in England in two sources, and their expression in legislation. The twofold inspiration came from the recurrent outbreaks of cholera and consequential commissions of inquiry, and from popular demand for reform, which was realised after each of the four extensions of the franchise (1832–1918). The Legislature placed on the statute book a wonderful series of enactments. The alarm caused by the ravages of cholera in 1831 led to the first steps in administrative sanitary reform; in 1849 there was a second visitation of cholera, and in 1854 a third. These cholera epidemics led to a new appreciation of the unsanitary condition of the country as a whole, to an understanding of the nature of the disease and its epidemicity, to the establishment of "cholera dispensary stations" and to the Infectious Diseases Prevention Act 1855

Concurrently with and following upon these epidemics there were various commissions of investigation. In 1838–9 the Poor Law Commissioners drew attention to the prevalence of epidemic disease and its relation to poverty. The reports by Neil Arnott, Kay, Southwood Smith and Chadwick were the predecessors of another famous series of investigations in 1859–65 by Greenhow and his colleagues under the Privy Council into epidemic diarrhoea, pulmonary disease, infant mortality and ague; and also into the four " elementary requisites of popular healthiness," viz., adequate food supply, sufficient house accommodation, healthy physical surroundings and wholesome industrial circumstances. They led the way to the new application of medicine for the removal of nuisances, the prevention of contagion and infection and industrial hygiene and welfare.

In 1843 Sir Robert Peel, at the instigation of Edwin Chadwick, advised appointing a Royal Commission to inquire into the outbreaks of disease in large towns and the best means of improving the public health, the report of which led to the passing of the comprehensive sanitary measure in 1848, the establishment of the General Board of Health and the appointment of medical officers of health. In 1869 was appointed the Royal Sanitary Commission, on which sat Thomas Watson, James Paget, Henry Acland, Robert Christison and William Stokes, and before which Simon, Budd, and Farr gave evidence. Speaking broadly, the 1843 commission found the existence of a serious national evil of insanitation and ill-health, and recommended a legislative remedy, whereas the 1869 commission found that the remedy had proved ineffective and recommended that " the present fragmentary and confused sanitary legislation should be consolidated." They proposed, in fact, for the first time, a Ministry of Health, and though the case miscarried, and the Local Government Board was created in 1871, a comprehensive Ministry of Health was at last established in 1919. The commission's summary of the national sanitary minimum of " What is necessary for civilised social life " provided the grand inventory of that period (1871) and was as follows:—

1. The supply of wholesome and sufficient water for drinking and washing.
2. The prevention of the pollution of water.
3. The provision of sewerage and utilisation of sewage.
4. The regulation of streets, highways and new buildings.
5. The healthiness of dwellings.
6. The removal of nuisances and refuse, and consumption of smoke.
7. The inspection of food.
8. The suppression of causes of diseases, and regulations in cases of epidemics.
9. The provision for the burial of the dead without injury to the living.
10. The regulation of markets, etc., public lighting of towns.

Registration of Death and Sickness.[1]—The programme of 1871 represented the most enlightened thought of the time regarding the sphere and scope of preventive medicine. Even now it is almost a complete summary of the elements of a sanitary environment. The commission also showed how it could be worked out in practice by laying down the general principles to be followed and by drafting a new statute. They diagnosed with unfailing accuracy the causes of imperfect sanitary administration—(*a*) the variety and confusion of authorities concerned in the public health, (*b*) the want of sufficient motive power in the central authority, (*c*) the non-coincidence of areas of various kinds in local sanitary government, (*d*) the number and complexity of enactments, (*e*) the needless separation of subjects, (*f*) the leaving some general Acts to voluntary adoption and the permissive character of other Acts and (*g*) the incompleteness of the law. Finally, the commissioners lent all the power and prestige of their position and experience in unreserved support of the great principle of local self-government.

Public Health Act, 1875.—The Public Health Act of 1875, which emerged from the labours of the Royal Sanitary Commission, may be regarded as marking a great advance in the development of sanitary administration. Before that time sanitation was interpreted in large measure as a negative policy —in a word, the removal of nuisances; after that time sanitation received a new connotation, positive, constructive, remedial. That is the reason why this Act forms the great line of division, the watershed in the progress of modern preventive medicine, on its environmental side. The report of Sir Robert Peel's Commission, in 1845, contains a significant suggestion in its recommendation that each local governing body should have a medical officer whose duty it should be " to ascertain the true causes of disease and death, more especially of epidemics increasing the rates of mortality, and the circumstances which originate and maintain such diseases, and injuriously affect the public health." No one can read the preamble of the report of the commission of 1869 on the history of the sanitary laws enacted up to that date without being impressed with their character. They dealt, almost monotonously, with nuisances and their removal, sewerage and drains, sewage utilisation, the paving, lighting and cleansing of streets, common lodging-houses, the supervision of artisans' dwellings, smoke nuisances, local government and the burial of the dead. The only group of laws directly concerned with disease was the Vaccination Acts. Then came the Public Health Act of 1875, which in conception and working led for 20 years to enactments on the prevention of river pollution, the protection of water supplies, the provision of housing accommodation and isolation hospitals, and the notification and prevention of infectious disease. The elementary Education Act of 1870, and the Public Health Act of 1875, were forms of germinative legislation bearing fruit in a single generation.

The Practitioner's Aid.—Whilst the state was thus calling into being various public medical services, the practitioner in medicine and surgery was finding ways and means of preventing disease met with in his practice, both infectious and non-infectious. Abortion, miscarriage, still-birth are preventable conditions. Children's disorders such as ophthalmia, rickets, dental decay and malnutrition are preventable, and the same may be said of many diseases of the skin, the eye, ear, nose and throat. The examination of recruits and of insurance patients shows that much physical impairment is due to the effects of rheumatism, dyspepsia, constipation, bronchitis, anaemia, debility, neurasthenia, heart disease, dental decay, mental disease or disorders of metabolism. Some of these conditions are due to factors such as infection (fevers, rheumatism, tuberculosis, venereal disease, etc.), or degenerative processes, like arteriosclerosis and nephritis, or fatigue and unhygienic living; others are more obscure, but the great bulk of them are in large degree preventable. Midwifery alone provides many opportunities for preventive medicine.

Surgical Aid.—Surgical conditions seem at first sight to be less directly preventable, and curative only. Yet the task of the surgeon is to serve and assist nature by placing the human body and its organs at her service, by removing obstructions from her path, by supplementing and aiding her processes and by fortifying the body defences against infection or accident. All this is of the essence of preventive medicine. It is an alliance with nature against disruptive forces. Surgery finds its preventive expression in a great variety of ways. The fundamental principles of aseptic surgery are the elimination of sepsis and its practice is repair, the removal of hurtful tissues and the avoidance of disablement. Preventive surgery may be illustrated in a general way as follows:—

(*a*) Surgery in children's conditions—enlarged tonsils and adenoids, phimosis, hernia, ophthalmia.
(*b*) Surgery in deformities—rickets, tuberculosis, scoliosis, talipes, flat-foot, hammer-toe, fractures.
(*c*) General surgery—sepsis, tuberculosis, varicose veins, hernia, venereal disease, malignant disease, tumours, thoracic conditions, abdominal and genito-urinary surgery, gynaecology, dental caries.
(*d*) Industrial surgery—wounds, fractures, injuries, poisons, fumes, anthrax, tetanus, etc.

The first generation of the 20th century (1900–24) witnessed a continued development in sanitary environment, which indeed must always remain the foundation of preventive medicine, and

[1] Report of the Royal Sanitary Commission 1871, vol. 1, p. 20.

in various new departures dependent upon the principles which had been established by the Public Health Act 1875, and by the growth of medical knowledge. The public health service expanded to include particular measures against tuberculosis and venereal disease, the provision of municipal midwives, and a remarkable extension of the supervision of maternity and child welfare. Indeed, the characteristic of this period was the progress made in personal hygiene as distinct from environmental hygiene. Its centre is the person rather than the premises. The School Medical Service was organised in 1907, systematic provision was made for the care of infancy in 1914, the National Health Insurance Act was passed in 1911 and medical research has been organised on a large scale.

Concurrently with these great movements increased attention was given to industrial welfare and the health of the factory worker. Time alone can show the effect on the public health of the wide extensions and applications of the public health principles of 1875. It cannot be doubted that an improved midwifery service, the care of the newborn infant, the systematic health supervision of every school child, improved hygiene in the workshop and factory and a system of health insurance by which medical aid is promptly available for 14,000,000 insured persons must exert in the course of time a profound effect upon the national health. That such an effect has already been produced is shown by the vital statistics. The following table gives the birth-rate, population, number of deaths, average annual death-rate and even mortality from 1871 to 1920:—

Period	Average annual birth-rate per 1,000 living	Average estimated population	Average estimated number of deaths registered	Average annual death-rate per 1,000	Average annual infant mortality, *i.e.*, deaths of children under one year of age per 1,000 births
1871–1880	35·4	24,225,271	517,831	21·4	149
1881–1890	32·4	27,384,934	524,477	19·1	142
1891–1900	29·9	30,643,316	557,538	18·2	153
1901–1910	27·2	34,180,052	524,877	15·4	128
1911–1920	21·8	35,750,765[1]	518,805	14·3[2]	100

[1] Including civilian population only from 1915–8.
[2] Including civilian mortality only from 1915–8.

In 1924 the birth-rate had fallen to 18·8, the death-rate to 12·2 and the infant mortality rate to 75 per 1,000 born. The decline in the infant mortality rate from 153 per 1,000 born in 1891–1900 to less than 80 for 1920–4 is one of the most significant and sensitive indications of the improvement of the public health. Perhaps an even more valuable indication is the expectation of life at birth. In 1871–80 the expectation of life at birth in London was for males 38 years, and for females 42. By 1920–2 these figures had risen to approximately 54 years for males and to 59 for females, a rise of 16 and 17 years respectively in two generations.

Since 1900 there have been various collateral developments in medicine which cannot fail to exert powerful influence on the prevention of disease. The use of X-ray (*q.v.*), of radium (*q.v.*) and of the ultra-violet rays has been conducive not only to greater accuracy of diagnosis, but also to steady improvement in the treatment of tuberculosis (*q.v.*) and cancer (*q.v.*). Heliotherapy (*q.v.*) and open-air treatment are likewise finding many applications. The perfection of the Wassermann-Bordet test and the discovery by Ehrlich of salvarsan (the 606th preparation tried for syphilis) have advanced the diagnosis and treatment of this disease, now carried out in England and Wales in 190 special clinics receiving state subsidy (*see* VENEREAL DISEASES). The Widal reaction for typhoid and various tests for tuberculosis have been followed by the Schick and Dick immunising tests for diphtheria and scarlet fever, and these have opened up new opportunities for the control of these diseases (*see* INFECTIOUS FEVERS).

The dispensary and sanatorium treatment for tuberculosis has been greatly developed, and this has led to the arrest or retardation of the disease in many individuals. The disease has been steadily declining in Great Britain since about 1875. The new knowledge of filter-passing microbes (*q.v.*) has created far-reaching possibilities, and that of the physiology of internal secretion has led to the introduction for therapeutic purposes of artificially prepared extracts, such as insulin (for diabetes), thyroxin (for myxoedema) and pituitrin (for acromegaly). (*See* ENDOCRINOLOGY.) There has also been an enormous development in the use of antitoxins, vaccines and serums (*see* IMMUNITY; SERUM THERAPY; VACCINE THERAPY)—the harvest of the epoch-making work of Louis Pasteur.

Lastly, the creation of the League of Nations has facilitated considerable development in the international study of hygiene, and there has thus been opened a new sphere for the application of preventive medicine to international health problems and the control of the tropics for the white man. Plague, yellow fever, malaria and sleeping sickness have now, under favourable circumstances, come under man's dominion.

See J. G. Fitzgerald, P. Gillespie and H. M. Lancaster: *An Introduction to the Practice of Preventive Medicine* (1923). (G. N.)

United States.—The rapid growth of America was associated with primitive sanitary conditions, so that epidemics of typhoid fever, cholera, yellow fever, typhus fever and other preventable plagues marred the development of the country. In many instances the water supplies were contaminated and sewage and wastes were disposed of by ready methods that were unsanitary and unsatisfactory. The reforms along these lines in recent years have worked hygienic marvels. The United States grew at a time when sanitation and hygiene were emerging from the Dark Ages. Notable contributions to the science and practice of preventive medicine and hygiene have been made by American workers in the laboratory and in the field.

In 1893 Theobald Smith demonstrated that Texas fever of cattle was transmitted by the bite of an infected tick, thus proving for the first time the great principle of insect-borne transmission of infection. Shortly afterwards the mosquito was shown to be the vector in the spread of malaria and then of yellow fever. Following this, other insects were found to be responsible for a long and growing list of infections. In 1900 Carter discovered the extrinsic period of incubation of yellow fever. In 1882 Carlos Finlay of Cuba implicated the responsible mosquito, but it remained for the United States Army Medical Commission, consisting of Reed, Carroll, Lazear and Agramonte, to prove the fact by a convincing demonstration in 1900. This discovery was soon put to practical use by White in New Orleans during 1905 when, for the first time, an epidemic of yellow fever was stamped out before the advent of frost. The work of Gorgas which made the building of the Panama Canal possible was a dramatic demonstration in preventive medicine.

The cause and modes of spread of tularaemia, another insect-borne disease, primarily of rabbits and secondarily of man, were discovered by McCoy and Francis, scientists of the Hygienic Laboratory of the U. S. Public Health Service. Ricketts lost his life from typhus fever in Mexico City while unravelling the mysteries of that disease, and McClintock was a martyr to Rocky Mountain spotted fever while studying that tick-borne infection which has been revealed by American investigators. A triumph was achieved by the Dicks of Chicago who demonstrated the cause of scarlet fever and developed an antitoxic serum for its cure, a toxin for its prevention and a skin test (the Dick test) by which it is possible to determine who are susceptible and who immune. Stiles pointed out the importance of hookworm disease and discovered an American species of this parasite. Trudeau founded at Saranac Lake, New York, the sanitarium for tuberculosis which now bears his name; Theobald Smith discovered the bovine tubercle bacillus; and Noguchi's brilliant achievements

have placed some obscure problems on a secure scientific basis. In the field of nutrition, Atwater and Benedict, Osborne and Mendel, and Lusk and McCollum have enriched the important subject of dietetics, which is one of the most fundamental factors in health. Among other outstanding contributions should be mentioned the work of Goldberger on pellagra and Strong on trench fever. Oliver Wendell Holmes, as early as 1843, pointed out the contagiousness of puerperal fever.

The blessings of anaesthesia were among America's first contributions to preventive medicine. Long, a country physician in Georgia, operated on several cases under ether in 1842–3. Wells of Hartford, Connecticut, in 1844 began the use of nitrous oxide in dentistry. The first public demonstration of a surgical operation under the deep sleep of ether was inspired by Morton and was performed Oct. 16 1846 at the Massachusetts General Hospital, Boston.

The United States was a pioneer in recognising the importance of clean, safe milk supplies. In Jan. 1908 the United States Public Health Service published a Bulletin of the Hygienic Laboratory entitled "Milk and Its Relation to the Public Health," which favourably influenced the milk supplies in the United States and elsewhere. Pasteurisation was advocated and is now generally applied to all large milk supplies throughout the land. While the United States was somewhat tardy in supplying clean and safe water to its large cities, it developed the method of rapid (or mechanical) sand filtration for muddy waters and has been quick to seize the advantage of chlorination. The recent reduction of typhoid fever in the United States is one of the dramatic demonstrations of preventive medicine.

The United States was early in the field to develop special schools for public health education. A School of Public Health was established by Harvard University and The Massachusetts Institute of Technology in Boston in 1913 (Rosenau, Sedgwick and Whipple). Other universities have participated in this movement, especially the University of Pennsylvania (Abbott), Johns Hopkins University (Welch) and the University of Michigan (Vaughan). American names especially associated with public health administration are Biggs, Chapin, Shattuck, Wiley and Wyman.

Health administration in the United States is part of the police power of the several states. The Federal Government has no constitutional power for local administration of health codes. It has, however, full powers with reference to maritime quarantine and interstate quarantine; it acts in emergencies and it promotes public health through demonstrations, co-operation and investigation. Federal health activities are centred in the United States Public Health Service, which is a bureau of the Treasury Department. Each state has a health organisation, and all the large cities and some of the smaller ones also have well organised health services. The county district is the weakest link in the sanitary chain, but in 1925, 280 of the 2,850 rural counties of the United States had full-time health officers. Many other agencies are active in preventive medicine throughout the country—for example, the International Health Board of the Rockefeller Foundation; the Rockefeller Institute for Medical Research; the McCormick Institute for Infectious Diseases; the Society for the Study and Prevention of Tuberculosis; the National Health Council; the Metropolitan Life Insurance Company, as well as universities, health centres, etc., all of which are active in promoting a better civilisation through obtaining and maintaining a higher standard of health. (M. J. R.)

PRICES (*see* 22.315).—The following article deals with the general movement of wholesale prices, (*a*) since 1903 in the United Kingdom and (*b*) since 1913 in certain other countries; (*c*) the wholesale prices of selected commodities; and (*d*) the general movement of retail prices of food in the United Kingdom. These general movements are measured by index numbers (*see* INDEX NUMBERS), which are averages, computed in various ways, of the changes of prices of selected commodities. The relative importance given to the various classes of commodities in the principle index numbers for the United Kingdom are indicated in the following table:—

	Board of Trade New Series[1] Base 1913	Base 1867–77	Statist or Sauerbeck 1913[2]	Economist Base 1901–5
Cereals	113	178	144	159
Meat	113	156	182	91
Other food, drink and tobacco	127	88	56	114
	353	422	382	364
Coal and metals	293	156	203	182
Textiles	207	178	175	227
Miscellaneous	147	244	240	227
	647	578	618	636
	1,000	1,000	1,000	1,000

[1] In the old series, discarded in 1920, the food group accounted for 652 and the materials for 348 in 1900.
[2] These are the effective weights reached by Sauerbeck's numbers when comparison is made with 1913.

During the very rapid and diverse price movements from 1914 to 1922 the results obtained by the three methods diverged (*see* Table II.): that of the Board of Trade is on the broadest and most scientific basis.

(*a*) *The United Kingdom.*—Table I. exhibits the general movement in the 12 years before the World War. The year 1903 is taken as the starting point, since, after the considerable fall in prices ending in 1896 and the subsequent temporary inflation of 1900–1, it may be regarded as a normal year. Wholesale prices rose steadily from 1902 to 1913, except for the short period of depression in 1908–9, but tended downwards in the first half of 1914.

TABLE I. *Index Numbers of Movement of Wholesale Prices in the United Kingdom. Level in 1913 Taken as 100*

Year	Board of Trade Old Series	Sauerbeck	Economist
1903	83	82	79
1904	84	83	81
1905	84	85	81
1906	87	91	88
1907	91	94	93
1908	89	86	83
1909	90	87	84
1910	94	92	90
1911	94	94	95
1912	99	100	108
1913	100	100	100
1914 (Jan. to June)	..	97	96

Immediately after the declaration of war in 1914 prices began to rise, and with certain interruptions continued to mount up till the spring of 1920, when the index numbers reached their maximum (*Statist* 323, end of April; *Economist* 326, end of March; Board of Trade 357, average of July). Till Oct. 1917 the increases showed a remarkable regularity, averaging 2% monthly, equivalent cumulatively to 27% per annum; on this scale the index in the successive Octobers would reach 106 in 1914, 135 in 1915, 171 in 1916, 217 in 1917 and 258 in 1918, numbers which (except the last) are in close agreement with those shown in Table II. There was, however, a definite seasonal movement super-imposed on this regularity; in the first three or four months of each year prices moved up with special rapidity, while in the summer the increase was slackened and in some cases was replaced by a fall. The check in the increase in the summer of 1917, following a specially rapid rise, is attributable to the control of prices which by that date was general. From Aug. 1917 prices continued to rise in spite of control till Sept. 1918, but the rise in these 13 months aggregated to only 13% (239 against 213).

After the Armistice prices fell slowly for five months, during the season in which in previous years the increase had been specially rapid, but expectations of a permanent fall were not realised; in the year beginning April 1919 the index rose from

224 to 323, or 44%. The reaction began in the early summer of 1920, and the fall was very rapid in the following winter and continued till the end of 1921, when prices were 60% above the pre-War level, and only half those at the maximum of April 1920 by *The Statist* account. During the subsequent four years the movement was relatively slight, but there was a definite fall and rise in the middle of 1923, and a further rise in the latter part of 1924. The gold basis was restored in May 1925, and both in anticipation of this and after it there was a fall amounting to 10% in the whole year, till prices were 58% above 1913; equilibrium with the United States price index was reached in the latter part of the year.

TABLE II. *Monthly Index Numbers (Statist)*

Average of Jan.–July 1914 = 100

End of	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Jan.		117	150	193	225	233	298	239	160	158	166	175
Feb.		122	154	199	227	227	317	220	160	160	168	173
March		126	158	205	228	224	316	215	161	161	166	169
April	100	128	163	209	230	224	323	206	163	162	166	167
May		130	164	212	231	235	316	196	164	160	165	165
June		129	159	218	233	242	311	189	164	155	165	159
July		129	158	214	233	250	309	191	162	151	168	162
Aug.	106	130	163	213	237	258	308	187	157	151	167	163
Sept.	108	131	163	214	239	260	302	181	155	155	171	161
Oct.	109	133	173	219	239	272	291	168	158	155	177	158
Nov.	108	137	183	222	237	280	272	166	158	160	176	161
Dec.	111	143	187	225	237	285	252	162	156	161	179	158

Yearly Average

	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Statist	131	164	212	233	249	301	193	160	157	169	164
Economist	128	167	212	234	244	298	190	167	170	183	175
Board of Trade: (Old series)	127	165	215	237	263	326	..	..	..	...	..
(New series)	..	..	..	..	..	316	203	164	164	171	165

(*b*) *Other Countries.*—The world movement of prices is best indicated by the United States index number, since in that country alone the gold basis has been maintained throughout the period 1913 to 1925. In the United States prices rose rapidly from the year 1916 to a maximum in 1920—in April the index was 273—and then fell rapidly till the spring of 1921; after slight variations, there was a rise from June 1924 to Feb. 1925, and during the subsequent 12 months the number remained close to 160. In all the countries included in Table III. there was a rise from 1915 to 1920, greater or smaller according to the amount of paper money issued. In Germany and Austria the increase was so great that the numbers reached were almost incredible. After 1920 there was a fall in all the index numbers in the table; by the end of 1925 Canada, Australia, South Africa, Sweden, the Netherlands, Switzerland and Germany had returned to the gold basis, and in Canada and Europe there was a close approximation to the American index. In Belgium, France and Italy depreciation recommenced in 1922, and in France and Italy prices had in 1925 passed the 1920 average. At the end of 1925 Japan was taking steps to stabilise prices in that country.

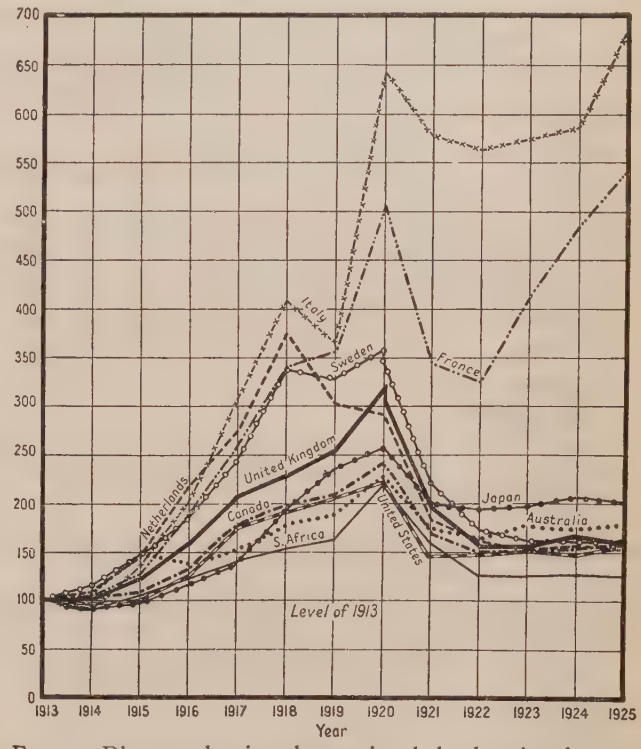


FIG. 1.—Diagram showing changes in wholesale prices in certain countries above or below the price level in 1913, which is taken in every case as equal to 100. The diagram is based on the figures given in Table III. below.

(*c*) *Selected Commodities.*—When commodities are taken separately, the measurements can be made more exactly, subject to the two following qualifications: (1) during the War period the ordinary sources of supply were so disturbed that pre-War kinds and qualities were no longer in the market (in *The Economist* index number 25 out of the 44 quotations included were subject to some modification of quality); and (2) a statement of prices is generally taken as meaning the price at which a purchaser can obtain the goods he desires, and at which a merchant is willing to sell, but in the time of control and rationing these conditions did not obtain, and the price was fixed by other conditions than those which influence a free market.

TABLE III. *Index Numbers of Wholesale Prices*

Year	United Kingdom Board of Trade		United States Bureau of Labour	Canada Official	Australia Official	South Africa Official	Sweden		Netherlands Official	Switzerland Lorenz	Belgium Official	France Official	Italy Bachi	Japan Bank of Japan
	Old Series	New Series					Svensk Handelstidning	Official						
1913	100	100	100	100	100	100	100	100	100	...	..	100	100	100
1914	100½	..	98	102	106	97	116	..	109	100	100	102	95	96
1915	123	..	101	110	147	107	145	..	146	..	..	140	133	97
1916	160	..	127	132	138	123	185	..	226	..	..	188	200	117
1917	209	..	177	179	153	141	244	..	276	..	..	262	306	149
1918	230	..	194	199	178	153	339	..	373	..	..	339	409	196
1919	255	..	206	209	189	165	330	..	304	..	..	356	366	236
1920	319	307	226	244	228	223	347	359	292	..	..	509	624	259
1921	..	197	147	172	175	160	..	222	182	191	366	345	578	200
1922	..	159	149	152	162	128	..	173	160	168	367	327	562	196
1923	..	159	154	153	179	127	..	163	151	181	497	419	575	199
1924	...	166	150	155	173	129	..	162	156	175	573	489	585	207
1925	..	160	159	160	169	128	...	161	155	162	558	555	689	..

Table IV. is based on the prices tabulated annually, in *The Journal of the Royal Statistical Society*, by the editor of *The Statist*. The index numbers have been recast, the average price in 1913 being taken as 100 for each commodity; the totals have been obtained by grouping together the separate entries on the same plan as in the original, but the change in the base year affects the results, which thus differ from those given in Table II. in the same way as if the weights had been changed.

TABLE IV. *Statist Index Numbers. Average for Each Year. Average for 1913 Taken as 100 in Each Case*

	1919	1920	1921	1922	1923	1924	1925
Vegetable food:—							
Wheat							
English Gazette	229	253	229	148	132	155	163
American	205	253	202	143	130	148	171
Flour, town made white	153	216	211	150	130	144	164
Barley, Gazette	278	330	200	147	124	172	154
Oats, Gazette	274	301	181	152	140	142	142
Maize, U.S. mixed	334	384	163	132	152	168[5]	163[5]
Potatoes, English	254	311	254	167	128	238	197
Rice, Rangoon	313	501	226	172	172	206	195
Average	255	319	208	151	138	172	169
Animal food:—							
Beef: Carcase, London							
Prime	200	231	215	164	147	152	148
Middling	220	255	224	167	152	155	150
Mutton: Carcase, London							
Prime	184	233	211	202	173	180	172
Middling	203	258	224	217	192	185	176
Pork: Carcase, London	233	306	221	184	162	127	154
Bacon, Waterford	248	311	232	189	148	138	167
Butter, Friesland	212	253	210	170	156	177	174
Average	214	264	220	185	161	159	163
Tropical food:—							
Sugar							
West Indian[1]	402	610	205	158	268	246[3]	171[3]
Beet, German[1]	..	..	..	148	246	213	125
Java, Floating Cargo	400	687	202	141	224	198[4]	113[4]
Coffee							
East India[1]	180	183	149	149	145	188	190
Rio[1]	215	210	119	140	104	161	186
Tea							
Congo, common[1]	270	..	87	172	220	182	157
Indian, good medium[2]	182	114	85	162	207	215	181
Average Import[1]	171	165	137	164	194	209	202
Average[1]	300	432	162	152	203	197	157
All Food: Average	250	322	203	164	161	172	164

[1] The entries in these cases of similar commodities are averaged before inclusion in the index numbers.
[2] These commodities are not included in the index numbers.
[3] White Javas, C.I.F. for 1924–5.
[4] Raw centrifugals for 1924–5.
[5] La Plata for 1924.

	1919	1920	1921	1922	1923	1924	1925
Minerals:—							
Iron							
Scottish Pig[1]	215	326	257	151	165	148	127
Cleveland Pig[1]	235	357	236	157	187	151	125
Common Bars	249	366	247	145	153	161	153
Copper							
Standard	135	143	102	93	97	93	91
English Tough Cake[2]	135	153	98	90	95	92	89
Tin, Straits	128	150	85	81	102	125	133
Lead, English Pig	154	209	127	141	148	187	196
Coal							
Best Yorkshire House[3]	211	149	150	160	151	128	138
Newcastle Steam[2]	293	330	187	159	181	143	106
Average Export	331	572	250	173	180	168	144
Average[1]	218	276	172	135	144	144	140
Textiles:—							
Cotton							
Middling American	280	330	134	173	218	232	180
Bhownuggar G.F.	251	240	102	141	176	194	194
Flax							
Petrograd[1, 4]	..	..	331	279	245	353	271
Russian Av. Import[1]	423	837	287	206	205	253	293
Hemp							
Manila Fair Roping[1]	185	207	127	105	105	139	145
Petrograd clean[1]	388	383	..	..	150	213	234
Jute, good medium	189	169	104	116	98	120	187
Wool							
Merino, Port Philip[1]	372	444	177	217	243	297	228
Merino, Adelaide[1]	338	337	122	180	214	268	183
Lincoln half hogs	183	178	69	79	97	153	139
Silk Tsetlee[5]	236	351	241	261	220	213	164
Average[1]	271	319	170	167	174	209	186
Miscellaneous:—							
Hides							
River Plate, Dry[1]	182	167	78	74	76	81	92
River Plate, Salted	206	192	93	93	86	91	93
Average Import[1]	198	233	111	93	95	100	115
Leather							
Dressing Hides[1]	187	223	129	125	120	117	118
Average Import[1]	211	370	240	187	163	176	171
Tallow, Town	255	218	105	101	106	123	123
Oil							
Palm	197	198	105	98	103	114	115
Olive	..	..	..	..	134	161	149
Linseed[1]	375	356	129	158	173	172	175
Seeds, Linseed[1]	306	345	159	166	171	178	177
Petroleum, refined	204	298	260	186	153	154	154
Soda, crystals	249	317	295	259	217	214	211
Nitrate of soda	216	215	165	125	117	118	116
Indigo, Bengal	332	527	416	358	273	220	209
Timber							
Hewn: Average[1]	344	300	172	116	120	125	120
Sawn: Import[1]	369	416	249	187	208	193	195
Average[1]	268	307	195	167	151	152	150
Average materials	256	302	181	159	156	168	159
Average, food and materials	253	311	190	161	158	169	161
Statist number	242	295	183	154	152	164	161

[1] The entries in these cases of similar commodities are averaged before conclusion in the index numbers.
[2] These commodities are not included in the index numbers.
[3] Wallsend Hetton in 1913.
[4] Livonian Z.K. from 1921.
[5] Common New Style from 1921.

It is at once evident that the various prices have not followed the same course; the extremes in 1920 were house coal, whose price rose only 49% in seven years, and Java sugar, where the price is 587%. This wide divergence of itself shows that the general index number cannot have great precision. The prices as recorded are the resultants of at least five forces, viz.: the general inflation of prices, the conditions of supply and demand for the separate commodities, the control of supply, the control of prices, the change of quality. In 1915–6 the principal increases may be traced to the diminution or difficulty of supply (cereals, sugar, flax), to acuteness of demand (wool) or to both (timber). In 1917–8 the prices of nearly all commodities whose supply was threatened or for which the demand was increased were controlled. The quality was changed directly in the case of flour, and indirectly when the prices were averages of several grades, as in the cases of meat, flax, leather and timber.

Food.—The price of wheat rose immediately after the beginning of the War, and with it the prices of flour, oats, maize and rice. In Great Britain the prices were checked by the establishment of a Government system of purchase at the end of 1916 and by the control of the prices of home-grown cereals in 1917; with this system, flour of mixed materials was substituted for wheat-flour and the product sold at a price kept constant and relatively low by the help of a subsidy, beginning in the autumn of 1917. In the case of wheat and flour the subsidy and control continued till the beginning of 1921, but the prices rose; the

prices of other cereals increased very rapidly from the autumn of 1919. An attempt was made to control the consumption of oats in 1917–8, otherwise cereals were not rationed. The wholesale price of potatoes was fixed from time to time, the Government undertaking to make good growers' losses, but the price was changed so frequently that the control had little effect. After the general fall of prices in 1920–1, the fluctuations were principally due to rather abnormal harvest vicissitudes.

During the War the price of meat increased somewhat less than that of commodities in general. Prices were fixed in Great Britain in Aug. 1917 and consumption was rationed early in 1918; after the Armistice control was gradually released, but prices of beef and mutton changed very little during the two years after the first fixing of them. After the great drop in prices in 1921–2, wholesale prices of beef and pork remained relatively low, and those of mutton high during the period 1922–5. Sugar was controlled till the beginning of 1921, at which date the world's supply had been adjusted to the new conditions, but the supply of beet sugar did not recover, and prices were relatively high till 1925.

Materials.—The prices of coal, iron and steel were subject to great fluctuations. Iron and steel were controlled during the War, and from Nov. 1917 till early in 1919 a subsidy was given to producers. On its removal prices rose very considerably in consequence of the great demand for construction and repairs. Subsequently there was the general collapse in prices, marked by the coal strike of 1921, partly due to the gradual return to normal conditions of the continental coal mines and steel works. Some stimulus was given to prices by the French occupation of the Ruhr district in 1923, but by the end of 1924 it was evident that the world's capacity for coal and steel production was in excess of requirements, and prices fell to an unremunerative level. The prices of copper and tin and, in some years, of lead fell relatively to general prices.

The prices of cotton and wool reached great heights in the boom of 1920, followed by a complete collapse in 1921. During the period 1922–5 a world shortage of supply (as compared with normal requirements) kept prices on a high level, while continued fluctuations of price hampered manufacture. The extraordinary rise in the price of flax was due to the cutting off of the Polish-Russian supply, which had not recovered by the end of 1925. Space does not permit any analysis of the price movements of miscellaneous materials, or of that of rubber, not included in the Statist list.

Retail Price Movements in the United Kingdom.—Table V. shows the movement of the Ministry of Labour's index of retail food prices. This measures the relative cost of purchasing each month exactly the same quantities and as nearly as possible the same kind of food as in a standard budget of working-class expenditure; this budget is based on an investigation made in 1904 and was modified slightly in 1914. During the period of control, 1917–9, the index is to some extent fictitious, since the quantities of the goods included could not be purchased, and generally no allowance is made for modifications of purchases when prices are changing unequally; but there is good reason to believe that these considerations are of little importance after 1920. There is a seasonal fall in the spring and rise in the autumn, owing to the inclusion of dairy produce, and in particular to the supposition that the same number of eggs are bought in Jan. and April; but not improbably this reflects a real change in the cost of nourishment. Though the number is based on an average of prices all over the country, it is nearly applicable to all districts, since in recent years there has been increasing uniformity in prices and their changes.

TABLE V. *Average of Retail Food Price Changes in the United Kingdom (Ministry of Labour Gazette). Level in July 1914 Taken as 100*

Beginning of	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Jan.	118	145	187	206	230	236	278	185	175	175	178
Feb.	122	147	189	208	230	235	263	179	173	177	176
March	124	148	192	207	220	233	249	177	171	176	176
April	124	149	194	206	213	235	238	173	168	167	170
May	126	155	198	207	207	246	232	172	162	163	167
June	132	159	202	208	204	255	218	170	160	160	166
July	133	161	204	210	209	258	220	180	162	162	167
Aug.	134	160	202	218	217	262	226	175	165	164	168
Sept.	135	165	206	216	216	267	225	172	168	166	170
Oct.	140	168	197	229	222	270	210	172	172	172	172
Nov.	141	178	206	233	231	291	200	176	173	179	172
Dec.	144	184	205	229	234	282	195	178	176	180	174
Year	131	160	198	215	219	256	230	176	169	170	171
Wholesale Food (Statist)	142	173	225	231	245	308	210	173	163	174	169

The Statist wholesale food index is repeated (on the basis of July 1914) for comparison, though the range of commodities and their relative importance are not the same in the two numbers. The rise up to 1920 is considerably smaller in the retail index, while the concurrence since 1921 is very striking. Retail prices in 1921 did not fall, however, so rapidly as wholesale, and it is generally to be expected that their movements will be later and of a smaller amplitude than those of wholesale prices.

(A. L. Bo.)

PRIMO DE RIVERA, MIGUEL (1870–), Spanish soldier and statesman, known as the Marquis de Estella, was born at Jerez de la Frontera Jan. 8 1870, and subsequently entered the Madrid military academy. After four years in Toledo he was ordered to Morocco in 1893 as lieutenant of the Infantry Regiment of Extremadura, and in Oct. of the same year was promoted to the grade of captain for extraordinary personal bravery. In 1895 he was adjutant to Gen. Martínez Campos in Cuba, and rose to be major commanding the infantry battalion of Zamora.

He served in the Philippines in 1897, and negotiated the Treaty of Biagnabato (Biacabato) on Dec. 12 1897, whereby the insurgents and their leader Aguinaldo surrendered and retired to Hongkong (*see* 21.339). Returning from the Philippines, in 1900 he commanded a battalion in Barcelona for a year and a half, after which he was transferred to the general staff, whence he repaired to Algeciras as commander of a battalion. In 1915 he was appointed Governor of Cadiz, and spent a month at the French front during the World War. His speech to the Hispano-American Academy advocating the exchange of Gibraltar for Ceuta or other North African territory, and corrosively criticising the Government's policy in Morocco, resulted in his being relieved from the governorship of Cadiz. His exceptional military talents, his brilliant exploits, his unaffected simplicity and straightforwardness, his sympathy with the feelings and interests of the army and the nation, had won for him the confidence of the King, the general staff and the public, so that despite his outspokenness in the academy, he was soon afterwards promoted to be general and chief of the First Infantry Division in Madrid.

In 1921 the Marquis de Estella was elected Senator for Cadiz, and delivered a powerful speech in the Upper Chamber reaffirming in emphatic terms the views he had already put forward respecting Morocco and the necessity of relieving the nation of that onerous burden. Whereupon Primo once again lost his post. But the effects of his uncommon civic courage and unselfish patriotism prevailed once more over considerations of petty discipline, and he was entreated to undertake the most difficult and dangerous post in Spain—that of Captain-General of Catalonia—with a view to ending the reign of terror there, of which the central Govt. was content to remain a listless onlooker. Separatism, syndicalism and genuine thuggism of the most dastardly character paralysed the population. Accepting the invidious task, the new captain-general soon reaped a measure of success fully proportionate to his chivalrous character, his personal influence and his limited legal powers.

Easy and generous to the point of familiarity in his private life, the Marquis de Estella was punctilious and exacting in matters affecting the nation, the army and the monarch, and his integrity was proverbial. He soon recognised the chaos in Catalonia for what it was—one of the indirect consequences of the breakdown of the parliamentary régime. This was also responsible for the mismanagement of the Morocco campaign, as

well as for the ferment in the army brought about by the niggardliness, the favouritism and criminal recklessness of the central Government. The Cortes, which in a decade had trebled the pay of its members, refused the money needed for the training and equipment of the rank and file of the army, while the average officer was so badly paid that he could not afford a sanitary dwelling, decent clothing or even a pair of leather boots. Although the evil had long been diagnosed nobody had had the courage to uproot it, until the dauntless Marquis de Estella surprised the world by his manifesto dated Sept. 12 1923, and published the following day, suspending the constitution and proclaiming in its place a directorate consisting of military and naval officers. He further announced that this arrangement was but a bridge leading to a future system of government better suited to Spain's needs than that which he abolished. This military coup d'état was carried out without bloodshed.

The methods of the directorate were prompt and radical. Separatism, Syndicalism and Bolshevism were put down swiftly and without needless rigour. An anti monarchist conspiracy was checked with dignity and disdain. Labour conditions were bettered, taxation reforms were drafted, a supplementary grant of 12,000,000 pesetas was made for education; the administration of justice, which needed thorough reform, was partially purged; gambling, which had become a cancerous growth on the body politic, was to a large extent suppressed throughout the realm, and promotion in the public services was made dependent upon merit. The parlous condition of the finances also exercised the ingenuity and tested the resourcefulness of the directorate, which within 15 months cut down a growing deficit of 1,000 million pesetas to 532 millions.

The dictator and his colleagues revived the mediaeval liberties of the municipalities, giving them strong incentives to self-government, and formed a national militia the function of which was to maintain public order in times of unrest, and otherwise to sustain the spirit of civic virtue. Lastly, Primo called into being under the name *la Unión Patriótica*, a fellowship of " citizens of goodwill " to work for the realisation of ethical ideals in public life, and hinder a return to the venal system just swept away. This innovation was welcomed with marked enthusiasm, and within a few months the members numbered over 1,250,000. Mindful of the undertaking he had given at the outset, Primo dissolved the directorate on Dec. 3 1925, and substituted a government composed of civil as well as military ministers—mostly young men—as a preparatory step towards a new régime. The dictator himself, however, became Premier, and his policy was pursued without change.

Upon his accession to power Gen. Primo de Rivera's views on the Morocco problem underwent a complete transformation, which he frankly proclaimed without apologies but not without explanation. History, he held, constantly modifies political situations, and methods must be adjusted to current events. Of this the Morocco imbroglio was an illustration. By the year 1923 it had ceased to be a purely Moroccan struggle on the part of Abdel Krim for home rule, and had become an international enterprise (*see* MOROCCO). (E. J. DI.)

PRINCE EDWARD ISLAND (*see* 22.344), a province of the Dominion of Canada. The population in 1921 was 88,615, a reduction of 5·46% from the census of 1911. This tendency to decline has continued in each decennial period since 1891 when the population reached its highest figure of 109,078. This island province, however, is still the most densely populated in the Dominion, having 40·5 persons to the square mile. Charlottetown, the capital (pop. 12,347 in 1921), is situated on the shore of Hillsborough Bay, which forms a fine harbour. Other towns are Summerside (3,228) and Souris (1,094). About 77% of the population is rural.

The government is vested in a lieutenant-governor, an executive council of nine members, six of whom are without portfolios, and a legislative assembly of 30 members; 15 councillors elected on a property qualification and 15 assembly men on popular franchise; the suffrage was granted to women in 1922. The province has four members in each of the Federal Houses of Parliament; the representation in the House of Commons, under an Imperial statute of 1915, cannot fall below the representation in the Senate.

In education progressive changes have been made, including the introduction of a minimum wage for teachers, a substantial increase in the education grant, and the establishment of an agricultural technical school in 1921.

Production.—Agriculture was still the leading industry in 1925, despite the annual decline in production from 1919 onwards. The yield in thousands of bushels and value in thousands of dollars of the principal field crops from 1922–5 was as follows:—

Crop	1922		1923		1924		1925	
	Yield	Value	Yield	Value	Yield	Value	Yield	Value
Spring Wheat	689	863	575	655	535	850	554	798
Oats	6,533	2,662	5,881	2,565	5,065	3,004	5,519	2,468
Mixed grains	652	408	738	421	766	574	749	438
Potatoes[1]	2,658	1,329	2,732	1,776	5,776	2,558	3,859	6,753
Turnips, mangolds[1], etc.	2,313	833	2,157	647	2,336	701	2,531	1,012
Hay and clover[2]	379	4,553	321	3,856	372	4,090	366	3,755

[1] Cwts. [2] Tons.

Seed-potato production, for export to the United States, showed a steady development during the years 1921 to 1924. Dairying and poultry-raising are important: the production of creamery butter increased from 670,908 lb. in 1910 to 1,537,437 lb. in 1923; during the same period the production of factory cheese fell from 3,293,755 lb. to 1,811,537 pounds. The breeding of silver black foxes is an established and profitable industry. After a long period of depression it began in 1922 to gain ground, and in 1924 was the second largest industry of the province, with 448 fox farms and an estimated revenue from the sale of pelts and animals of about $2,000,000.

The fisheries of the province were valued at $1,201,772 in 1924, a reduction of over 30% as compared with the preceding year. The lobster catch formed more than half of the total, oysters ranking second in importance. Attempts to replant the oyster fields have largely proved a failure owing to the presence of destructive pests. Manufacturing is limited chiefly to food products, the gross value in 1924 being $4,462,821.

In 1924 the province had 279 m. of railway, and daily communication by car ferry with the mainland has been maintained, with rare interruptions, summer and winter, since 1918. Both are operated by the Canadian National Railways. The construction of a tunnel to replace the ferry, and the standardisation of gauges on the island railways have frequently been advocated. (S. LE.)

PRINCE OF WALES: *see* EDWARD, PRINCE OF WALES.

PRINCETON UNIVERSITY.—In Sept. 1910 Woodrow Wilson resigned the presidency, and in Jan. 1912 Prof. John Grier Hibben was elected president. The period between 1912 and 1925 was marked by gradual restoration of solidarity after the disrupting controversies of the preceding four years; by extended administrative reorganisation; by promotion of faculty autonomy, remuneration and welfare; by clarification of educational aims; by closer attention to the physical, intellectual and moral environment of undergraduate life; by wider recognition of alumni representation.

In 1912 and 1919 the business organisation of the university was remodelled. A standing committee of trustees and of the faculty was instituted in 1912 to consider all matters of educational policy and administration; in 1913 the faculty was given voice in forming its committees and initiating appointments and promotions; in 1918 the rights of the individual in

cases of dismissal were safeguarded; a new scale of salaries was adopted in 1920; retiring allowances and insurance were set in 1922; and relief for housing shortage was supplied in 1922 and 1925. Especial attention was given to the development of the students' health, by thorough physical examination, and by required supervised exercises. A development of the honour system in examinations (adopted 1893), to cover petty dishonesties, was authorised in 1921 and student self-government was so extended that by 1925 the conduct of discipline, student activities and the regulation of athletics were shared by joint committees of faculty and undergraduates. In the World War over 5,600 Princeton men were in service. The university laboratories were occupied by Government bureaus of research, and the dormitories by a school of aviation, a naval paymaster school, a student army training corps and a naval training unit. The atrium of Nassau Hall was converted into a memorial of the 150 men who died in service and a scholarship was founded in memory of each.

Additional Departments.—In 1913 the erection of the residential graduate college rendered permanent what had been an experimental feature of the Princeton Graduate School. By maintaining the highest standards and limiting the number to 200 (1922) the Graduate School planned to meet the need for gifted young scholars. A School of Architecture, opened in 1920, was developed within the department of art and archaeology. The School of Engineering was in 1921 reorganised to lead to the degree of B.S. in Engineering, and to offer graduate courses leading to the degrees of C.E., E.E., M.E., E.M. and Chem.E. The separate School of Electrical Engineering, established in 1889, was absorbed by the School of Engineering. Other new departments were those of psychology (separated from philosophy); politics (separated from history); music; and military science. New professorships were endowed in history, mediaeval history, Spanish, chemistry and ancient literature. After the War a field artillery unit was established and erected into a Department of Military Science.

Scholastic Changes.—The entrance requirements were revised in 1913 and 1919. To place the university in closer touch with American secondary education, Greek was no longer required (though strongly advised) for the A.B. degree. The curriculum was remodelled in 1919, and in 1923 new standards for bachelor degrees were put into effect. The elective principle was broadened by a new plan of upper class study, developing the application of the preceptorial system. Meanwhile the enrolment reached the capacity, 2,000, set by the university. To keep within this number, a plan of selective admission to the freshman class was adopted in 1923.

In 1919 the Alumni Association of Nassau Hall founded in 1826 was reorganised into a national association, and in 1922 the number of trustees elected by the alumni was increased from five to eight, or nearly one-fourth of the board.

Endowment and Buildings.—The inadequate endowment after the World War led to a campaign, and the raising of about $9,000,000. A bequest from the late Henry C. Frick, not fully received in 1925, was expected to amount to about $5,000,000. A permanent committee was appointed in 1925 to obtain an additional endowment of $20,000,000.

During the period 1912 to 1925, 22 new buildings were erected, and the foundations were laid (1925) of a new chapel. Among these buildings were the Graduate College, two units of faculty apartments, six dormitories, a new infirmary, a psychological laboratory, university dining halls, a stadium, a rink, a university power house and permanent quarters for the field artillery unit. In 1912 the endowment was $5,194,861, income $766,943, disbursements $831,538, salaries and expenses $408,360. In 1925 the endowment was $15,159,393, income $1,835,091, disbursements $1,873,166, and salaries and expenses $1,690,999. The library grew from 337,965 vols. in 1912 to 576,849 in 1925, not including 286,851 pamphlets, manuscripts, etc. In the same period the faculty increased from 182 to 260, the graduate enrolment from 152 to 196 and the undergraduate enrolment from 1,391 to 2,270. (V. L. C.)

PRINTING (*see* 22.350).—Since 1910 many improvements have been made in high speed machinery and in mechanical details.

Linotype.—The linotype machine has been improved and is made with four main magazines, each containing a complete range of types of a different body or face. A lever changes the magazine, and the width of the mould can be altered quickly so that varying types and sizes can be set without delay. Side magazines, worked by an additional keyboard, are fitted, which will set much larger type on the normal body, the letters overhanging and being supported by leads or slugs.

Monotype.—The monotype has a greater range of faces which can be set at one time. The machine will set solid type up to 24 points at a much slower speed, and also overhanging initial letters which are larger than the normal body. The improvements on both machines are very useful for catalogue and newspaper work.

The Ludlow.—In the Ludlow the matrices of the type are set by hand, and clamped in the machine, which casts a solid line of type, and the matrices are returned to the case by hand. This machine is used entirely for display work or advertisements, and large types, with an overhang supported by slugs, can be cast. A wide range of faces and sizes in unlimited quantities, or repetition lines, can thus be obtained, and the type is always cast afresh for each job. The Supertype composing machine matrices are set in a manner similar to the linotype, but single letters are cast instead of a slug for each line.

Automatic Feeder.—The use of automatic machines to feed the sheets of paper to the printing machine has been widely adopted, and continuous running is possible for long periods, whereas with hand-fed sheets it is necessary to stop the machine frequently when a fresh supply of paper is put on the feed board. Mechanical feeders are of the "pile" or the "continuous" type. In the pile feeder a stack of paper is automatically raised as each sheet is separated and lifted by air suction, and passed down a sloping board to front lay marks, and adjusted by moving side marks which place the sheet in the exact position for the grippers on the printing cylinder. Electrical or mechanical devices stop the machine if two sheets or no sheet be fed in by error. In the continuous type of feeder, small quantities of paper are placed and combed out by hand on the feed board, and then mechanically fed to the machine by somewhat similar means. With these mechanical feeders a higher output is obtained, and in large sizes a stack of paper can be wheeled on a trolley to the feeder. An extended delivery carries the printed sheets beyond the machine to a delivery board which descends gradually, and a truck load of paper can be wheeled away without handling to the binding department, and thus much handling and time is saved. The smaller sizes of printing machines are now built with an automatic feeder as an integral part of the construction, and speeds up to 4,000 per hour are possible, which could not be attained on a hand-fed machine.

Process Work.—Three-colour printing is used in increasing quantities for illustrations of all kinds. Absolute accuracy in register, height to paper, etc., is essential, and many improvements have been made. Blocks before being printed are gauged to 1,000th of an inch, and underlaid to make them dead-level. If a large edition be required, and plates are used on a flat bed printing machine, steel mounting blocks, planed to 1,000th of an inch, built up in small sections, with screws for adjusting the position of the plates, give a flat hard printing surface and perfect register between the three or four colour plates. Less time is then taken in making ready, and with modern machinery long runs of colour work can be obtained at a high speed without showing bad register or signs of wear.

Good colour printing requires uniform lighting, and special electric lamps have been perfected to give the effect of sunlight or northlight, and so enable printing to be carried on day or night without the variation caused by changing from natural to ordinary artificial light. The expansion and contraction of paper caused by variations in temperature or humidity prevent good register, essential in colour printing. Self recording hygrometers and thermometers are used to overcome these difficulties.

Newspaper Work.—In newspaper printing there has been a steady improvement in details. Most of the daily papers now have a page devoted to half-tone illustrations, which were formerly restricted to the daily papers specialising in pictures (*see* NEWSPAPERS). The growth in the circulation of the newspapers has been aided by the increased output of the modern newspaper printing machine. The running speed of the machines is much higher, and the following are the principal improvements. Roller bearings have been fitted to the printing impression cylinders, and ball bearings to some of the other moving parts, in order to reduce friction and give smoother and easier running. For the inking rollers, which are covered with a rubber-like coating made of glue, treacle and glycerine, a new non-melting composition has been invented which enables the machines to run at a higher speed. A fine spray of ink is forced under pressure through a number of minute holes upon the rollers, supplying a continuous and uniform quantity of ink when the machine is running at a high speed.

Costing Methods.—Mention may be made of the development of proper costing methods in the printing trade. This movement began in the United States and spread later to Great Britain, with the result that in both countries a uniform system has been officially adopted. The system leads to many improvements, and points out the high cost of running obsolete and inefficient machinery, and where losses are incurred. The methods of dealing in paper have been standardised, first in Great Britain and afterwards in the United States. The sizes have been fixed and the ream containing a variable number of sheets abandoned in favour of 1,000 sheets as a basis for selling, which gives the advantage of decimal calculations. Other investigations are being made in order to standardise and simplify the methods which have been the slow growth of centuries.

(W. H. HL.)

PRESSES OF VARIOUS KINDS

Styles of Presses.—Four styles of presses were in common use in 1910 in book and job offices: platens, drum cylinders, stop cylinders and two-revolution cylinders. In the platen press the form was held in a perpendicularly stationary position, the printing surface, or "platen," opening on a hinge movement during the feeding of the sheets and while the inking rollers were passing up and down over the surface of the type forme. The drum-cylinder press was so called because of the resemblance of the end view of its impression cylinder to a large drum. Enough of the circumference of the cylinder was cut away to permit, after the impression had occurred and without stopping the cylinder, of the return of the type forme for re-inking and another impression. In the stop-cylinder press, only a small part of the circumference of the cylinder was cut away; the cylinder, which was of course smaller in size than in the drum, stopped with its flat side at rest over the forme, which thereby was provided with sufficient headroom for its return. In the two-revolution press the cylinder was not stopped but was automatically raised and, while the forme was returning, the cylinder made a second revolution. The motion lost by the stopping of the cylinder in the drum- and stop-cylinder presses was saved in the two-revolution press, thereby giving it greater speed and consequently more production.

Printing of newspapers of all but limited circulation was done on rotary presses. The forme was stereotyped in a half-circle, two pages encompassing each cylinder, which in printing rotated against the impression cylinder, lost motion being avoided and the ultimate in speed seemingly achieved. The presses were built on the "deck" system, one unit above another. The paper was fed from a roll at one end and came out at the other as completed and folded newspapers. In lithographic printing the stone carrying the printing surface was just beginning to give way to zinc and aluminium sheets for the same purpose. "Straight matter" composition was done on two type-casting machines, one producing single types and the other producing completed lines or "slugs."

The situation in 1926 was as follows:—

The platen press was still much used. For short runs it continued to be hand-fed; for long runs it was equipped with automatic feeding devices that greatly augmented production such as those described above. Both drum-cylinder and stop-cylinder presses had practically disappeared. The two-revolution press had been developed to a high state of perfection; it was built in small and large sizes and also for printing in two colours at one operation.

Automatic job presses have come into general operation since 1910. Three of them are the Kelly, which embodies the principle of the two-revolution cylinder press; the Miehle vertical, which is in effect a fast small stop-cylinder with a vertical stationary form; and the Miller high-speed press, which has a two-revolution movement with the difference that the bed and not the impression cylinder moves up and down.

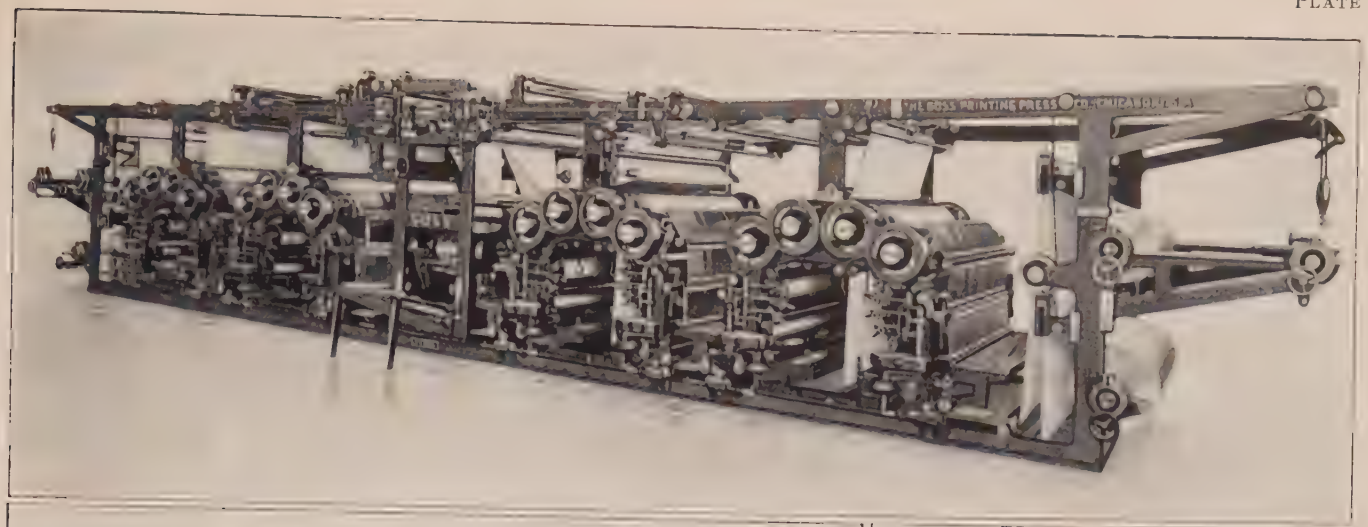
Rotary Presses.—The rotary principle still prevails in newspaper offices, but the "deck" style of construction has been abandoned for what is called the "multiple unit" basis. Under this system, when additional equipment is required one press is not superseded by another; a unit is simply added and thereby a sextuple becomes an octuple, an octuple a decuple, etc. The presses are built heavier and stronger. The old method of hand stereotyping has been superseded by autoplating. A further development in press construction, known as the "tubular" system, has been perfected. By its use each plate is cast as a tube instead of in semi-circular form. This tube is slipped over a cylinder, which prints a complete page with every revolution.

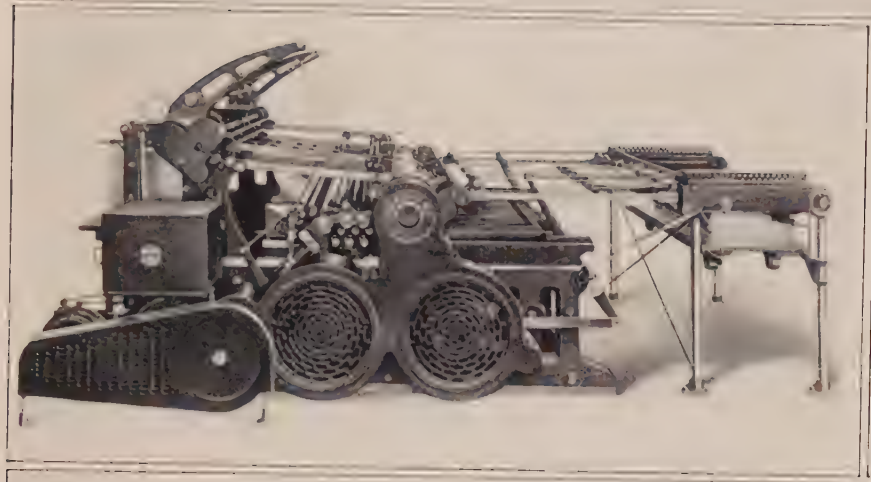
The rotogravure press (*see* PHOTO-ENGRAVING) is making rapid strides in the newspaper field, and may be expected in time to play an important part in the commercial and book printing fields also. Most illustrated Sunday supplements are printed on rotogravure presses.

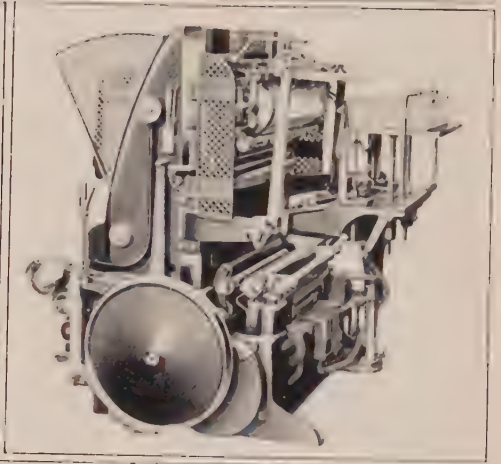
Lithography.—In lithographic printing, the stone from which impressions were formerly taken has almost completely disappeared. In its stead are zinc and aluminium sheets which, encircling the printing cylinder, permit the complete application of the rotary principle to lithographic production also. A further development is what is known as the "offset" process, in the operation of which the design to be printed is first transferred to a rubber blanket, from which it is again transferred to the paper. Whereas formerly only smooth-surfaced, specially prepared papers could be printed upon lithographically, by the offset method any paper, whether smooth- or rough-surfaced, may be used with equal facility. Offset seems to be particularly adapted to colour work.

Tonnage Production.—A new field, sometimes known as "tonnage production," concerns itself with magazine printing and is the outstanding development in printing machinery during the 15 years ending in 1926. Whereas only a few years earlier a circulation of 500,000 copies of weekly and monthly periodicals, printed in one colour, was a rarity, in 1926 four and five times that number, with almost numberless pages in two and four colours, is accepted as nothing out of the ordinary.

Offsets.—Tonnage production in one colour presented only a single problem, which was that of quickly drying the sheets. The prepared surface on a cylinder against which a sheet is pressed in the impression contact is called a tympan. When a sheet is printed on both sides during a continuing operation, the printed side is likely to smudge the tympan as the blank side is taking the impression: this smudge when it appears on the next printing is known as "offset." When properly controlled, as in lithographic printing, offset becomes a process and produces fine effects. In relief printing, on highly surfaced papers, however, offset must of necessity be eliminated. Offset is not a problem in newspaper production, for the reason that printing on newsprint dries quickly, but the case is different with printing on supercalendered and coated papers, such as must be employed for the half-tone and process plates with which magazines are illustrated. At first the remedy was believed to be found in a "shifting tympan" that changed the surface at intervals, but the device was abandoned because of the time required for the shifts.







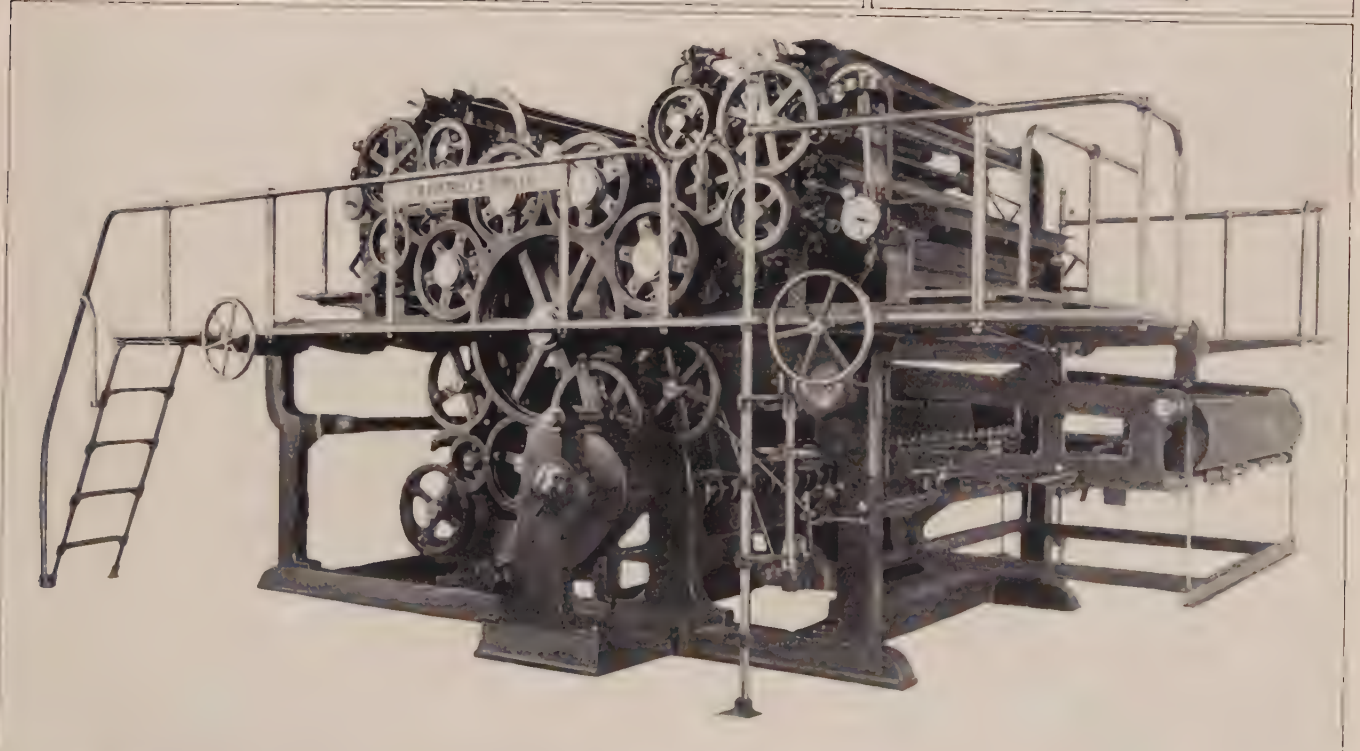


FIG. 1. Goss Unit Type Octuple Press 174-A, for printing newspapers and delivering them (centre of picture) folded to half-page size and counted; size of page usually about 17X23 inches. Speed of 72,000 copies 16 pages, per hour, or 36,000 copies 32 pages. Requires 75 horsepower. FIG. 2. Kelly Press Model [illegible] prints paper from 8X12" to 22X34" at 2,000 to 3,000 impressions per hour. The automatic feeder [illegible] a stack of paper at the [illegible] The press delivers the printed sheets into a pogger-box or flyboy, the bottom of which is a truck. [illegible] At the head [illegible] the truck is lowered, and the fully loaded truck is then hauled away without further handling of the paper. FIG. 3. Miehle Vertical Press [illegible] paper from 8X5" to 12|X19" at from 2,500 to 3,600 impressions per hour. Requires 2 horsepower. FIG. 4. Cottrell Multi-Color Sheet-fed Rotary Press [illegible] 4 colors simultaneously on one side of the paper, in sheets up to 37X50" at 2,500 to 3,000 [illegible]. It [illegible] Cottrell cylinders.

The Cottrell Rotary Press.—The late Mr. C. B. Cottrell, founder of C. B. Cottrell and Sons Co., solved the problem with the Cottrell Rotary Press. It provided an automatic shifting tympan that furnished an entirely new and clean impression surface as often as necessary to prevent offset. This press, with roll feed to print on both sides of the web, had all the fine printing qualities and conveniences of the flat bed press, plus the speed of the rotary, and met at high speed all the requirements of printing without smut or offset. The shifting tympan has been superseded by a " travelling offset " web. The Cottrell Co. added colour cylinders to the printed units and so perfected two colours on each side of the web, and, in subsequent developments along the line of multi-coloured printing, has produced a rotary perfecting press, printing from a roll of paper and producing four colours on one side and two or four colours on the other side of the web.

A further improvement is the McKee process for colour printing, which produces a printing plate having graduated elevations on its printing surface, corresponding in order with the solid or dark tones and the intermediate tones of the subject on the face of the plate, varying in structural thickness in accordance with the several pressures required for printing and in accordance with the various tones of the subject on the face of the plate. Such a printing plate has the sections which are designed to print the darker shades permanently elevated above the levels of the sections adapted for the lighter shades, and the levels are graded one into the other from the permanently elevated parts to the lightest printed shades, so that in profile the plate is uneven or irregular in its printing surface and level on the back. The usual underlays and overlays are not required, since their effects are produced on the face of the plates, and the " strike-off " between the cut overlay and plate which happens so often is obviated.

In short, a printing plate is produced wherein the required make-ready is permanently produced in the face of the plate. Until the McKee process was perfected and used in conjunction with the Cottrell multi-colour press, it was customary to print only one colour at a time at each passage of the sheet through the press, requiring as many separate and independent printings as there were colours required. By the McKee process, colour printing can be produced on presses having one impression cylinder common to all of the plate cylinders. The Cottrell multi-colour press produces by a continuous operation that consists of one passage of a sheet through the press a picture in which the different colour values are effectively brought out.

See G. T. Jacobi, *Printing* (1919); J. Southward, *Modern Printing* (1922). (J. C. O.)

PRISONERS OF WAR.—The procedure laid down by international agreement for the treatment of prisoners of war under the Hague regulations was severely tested during the World War. In the first place, it must be borne in mind that Great Britain, France, Italy, Germany and Austria together claim to have taken not less than 6,000,000 prisoners, while Austria admits having lost 1,500,000 prisoners to Russia.

Of the 200,000 British prisoners of war more than 90% were taken by the Germans, the remainder being principally in Bulgarian and Turkish hands. The following brief account will, therefore, deal for the most part with the treatment and experience of British prisoners of war in Germany and conversely of German prisoners of war in Great Britain. For this purpose three divisions will be made, namely, civilian or non-combatant prisoners; officers; and rank and file.

Civilians.—The internment of large numbers of civilians had not been contemplated by the framers of the Hague regulations, and therefore presented an entirely new problem. By the end of Nov. 1914, some 29,000 Germans were interned in Great Britain, while in Germany more than 112,000 civilians, of whom not more than 6,000 were British, were in a similar position. In both countries accommodation was at first definitely bad. Newbury race-course was one of the first internment camps in England. The German reply to this was Ruhleben race-course. Newbury was abandoned after a few weeks, but Ruhleben remained the principal civilian camp till the end of the War. Decidedly bad at first, conditions there gradually improved, largely as a result of the efforts of the prisoners themselves.

Civilian prisoners were in neither country compelled to do any work beyond what was necessary for the cleanliness and order of their camps. In Great Britain, however, civilian prisoners were given the opportunity to volunteer to work, and some 1,500 were given employment, mainly in agriculture. In Great Britain each internment camp had its own small hospital. At Ruhleben the medical arrangements were at first quite inadequate, but later they improved considerably.

Officers.—The treatment of all combatant prisoners in Germany, officers and men alike, varied greatly with the situation of the camp, and particularly with the personality of the commandant. In the X. Army Corps district, for example, all prisoners came under the malign influence of Gen. von Häinisch, who invariably appointed men of his own kidney as camp commandants. Accommodation ranged from comfortable hotels, as at Augustabad, to badly constructed huts, as at Strohen, near Hanover. Fuel was always scarce, in some cases, as at Holzminden, practically non-existent.

As regards food, the insufficiency and unsuitability of the German rations made the prisoners almost entirely dependent on parcels from home. It is to the credit of the German authorities that the majority of these parcels arrived intact. No work was required of officers; and for the care of the camp, orderlies, usually of the same nationality as the officers, were provided in most cases. The most serious complaints that can fairly be made on behalf of officer prisoners in Germany are shortage of fuel, inadequacy of cooking arrangements, and especially in the X. Army Corps district, the determination of the camp commandants to prevent the prisoners from introducing any degree of comfort into their situation.

German officers were confined in England in large country houses and public institutions. It can fairly be said that on the whole they were better fed and housed than British officers in Germany, and the facilities provided for their recreation were much more adequate.

Rank and File.—While the experiences of civilian and officer prisoners of war are of considerable interest, it is undoubtedly by their treatment of the rank and file prisoners that the nations concerned must be judged. All belligerents compelled prisoners to work, as they were entitled to do, provided that prisoners were not compelled to undertake work directly connected with the military activities of their captors. According to numerous reports, all the belligerents at various times broke this rule in the spirit at least; and Germany several times broke it in the letter.

Camps were of two principal classes, main camps and working camps. The former were usually composed of hutments similar to those seen in the English temporary military camps, the whole being surrounded by barbed wire, and frequently subdivided by barbed wire into sections. The outstanding complaint from British prisoners regarding the main camps in Germany seem to be on the ground of overcrowding—at Wittenberg, for instance, 15,000 to 17,000 men were confined in an area of about 10 acres. As regards accommodation working camps varied enormously. Men sent to work in factories were sometimes housed in quarters normally provided by the employer for bachelor workmen; men working on farms lived in small camps erected near the farm or occasionally in the farm buildings themselves. Treatment in such quarters likewise varied with the personality of the employer or of the non-commissioned officer in charge of the camp or compound. On the whole the German non-commissioned officer was a harsh and frequently brutal commandant. The discipline in German factories, mines and the like was at all times very severe; and apart from disciplinary measures, too many authentic cases of gratuitous brutality have been recorded against the German authorities, particularly against non-commissioned officers in charge of working parties.

Reprisals.—Hard though the lot of the prisoners of war set to work in factories and mines undoubtedly was, the most

terrible chapter of the sad story concerns those unfortunate individuals selected as the subjects of reprisals by their captors. This barbaric method of avenging wrongs inflicted on their subjects was employed by all the belligerents from time to time, but authoritative evidence shows that Germany was in this respect by far the worst offender. One of the most notorious examples of German reprisals was the transfer of 500 British soldiers to the Eastern Front in Feb. 1917. After being forced to march long distances through appalling country, with insufficient food and clothing, these unfortunates were housed in a tent pitched on the snow beside the frozen river Aa, within range of the Russian guns. Many of the men died and many others lost fingers and toes through frost-bite.

Organisations for Prisoners.—The relief of prisoners of war was at first left in the various countries to individuals. It consisted inevitably in the sending of parcels of food and other necessaries. In Great Britain, whose subjects were much worse off than were the German prisoners, it gradually became clear that some control of the parcel supply was required, as individual enterprise resulted not only in an unfair distribution of parcels, but also in an imperfect selection of commodities to be sent. Early in 1915, a Prisoners of War Help Committee was established in London. Having no authority, however, it was a comparative failure, and in Sept. 1916, it was superseded by the Central Prisoners of War Committee of the British Red Cross and Order of St. John. This body had absolute control of parcels and from its inception till the end of the War maintained a steady stream of suitable parcels to all ranks.

Repatriation.—By Aug. 1915, the British and German governments had reached an agreement regarding the repatriation of officers and non-commissioned officers incapacitated by wounds or illness from further active participation in the War. Further agreements were subsequently reached providing that prisoners less seriously wounded or ill, and prisoners who had been in captivity for over 18 months, might be sent to Holland or Switzerland for internment there. Immediately after the Armistice, the repatriation of all prisoners commenced, but owing largely to transport difficulties it was several months before the undertaking was completed.

Turkish and Bulgarian Prisoners.—British soldiers who were captured by the Turks have brought very serious charges against their captors. Officers, particularly those of high rank, appear to have been treated with almost theatrical courtesy; but the rank and file were subjected to appalling hardships, being housed in quarters which were nothing short of filthy, and fed and clothed in a manner deserving of the severest censure. Many of the prisoners died and many more returned after the War completely broken in health.

The Bulgarians, once they understood that the somewhat primitive disciplinary methods employed in their own army were quite unsuitable and unnecessary in the case of British soldiers, treated their prisoners with quite a reasonable degree of humanity, and fed, housed and clothed them as well as could be expected, having regard to the resources at their disposal.

BIBLIOGRAPHY.—A large number of reports were rendered at various times by the United States on the treatment of prisoners of war in Great Britain and Germany; and a considerable amount of correspondence took place between Great Britain, Germany and Turkey. Of non-official works, J. W. Gerard's *My Four Years in Germany* (1917) is perhaps the most reliable. For a picture of life as an officer prisoner in Turkey see E. H. Jones, *The Road to En-dor* (1920). (C. R. D.)

PROBABILITY (*see* 22.376).—1. The relation of the mathematical theory of probability to other branches of science has altered to some extent. From being a separate subject, providing interesting problems to the mathematician, it has almost come to be a part of a larger subject, the theory of statistical frequency; at any rate it is one of the aspects in which statistical frequency may be studied. The theory of probability was originally concerned mainly with games of chance, and to some extent also with vital statistics. The discovery of the "law of error" brought all scientific observations into its field. And it has received a great stimulus from the statistical study of variation and correlation, mainly arising out of Francis Galton's investigations of heredity. This has led to some reconsideration of principles.

2. *Typical Questions.*—A box contains 5 balls, all, so far as we can see, exactly alike, except that one is red and the remaining 4 are white. A ball is drawn at random from the box. What is the probability that it will be the red ball?

A reasonable answer, but a provisional one (*see* para. 8), is that the probability is $\frac{1}{5}$. But, before we give this answer, the question itself gives rise to several questions. What do we mean by "at random?" What do we mean by "probability?" In what sense can a probability be a number, or be measured by a number? Why does the number necessarily lie between 0 and 1? How is this number, which is or measures the probability, to be ascertained? And at what stage of the proceedings does probability, as such, cease to exist? We say that a ball "is drawn;" do we mean that it is going to be drawn, and that the probability that it will be the red ball ceases to exist as soon as the ball is drawn? Or, supposing the ball has been drawn and we do not know which ball it is, can we say that the probability that it is the red ball is so-and-so?

3. *Measurement of Probability.*—For numerical measurement of probability there seem to have been three methods used; each of them leads to 1 as the measure of certainty.

(i) The study of probability was originally, in the main, the scientific study of gambling. If A has a chance of winning a prize X, the primary object was to find V, the value of his chance. The ratio of V to X is a fraction between 0 and 1, which may be called the probability of A winning the prize. In the present case, suppose there are 5 persons, each of whom in turn is to draw a ball, and that whoever draws the red ball is to get 10 shillings. Then it will no doubt be agreed that each person's chance of drawing the red ball is worth 2 shillings; each person's probability of drawing this ball can therefore be said to be $\frac{1}{5}$.

(ii) The rule usually given in text-books is as follows: If an event can happen in N ways, all of which are equally likely, and if P of these ways are called "favourable," then the probability of the event happening favourably is P/N. One objection to this is that it introduces a new phrase, "equally likely," without defining it. If what is meant is that the numerical probabilities are equal, we are working in a circle. Another objection is that it does not cover all cases.

(iii) The modern idea is to base the probability on statistics. To find the probability that under conditions C an event E will happen, we enquire as to the relative number of cases in which it actually does happen. If we find, or if it is reasonable to suppose, that in N cases in which the conditions C are created it happens in pN cases, we can say that the probability of it happening under these conditions is p. It is assumed, of course, that its happening or not happening in any one case is not affected by its happening or not happening in any other case.

The adoption of the statistical basis disposes of a good many difficulties. If, for instance, the ball has been drawn, so that it is definitely red or white, but we do not know which, we can speak of the probability that it is red; for we are dealing statistically with the class of cases in which the ball has been drawn, and are considering, out of these, the cases in which the ball is red.

4. *Randomness.*—The expression "at random," or *randomness*, does not seem, at any rate on the statistical basis, to mean anything more than that we are dealing with a question of chance. To say "A ball is taken at random, the chance that it will be red being $\frac{1}{5}$" is the same as to say "A ball is taken under such conditions that the chance that it will be red is $\frac{1}{5}$."

5. *Mathematical Treatment.*—The treatment of a problem in probability usually consists of three stages:—(1) the numerical determination of probabilities, either of single events or of joint occurrence of events (2) the deduction, by mathematical methods, of other probabilities (3) the application of the results so obtained. We have so far dealt with (1). We have now to consider (2). The mathematical treatment involves the addition and multiplication of probabilities, and the inverse processes, subtraction and division. These processes follow certain rules.

(i) The *addition rule* is that if an event C (*e.g.*, the drawing of a ball from a box) can be associated with one or other of two events E and F (*e.g.*, the ball drawn being red or being white) but not with both, and if the probability of C being associated with E is p, and the probability of C being associated with F is q, then the probability of C being associated either with E or with F is $p+q$.

(ii) The *multiplication rule* is that if the probability of C being associated with E is p, and if, in the cases in which C is associated with E, the probability of D being associated with G is r, then the probability that C will be associated with E and D with G is pr. (This form of statement avoids the introduction of " independence " of probabilities.) These rules are sometimes stated as theorems, sometimes as axioms. They are both deducible from the statistical definition given in (iii) of para. 3.

6. *Inverse Probability.*—A class of problems of increasing importance is that of determining the probability that an event E has been preceded by an event C, this being one of a definite number of possible and mutually exclusive antecedent events C, C', C'' . . . . Such a probability is often called an *inverse* or *a posteriori* probability; the probability of an event C being followed by an event E being called a *direct* or *a priori* probability. The treatment of " inverse probability "cases has sometimes been discredited, not without justification; the problems which mathematicians have set have often been impossible of solution, on account of the data being insufficient, and arbitrary assumptions have had to be made.

The following may be taken as a typical question in inverse probability. A box contains 5 balls, 1 of which is known to be white and 3 red, the remaining one being either white or red. A ball is drawn and is found to be white. What is the probability that the box contained 2 white and 3 red balls? It is impossible to answer this question without further information. The box has been filled in some way: the method of filling having led to the box containing 1 white and 3 red balls, we require to know the probability that it will lead to the other ball being white or being red, respectively. When we know this, the problem is a straightforward one, if we use the statistical method.

Suppose that the probabilities in question are $\frac{3}{5}$ and $\frac{2}{5}$ (as might possibly be the case if the box were filled from a source containing white and red balls in the ratio of 3 : 4). Then we may express the problem as follows: There are " W " boxes containing 2 white and 3 red balls, and " R " boxes containing 1 white and 4 red balls; their frequencies being in the ratio of 3 : 2. A box is taken at random; and a ball is drawn from it and is found to be white. What is the probability that the box is a W box? From the data we get the following (Table I.) as a representative frequency-distribution for 1,000 such drawings:—

TABLE I.

	From W boxes	From R boxes	From all boxes
White ball drawn . .	240	80	320
Red ball drawn . . .	360	320	680
Total drawings . .	600	400	1,000

It will be seen that the required probability is $240/320 = \frac{3}{4}$. (This can be verified by using the ordinary method.)

Now compare the above question with the following. A man being called short or tall according as his height is under or over 67½ in., suppose that, in a community in which every man has one son who attains maturity, the statistical relation between height of father and height of son, in a representative 1,000 pairs of father and son, is given in Table II.:—[1]

TABLE II.

	Father Short	Father Tall	Total Fathers
Son short . . .	250	89	339
Son tall . . .	215	446	661
Total sons . .	465	535	1,000

What is the probability (*a*) that the son of a tall father is tall, (*b*) that the father of a tall son is tall? The answers are (*a*) 446/535 (*b*) 446/661. If we make a distinction between " direct " and " inverse " probability then, since the father precedes the son, (*a*) is a case of direct and (*b*) a case of inverse probability. But in which category are we to put such a question as:—What is the probability that a girl with fair hair has blue eyes? It is clear not only that there is no fundamental difference between the two classes of cases, but that, if we do make a distinction, we must introduce a third category, that of probabilities with regard to concurrent events.

7. *Errors of Randomness.*—The distribution in Table I. is a *representative* distribution, *i.e.*, the numbers in the different compartments of the table are exactly proportional to the corresponding probabilities. But, if 1,000 boxes were taken at random in the way described and balls were drawn at random from them, these exact numbers would not be likely to appear. The differences between the actual numbers obtained and these theoretical numbers are the *errors of randomness*, or *errors of random sampling*. The consideration of the relative frequencies of errors of this kind constitutes the *theory of error*, which is the main link between the theory of probability and the theory of statistical frequency. It forms a large part of the former, and is a particular case of the latter.

8. *Lack of Finality.*—We may revert, finally, to the question put at the beginning of para. 2. We said that, on the data, we may reasonably say that the probability of the red ball being drawn is ⅕th. But this is only a provisional estimate, the test of which is the result of actual drawings. If we find that the red ball is drawn more often than each one of the white balls, we must conclude that our original estimate of the probability was wrong, and must modify it accordingly. This is, in effect, using the statistical basis. But even this basis only enables us to obtain an approximate value, which is liable to be modified by further statistics. It is never possible to find the true value of any particular probability. And the problem of determining the best value, being based on an investigation of past facts, is really a problem of inverse probability.

REFERENCES.—For a quite elementary view of the theory of probability, reference may be made to W. A. Whitworth's *Choice and Chance*, or to chapters in some work on Algebra, such as those of G. Chrystal or H. S. Hall and S. R. Knight. The principles of the subject were considered by J. Venn, *The Logic of Chance* (1st ed. 1866); this is still the standard work. J. M. Keynes, *A Treatise on Probability* (1921), deals with the logical foundations of probability, whether capable of numerical measurement or not. On the statistical side, G. U. Yule, *Intro. to the Theory of Statistics* (1911), is of value, especially as regards the theory of sampling. A. L. Bowley, *Elements of Statistics* (4th ed. 1920), is more advanced. A very full mathematical equipment is provided by E. T. Whittaker and G. Robinson, *The Calculus of Observations* (1924). A considerable number of books on the mathematical study of statistics have appeared. The annual volumes of *Biometrika*, from 1902 onwards, are indispensable to the serious student. (W. F. S.)

PROBATION (*see* 22.404c).—Probation, as a system of release from court without commitment to prison or reformatory, originated in Massachusetts, U.S.A. in 1878, and has been extended by law to every state of the United States and to the territory of Hawaii. Twelve states limit probation to juveniles under 16 or 21 years of age; several others use it only for first offenders or for special classes of cases. Massachusetts has probation officers in every court in the State. Many states have them only in the larger cities. Probation work is supervised by a State Probation Commission in Massachusetts and New York State and by a State Probation Dept. in Indiana. A 1925 directory of probation officers includes names and addresses of 3,028 probation officers in the United States and 107 in Canada. The National Probation Assn. (370 Seventh Avenue, New York City) stimulates the development of probation and holds annual conferences.

Application of the probation system has not kept pace with the law. An investigation showed that children's courts empowered to use probation, and disposing of 175,000 cases a year, had probation officers in only one-half of the courts. During 1923 there were 29,763 placed on probation by all courts in Massachusetts and 24,633 in New York State. Approximately 400,000 were on probation during the year in the whole United States. Studies of results of probation show that from 44% to 75% are genuinely improved.

Law of 1925.—The most significant advance in the probation system in the United States was the passage of the first Federal Probation law, May 1925. This authorises district courts, after convicting for any offences except those punishable by death or life imprisonment, to suspend sentence and release on probation for a maximum period of five years. Federal judges may appoint probation officers to investigate cases referred by court and to aid in bringing about improvement in conduct and condition of probationers. After governmental appropriations are made, salaries may be fixed by judges subject to approval of the attorney general. Appointments of salaried officers are by

[1] Adapted from K. Pearson and A. Lee, *Biometrika*, vol. ii (1903), 415.

competitive civil service examination. In some districts, county and city probation officers have volunteered to serve as Federal probation officers.

The probation system has extended rapidly to all parts of the world and is being applied increasingly in children's courts. Of 14 European countries where inquiry was made in 1925, 12 had probation laws; in 11, probation officers were paid by state or municipality; 1,380 salaried probation officers were reported. Among the countries which have adopted a probation system are England and a number of British colonies, Austria, Belgium, Denmark, Greece, Holland, Norway, Poland, Spain and Sweden. The juvenile court in Paris employs a salaried probation officer. England has a national association of probation officers. (*See* BORSTAL SYSTEM.) (M. M. H.)

PROCESS: *see* PHOTO-ENGRAVING.

PRODUCTION, CENSUS OF.—The census of population, regularly repeated in most civilised countries, furnishes an indication of the numbers of workers at the ages most important for productive effort. When associated with a record of the occupations of the working population, an index to the distribution of the productive energies of the community in various directions is furnished. The grouping of the population by the industries in which they are engaged furnishes further valuable material for a general survey of resources. This grouping, undertaken in this country at the population censuses of 1911 and 1921, is in some cases, as in Germany, made the object of an independent inquiry, the numbers of establishments and of the persons employed by them being ascertained for each industry. Inquiries of the character referred to above furnish no information regarding the amount and character of the products of the various industries.

Agriculture.—In many, indeed in most, countries no general survey of the products resulting from the labours of the inhabitants is carried out. In countries mainly devoted to agricultural industry, the ascertainment of the distribution of the cultivated area among its principal uses, and of the quantities of the leading crops and the numbers of livestock maintained, give information of the greatest importance relating to the country's production. Where the extraction of minerals is important, the quantities of such minerals produced are a necessary element in the survey of the country's industrial resources. In various countries in which manufacture has reached a considerable degree of importance, periodic returns of the output of various leading products of the manufacturing industries are added to the records of agricultural and mineral products obtained. These surveys are, however, not merely incomplete in the degree in which they do not cover the productive activities of the country, but fail to furnish a satisfactory measure of the results of that activity. For that purpose a census not of products but of production is needed. For the extractive industries the record of products serves to measure production reasonably well, since the value of the products of other industries used up in the processes essential to the extraction of new products is, in general, comparatively small in relation to the value of the new products secured.

Even in the case of field crops, however, the seed required is often an important fraction of the crop secured, and a record of the quantities harvested does not furnish figures of the amounts that are available for consumption in or for sale beyond the limits of the country under consideration. A sound estimate of the " production " of agriculture would need, indeed, a deduction from the gross total of crops harvested not only of the seed which has been required to produce those crops, but also of the equivalent of manures used and of the requirements for the replacement of tools and equipment so as to maintain the stock of such tools, etc., undiminished. In dealing with animal products, allowances must, in like manner, be made for food consumed in the maintenance of the animals and for other supplies used up in the business of stock rearing, so far as these goods are obtained from sources beyond the limits of the agricultural industries under survey.

Industry.—The principles illustrated in these references to the distinction between a census of products and a census of production have especial importance in reference to many manufacturing industries. While the progress of a given industry may be reflected in the quantities of certain products characteristic of that industry, so long as the structure of the industry remains without changes affecting the relative importance of these products in the industry as a whole, the comparison of different industries, and of different divisions of the same industry, cannot be made on the basis of the aggregate value of the products of the industries compared. There are two important reasons for this. On the one hand, if industries were otherwise similar in character, but made use of different materials, they would yield aggregates of products, the value of which would be higher or lower according to the values of these different materials. Materials costing £50,000 might be worked up into products worth £100,000, and precisely similar operations on materials costing £75,000 might yield products worth £125,000. Measured by the value of products, the second industry appears to have a yield 25% greater than the first, while the actual increments in value of materials used were the same in both cases.

On the other hand, the same materials may be advanced from stage to stage in manufacture in different establishments, and the products of the series of establishments will show values gradually increasing, the material of each being the product of the preceding. It would not be a sound conclusion from such a record that the productive importance of the successive establishments was in the order of the processes, and that the increasing values of the goods from stage to stage reflected the importance of the productive services of the series of establishments. In comparing establishments making use of different materials and conducting processes of manufacture dissimilar in character, as in the two types of cases dealt with above, no true comparison of the value of the productive contribution of each can be expected to result from a single comparison of the value of their products.

A census of production must, accordingly, be something more than an enumeration of the products of the various establishments and industries surveyed and a record of their values. The products of other establishments or industries which have been used up in the productive processes surveyed must be ascertained if a true measure of the production carried on is to be secured. In strictness the effects of wear and tear, so far as not made good by the staff maintained within the establishment for that purpose, and also the effects of obsolescence on the plant and buildings, should be evaluated and included in the deduction, from the value of the gross output, needed to arrive at the value of the contribution made to production. In practice detailed allowances for depreciation cannot be estimated with a precision approximating to that attainable with reference to cost of materials, and adjustments in respect of the consequent overestimate of the production have to be made by some means other than the simple aggregation of the depreciation suffered by each establishment. The result of deducting the value of materials used from the value of the products resulting from work on them is designated " net output " in the reports on the Census of Production in the United Kingdom and is dealt with under the title " value added in manufacture " in the reports on the Census of Manufactures in the United States.

In addition to an enumeration of the kinds and values of goods produced, there is needed, for a proper understanding of the significance of these data resulting from a census, a record of the numbers of persons employed in the production of those goods and of the mechanical aids to production at their disposal. Information as to the distribution of the value of the recorded production between wages, returns to capital, taxation, profits, etc., will also have much importance, in view of the reaction of distribution on productive efficiency; but inquiries regarding the distributive allocation of the values produced do not appear to be an essential part of the census of production itself.

Information on these matters, like information regarding the quantities and values of imports and exports of the various classes of goods with which the census is concerned, is of very great importance in the application of the results secured by

means of the census. The comparison of the imports and exports of any class of products with the amounts and values of similar products made within any country affords information of fundamental importance. For the aggregate of all industries it furnishes measures of the dependence of the material welfare of the country on its foreign trade. Further, since the material income of a country consists in the goods produced and in those which are obtained from abroad in exchange, a census of production furnishes a basis for measuring the amount of, and the changes in, the total income of the community. In so far, too, as capital goods and consumption goods are capable of distinction, the total of products applied to capital purposes, replacement and increase together, can be ascertained. The formation of a reasonable estimate of what is required for maintenance of the existing stock of capital enables an estimate to be made, of a corresponding degree of reliability, of the increase of capital. Thus results of uncertain estimates formed on other principles can be submitted to useful tests.

Censuses in Different Countries.—The United States has the longest record of periodic censuses of production, covering agriculture, mining and manufacture. The decennial census of population in that country was accompanied by inquiries into production from 1850 onwards. After 1900 these inquiries were made quinquennial and, since the close of the World War, have been biennial. In Canada, since Confederation, a similar series of production returns has been secured, and these have become annual since 1917. Australia, New Zealand and the South African Union have also annual returns of production in manufacturing as well as in extractive industry. In Europe similar inquiries have been irregular and relatively rare. The United Kingdom took its first Census of Production for the year 1907; the second, relating to 1912, was not completed owing to the War; and the third, relating to 1924, is in progress. No decision has been announced as to the resumption of the quinquennial series arranged to follow the first census or its replacement by a series at other predetermined intervals. In the Netherlands, war necessities led to the initiation of inquiries into production, and occasional inquiries have taken place in Sweden (1914–7), Norway (1909 and 1916), France (1800–12, 1845, 1861–5), Belgium (1880), Rumania (1901–2), Bulgaria (1922), Hungary (1899–1900) and Russia (1900 and 1908). A new census of industry in Russia was announced in 1926. Various countries have undertaken, annually or at longer intervals, a census of industrial establishments of a more or less complete census of products.

Particulars of the latest of the inquiries in the several countries mentioned above may be found in the bibliography below.

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PROFITEERING.—This word came into colloquial use early in the World War, and, having been included in the title of an Act of Parliament in 1919, may be considered to have received official recognition as part of the English language. It signifies the making of an unreasonably large profit on the sale of goods or services, particularly those in common use.

I. GENERAL

In normal times before the War, opportunities for making unreasonably large profits were to a great extent restricted by the play of competition, and in fact competitive prices were widely regarded as being *prima facie* reasonable. No doubt an exceptional demand or an unexpected shortage of supply might lead to a sharp rise of prices and swell profits sometimes to an unreasonable extent. But for the most part movements were gradual; changes in prices and profits also served a social purpose in bringing about adjustments in supply and demand. When competition was excluded, the possibility of unreasonably large profits being made was obviously increased, and there was a widespread tendency on this ground to regard monopolies with suspicion. Some industries which could not ordinarily be run on competitive lines, or which tended to become monopolies, were consequently carried on as public undertakings, or were controlled by public authority as regards rates and conditions of trading.

This applied generally to railways and public utility services, such, for instance, as gas and water undertakings. For many years before the War there had also been a tendency for competition to be excluded to a greater or less extent in an increasing number of industries through the formation of trusts or combines. Though the selling prices fixed by such organisations were not in all cases higher than those which would have prevailed under competitive conditions, they were certainly higher in many cases; while even when they were not, a feeling was apt to arise where large profits were being made that the trust or combine in question was taking for itself an unduly large share in the economies effected by the elimination of the wastes of competition. The belief that unreasonably large profits were being made was undoubtedly the most powerful motive in the campaign for the control of trusts and combines in various countries.

War Conditions.—War conditions tended very greatly to increase the opportunities for profiteering. On the one hand insistent and insatiable demands arose for munitions and other supplies required in connection with the War; and, on the other hand, the available supplies of many articles were reduced below the normal. The circumstances of the time frequently made it impossible to effect as speedy an increase of production in response to the call of demand as would have been the case in peace time. Another factor which tended to swell prices and profits was monetary inflation. This meant a continuous increase of purchasing power and growth of demand without a corresponding increase in supply. Manufacturers and traders consequently found that they were nearly always able to sell their goods at rather higher prices than would have been required to recompense them for the cost and to yield a normal profit. It was not perhaps adequately recognised that in many cases some loss on capital account was being incurred at the same time, owing to the fact that when stocks had to be replaced or plant renewed the nominal capital ordinarily required for the purpose was no longer sufficient. In many trades, however, there can be little doubt that after full allowance was made for this, profits (whether reckoned in absolute amount or as a percentage on turnover) were much above the normal.

Various measures were taken during the War to restrict profiteering, especially in belligerent countries. These included the fixing of maximum prices, and in some cases of profit margins at each stage of production and distribution. Rationing of primal necessaries served to distribute supplies evenly and to prevent them from being sold to the highest bidder. The weapon of taxation was also employed in the form of highly graduated income taxes, excess profits taxes, etc., to secure for the public revenue a substantial part of the high War-time profits made by private interests.

Period of Post-War Readjustment.—After the War, the universal hope was to get back to "normal" conditions, whatever these might be, as speedily as possible. Events, however, were to show that in many countries, especially European countries, the way to peace and prosperity was long and rough. As the result of a widespread continuance of inflation, profiteering was in some cases more rife after the War than during its continuance. Under conditions of extreme inflation, such as occurred in Germany in 1923, profiteering became widespread. The rise of

prices was so rapid that profits of hundreds or thousands per cent could be made by holding goods even for a few days. That, however, was a profit in paper marks, and it was obvious that paper marks, while circulating as currency, were entirely untrustworthy as a standard of value. The true position did not become clear until after a stable currency had been reintroduced. It was then seen that while a comparatively small number of persons had made and retained fortunes, a vast mass of people had been reduced to penury.

II. PROFITEERING IN GREAT BRITAIN

British Govt. Measures.—In Great Britain, inflation reached comparatively small dimensions. Following the Armistice, the general level of prices was for a time downwards, and during this period many War-time controls were withdrawn. Subsequently, prices began to rise and continued to advance until the spring of 1920, when a rapid fall began. Public apprehension led in the summer of 1919 to the passing of an Act to check profiteering, commonly cited as the Profiteering Act 1919. This Act conferred upon the Board of Trade powers (*a*) to investigate prices, costs and profits at all stages; (*b*) to receive and investigate complaints regarding the making of excessive profits on the sale of any article to which the Act was applied by the Board of Trade, and after giving the parties an opportunity of being heard either to discuss the complaint or to declare the reasonable price for such articles, and to order the seller to refund to the buyer any amount paid in excess of such reasonable price, the board also having power, where it appeared to them that the circumstances so required, to take proceedings against the seller in a court of summary jurisdiction; and (*c*) to obtain from all sources information as to the nature, extent and development of trusts and similar combinations. The Act was to remain in force for six months only, but it was subsequently continued for a further three months, and later, by an amending Act, for six months more until May 19 1921.

To deal with retail trade, local committees, numbering in all over 1,800, were set up, and the Board of Trade delegated to them the bulk of their powers under the Act relating to retail sale. There were also 108 appeal tribunals to which the seller had the right of appeal against the decision of a local committee. The task of dealing with larger transactions of wholesalers or manufacturers affecting whole trades or industries was entrusted by the Board of Trade to a central committee, which worked through three standing committees: the investigation of prices committee, the complaints committee and the standing committee on trusts. These standing committees in turn appointed sub-committees as required to deal with particular questions. The investigation of prices committee made investigations into the cost of production of various articles in all stages of their manufacture. Reports were published as Parliamentary papers on agricultural implements and machinery, aspirin, biscuits, boot and shoe repairs, brushes and brooms, clogs, costings in government departments, furniture, gas apparatus, matches, metal bedsteads, motor fuel, pottery, standard boot and shoe schemes, tweed cloth, worsted yarns, wool and the wool top-making trade. The complaints committee undertook the investigation of specific complaints and also investigated specific transactions brought to their notice, even when there was no formal complaint.

The committee on trusts was responsible for obtaining information as to the nature, extent and development of trusts and combines. Numerous investigations were made and Parliamentary papers dealing with the following subjects were published: dyes and dyestuffs, dyeing, finishing, bleaching and printing, electric cables, electric lamps, explosives, farriery, fish, fixed retail prices, fruit, glassware, iron and steel products, laundry prices, meat, milk, oils and fats, pipes and castings, road transport rates, salt, sewing cotton, soap, tobacco, uniform clothing, vinegar and yeast. Mention may be made further of a provision contained in the Profiteering (Amendment) Act, 1920, which authorised the Board of Trade to approve suitable schemes submitted by persons representing a substantial proportion of those engaged in the production or distribution of goods to which the original Act was applied limiting the profit to be allowed on such manufacture or distribution. Any profit which did not exceed the amount fixed was then not to be regarded as unreasonable under the Act. Only two such schemes (relating to men's ready-made and made-to-measure clothing and to the retail sale of coal in the London area) were actually approved by the Board of Trade.

Since the lapsing of the Profiteering Act in 1921, there has been no special legislation in Great Britain against profiteering except for the continuance of restrictions on the rent which may be charged for certain classes of houses. Public feeling, however, continued to be very susceptible on the question, especially when a rise of prices occurred. Various public inquiries have been conducted into costs of production and distribution of foodstuffs and other articles of common consumption, the most important of these being (*a*) the inquiry of a committee appointed in 1922 under the chairmanship of Lord Linlithgow to enquire into methods and costs of selling and distributing agricultural, horticultural and dairy produce in Great Britain and the diminution of the disparity between the price received by the producer and that paid by the consumer; (*b*) the inquiry of the royal commission on food prices appointed in 1925 and (*c*) the proceedings of the food council appointed in 1925 following the report of the royal commission on food prices to watch over food prices and supplies.

In European Countries.—In the countries of Continental Europe public interest in prices and profits has been fully as great as in Great Britain. Periods of inflation in different countries were marked by a variety of measures designed to check speculation and prevent further rises of price. As countries got back on to a stable currency basis, or began to deflate their currency, the problem changed into one of ensuring that the benefit of stable or falling costs was reflected in quotations, and that the inevitably large profits of the inflationary period were not perpetuated. It was felt that the force of competition had been impaired, and that special action was necessary with regard to combines. Legislation motived largely by the desire to mitigate profiteering by combines was consequently passed in several countries, including notably Germany, Czechoslovakia and Norway.

The German experiment, represented by the "decree against the abuse of economic power," which came into force in Nov. 1923, is of particular interest. The decree provided amongst other things that the German Minister of Economic Affairs may, when he considers a cartel agreement or the method of putting it into operation detrimental to the public interest, apply to the Cartel Court set up in accordance with the decree to have the agreement declared void or the particular method of carrying it out forbidden. The public interest or the common good is to be considered as detrimentally affected, particularly when supply or demand are restricted in a manner not economically justifiable; when prices are raised or kept high; or when, in the event of prices being quoted in a stable currency, extras for risks are included; or when economic freedom is unreasonably restricted by boycott in buying or selling or by the fixing of discriminating prices or conditions. Until the summer of 1925, action by the government was confined to unofficial intervention, and it was claimed that this was successful in bringing about a large number of price reductions and in preventing price increases. It was decided, however, to make a more rigorous use of the powers under the decree and suits were brought in the Cartel Court charging a number of Cartels with jeopardising the economic life of the country by the maintenance of excessive prices. Should existing powers prove inadequate, the German Govt. has announced its intention of amending the decree. (C. K. H.)

III. PROFITEERING IN THE UNITED STATES

United States.—"Profiteering," as the term has been used in the United States, may be roughly defined as consciously taking and retaining profits considerably in excess of the return necessary to equilibrate demand and supply, especially when such

profits are the result of prices enhanced by the activity or policy of the recipient. Its meaning has therefore a direct relation to the current conception of a legitimate business "profit"—a point on which public opinion during the World War became peculiarly sensitive. Probably, conscious direct control of industrial processes never reached such development in the United States as during the World War. Prices were fixed and both supply and demand controlled. An unusual mass of information concerning cost, production, consumption and stocks was obtained. The chief sources of information are the cost reports of the Federal Trade Commission and data compiled from the income-tax returns.

According to income-tax returns from some 7,000 corporations their net earnings of the pre-War years 1911–3 averaged 11% on invested capital. Unfortunately, returns are not available in published material for these same corporations in 1917, but for 1918—a year of lower profits—they averaged 15%. The year 1917 was the time of maximum profits.

These income-tax returns are not conclusive. They do indicate, however, that average profits increased considerably between the pre-War period and 1918. More accurate and illuminating figures concerning particular industries were obtained by the Federal Trade Commission. A study of the costs of 37 wheat-flour companies showed that the average earned on investment was 12·6% in the fiscal year 1913–4, 17% in 1914–5, 38·4% in 1916–7 and 34% in 1917–8. That this increase in profits was not due solely to increase in business is evident from the fact that the percentage earned on sales also increased, the rate being 3·4% in 1913–4 and 6·5% in 1916–7. In 1917 there was apparently no limit to the price purchasers were willing to pay, the condition being one of panic. In the next year profits were somewhat abated by government regulation.

Twenty-two manufacturers of farm implements made at this time about 85% of the product in the United States. Their profits increased from about 9% on investment in the years just prior to the War to 16·6% in 1917 and 19·9% in 1918; and the rate of profit on sales increased several fold. There was no general shortage of farm implements and no unusual demand, for exports were cut off.

From Senate Document No. 248 (65 Cong. 2nd Session) further evidence of profiteering may be gained. It appears that oil companies circulated reports that the supply of gasolene was dangerously short, for the purpose of maintaining prices of that commodity while making "enormous" profits on fuel oil. Concerns bottling or canning vegetables, which had made future contracts, sometimes withheld portions of their output from delivery on such contracts and sold in the higher "spot" markets. In frequent cases licences were revoked by the Food Administration. The practice of such concerns in maintaining re-sale prices for jobbers contributed toward maintaining the general high level of prices and increased profits in some instances. According to the same document the steel companies in 1917, prior to government price-fixing, made abnormal profits, and a number continued to make unusually heavy profits thereafter. The United States Steel Corp., which made 5% before the War, received 25% on investment in 1917; and 10 smaller concerns made from 30% to 319% on their investments. Certain sulphur companies took advantage of the War demand for sulphur to raise their prices to such an extent as to reap net profits of approximately $15 a ton, which meant over 200% on investment in one case. The profits of tanners increased from two to five times, as they took advantage of the enormous demand for leather and exacted very high prices. The price of hides was rapidly advanced, notwithstanding that at the same time "great supplies were withheld from the public." Upon learning of approaching price control, one of the large packers took steps "quietly and promptly" to increase the appraised value of his tanneries.

Without further evidence it may be concluded that profits in many industries increased in the earlier part of the War more than 100% above the pre-War level, and that this increase was in not a few cases due in part to profiteering as above defined. High prices do not necessarily indicate excessive profits, but there is reason to believe that profiteering was common in cement, petroleum, lumber (notably ship timber), wool, clothing, sulphur, naval stores, rice, sugar, sand and gravel, raisins and other products, in addition to those already mentioned. In most of these cases the government reduced prices and profits through some form of control.

The U.S. Govt. attempted to deal with profiteering in three ways: (1) taxation; (2) price-fixing; (3) direct action under the Food Control Act. The first and the last methods proved largely ineffective.

By special taxes levied on profits, many thought that the spoils of the profiteers could be regained by the public. In 1916 a tax of 12½% was levied on the profits of munitions manufacturers; and a general "War profits tax" and an "excess profits tax" were imposed in 1917. In 1918 these taxes were combined. But, unfortunately, it proved so easy for most corporations to increase their investment accounts, and to pad their expenses, that the worst profiteers often showed small excess profits. Moreover, a considerable part of the tax was shifted to consumers in the shape of higher prices, as was possible during the inflation period.

Government price-fixing, while it did not prevent profiteering, did moderate the evil, notably through such substantial reductions as were made in the prices of wool, coal, sugar, flour and sulphuric acid. Unfortunately, this means was not used as vigorously and thoroughly as it would have been had there not been an ill-founded reliance upon profits taxes.

On Aug. 10 1917 the Food Control Act became law. Section 4 of this Act made it unlawful for any person to hoard or to make any unjust or unreasonable charge in transactions relating to "necessaries" (foods, feeds, fuel, fertilizers, farm implements and machinery), but imposed no penalty. Sections 6 and 7, however, provided for penalties and seizure, in case of hoarding. Section 5 authorised the licensing of dealers in necessaries and the fixing of fair storage charges, commissions, profits or practices. The fixing of prices for coal and coke was authorised in section 25. It was under this Act that the Food Administration operated, and, as already indicated, its control over prices was partly effective. On June 30 1919, however, the activities of the Food Administration were suspended; and as the agitation concerning the "high cost of living" grew in volume, the Department of Justice assumed the task of enforcing the law, which remained in force while a state of war was only technically in existence. But the Attorney-General found his efforts limited by the absence of a penalty clause in section 4 and the restricted definition of "necessaries," and, at the President's request, Congress re-enacted the law in Oct. 1919, with amendments to cover these defects. According to the annual report of the Attorney-General for 1920, since Oct. 1919 sentences had been imposed on 49 sugar dealers and 20 clothing dealers. In addition, six sugar dealers and one flour dealer had been convicted of hoarding, and two coal dealers had been sentenced under the provision as to fixing reasonable prices. In all there had been over 2,000 indictments, arrests and sentences, involving chiefly the commodities just mentioned, together with meats, potatoes and meals at restaurants. The great majority could not be sustained under the law.

Meanwhile, a growing hostility to the Act was apparent. The upshot of the matter was a decision of the U.S. Supreme Court in Feb. 1921, which declared the Act unconstitutional. The reasoning of the court was that Congress alone had power to define crimes against the United States; and, therefore, because the Act was vague and indefinite, and fixed no precise standard of guilt, and because it did not inform the defendant of the nature and cause of the accusation against him, it was unconstitutional. Thus ended the anti-profiteering crusade of the Attorney-General. Meanwhile, from April 1920 prices began to decline, and with that decline came a loss of interest in the subject of profiteering.

In a sense the U.S. Govt. was to blame for much War-time profiteering. In the first place it was lax in letting contracts

and making purchases, either directly, or indirectly, by placing authority in the hands of interested persons. The " cost-plus system " invited profiteering as well as inefficiency. In the second place its combination of excess profits taxes and price regulation was unfortunate. At the same time that it fixed prices on a cost basis it spread the idea that it made little difference if excess profits were earned, as such profits would be reached by taxation. Taxation, however, proved at best to be an inadequate means of reaching profits, and early laxity in defining cost and investment made this means nugatory.

PROFIT SHARING (*see* 22.423).—Between 1910 and 1925 numerous schemes of profit sharing were initiated in the industrialised countries of the world. But the whole of these experiments touched no more than an insignificant proportion of the industrial and commercial concerns of the time, if we except the compulsory profit-sharing scheme introduced into the coal-mining industry of Great Britain by the terms of settlement of the great dispute of 1921. That scheme has in practice shown the almost inevitable failure of any system imposed by an outside authority upon an unwilling industry. For there is no reason to think that its effect has been other than to increase suspicion between employers and employed, to subsidise incompetence at the expense of competence, and to prevent the development of the industry in regard to technical equipment by decreasing the fund available for capital expenditure.

Practical Difficulties.—The latter consequence of profit sharing is, indeed, a difficulty which is almost insuperable in any instance in which the wage-earners' share in the profits is calculated upon a scale so generous as to produce an appreciable increase of their material prosperity and to promote good feeling between capital and labour. For, if the worker's share is so large as to reduce seriously the profits of the individual concern, it is clear that the latter will be less able to compete in the market owing to the decreased amount available for the technical improvement and expansion of the business. In one successful example well known to the present writer, the owner of the business is reduced almost to penury owing to the fact that his share amounting to thousands of pounds annually, is barely sufficient to provide the fresh capital required year by year for natural and healthy expansion of the business. Moreover, the limitation of his profit would render it difficult for him to offer a speculative attraction to fresh capital from outside.

In this capital difficulty is probably to be found the reason why the advocates of profit sharing are almost invariably advocates also of co-partnership. A natural development of profit sharing has been the offering of inducements to employees to invest their profits in the shares of the undertaking in which they work. But it would appear that there are very grave objections to this latter system. For from the employees' point of view it is manifestly unwise for any person, who is dependent mainly upon a weekly wage, to invest his savings in the same concern, or even in the same industry, as that from which he draws his wage. If he does so the failure of his income from the one source is only too likely to coincide with a failure of his income from the other. Clearly the small investor should place his savings in the safest possible securities. By doing so he helps industry no less than if he were to risk their loss by direct investment in industry. If he chooses government stocks, his choice tends to reduce interest rates upon such securities, thus diverting capital into industry and simultaneously lightening the tax burden upon it.

A further objection to co-partnership is to be found in the fact that it almost invariably gives rise to a demand for democratic control of the capital resources of the business in which it is practised—that is to say, for a method of control whereby voting power is based upon counting of heads and is not conferred, as in the joint-stock company system, in proportion to the amount of capital contributed by each individual voter. The complete failure of experiments in guild socialism in Great Britain is proof of the dangers of such a system of control and its tendency to cause a fatal dissipation of capital resources in attempts to maintain a high standard of living in periods of trade depression.

Labour Banking.—Certain developments in the United States would seem to hold out more substantial hopes than does co-partnership of rapid progress toward the economic Utopia, where every worker is a capitalist and (as a necessary consequence) every capitalist is a worker. The establishment of trade-union banks in America during the period under review is a matter of the highest interest to all who in other countries are endeavouring to increase the economic liberty of the wage-earners. If it is borne in mind that trade unionism was, in its origin, a movement with the object of giving the employed in relation to his employer a degree of liberty which the possession of capital alone can afford, it is not surprising that the great prosperity of the American worker should have led him to take steps still further to secure his position by using trade-union capital in banking. The development would seem to be a natural one, though in other countries it will probably take a somewhat different form, to which reference will be made later. The chief danger would seem to lie in the control of large amounts of money being placed in the hands of inexperienced persons. But if serious incompetence or dishonesty is not encountered in the early stages of the expansion of Labour banking, there seems to be good reason to hope for a very great and beneficent growth of the system in the future, accompanied by a most valuable economic education of the workers concerned.

In Great Britain, however, it may well be that the difficulty in regard to capital should be dealt with by extension of the existing banking system rather than in direct control of credit by trade-union banks on the American plan. If a part of the increased earnings of labour, arising from profit sharing, can be attracted into the banks in the form of deposits, those institutions will be in a position to make correspondingly increased advances to industry and thus to provide for larger turnover without an increase in the subscribed capital of the concerns in question. By this means the savings of the small investor would be guarded from the danger of his inexperience, and would be kept available for withdrawal at comparatively short notice without capital depreciation—two conditions which are essential if the habit of investment is to spread rapidly among the manual workers.

At present the floating credit available for industry is mainly provided by the undrawn balances of the dividends of the *rentier* paid half-yearly into the banks. The additional resources placed in the hands of the latter by the creation of a numerous class of persons, mainly dependent upon a weekly wage but having also smaller or larger amounts on deposit, would tend to reduce the price of credit and to that extent to add to the real value of wages.

An essential condition of material prosperity is political stability; and political stability under a democratic constitution is only assured when the majority of the people is composed of capitalists. Profit sharing would appear to be the first step toward that condition of affairs, though experience has shown that many men will neglect to make any provision for the future, even when a profit-sharing scheme in being gives them twice the normal wage rate over a considerable period. But the duty of the employer would seem to demand that he should at least make it possible for his workers to become capitalists, while preventing them from placing the control of their capital at the mercy of a popular vote. So far as the prosperity of industry is concerned, it is of small importance who owns capital. The important matter is the question of who controls it.

General Principles.—The following principles, based on experience, are considered essential to the successful working of any scheme applied to a business which is not (like a gas undertaking) of the nature of a monopoly:—

(1) The motive for the introduction of a given scheme has a profound influence on its success or failure. If the intention of the employer is simply to increase his profit, failure is to be expected, since the scheme is in that case no more than one of collective piecework, to which the term " profit sharing " cannot properly be applied. But if the employer initiates a scheme mainly with the intention of adding to the material prosperity of the employed, without aiming at direct benefit to himself, success may be anticipated.

(2) It follows that a high degree of mutual confidence must already exist between employer and employed before a profit-sharing scheme can be introduced with a fair prospect of success.

(3) The scheme must be drawn up in such a way as to insure that, in time of trade prosperity, the addition to basic wages shall be substantial. The profit bonus should be paid, in part at least, at frequent intervals rather than annually or half-yearly.

(4) The employer must be prepared to meet instantly demands from the workers for improved machinery and organisation, and must give to them as much information as possible regarding the position of the business from month to month. (A. Ho.)

PROGRESSIVE PARTY (*see* 27.735).—The title Progressive party has been taken twice in the United States by third-party movements, first in the presidential campaign of 1912 and again in 1924. Both movements represented revolts against the conservative leadership of the Republican party; both were led by prominent figures formerly of that party; and both sought to effect an alliance of the agrarian elements of the northwest with labour elements in the industrial sections of the country, as against the dominant financial and industrial interests of the north-central, Atlantic and New England strongholds of the party.

The Progressive party movement of 1912 was heralded by the "insurgent" outbreak among Republican members of Congress in 1910, which succeeded in reducing considerably the powers of the Speaker of the House of Representatives. Opposition to the administration of Taft, then President, took concrete form early in 1911 when the National Progressive Republican League was organised under the leadership of Senator R. M. La Follette of Wisconsin. During the following year, however, Theodore Roosevelt placed himself at the head of the Progressive movement. Alleging unfair tactics on the part of the "Old Guard," his followers left the Republican national convention held in Chicago (June 1912), and Roosevelt was nominated for the presidency by a Progressive national convention also held in Chicago early in August of the same year. As a result the Republican party was hopelessly split, Roosevelt receiving a popular vote exceeding that of Taft by more than 600,000. Woodrow Wilson, Democratic candidate, was successful, obtaining the electoral vote of all except eight states. Although defeated in this national campaign, the Progressive movement was influential before and after 1912 on the course of affairs at Washington, and it was directly instrumental in writing upon the statute books many states laws regulating corporations and labour, and establishing the initiative, referendum, recall, corrupt practices acts and direct primaries.

In 1916 harmony was restored in the Republican party, Roosevelt returning to his former allegiance. During the World War partisanship was in abeyance, but upon its termination the old rift soon reappeared. The administration of Harding encountered increasing agrarian dissatisfaction, and this was true also of the first portion of the Coolidge administration. In 1924 the contingent from Wisconsin and neighbouring states, after sitting in the Republican convention at Cleveland, held a Conference for Progressive political action made up chiefly of farmer, labour and socialist delegates. Senator R. M. La Follette was nominated for the presidency, and later Senator B. K. Wheeler of Montana for the vice-presidency. The platform promised a complete house cleaning in the executive departments, public control of national resources, public ownership of railways, tariff and tax reduction, agricultural relief, labour legislation, public referendums on peace and war, direct nomination and election of the president, extension of the initiative and referendum to the Federal Govt., election of Federal judges and a constitutional amendment providing that Congress may by re-enacting a statute make it effective over a judicial veto. Republican strategy during the campaign of 1924 consisted largely in denouncing the alleged ultra-radicalism of the La Follette platform, particularly the planks concerning the judiciary, meanwhile for the most part ignoring Democratic attacks. This strategy was completely successful, Coolidge receiving an enormous majority both of the popular vote and in the electoral college. La Follette carried only his own state, but polled almost a sixth of the popular vote. (*See* UNITED STATES: *History*.) (R. C. B.)

PROHIBITION.—As a legal term, prohibition is discussed in an earlier article (*see* 22.427) and as a phase of the temperance movement in connection with intoxicating liquor, and as a legislative method, especially under State and local option laws in the United States it is treated historically to 1910 in the article TEMPERANCE (*see* 26.578). The closely related legislation since 1910, regulating the liquor traffic in Great Britain and other countries, including the United States, where it furnishes the necessary background for the understanding and interpretation of prohibition, is reviewed in the article LIQUOR LAWS (*q.v.*) (*see* also 16.759).

With its adoption on a national scale by constitutional amendment, ratified Jan. 16 1919, by the necessary number of States, and in force over the entire territory of the United States one year thereafter, Jan. 16 1920, prohibition became by common consent the greatest social experiment of modern times.

The 18th Amendment.—The 18th Amendment to the Constitution of the United States reads as follows:—

Section 1. After one year from the ratification of this article the manufacture, sale, or transportation of intoxicating liquors within, the importation thereof into, or the exportation thereof from the United States and all territory subject to the jurisdiction thereof for beverage purposes is hereby prohibited.

Section 2. The Congress and the several States shall have concurrent power to enforce this article by appropriate legislation.

Section 3. This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by the Legislatures

Votes in State Legislatures on Ratification of Eighteenth Amendment

	Senate		House	
	Date	Vote	Date	Vote
(1) Mississippi	1- 8-18	28 to 5	1- 8-18	93 to 3
(2) Virginia	1-10-18	30 to 8	1-11-18	94 to 13
(3) Kentucky	1-14-18	28 to 6	1-14-18	66 to 10
(4) South Carolina	1-18-18	28 to 6	1-28-18	66 to 29
(5) North Dakota	1-25-18	43 to 2	1-25-18	96 to 10
(6) Maryland	2-13-18	18 to 7	2- 8-18	58 to 36
(7) Montana	2-19-18	35 to 2	2-18-18	77 to 8
(8) Texas	2-28-18	15 to 7	3- 4-18	72 to 30
(9) Delaware	3-18-18	13 to 3	3-14-18	27 to 6
(10) South Dakota	3-19-18	43 to 0	3-20-18	86 to 0
(11) Massachusetts	4- 2-18	27 to 12	3-26-18	145 to 91
(12) Arizona	5-23-18	17 to 0	5-24-18	29 to 3
(13) Georgia	6-26-18	34 to 2	6-25-18	129 to 24
(14) Louisiana	7- 6-18	21 to 20	8- 8-18	69 to 41
(15) Florida	11-27-18	25 to 2	11-27-18	61 to 3
(16) Michigan[1]	11- 2-19	30 to 0	1- 2-19	88 to 3
(17) Ohio	1- 7-19	20 to 12	1- 7-19	85 to 30
(18) Oklahoma	1- 7-19	43 to 0	1- 7-19	90 to 8
(19) Maine	1- 8-19	29 to 0	1- 8-19	122 to 20
(20) Idaho	1- 8-19	38 to 0	1- 7-19	62 to 0
(21) West Virginia	1- 9-19	27 to 0	1- 9-19	78 to 3
(22) Washington	1-13-19	42 to 0	1-13-19	93 to 0
(23) Tennessee	1- 9-19	28 to 2	1-13-19	82 to 2
(24) California	1-10-19	24 to 15	1-13-19	48 to 28
(25) Indiana	1-13-19	41 to 6	1-14-19	87 to 11
(26) Illinois	1- 8-19	30 to 15	1-14-19	84 to 66
(27) Arkansas	1-14-19	34 to 0	1-13-19	93 to 2
(28) North Carolina	1-10-19	49 to 0	1-14-19	93 to 10
(29) Alabama	1-14-19	23 to 11	1-14-19	64 to 34
(30) Kansas	1-14-19	39 to 0	1-14-19	121 to 0
(31) Oregon	1-15-19	30 to 0	1-14-19	53 to 3
(32) Iowa	1-15-19	42 to 7	1-15-19	86 to 13
(33) Utah	1-15-19	16 to 0	1-14-19	43 to 0
(34) Colorado	1-15-19	34 to 1	1-15-19	63 to 2
(35) New Hampshire	1-15-19	19 to 4	1-15-19	221 to 131
(36) Nebraska	1-13-19	31 to 1	1-16-19	98 to 0
(37) Missouri	1-16-19	22 to 10	1-16-19	104 to 36
(38) Wyoming	1-16-19	26 to 0	1-16-19	52 to 0
(39) Wisconsin	1-16-19	19 to 11	1-17-19	58 to 35
(40) Minnesota	1-16-19	48 to 11	1-17-19	92 to 36
(41) New Mexico	1-20-19	12 to 4	1-16-19	45 to 1
(42) Nevada	1-21-19	14 to 1	1-20-19	33 to 3
(43) Vermont	1-16-19	26 to 3	1-29-19	155 to 58
(44) New York	1-29-19	27 to 24	1-23-19	81 to 66
(45) Pennsylvania	2-25-19	29 to 16	2- 4-19	110 to 93
(46) New Jersey	3- 9-22	12 to 4	3- 7-22	33 to 24

[1] Repassed in Lower House to correct error Jan. 23.

Total Senate Vote 1,309 for, to 240 against, 84% dry.
Total House Vote 3,775 for, to 1,025 against, 78⅔% dry.

of the several States, as provided in the Constitution, within seven years from the date of the submission hereof to the States by the Congress.

On Jan. 29 1919 the Secretary of State issued a proclamation to the effect that on Jan. 16 of that year the ratification of the 36th State, making the necessary three-fourths of all the States, had been filed. Later it was ratified by 10 additional states.

In six States (South Dakota, Idaho, Washington, Kansas, Utah and Wyoming) the vote in favour of the amendment was unanimous in both Houses. In only two States (Connecticut and Rhode Island) the amendment has not been ratified. When the matter was twice before the Legislature in Rhode Island the Senate voted 20 to 18 in 1918 and 25 to 12 in 1919 to postpone indefinitely the consideration of the amendment. In Connecticut the Senate voted 14 for to 20 against ratification and the House 153 for to 96 against, thus making a total vote in both States of 197 for to 161 against the amendment.

Dr. Ernest H. Cherrington in "World Wide Progress toward Prohibition Legislation" (*Annals*, Amer. Acad. of Pol. and Social Science, 109.223, Sept. 1923) says: "No amendment to the Federal Constitution ever received as strong official sanction by the States as the 18th Amendment. The original Constitution was adopted in the 13 original States by a majority of about two to one. The aggregate vote in the State Senate and State Houses of Representatives for the ratification of the 18th Amendment shows a majority of more than four to one." The Bill of Rights (the first 10 amendments) and the 11th Amendment were ratified by 10 out of 13 States. The 12th Amendment was not ratified by four States, the 13th Amendment by five States, the 14th Amendment by four States, the 15th and 16th amendments by six States, the 17th and 19th amendments by twelve States. But the 18th Amendment was ratified by 46 out of 48 States. Forty-seven States have enacted laws to help carry into effect the provisions of the 18th Amendment; and in one State (Nevada) such a law was held unconstitutional on technical grounds as to form. Only one (New York) has repealed or weakened such a law.

Dr. Fabian Franklin, the author of "*What Prohibition Has Done to America*" (N.Y., 1922) says in "What's Wrong with the 18th Amendment?" (*Annals*, 109.48, Sept. 1923) in denouncing what he terms a legislative atrocity: "Everybody knows—everybody knew when the 18th Amendment was adopted that in every one of our great cities, so far from there being an overwhelming majority in favour of prohibition, there was a decisive majority against it. Everybody knew that the like was true in many of the smaller cities. Everybody knew that there were many whole States, great and small, in which prohibition could not command a majority of the people, and that there were a number of others in which the vote would be nearly evenly divided. In the face of such a situation it is idle to talk of the question whether or not a majority of the whole people of the United States favoured or did not favour the 18th Amendment. The only question is whether it was an outrage, perpetrated by a majority upon a minority or an outrage perpetrated by a minority upon a majority."

It may be that the votes of the people are not correctly reflected in the votes of their representatives in Congress or in the State Legislatures, or, as Dr. N. M. Butler has often put it, that neither the representatives nor the voters have the courage to vote as they drink. It is difficult, however, to reconcile Dr. Franklin's view with the records of the votes in the Congress that proposed the 18th Amendment, elected before the United States entered the World War and therefore not influenced by the absence in military service of men opposed to prohibition as has been claimed, and including a Senate elected for the first time by popular vote under the provisions of the 17th Amendment, or with the votes for ratification or with every subsequent vote in Congress on the Volstead Act and its amendments providing for enforcement of prohibition. Prof. Felix Frankfurter of the Harvard Law School has said (*Annals*, 109.193): "Prohibition was written into the Constitution with as much deliberation as attended the enactment of any amendment to the Constitution. Prohibition was the culmination of 50 years of continuous effort; nor did the movement lack alert, persistent and powerful opposition."

State Prohibition.—State-wide prohibition was the law in 33 States, more than two-thirds of all the States at the time the 18th Amendment went into effect. It had been written into the constitution of 18 of them, and in most cases it had been adopted or ratified in a referendum election. It had been adopted in the territories, in 1917 in Alaska and Porto Rico (ratified by the voters), and in the District of Columbia by Congressional enactment and in 1919 in Hawaii. At the time the amendment went into effect (Jan. 1920), 90% of the townships and rural precincts, 85% of the counties and over 75% of the villages of the United States were under prohibition by State legislation. Two-thirds of the members of the United States Senate and more than two-thirds of the House of Representatives came from States or districts having State prohibition. Local option and State prohibition had put 68·3% of the population and 95·4% of the land area of the United States under prohibition and the amendment and subsequent legislation pursuant thereto really affected directly and radically only 31·7% of the population and 4·6% of the land area of the United States.

National Prohibition Introduced

Influence Behind National Prohibition.—Nation-wide prohibition came with surprising suddenness. It was greatly accelerated by the World War. It was not caused, however, by the War. It had a long natural history. For more than a century temperance reform had been a growing moral issue. Its legislative history dated back nearly 70 years to the first State prohibition law in Maine in 1851. New scientific knowledge in the pre-War years since the beginning of this century had emphasised the menace to health and efficiency and the frightful cost and waste inherent in the consumption of alcoholic beverages in even moderate quantities relatively to earlier standards of moderation and excess. New industrial economics did not seem to find any place for alcoholic beverages in working out the problems of the expansion and large-scale production of American industry, trade and commerce. New educational forces caused the saloon to be regarded with increasing disfavour as a social institution, the so-called poor man's club, and a growing irritation concerning the saloon as a political menace was manifest.

Long before the United States entered the World War the conviction was growing that social and industrial efficiency, and even national prosperity, could not be achieved at any less cost than whatever sacrifices might be involved in national prohibition. The legislation by Congress for several years before War-time prohibition (*see* Liquor Laws) shows that every effort was made to supplement and strengthen State and local prohibition, and judicial decisions illustrate the same tendency in order that national prohibition should not be adopted except as a last resort and in obedience to a compelling necessity. As soon as the United States entered the World War two economic factors—the fear of the loss of man-power on account of intemperance, and the loss of food used in the manufacture of alcohol, but needed to supply the army of the United States and its Allies—served to turn the scales in favour of national prohibition as a war measure. The satisfactory experience with war-time prohibition in its initial stages served to crystallise an overwhelming national sentiment in favour of permanent constitutional prohibition.

After Ratification; Provisions for Enforcement.—The Draft Law of May 18 1917, the Food Control Act of Aug. 10 1917, and an Act to Promote the Efficiency of the United States Navy, approved Oct. 6 1917, gave the President prohibitory powers to be exercised for war purposes. The so-called War Prohibition Act was not enacted until Nov. 21 1918, 10 days after the signing of the Armistice, as an amendment to the Agricultural Appropriation bill. It provided that after June 30 1919, until the conclusion of the War and of demobilisation, the date of which was to be determined and proclaimed by the

President, it was unlawful to sell for beverage purposes any distilled spirits from bond except for export. It also provided that after May 1 1919 no grain, cereals, fruit or other food products should be used in the manufacture or production of beer, wine or other intoxicating malt or vinous liquor for beverage purposes, and after June 30 1919, no beer, wine or other intoxicating malt or vinous liquor should be sold for beverage purposes except for export until the conclusion of the War and of demobilisation. Importation of distilled, malt, vinous, or other intoxicating liquors was prohibited. The War Prohibition Act continued in force until national prohibition under the 18th Amendment and legislation pursuant thereto became effective on Jan. 16 1920, one year after the ratification of the amendment. The President had not prior to that time proclaimed the conclusion of demobilisation.

The Volstead Act.—The national Prohibition Act, popularly known as the Volstead Act and sometimes referred to by its longer title, the Prohibition Enforcement Law, passed the House of Representatives July 22 1919 by a vote of 287 to 100, three members voting "present." It passed the Senate with slight amendments and without a roll-call on Sept. 4 1919. The conference report to the Senate and House was adopted in the Senate Oct. 8 without roll-call or record vote, and in the House by a vote of 321 to 70 on Oct. 10. The measure then went to the President, who vetoed it and returned it with his veto message Oct. 27. The House on the same day, by a vote of 176 to 55 passed the bill over the President's veto, and the Senate, by vote of 65 to 20 on Oct. 28 1919, did likewise, and on that day the measure became law applicable by its terms immediately for the enforcement of the War Prohibition Act, and "when the 18th Amendment to the Constitution goes into effect," intended to carry out the purposes of that amendment. The Act is notable for its definitions, including the fixing of ½ of 1% of alcohol by volume as the test of intoxicating liquor, and the delegation of power to the Commissioner of Internal Revenue to make regulations, with the approval of the Secretary of the Treasury, having the force of law, for carrying out the provisions of the Act.

Validity Tested.—The constitutional validity of the adoption of the 18th Amendment and of the Volstead Act and its definition of intoxicating liquor was tested in the U.S. Supreme Court and promptly sustained in the leading cases of Hawke *v.* Smith, decided June 1 1920 (253 U.S. 221), and Rhode Island *v.* Palmer, decided June 7 1920 (253 U.S. 350), in which the Court disposed of seven cases pending. The Court had previously sustained the War Prohibition Act and the ½ of 1% limit which it specified. The liquor interests hoped that greater latitude might be given through a strict construction of the first section of the 18th Amendment, which did not specify the content or define intoxicating liquor. It was argued that the amendment therefore did warrant legislation forbidding the sale and manufacture of liquor which was in fact non-intoxicating, whether it contained more or less than ½ of 1% of alcohol. The Court, however, without stating or discussing this contention, cited the War prohibition cases in support of the conclusion that while "recognising that there are limits beyond which Congress cannot go in treating beverages as within its power of enforcement, we think those limits are not transcended by the provision of the Volstead Act."

The Working of the Volstead Act

Enforcement.—The Volstead Act provides for drastic enforcement. The difficulties of enforcement were foreseen especially by those who knew the history of State prohibition laws and the experience in some cases of a half-century in the struggle to enforce them. It was sought therefore to give the Government ample powers, through the Commissioner of Internal Revenue of the Treasury Dept., to detect and suppress all manner of violations. The regulations under the Act which apply to physicians' prescriptions and the procuring of wine for sacramental purposes are also drastic, and similar provisions were made more so in the Supplemental Prohibition Enforcement Act of Nov. 23 1921 (C. 134 Stat. 42), better known as the Anti-Beer Act because it provided that beer with a greater content than ½ of 1% could not be prescribed for medicinal purposes, that only spirituous or vinous liquor, the latter containing not more than 24% of alcohol by volume could be prescribed, and that not more than ¼ gal. of vinous liquor nor any quantity of liquor containing more than ½ pint of alcohol could be prescribed for the use of any person within 10 days, and that no physician may have more than 100 permits within 90 days unless to meet emergency needs, to be demonstrated to the satisfaction of the commissioner who issues such permits. This may seem to be an unnecessary and unwarranted interference with medical science, but the provision indicated that no power would be refused that the administrative authorities might find necessary to make the enforcement of national prohibition effective.

Other provisions of the Supplemental Act give the enforcing authorities control over importations for non-beverage purposes; provide that both the Supplemental and the National Prohibition Acts apply not only to the United States but to all territory subject to its jurisdiction, that liquor laws in force when the National Prohibition Act was adopted and not in conflict therewith, shall continue in force, and also made it unlawful for any U.S. officer to search any private dwelling without a search warrant.

With respect to the latter point, which seemed to emphasise a constitutional limitation upon the powers of the enforcing authorities, the Supreme Court in 1925 (Carroll *v.* U.S., 69 L. ed. 347) upheld the search of an automobile or vehicle of transportation without a warrant where the search was not malicious or without probable cause, and the same Court sustained, as within the police powers of the States, a Georgia statute which prohibited the possession of liquor which had been legally acquired—that is, before prohibition (Samuels *v.* McCurdy, 69 L. ed. 371). It is proposed in an administration bill sent to Congress in 1926 to strengthen the seizure and search provisions of the prohibition law. The Dept. of Justice has approved the wider use of the padlock and abatement of nuisance provisions of section 22, and other sections of the National Prohibition Act. These are drastic but the only effective means of securing enforcement in the worst wet areas where organised opposition is powerfully entrenched. The methods employed in the enforcement of law of this character necessarily involve, as in the case of tariff and revenue laws and other laws where there is a strong motive to defeat their purpose, many nice questions of constitutional guarantees of liberty and protection of innocent persons. The Supreme Court, however, has in all its decisions thus far, with the possible exception of one case in which it held section 35 of the national prohibition law invalid because of the denial of a trial by jury in the collection of a tax which was a penalty for a crime, gone very far to sustain the Government and Congress in the exercise of every power necessary to carry out a lawful purpose.

The Concurrent Power.—The theory of enforcement of the 18th Amendment and laws pursuant thereto is that of joint action of the Federal and State Govts. under the "concurrent power" granted in the second section of the amendment which declares "The Congress and the several States shall have concurrent power to enforce this article by appropriate legislation." The question of the meaning of "concurrent power" was settled by the Supreme Court in Hawke *v.* Smith, which held that this provision of the amendment was within the amending power, was a part of the constitution and "must be respected and given effect the same as other provisions of that instrument," was "operative throughout the entire territorial limits of the United States" and "of its own force invalidates every legislative act, whether by Congress, by a state Legislature, or by a territorial assembly, which authorises or sanctions what the section forbids." The Court further held that "concurrent power" does not enable Congress or the several States to defeat or thwart prohibition, but only to enforce it by appropriate legislation, and that these words do not mean joint

power, or require that legislation thereunder by Congress to be effective shall be approved or sanctioned by the several States or any of them. Neither do the words "concurrent power" mean that the power to enforce is divided between Congress and the several States along the lines which separate or distinguish foreign and interstate commerce from intrastate affairs. The power confided by the second section of the amendment to Congress, while not exclusive, is territorially co-extensive with the prohibition of the first section, embraces manufacture and other intrastate transactions as well as importation, exportation and interstate traffic, and is in no wise dependent on or affected by any action or inaction on the part of the several States or any of them.

Administrative Difficulties.—The obstacles to efficient enforcement have not come from the Courts but rather from the administrative difficulties due to the lack of enforcement machinery of the Government and in part to the location of enforcement machinery in several departments of the Government. It was a mistake at the outset not to have put the appointment of all enforcement officers under Civil Service rules and this will doubtless soon follow the recent reorganisation of the prohibition unit in the Treasury Dept., which is responsible for the gathering of evidence, while the Dept. of Justice is responsible for trying cases which arise under the law. The judicial conference of the senior circuit judges, with the concurrence of Chief Justice Taft recommended in Nov. 1924, that the prohibition unit be transferred bodily to the Dept. of Justice and that all the appropriations for such enforcement should be expended under the Attorney-General. The judges thought that thus "the attempted prosecution of trivial, futile and unimportant cases which now crowd the dockets can be avoided, and only those cases taken up and pressed which will really deter the principal offenders, and in the preparation of which district attorneys will have a personal responsibility."

It is generally thought that the experience and technique of the Treasury Dept. in the enforcement of liquor revenue laws are essential for the detection of violations and must be more closely co-ordinated with prosecutions by the Dept. of Justice. Both in theory and practice, in the nature of the proceedings in Federal Courts requiring jury trial, and in the absence of Federal police courts to dispose of petty cases, "the resources of the Federal Govt. in administration and judicial machinery are sufficient to cope successfully only with what may be called the 'wholesale' aspects of the enforcement problem—smuggling (*see* BOOTLEGGING AND SMUGGLING), including report of arrests, seizures, etc., made by Federal prohibition officers, the withdrawals of bonded liquors, the diversion and conversion of industrial alcohol to beverage uses, interstate transportation of liquors and the major conspiracies to violate the law, some of which are of giant proportions." For the rest, State and local machinery must be relied upon for the purpose of enforcing the law (see F. Ernest Johnson, "Prohibition Enforcement," *American Year Book*, 1925, pp. 248–52).

Present and Proposed Reorganisation of the Prohibition Unit.—On April 1925 the Customs and coast-guard services and the prohibition unit (previously under the Commissioner of Internal Revenue) were grouped together and put under Gen. Lincoln C. Andrews, U.S.A. retired, recently appointed for the purpose an assistant secretary of the Treasury. Decentralisation is of the essence of this plan by which the country was divided into 22 districts, corresponding to existing judicial districts, with two additional for Hawaii and Porto Rico, each under an administrator who is made fully responsible and given ample authority for the enforcement of the law in his district. To bring the whole problem still more directly under the eye of the Secretary of the Treasury and the President, the recommendation of the Secretary of the Treasury to Congress is to create a bureau of Customs and a bureau of prohibition, each with a commissioner directly responsible to the secretary, and to take from the overworked commissioner of Internal Revenue all activity in regard to prohibition enforcement and put it up to the Secretary of the Treasury and such officials as he may designate.

Treaties to Check Liquor Smuggling.—A series of treaties embodying the so-called 12-mile limit or one-hour run for boarding and examination of private vessels under foreign flags have been negotiated, beginning with Great Britain in Jan. 1924, ratified and proclaimed May 22 1924, and including the principal countries of Europe, and Canada, Cuba, Panama and Mexico among near neighbours. These treaties uphold the principle that three marine miles constitute the proper limits of territorial waters but permit the boarding of private vessels outside territorial waters but not at a greater distance than one hour from the coast. As an offset for this privilege foreign vessels are permitted to carry liquors in territorial waters "when such liquors are listed as sea stores or cargo destined for a port foreign to the United States" and are "kept under seal continuously while the vessel on which they are carried remains within said territorial waters."[1]

Civil and Criminal Prosecutions.—An astonishing amount of prohibition litigation is reported by the Dept. of Justice as having been handled by the Federal courts. In an official report issued Sept. 16 1924, covering the $4\frac{1}{2}$ years that prohibition had been in effect from Jan. 16 1920 to June 30 1924, it is stated that there were during this period 195,050 criminal prohibition cases filed; 15,019 trials by jury in prohibition cases; 152,635 persons convicted for violating the national Prohibition Act; and 6,235 persons acquitted. Fines assessed amounted to $20,881,136, of which amount $7,041,564 was assessed during the year ended June 30 1924.

The criminal prosecutions under the National Prohibition Act and other data in connection therewith are given in the table below, and a summary of the number of arrests, seizures, etc., also for the period 1920–5, will be found in a table in the article BOOTLEGGING AND SMUGGLING (*q.v.*). Statistics concerning intoxicating liquors compiled by the Commissioner of Internal Revenue and published annually by the Treasury Dept., prohibition unit, usually in the month of April, should be consulted for further details and verification of these figures.

Mrs. M. W. Willebrandt, Assistant Attorney-General, in her report for the fiscal year ending June 30 1925, gives the following summary of the civil suits to which the United States was a party during the fiscal year and in connection with the Prohibition Act:—

Civil cases pending June 30 1924	5,680
Civil cases terminated	5,927
Judgments against U.S.	444
Civil cases commenced during fiscal year	7,271
Judgments for U.S.	4,471
Dismissed after payment or compromise	71
Dismissed for other reasons	941
Appealed to Circuit Court of Appeals	55
Appealed to Supreme Court	2
Trials by jury	233
Civil cases pending June 30 1925	7,024
Amount of judgments obtained	$303,715
Amount realised from such judgments	$185,548
Amount realised from old judgments, settlements by compromise, etc.	$ 63,570
Amount paid through United States Attorney, on demand, in cases where no actual civil suit was commenced	$ 37,976

Penalties are reported as rapidly growing much stricter and the average jail sentence longer. During the time prohibition has been in effect in Federal courts, the Dept. of Justice report of 1924 stated that 82% of all the persons against whom complaints have been filed for violations have been convicted.

Mrs. Willebrandt, in her report to the Attorney-General for the year ending June 30 1925, is quoted (*World Almanac*, 1926, p. 178):—

It is quite apparent that the Federal judicial machinery has reached its peak in the disposition of cases. If the dockets are to be cleared and the number of pending cases kept at a reasonable figure, it is necessary that additional assistance, both judicial and prosecuting,

[1] For recent treaties of this character negotiated, see article by C. G. Fenwick (*Amer. Year Book*, 1925, p. 43), and for court decisions regarding claims under these treaties, see article by Chas. E. Hill (*ibid.*, p. 226).

Criminal Prosecutions under the National Prohibition Act in Federal Courts

	1920	1921	1922	1923	1924	1925
Pending first of year	..	2,548	10,472	16,761	23,052	23,818
Commenced during year	7,291	29,114	34,984	49,021	54,227	50,743
Terminated during year	5,095	21,297	28,743	42,730	48,623	47,925
Convictions	4,315	17,962	22,749	34,067	37,558	38,498
Acquittals	125	765	1,195	1,770	2,128	1,805
No. 1 Pros. or discontinued	623	2,179	3,549	4,857	4,746	5,500
Quashed or dismissed	32	391	1,250	2,036	4,191	2,122
Pleas of guilty	4,109	16,610	20,571	30,654	33,743	35,034
Trials by jury	332	2,075	3,346	4,835	3,524	5,389
Pending close of year	2,196	10,365	16,713	23,052	23,818	24,684
Fines, forfeitures, etc.	$605,314	$3,360,298	$4,041,456	$5,832,389	$7,577,014	$7,681,947
Realised on fines, etc.	$507,483	$2,418,118	$2,376,305	$4,033,476	$5,682,720	$4,869,503
Collected without prosecution	..	..	$ 847	$ 144,529	$ 84,053	$ 65,430
Sentences imposed	No record	No record	1,552 years	2,241 years	3,187 years	4,569 years

be given at the points where clogged dockets and a continuous inrush of cases make the speedy administration of justice practically impossible. United States attorneys throughout the country are handicapped by insufficient legal and clerical assistance, and in many districts are prevented from promptly disposing of criminal prosecutions by the inability of the courts to give sufficient time to the holding of criminal sessions.

The small penalties provided by the National Prohibition Act are increasingly deplored by U.S. attorneys, judges and other officials charged with duties and conversant with conditions relating to law enforcement. They are disproportionate to the penalties imposed for violation of other Federal laws, and at least for illegal manufacture, sale, transportation and importation, acts receiving particular constitutional condemnation, the penalties should be much higher. Additional judges and increased office help for U.S. attorneys are absolutely necessary to bring about a more speedy disposition of criminal cases in the congested districts.

This judgment is affirmed by many district attorneys and in frequent reports by the present District Attorney for the southern district of New York and his predecessors. This is one of the most difficult districts for enforcement because of the volume of business and the absence of a State enforcement law.

The Cost of Prohibition.—Much controversy has raged over the cost of enforcement. The Federal budget for 1925–6 carried a total of $21,940,529 for prohibition enforcement, which included $12,634,000 for the coast guard. Excluding the cost to the States, which in most cases is more than offset by fines collected, which indeed in some instances are a source of considerable revenue to the States, and excluding the expenditure of the Dept. of Justice on account of the Volstead Act, which, of course, cannot be segregated in the general appropriation for the Dept. of Justice, it is estimated that the total expenditure on account of the prohibition law by the Federal Govt. for the fiscal year 1925–6 will be a little more than $19,300,000. In addition, there will be some capital expenditure for the coast guard, partly attributable to the prohibition enforcement service it renders. The construction of two new coast guard cutters at a cost of $9,000,000 is one such item. The total amount realised on fines in the previous fiscal year was nearly $5,000,000 and the total value of property seized was over $10,000,000. These figures will not be less, and may be considerably more for the current fiscal year. The most conservative estimate of the direct economic benefits of prohibition in dollars and cents, while impossible to estimate with even approximate scientific accuracy on the basis of present records, are nevertheless much greater than the net cost of present enforcement plus the loss of revenue from the Federal taxation of the liquor traffic at its highest level in pre-prohibition days. There is no question but that the Federal taxpayer could afford to increase greatly the expenditure for enforcement of prohibition without having to incur any tax burden on that account.

Economic and Social Results

The only positive economic and social result of prohibition upon which there is substantial agreement among those who oppose and those who favour it is the passing of the saloon. This has been an undisputed gain everywhere, economically, socially and politically. There is no demand for its re-establishment. The low-priced automobile, a home and the expansion of the family budget to include many things that formerly were luxuries, have become in a few years under prohibition and are becoming on an accelerated scale an acceptable substitute for the poor man's club, now recognised as never before as a wasteful and unnecessary adjunct in the domestic economy of the average citizen of moderate means.

The widespread and growing diffusion of ownership of property and the investment of small increments of surplus earnings in good income-producing shares in the working capital of the country have been made possible, to a considerable degree, by prohibition and the consequent removal of the saloon as a temptation and organised agency of exploitation of an appetite and of a human weakness. However great—and it is certainly astonishingly large—has become the organised business of the bootlegger and the illicit liquor traffic it has not and cannot in the very nature of things as an outlaw industry exploit the great mass of people of small means by the direct and effective appeal the saloon was able to make. This is an economic result worthy of consideration and in a measure explains the real opposition to the so-called liberalisation of the prohibition law and the proposal to permit light wines and beer. There is a doubt in the minds of most persons of experience in the administration of liquor laws, not confined by any means to fanatical prohibitionists, whether this can be done without a return of the saloon or some analogous institution which would render as great a social and economic disservice to the community.

Experience in Quebec and in other parts of Canada under state control seems to support this view. From a financial and administrative point of view after four years of operation, the Quebec liquor law was declared an unqualified success by the head of the liquor commission of the province, but there is ample testimony to the fact that the government beer store and the café, authorised to sell beer for consumption on the premises, although no bars are allowed, have brought back in fact most of the disadvantages without some of the obvious advantages of the former saloons. The effect, moreover, upon the illicit liquor traffic and the consumption of hard liquor has not been all that was expected.

Many attempts have been made to appraise the economic and social results as distinguished from the moral and political phases of national prohibition. The records do not exist for a sufficiently long period, nor do they give comparable data for a sufficiently wide area to measure objectively, statistically and by scientific methods enough tests such as arrests for drunkenness, alcoholic psychosis, deaths from alcoholic diseases, etc., in order to arrive at positive conclusions. Most of the statistics available cover only five years at most under national prohibition during a period when the economic life of the country was operating under exceptional conditions of post-War adjustments to excessive economic disturbances and upheaval. This period is altogether too short to determine trends, even if under normal conditions, in so complicated a problem where it is difficult at best to isolate and measure many of the controlling factors.

The Federal Council of Churches Report.—The most comprehensive and best attempt from the point of view of scientific method to evaluate economic and social results is that of the Federal Council of Churches Report (*Research Bulletin No. 5*, "The Prohibition Situation"). For that reason and because its

conclusions were so largely negative and tentative, it has been roundly condemned by both sides to the bitter controversy raging between the "wets" and the "drys." Its most valuable contribution has been to point out the need for better and more uniform records of arrests for drunkenness, of cases of alcoholic morbidity and mortality, of violations of law, prosecutions, sentences, etc., so that after a sufficient period of 10 or 20 years has elapsed we may be able to reach conclusions having scientific validity.

The Federal Council report does furnish some significant samples of data carefully selected from good sources and scientifically handled as far as the samples go. The results of a questionnaire that brought a 10% return from 2,700 members of the National Conference of Social Work—a group of persons enjoying unusual opportunities for careful observation—showed a large preponderance of favourable replies as to the effect of prohibition on the homes of working people in better furnishing of the homes, larger proportion of the husband's income going to the wife and family, improved marital relations, better sanitary and health conditions in homes, better mental health of the home as shown by better family co-operation, respect of children for parents and of parents for children, and by higher educational ideals. Favourable replies also preponderated with respect to community effects such as less children's delinquency, less malnutrition among young children, and liquor for minors less accessible; on the contrary, more drinking by young people as compared with pre-prohibition times, and a worse attitude toward law enforcement and respect for laws in general.

American Bankers' Association Figures.—The official figures of the American Bankers' Assn. for Savings and Individual Bank Deposits are: The *per capita* savings deposits in the United States have increased from $89 in 1912 to $137 in 1920 and $186 in 1924, while the *per capita* total deposits for the same years were $175, $306, and $367 respectively, and total savings deposits amounted to nearly 8½ billion dollars in 1912, over 14½ in 1920, and over 20½ in 1924. Likewise, total individual deposits increased from more than 16½ billions in 1912 to 32½ in 1920, and over 41 billions in 1925; the total number of savings depositors increased from 12½ millions in 1912 to nearly 21 millions in 1920, and over 38½ in 1924. While, of course, other factors besides prohibition enter into this result "it would be idle," says the F. C. report, "to dispute the assumption that prohibition has been a factor, and an important one, in keeping savings deposits on a high level."

Mr. F. Ernest Johnson, in summarising his F. C. report, says ("Prohibition Without Propaganda," *Atlantic Monthly*, Feb. 1926): "Our first important finding was the undoubted material and social gain that has resulted to the nation as a whole from the outlawing of the liquor traffic and particularly from the passing of the saloon. Living conditions among the working people improved, savings were increased, the death rate from alcoholic diseases declined, cases of dependency due to alcoholism became less numerous, arrests for drunkenness fell off very materially, and there was a reduction in the number of arrests for other offences. But the second major finding of the study revealed that these gains were not entirely permanent. The impressive decline terminated abruptly in 1920 or approximately at that time, and a counter-trend was at once established. This trend has continued with disquieting steadiness since that time, with this reservation, that the picture for 1924 shows some indications that the present year may mark the climax of the reaction." The third major finding, he shows, had to do with enforcement. The conclusion was that the machinery of enforcement was stronger in 1925 than it was in 1920 and that the rise of the liquor curve indicates the extent to which the outlaw liquor industry has outstripped the efforts of the Government to perfect its own organisation.

Drug Traffic.—Among the minor findings is that prohibition has had no effect either way upon drug addiction and the drug traffic. This conclusion is supported in an important survey of prohibition and drug addiction prepared by the committee on traffic in opium of the Foreign Policy Assn. and sent to the prohibition unit, July 8 1925. Likewise the F. C. report gives no support to the theory that prohibition has caused a moral breakdown among young people, and this conclusion is substantiated from many other sources. The wholesale charge that respect for law is being broken down by the want of observance of the prohibition laws is shown to rest upon a gratuitous assumption. Finally, the report stresses as its most conclusive finding that social legislation is not a substitute for social education and that "the illicit liquor traffic will be finally overcome only when and where education in temperate living strongly reinforces the arm of the law."

Mr. Hoover's Views.—To revert to the economic issue, so competent an observer as Secretary Herbert Hoover is not quite sure of the moral results that can be safely claimed but stresses and emphasises an economic factor of the greatest importance, namely, the increased productivity of labour. In a formal statement as late as March 1925 (*Christian Science Monitor*) he said:

> There can be no doubt of the economic benefits of prohibition. Viewing the temperance question only from this angle, prohibition has proved its case. I think increased temperance over the land is responsible for a good share of the enormously increased efficiency in production, which statistics gathered by the Dept. of Commerce show to have followed passage of the dry law. Exhaustive study from many angles of production over average periods 10 years apart, before and since the War, would indicate that while our productivity should have increased about 15% due to the increase in population, yet the actual increase has been from 25 to 30%, indicating an increase of efficiency of somewhere from 10 to 15%.

Mr. Hoover also says: "There is no question, in my opinion, that prohibition is making America more productive" and that the increased productivity of labour, which is to be attributed to improved labour-saving devices and the elimination of waste as well as to prohibition, but for which prohibition is largely responsible, is something over and above the natural increase which arises from increased population, higher prices and the inflated dollar. Agriculture is cited as a particularly good example where there has been no increase in the number of farmers for a decade but an annual increase of 7·5 to 17·5 million tons in average exports of agricultural products, which shows that the individual farmer has increased his efficiency in production from 15 to 20%.

As a Moral and Political Question.—The "drys" have been inclined perhaps to overwork the economic argument and the "wets" to over-emphasise the "incubator of crime" argument and to shift the controversy to the moral and political issues involved. The Federal Census of Prisoners 1923 preliminary report, made available in Dec. 1925, throws some light on moral aspects. Commitments to Federal and State prisons and reformatories, and to jails and workhouses, including all county and municipal penal institutions and certain State institutions used for prisoners convicted of misdemeanours, or minor offenses, show for the years 1910 and 1923 (the latter seems to be almost the peak year for the reaction trends affected by prohibition); total commitments, ratio per 100,000 population, 1910 equals 521·7, 1923 equals 325·1, a decrease of 37·7%; drunkenness, 1910 equals 185·9, 1923 equals 83·1, a decrease of 55·3%; disorderly conduct, 1910 equals 99·9, 1923 equals 48·5, a decrease of 51·5%; violating liquor laws, 1910 equals 8·4, 1923 equals 35·8, an increase of 326·2%.

Behind every moral and political issue lies an individual or group economic experience, out of which the moral and political concepts arise and in which they have their roots. Prohibition is fundamentally an economic issue. As that is finally determined in the sober judgment and experience of the American people prohibition will fail or become the accepted permanent policy of the nation. The amendment may never be eliminated from the constitution but it might become as much of a dead letter as the constitutional method for electing the President has been for a century or as ineffective as the 15th Amendment has been for a half-century. That will depend upon the final judgment of the majority of the people upon the economic facts and results. The moral and political questions concerning its enforcement and its effect upon public morals and upon political institutions of the

republic will be shaped accordingly. In a country as large and rich in material resources and capacity for self-government as the United States, it is futile to say that prohibition cannot be enforced, if it can be economically justified, whether a large majority or a respectable minority favour it as a matter of personal preference. That might have been true of even the largest single states surrounded by "wet" areas in close economic relations and activities. It is hardly likely that international sanctions will be necessary for a country as isolated as the United States, though it is by no means certain that they will not be forthcoming as fast as the economic evidence for national prohibition is adequately ascertained and made known. Until that evidence becomes much more conclusive than it is to-day or will likely be for some years, perhaps a generation to come, the average man is apt to rely upon his instinctive moral and political judgments to carry on the social experiment of national prohibition.

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PROHIBITION IN CANADA

In Oct. 1920 prohibition was defeated in British Columbia, but a referendum re complete prohibition of the liquor traffic was carried in Nova Scotia, Manitoba, Saskatchewan and Alberta. In April 1921 Ontario voted Prohibition, and in May Government control became effective in Quebec. In 1923 Manitoba adopted a scheme of government control, a change of policy which was followed by Saskatchewan and Alberta. In Oct. 1924 a plebiscite taken in Ontario gave a majority in favour of the continuance of the Ontario Temperance Act, but the majority in favour of prohibition was considerably reduced. In July 1923 a vote was taken under the provision of the Canada Temperance Act in the county of Stanstead, Quebec, when repeal was carried by a large majority and became effective from Sept. 1923. Seven provinces have carried plebiscites in favour of the prohibition of the importation of intoxicating liquors. Exportation is prohibited from New Brunswick, Prince Edward Island, Manitoba, Alberta and Saskatchewan. It thus appears that whether impressed by the effects of prohibition in the U.S.A. or swayed by the merits and advantages, economic and personal, of a publicly regulated liquor traffic, feeling in Canada is moving towards a wide modification of the position taken up under the stress of war conditions.

In support of the conclusion that the Quebec Liquor Act has proved successful in reducing drunkenness, bootlegging and the illicit manufacture of inferior alcohol, in stimulating the demand for beer and light wines and in effecting a diminution of the use of hard liquor, the following figures are of peculiar significance:—

Arrests for Drunkenness					
	1920	1921	1922	1923	1924
Montreal . .	7,608	6,363	4,356	3,761	1,218
Quebec . .	1,162	875	833	833	288
Hull . . .	1,894	1,144	1,004	876	263

The Quebec Liquor Commission established stores where alcohol is sold in sealed packages—one bottle at a time between 9 A.M. and 6 P.M. except on Saturdays (9 A.M. to 1 P.M.). On holidays and election days the stores are closed. Wines and beers are sold in licensed hotels, restaurants, etc. The alcohol sold is submitted to analysis. No store for the sale of alcohol or wine may be opened in a municipality which is opposed to it. (See *Canada Year Book* and the *Report* of the Quebec Liquor Commission.)

PROLONGATION OF VIGOUR: *see* REJUVENATION.

PROPAGANDA.—With the advent of the World War, propaganda took on the character of a new, if inexact, science. Germany was the first to realise its value as one of the weapons of war and was the first to reap advantages from the military situation; for propaganda, a word which has come into considerable disrepute, is in its proper sphere the presentation of a case based on reliable evidence, and the best and most effective propaganda during the War was military success. But there was a large and vitally important field concerning war responsibilities and war aims, which, together with the nature of military and naval progress, influenced the decision of countries which subsequently became combatants on one side or the other. It was an important, if subsidiary, element of diplomacy and war operations.

Propaganda had several distinct phases. The first was the maintenance of what was known as "the home front," the second the disheartening of the enemy, and the third the persuasion of neutral states and potential allies of the justice of the cause and its inevitable victory, not only from the point of view of military co-operation, but also from that of obtaining necessary supplies.

The Home Front.—The first phase, namely the maintenance of national determination, started with everything in its favour. In all the countries which entered the War during the first few weeks, the people were solidly behind their governments, believed in the cause for which they were fighting and were confident of victory. Public men of all parties and every class, and virtually the whole national press became propagandists at once, and this also in itself was already, though incidentally, propaganda abroad. It became necessary, however, to organise it carefully as the War developed, especially to meet times of stress and failure.

Of all people, it is probably just to say that the British were treated most frankly by their Government, but the exigencies of the struggle for existence involved in all states a not always inexcusable suppression of facts. This, accompanied by exaggeration of facts, was undoubtedly responsible to some extent for giving propaganda its bad name, but the main cause was falsification of facts, sometimes through incomplete information but more frequently through deliberate intention. It took some states a long time to realise, and some others never fully learnt, that false information ultimately defeated its own purpose, but it sometimes gave momentarily apparent advantages. A military engagement, for example, described by both sides as a victory gave the propaganda advantage to the loser, at any rate until such time as experience had indicated how such contradictory statements should be read and analysed, because it left in doubt the rightful claims of the victor. False news in the political field was very much more difficult to check.

Work in Neutral States.—One of the hardest problems was to retain or gain the sympathy of neutral states and to dishearten the enemy. In some of the smaller states there was reluctance, while the military situation was uncertain, definitely to show sympathy for one side or the other, and the rigid censorship maintained by all nations at war made it difficult for anything but favourable versions of events to reach the home public. The methods pursued in this task were roughly the same in all countries. Governments built up special departments composed of people acquainted—or supposed to be acquainted—with publicity methods and with the political and psychological conditions of different countries of the world. There was a great difference, for example, between the way in which a case should be made to appeal to the United States of America, to Holland and to the Far East.

Every government issued a regular wireless service; large sums of money were spent on cables, and on subsidising press agencies and neutral newspapers (which sometimes became so partisan as to lose completely their value); new agencies were started in camouflaged form and in some cases new journals and illustrated periodicals published. Every embassy and legation was a propaganda centre in some form or other. Neutral pressmen were invited to the fighting front to describe the confidence of the soldiers; to the fleets to see their invincibility; to the home factories to observe their adequacy for meeting all requirements; to the prisons to describe the happy state of war prisoners. Articles and letters were sent abroad in thousands. This was all organised from home, with agents of every sort and kind all the world over, including neutrals and in a limited number of cases, enemy subjects as well.

Switzerland, situated between France, Germany, Austria and Italy and containing a mixed population with affinities with both sides in the struggle, was a cockpit of propaganda, diplomacy and espionage. Agents poured into a country which was such a useful centre to get material into enemy lands on either side. It is recorded, for example, that Lenin, who, with Trotsky and Radek, lived some time in Switzerland, was able to get revolutionary pamphlets from Berne to the Russian and German trenches, and many ruses were successfully adopted to accomplish this sort of thing all round.

The world was filled with a mass of confused and contradictory tales. For a considerable period this was so baffling that propaganda had the effect of cancelling itself out, but later on a certain art was developed in making proper deductions; it was not impossible, even amidst the confusion, to gain an approximate idea of what was, in fact, happening. The wiser participants in the game found that often a studied understatement had more effect, actual and ultimate, than glowing exultation.

Wireless Propaganda.—In the wireless fight, the Germans, with their powerful station at Nauen, were better equipped technically than any of the other powers, and this was important for them as they were prevented by their geographical war position from using many of the ordinary means which were at the disposal of their opponents for reaching countries far afield. They used it not only to reach more distant parts of the earth than could be at first reached by other stations, but also for the despatch of press messages by neutral press correspondents, and as many as 10,000 or 15,000 words a day were included in this way for America. Not much of this wireless, either from Germany, from Great Britain or from other countries received newspaper publicity, but it undoubtedly served many useful purposes. It remains a puzzle to understand why some enterprising neutral paper did not regularly publish in parallel columns the arguments and descriptions issued from the various wireless stations. They were sometimes ridiculous and frequently amusing. The practice of the British Govt. was to release the more ridiculous and amusing features of enemy wireless, which could be done with great effect.

Much was made on either side of admissions, or of appearances of discouragement in enemy countries, two of the more notable incidents being the German use of the Lansdowne letter which questioned the possibility of complete victory for either side, and the British use of Prince Lichnowsky's memorandum on the British pre-War desire and work for peace. They were given the utmost possible circulation in many languages. Exhaustive statistical information was issued to show that Germany was on the point of starvation, or that her manpower and supplies were failing and the same methods were applied to show the precarious situation of Britain.

These accounts of enemy distress had considerable effect on the home populations, despite the fact that each side was able to convince its own people of the exaggerations or suppressions of the other. The German accounts of the results of air raids on Great Britain could be actually tested by the population, and the remarkable success with which the British people were kept ignorant of the incident of H.M.S. "Audacious" (which was fully described in the neutral and enemy press) was not without its value to Germany, whatever might have been the military reasons for British suppression. Exaggerations served some purpose, however, in forcing admissions from opponents. The German claims in the submarine campaign compelled the British Govt. to give its people some idea of what the circumstances were, and depressing facts had to be issued. These, in turn, just because they were unpleasant admissions, had the effect of diminishing belief in German claims.

Efforts on the Fighting Front.—Direct efforts to make an impression on the enemy, apart from the intense efforts through neutral countries, were made on the fighting fronts. Imitation newspapers, leaflets and all kinds of material were sent across the lines by means of aeroplanes, balloons and hand-grenades, but it is doubtful whether this had any real influence until the actual military situation made the information at least plausible. The British and Allied peoples undertook a big offensive of this kind in 1918. The organisation of it on a large scale began in England before the great German offensive in March, but its execution reached its full height when it was clear to all that Germany must lose the War. The millions of leaflets dropped over and behind the German lines during the summer of 1918 brought deadly confirmation to the already disturbed minds of the German soldiers and people, and although it was not unnatural for the German military leaders to attribute, as they subsequently did, an undue share of the causes of their defeat to this propaganda of their opponents, it did, very probably, by helping to confirm the growing German fears, take the heart out of any further prolonged resistance which might possibly have been demanded of them.

Propaganda After the Armistice.—With the end of the War the political side of propaganda was continued with reinforced energy. At the Paris Peace Conference there was an inexhaustible supply of documents containing a whole variety of arguments and claims, and no body of statesmen could ever have met in circumstances where the enormous problems to be settled were "propagandised" with such highly developed resources. This intensity gradually slackened during the years after the peace treaties had been concluded, but there has remained a widely applied system of official Press bureaux as a part of the normal State equipment, with Press attachés at embassies and legations to explain and defend national peacetime causes. They differ somewhat in character and influence and on the whole are marked by a growing sobriety. But there still exists a propaganda state of mind which differs from anything experienced before the war. (H. R. C.)

PROPELLER: *see* AIRSCREW.

PROPERTY, LAW OF (*see* 22.440).—From time to time in English history drastic changes in regard to land tenure have been carried into effect as part of the evolution of national life. One such change has been accomplished by the passing of the Law of Property Act 1922 and the series of Acts into which that great measure was subsequently divided. The effect is almost comparable with that produced upon Roman Property Law by Justinian's legislation. The new Acts consolidate and codify all that remained unrepealed of the statute law relating to land from the time of Edward I. to the present date, incorporating in the process much of the common law that has hitherto obtained.

The Act of 1922 finally carried into effect much of what was "in the air" in Commonwealth days when military tenures were abolished and suggestions were first made for the starting of a land register—an object in part effected during the 19th century. The history of this achievement may be told quite shortly. In 1908, following attempts begun in 1895 to amend the existing law in various ways, a royal commission was appointed to consider the working of the Land Transfer Acts. As a result of the work of the commission, a bill was introduced into Parliament shortly before the outbreak of the World War with the object of assimilating the law of real to that of personal property. This was suspended until after the War, but in 1919 a committee was nominated to advise upon the whole matter. This resulted in a bill being introduced in 1920 in the House of Lords, which, after review by a joint committee of both Houses, was approved and finally passed as the Law of Property Act, 1922.

Two principal motives underlay the Act. It aimed at simplifying generally the law relating to the tenure and devolution of land and houses and at cheapening the cost of sale, purchase, mortgage and other like transactions by cutting away the anomalies and abuses still left as remnants of that feudal system which itself was brought to an end more than 200 years ago. In order to bring about these results it was first of all necessary that there should be one set of rules only governing property in land. Hence all local and customary tenures had to be abolished and that has been done just as the old military tenures were done away with in Commonwealth times and their abolition confirmed by the Statute of Tenures passed in the first year of Charles II. Moreover, there being two systems of land tenure in operation side by side, viz., freehold, and customary (including copyhold) each with different incidents and each submerged in archaic technicalities peculiar to itself, it was most essential that in land, as in chattels, there should be one legal, absolute and ostensible ownership, whatever other interests there might be apart from ownership. That has been achieved by converting all freehold estates into fee simple, subject, where necessary, to appropriate equitable interests; whilst mortgage is now made by demise, the mortgagor having the legal estate and the mortgagee holding for a term of years—thus reversing the former position, in which the mortgagee had the legal and the mortgagor an equitable estate.

The simplification of the law of property itself was accompanied by a simplification of the several processes by which sale, purchase, mortgage and the like transactions could be carried through. What had been begun by the Act for the Abolition of Fines and Recoveries in 1833 and continued by the various Conveyancing Acts since passed has been completed notably by the repeal of the Statute of Uses. Further, the law of realty has now been largely assimilated to that of personalty. Primogeniture has been abolished, and both real and personal estate devolve upon intestacy in the same way. The heir-at-law disappears and an entirely new code is provided which places husband and wife on the same terms with regard to each other's property and the property of intestate children.

The wide scope of the Act of 1922 was shown in its preamble, which ran as follows: "An Act to assimilate and amend the law of real and personal estate, to abolish copyhold and other special tenures, to amend the law relating to commonable lands and of intestacy, and to amend the Wills Act 1837, the Settled Land Acts 1882 to 1890, the Conveyancing Acts 1881 to 1911, the Trustee Act 1893 and the Land Transfer Acts 1875 to 1897." After it had been passed, its operation was suspended until an amending Act embodying various modifications had been passed and later a series of measures into which its various sections, as amended, had been divided and embodied.

Abolition of Customary Tenures

There still remains unrepealed, however, a substantial portion of the Act of 1922 itself, viz., parts V. and VI., which deal with the abolition of copyhold and customary tenure and the extinguishment of manorial incidents; part VII., which relates to the conversion of perpetual leaseholds; and certain schedules. The effect of these enactments may be summarised thus:—

1. *Enfranchisement of Copyholds.*—As from Jan. 1 1926 every parcel of copyhold land became automatically converted into freehold, and the original tenant (or the person for the time being entitled) was to receive a document termed an "assurance," which, upon production within six months thereafter to the steward of the manor of which the land formed part and upon payment of all dues in respect of fines, reliefs, heriots, rents or fees, was to be endorsed by a certificate which operates to give to the holder the full legal estate.

2. *Extinguishment of Manorial Incidents.*—Certain manorial incidents connected with copyhold tenure are made to disappear at once, viz.:—

(1) Liability for forfeiture for conveyance or attempted conveyance or for alienation without licence, whether by sale, lease, mortgage, or otherwise;

(2) Customary suits and services and fealty;

(3) Escheat (subject, however, to escheat to the Crown in certain cases of intestacy as *bona vacantia*); and

(4) Borough English, gavelkind, and other customary modes of descent, dower, freebench, tenancy by the curtesy, and like customs, in pursuance of the new law as to devolution of property (*see* Administration of Estates Act below).

Another set of manorial incidents are "saved" temporarily—that is to say they remain as at present until extinguished in accordance with the general scheme for their ultimate abolition. These are:—

(1) Quit-rents, chief-rents and other similar rents and payments;

(2) Fines, reliefs, heriots and dues (including fees payable to stewards);

(3) Forfeitures other than as set out above; and

(4) Rights as to timber.

All these must be extinguished in one of three ways: (*a*) by agreement as to compensation between lord and tenant, or (*b*) by notice to fix compensation served by one upon the other (but the lord may not serve such notice before Jan. 1 1931), or (*c*) if no agreement or no service of notice has been effected within 10 years after Jan. 1 1926 then by automatic expiry at that date.

Certain manorial rights and liabilities are preserved. They are not to be regarded as "manorial incidents" for the purposes of the Act, but they may become such by agreement between the parties. They are:—

(1) Rights of common enjoyed by the tenant;

(2) Mining and mineral rights, franchises, royalties and privileges in respect of fairs and markets and sporting rights enjoyed by the lord; and

(3) All existing liabilities, however arising, as to the construction or maintenance or cleansing of dykes, ditches, canals, sea or river walls, piles, bridges, levels, ways and other works required for the protection or general benefit of any land within a manor or for abating nuisances therein.

Compensation for the extinguishment of manorial incidents is payable to the lord of the manor according to scales provided in the rules made by the Minister of Agriculture (No. 810 of 1925), and stewards are also compensated for loss of their office and fees upon an equivalent basis. Compensation moneys may be paid either in a lump sum or by a terminable rent-charge.

3. *Conversion of Perpetually Renewable Leaseholds.*—Perpetually renewable leases and underleases are converted into long terms (*i.e.*, of 2,000 years) at the rent and subject to the covenants and conditions and other provisions originally payable or enforceable.

Out of the rest of the Act of 1922 have sprung seven new statutes, each of which is in itself a consolidation Act, viz., the Law of Property Act 1925 (15 Geo. 5 c. 20); the Settled Land Act 1925 (15 Geo. 5 c. 18); the Trustee Act 1925 (15 Geo. 5 c. 19); the Land Registration Act 1925 (15 Geo. 5 c. 21); the Land Charges Act 1925 (15 Geo. 5 c. 22); the Administration of Estates Act 1925 (15 Geo. 5 c. 23), and the Universities and College Estates Act 1925 (15 Geo. 5 c. 24). The whole system of legislation came into operation on Jan. 1 1926. From the summary which follows we omit the Universities and College Estates Act, which consists only of consequential provisions relating to the Universities of Oxford, Cambridge and Durham (with their constituent colleges) and the public schools of Eton and Winchester.

Tenure and Devolution of Property in Land

Estates and Interests in Land.—The Law of Property Act 1925 introduces far-reaching changes into the English law relating to the tenure, transfer and devolution of property in land. It is divided into 12 parts and contains seven schedules. It embodies the changes originally introduced by the Law of Property Act 1922 as amended by the Law of Property (Amendment) Act 1924 and in effect provides an entirely new code of law governing the subjects within its scope.

General Principles as to Legal Estates, Equitable Interests and Powers.—As from Jan. 1 1926 the only estates in land capable of subsisting or of being conveyed or of being created at law will be:—

(*a*) An estate in fee simple absolute in possession;

(*b*) A term of years absolute;

and the only interests or charges in or over land:—

(*a*) An easement, right or privilege for an interest equivalent to an estate in fee simple absolute in possession or a term of years absolute;

(*b*) A rent-charge in possession issuing out of or charged on land, being either perpetual or for a term of years absolute;

(*c*) A charge by way of legal mortgage;

(*d*) Land tax, tithe rent-charge, and any other similar charge on land which is not created by an instrument;

(*e*) Rights of entry exercisable over or in respect of a legal term of years absolute, or annexed, for any purpose, to a legal rent-charge.

All other estates, interests, and charges in or over land take effect as equitable interests.

The only powers now left to operate are such as are (*a*) vested in a legal mortgagee; (*b*) vested in an estate owner in right thereof and exercisable by him or by another person on his behalf; and (*c*) special statutory powers under various Acts. All such are to be known as "legal" powers whilst all others are to be termed "equitable" powers. The Statute of Uses is repealed together with section 62 of the Conveyancing Act 1881—all legal interests of the sort formerly created thereunder to be equitable interests only, if created after 1925. Liability to death duties is made incidental to the ownership of legal estate, except in the hands of a purchaser for value, but without prejudice to existing liabilities. The parties accountable will be (*a*) the personal representative and (*b*) the legal owner.

An important change is made by treating husband and wife as two persons for all purposes of the acquisition of property under a disposition operating after 1925.

Contracts, Conveyances and other Instruments.—Part II. of the Act re-enacts various provisions of the repealed statutes and introduces numerous variations in the existing law and practice of conveyancing. It deals very drastically with the subject of title on sale, providing *inter alia* for the substitution of 30 years in place of 40 as the period of the commencement of title. It re-enacts with some variations part of section 4 of the Statute of Frauds, making it necessary that in future all contracts for the sale or other disposition of land or any interest in land shall be in writing. Whilst, with a few exceptions, all conveyances of land or of interests therein are to be void for the purpose of creating legal estate unless made by deed.

In abstracts prepared after 1925 it is not to be deemed necessary or proper to include an instrument relating only to interests or powers that will be "over-reached" by the conveyance of the estate; but equitable interests or powers which will not be so over-reached must be properly disclosed.

Mortgages, Rent Charges and Powers of Attorney.—Where a mortgage of land is created by deed expressed to be by way of legal mortgage the mortgagee is to have the same protection, powers and remedies as if he had, in the case of freeholds, a mortgage term of 3,000 years (that being the term into which under the Act all existing mortgages are to be converted); whilst appropriate provisions are added to bring mortgages of leaseholds into sub-terms on the same lines. The effect will be that in future each party will get a term—the first mortgagee for 3,000 years—and subsequent mortgagees a slightly longer and sub-mortgagees a slightly shorter term than the first mortgagee by way of preserving a nominal reversion.

Law of Entail.—In future, an estate tail will only be created by using the words "heirs of the body" or a statutory equivalent, in deeds and wills. Enrolment of disentailing assurances is done away with, and the "Rule in Shelley's Case" is abrogated.

Leases and Tenancies.—Here some important changes have been introduced, including the abolition of the doctrine of *interesse termini, i.e.*, the right which rests in the lessee of lands under a demise before he enters into possession and becomes tenant under the lease. In future, all terms for years absolute take effect from the date fixed for commencement of the term, without actual entry and by way of transmutation of possession.

Powers of Appointment.—Special provisions are made to meet cases of fraudulent appointment. An instrument purporting to appoint is not, save in certain exceptional circumstances, to be void against a purchaser or person deriving title under him in good faith, dealing with an appointee not less than 25 years of age, for valuable consideration, and without negligence.

Perpetuities and Accumulations.—The rule prohibiting the limitation of land to the issue of an unborn person after a life estate given to that unborn person is no longer to operate. Other changes are made affecting perpetuities and the accumulation of surplus income.

Married Women and Lunatics.—The existing statutory provisions affecting these two classes of persons are re-enacted in more definite form—additional powers being given to the Court in regard to both. In these respects the Act dovetails in with the provisions relating to these classes of persons to be found in the Settled Land and Trustee Acts (which *see*).

Voidable Dispositions.—The law is strengthened in regard to fraudulent conveyances.

Wills.—Necessary changes to meet the general scheme of law reform are made in the disposition of income derivable from freehold land.

Marriage is not to revoke a will expressed to be made in contemplation of marriage; and the law is clarified as to the right of a bastard to dispose of realty or chattels real by his will.

Public Access to Commons.—Of the miscellaneous matters being dealt with in Part XI. the most important is the provision giving right of access to the public for "air and exercise" to metropolitan commons, manorial wastes, and any manorial lands subject to rights of common which are made subject, temporarily or otherwise, to these added public rights by the wish or consent of the manorial lord.

Administration of Estates.—By the Administration of Estates Act 1925 the law relating to the administration of the estates of deceased persons has been drastically altered, and the statute book has been cleared of the whole growth of legislation upon the subject that has accumulated since the time of Edward I. Its sweeping changes can best be appreciated by reference to the Act itself; and its text—unlike that of most Acts of Parliament—is by no means difficult for the layman to follow. One of the principal objects of the whole scheme of reform was to assimilate the law of real to that of personal property. The Administration of Estates Act carries that assimilation into practice chiefly in respect of the law of intestacy. Under the old law, which obtained until 1897, when the net value of the real and personal estate of a person dying intestate exceeded £500, his widow (if any) was entitled to £500 as a prior charge subject to which all freehold estate went straight to the heir-at-law without the intervention of any personal representative, whilst leasehold property was classified as personal estate and as such went to the personal representative. The Land Transfer Act of 1897 introduced intervention of the personal representative in the devolution of real estate; but now, by the Administration of Estates Act 1925, legal heirship, dower and curtesy and all similar customary methods of descent are abolished and an entirely new system is set up under which real and personal estate both devolve upon the personal representative to be held by him, as to the real estate upon trust to sell the same and as to the personal estate to call in and realise also, and then, after payment out of the total proceeds of the entire estate of funeral and testamentary expenses and debts of deceased, to dispose of the residue in accordance with the rules of distribution applicable to the case.

Trustees and Settlements

Trustee Act 1925.—This measure consolidates the whole law regarding trustees, their duties and liabilities, into one Act, absorbing in the process the various changes introduced by the Law of Property Acts 1922 and 1924. The provisions of the Act require to be read at many points in conjunction with one or other of the several statutes grouped with it in the entire scheme for amending the law of property. Thus, in the matter of vesting deeds and trust instruments generally its provisions dovetail in with those of the Settled Land Act; and in regard to trusts for sale with those of the Law of Property Act 1925. Other provisions correlate closely with those of the Administration of Estates Act.

Enlarged powers are given to trustees with regard to compounding of liabilities, employment of professional agents, sale by auction and other administrative matters. Greater indemnity is provided against their liability for negligence for which they personally were not to blame. Enlarged powers are bestowed in regard to the lending of trust monies upon security for repayment and in regard to mortgages upon land sold or leased up to 500 years. On the other hand, there is increased liability in respect of investment in industrial securities. Generally, the Act reviews the whole subject of investments. Entirely new arrangements are made for the appointment and discharge of trustees, in the interests of expedition and the saving of expense—particularly by obviating as far as possible the need for applications to the Court.

Settled Land Act 1925.—This Act, standing alone, constitutes a great measure in itself. It contains 120 sections and five schedules. It repeals and consolidates all existing enactments relat-

ing to settled land in England and Wales and introduces many new provisions originating in the Law of Property Act 1922 and the later amending Act of 1924.

The Act defines " settlements " and " compound settlements " and makes special provisions in the interest of infants and married women. It applies the new system affecting estates in land under the Law of Property Act 1925 to settled land and deals in detail with vesting deeds and trust instruments. The whole position of the tenant-for-life and of a limited owner having the powers of a tenant-for-life comes under review, and extended freedom is given in regard to sale and exchange, leasing powers (both in regard to the land or to any easement attaching to it), investment of capital moneys, expenditure on improvements, etc. A new power is given to treat as one whole estates settled by different settlements upon the same limitations, and special provisions are made for the protection or recovery of land settled or claimed as settled.

The powers of trustees in regard to management of landed estates during the minority of the tenant-for-life are reviewed, and important restrictions are imposed in some directions, while in others greater freedom is permitted and the powers and duties of trustees generally are rendered less onerous. These powers and duties, however, are more fully dealt with in the Trustee Act.

Registration of Titles and Charges

Land Registration Act 1925.—Under this statute a remodelled scheme of law relating to the registration of title has been introduced, and although it has not created any new legal principle it has done what was needed to bring registration of title into line with the other changes effected by these Acts. In future, the only person who may apply to have a title registered must be either (1) the owner of a legal estate (not being an infant) or (2) a person—other than a mortgagee or a person who has merely entered into a contract to purchase—who is entitled to demand a legal estate. Prior to this, mere contractors to purchase could register. Formerly, money was raised on registered land by way of registered charge. This system has been enlarged and a registered proprietor may raise money alternatively by mortgaging the land as though it were not registered and protect it by a " caution " in a prescribed form—the land certificate in either case then being deposited in the registry until the mortgage or charge is cancelled.

Registration of title has not hitherto been compulsory in all parts of the country. It has been open to a County Council by resolution adopted at a meeting attended by two-thirds of its members to enforce compulsory registration within its own county. This right is continued for the time being, but 10 years hence (*i.e.* in 1936) the new method will be introduced of requiring compulsory registration in any county by Order in Council subject to the right of the County Council or of any law society whose area is affected to insist upon a public enquiry before any such Order is made. Where unregistered land situated in a compulsory area is sold and conveyed the purchaser is required to apply for registration within two months—otherwise the conveyance will be void as regards the legal estate. Adverse possession will give a good title to registered land upon proof of title in the same way as it will to unregistered land: so that if a man is in adverse possession of registered land under circumstances which (had it not been registered) would have enabled him to extinguish the title of the registered proprietor he will be able to secure the legal estate by virtue of his adverse possession.

The Act contains new provisions in regard to the bankruptcy of registered proprietors of land. When a bankruptcy petition is presented it may be registered under the Land Charges Act and a " creditors' notice " will then be placed against the title—which will affect the rights of all creditors. If, in due course, the proprietor is adjudicated bankrupt, his trustee is entitled to become registered proprietor, but he cannot deal with the land until he has become so registered. Moreover, if he fails to do so immediately he may be postponed to other claimants in certain events.

Death Duties.—Very important provisions (some of them entirely new) relate to death duties. As regards such duties arising before the Act the old provisions of the Land Transfer Acts remain: but as to those becoming due after Jan. 1 1926 new rules have been made. When a registered proprietor dies a notice of the pending liability is to be entered on the register, and thereafter no transactions will be registered without the cognisance of the Inland Revenue authorities. The liability for death duties in respect of the land will rest upon (*a*) the personal representative in whom it has become vested, or, alternatively, (*b*) in the registered proprietor other than a purchaser who has acquired it free from the charge in respect of duties.

Land Charges Act, 1925.—This, an Act dealing entirely with ministerial matters arising out of the new legal system, is described in its preamble as " An Act to consolidate the enactments relating to the registration of pending actions, annuities, writs, orders, deeds of arrangement, and land charges, and to searches." It aims at simplifying the procedure by which purchasers of land can find out what, if any, encumbrances exist upon it and all else regarding threatened litigation affecting it. One very important change is involved in the requirement that all mortgages which are not protected by the deposit of title deeds must be registered as land charges. Such registration is to operate as formal notice, and failure to register will render the charge void as against a purchaser. (W. M. F.)

PROPORTIONAL REPRESENTATION: *see* ELECTORAL LAWS.

PROTESTANT EPISCOPAL CHURCH (*see* 22.473a).—The progress of this Church in the United States, so far as its organisation and official life are concerned, is registered largely in the activities of its Triennial Convention. In the convention of 1910, stimulated by the recent missionary conference in Edinburgh, action was taken toward calling a world conference on faith and order for all churches believing Jesus Christ to be God and Saviour of the human race.

The date and place set for the conference was 1927 in Lausanne. All the major churches in Christendom, excepting the Roman Catholic Church, will send representatives. The movement is indicative of the interest of the Episcopal Church in unity. In 1913 the long-standing Article of the constitution providing for provincial organisation was made effective by the passage of a canon uniting the dioceses and missionary districts of the Church into eight provinces with limited jurisdiction. Every attempt to give the provinces real authority to the relief of the presiding bishop and of the general convention has thus far (1926) failed. Under the leadership of the Bishop of Massachusetts (Dr. Lawrence), in accordance with action by the general convention of 1913 a pension fund was set up on actuarial calculations, taking cognisance of accrued liabilities, which has since become the model of similar funds in other churches.

The Book of Common Prayer.—The revision and enrichment of the Book of Common Prayer (*see* PRAYER BOOK) has been discussed and progress made, consuming much time, for five successive conventions, and comes to a close in 1928. During the World War the Episcopal Church took its stand behind the government and lent its personnel and resources in aid of the country and its Allies. In the last convention (1925) action was taken in the House of Bishops looking toward a declaration of the Church's mind on war.

The National Council.—A far-reaching change was made in 1919 in the organisation of the Church by the establishment of the presiding bishop and council as the executive body of the general convention acting between sittings. This body, later termed the national council, began with four departments—missions and church extension, religious education, Christian social service, finance and publicity, " with power to organise such other departments as the work might demand." The budget system was adopted for the general work of the Church. The Rt. Rev. Dr. Gailor was elected president of the council. In 1923 the venerable Bishop Tuttle died after holding the position of presiding bishop of the Church for 20 years. He was succeeded by Bishop Garrett, and upon his death Bishop Talbot became presiding bishop, continuing in office until

Jan. 1925, when he was succeeded by Bishop Murray. Bishop Murray became the first presiding bishop by election, the office hitherto having gone to the senior bishop of the Church by consecration.

The activities of the Church have been greatly enlarged since 1919. Work among foreign-born has been intensified, relations with oriental churches have been enlarged and missionary responsibility systematised and consolidated. Twice—once by a fraction of the lay vote and three years later by a tie vote in the House of Bishops—the Episcopal Church has refused to become a constituent member of the Federal Council of the Churches of Christ in America. In 1925, through its national council, it increased contacts from two to eight with corresponding departments of the Federal Council.

Statistics.—The Episcopal Church in 1925 numbered 1,193,321 communicants, an increase of 264,541 over 1910. There were 6,140 clergy (1,400 of whom are non-parochial) and 3,740 lay readers ministering to 8,397 parishes and missions. The number of candidates for Holy Orders was 454. There were 498,814 scholars in Sunday-school. The dioceses and missionary districts numbered 104. The total contributions for 1925 amounted to $41,746,055. The Episcopal Church is strongest in the great centres of the East, but it declines in strength toward the West. See the *Journal* of the General Convention 1910–25.

(C. H. Br.*)

PROTHERO, SIR GEORGE WALTER (1848–1922), British historian, was born in Wiltshire Oct. 14 1848, being the eldest son of Rev. G. Prothero, Canon of Westminster Abbey. Educated at Eton, he went from there to King's College, Cambridge, of which society he became a fellow. For a time a master at Eton, he soon returned to Cambridge as lecturer and tutor at King's College, where he was senior tutor from 1881. In 1884 he was appointed university lecturer in history; in 1894 he went to Edinburgh as professor of history; and in 1899 he succeeded his brother Rowland, afterwards Lord Ernle, as editor of *The Quarterly Review*. During the World War he was director of the historical section of the Foreign Office and in that capacity he attended the Peace Conference in Paris. He was created K.B.E. in 1920 and died in London July 10 1922.

Prothero's chief historical works are *The Life and Times of Simon de Montfort* and the collection of authorities entitled *Select Statutes and other Constitutional Documents*. He was editor of the Cambridge "historical series" and one of the editors of *The Cambridge Modern History*.

PROTIĆ, STOJAN (1857–1923), Yugoslav statesman, was born at Krušvak Jan. 29 1857 and at first entered the Government service. He soon came into conflict with the repressive régime of King Milan and in 1882 became editor of *Samouprava* and a leader of the new Radical party. He was imprisoned for a press offence in 1883 and again in 1885. He held subordinate posts in the Radical Cabinet of 1887. In 1899 an attempt on King Milan's life was used by the Government to rid itself of its Radical rivals. Protić was sentenced to 20 years' hard labour, although, in fact, he had no connection with the crime. Pardoned nine months later, he became director of the National Library. After the revolution of 1903 he represented the Radicals in the first provisional Cabinet under King Peter and remained Minister of the Interior in most of the succeeding Cabinets down to 1907. He was Finance Minister during the Bosnian crisis and again became Minister of the Interior during the period of the Balkan Wars and the European crisis of 1914. Early in 1914 he came into conflict with the "black hand," a secret terrorist organisation in the army. This conflict is one of the best proofs that the Serbian Government had no connection with the "Black Hand" in its alleged share in the Archduke's murder.

Protić remained out of office during the period of coalition Government from Dec. 1914 to June 1917, but continued to exercise great influence in the background. He was returned to office in 1917 and played an active part in the negotiations leading to the Corfu agreement between the Serbian Govt. and the Yugoslav Committee. He showed more comprehension for the Croat and Slovene standpoint than his colleague Pašić, and when the conflict between Pašić and Trumbić in 1918 delayed the recognition of Yugoslavia by the Allies and created an awkward situation with Italy, Protić was appointed the first Premier of the new Yugoslav State. He was keenly interested in the constitutional problem, and after his resignation in Aug. 1919 published his own draft project. Disagreeing with the exaggerated centralism of Pašić, he declined office in 1921 and drifted steadily away from his old colleague. Protić died in Belgrade in Nov. 1923. His publications include *The Aspirations of Bulgaria* (1916) and *Le problème Albanais*, etc. (1913), issued under the pseudonym of "Balkanicus."

PROTOZOOLOGY (*see* 22.479), is that branch of zoology which is concerned with the group of animals known as the Protozoa. The Protozoa are very interesting and important animals, from both the practical and the theoretical standpoint. Nevertheless, they are all small, and most of them are of microscopic dimensions. To the general public they are therefore invisible, and consequently unknown, except by the conspicuous results—such as diseases—which they occasionally produce. In common speech they are still nameless, though they are popularly included among "animalcules" and "microbes." But these are unscientific and unnatural groups, which comprise all microscopic creatures, both animals and plants; and consequently the protozoa are still confused, in the popular mind, with other "microbes," such as the Bacteria (*see* Bacteriology), with which they have no connection.

As an individual science protozoology only became self-conscious at a quite recent period. The name itself, though already in use between 1870 and 1880, only became current after the opening of the 20th century—that is to say, within the memory of many living zoologists. But the science was really born—though not baptised—when the first Protozoa were discovered, in the latter half of the 17th century, by a man who was neither zoologist nor physician, but a draper who occupied the position of chamberlain to the sheriffs of the little town of Delft in Holland—Antony van Leeuwenhoek (1632–1723). This remarkable man made his own microscopes, lenses and all, and turned them upon almost every object which suggested itself to his quick imagination. In the course of his work he examined the water from the leaden gutters of his house, from the well in his courtyard and also fresh rain-water, snow-water, and "the water wherein pepper had lain infused." He found that all these liquids and many others, were not clear and empty when viewed by the microscope, but teeming with living creatures. The discovery was promptly communicated by letter to the Royal Society in London, who published a part of it in the year 1677. Some of the animals which Leeuwenhoek there described can now be identified as Protozoa and his letter may therefore be regarded as the first page in the history of protozoology.

Leeuwenhoek, the father of protozoology, himself studied and described many Protozoa and his observations were soon repeated and confirmed by others. But for many years protozoology made little progress, and remained essentially what it was originally—an amusement rather than a science. Although many good observations were made and recorded, they were always disjointed and often distorted by fancy and speculation. Many good zoologists regarded with doubt and misgiving everything seen with the microscope, an attitude of mind which has not quite disappeared even in these days of perfect instruments. Even the great Linnaeus (1707–78) never overcame his suspicions sufficiently to incorporate the Protozoa firmly in his system. His mental attitude is shown in the name "*Chaos infusorium*," with which, in 1767, he dubbed a mixed lot of questionable protozoal organisms—the term *Chaos* itself having been suggested, no doubt, by Ovid's "*rudis indigestaque moles*."

But already at this period many workers were convinced that the protozoa—or "infusoria," as they were then called from their occurrence in infusions—have a real existence. The once notorious John Hill (1716–75) in 1752 for the first time scientifically named a number of Protozoa which he had seen in infusions. But it was not until 1773 that a serious attempt was made to reduce the chaos to order by careful observation and description and classification of the "infusoria." This notable work was done by the Danish naturalist, O. F. Müller (1730–84); and his last book, published posthumously in 1786, is the first systematic treatise on protozoology. Müller was able to attempt a comprehensive systematic treatise on the protozoa, because a very considerable advance had taken place in biological thought since microscopic organisms were discovered. Many of the earlier workers, like the uneducated at the present day, believed in spontaneous generation. They believed, with Aristotle, that many "imperfect" animals were bred in mud, water or decomposing matter; and so long as this view was tenable there was no reason why these misbegotten offspring of the superabundant

vitality of the earth should display any particular constancy in their appearance or any fixity of form. Consequently, to attempt to describe and classify the "Infusoria" must have seemed a futile task to many men of science 200 years ago.

In the latter half of the 18th century many minor contributions were made to protozoology, but no considerable advance was made until about 1830, when the Berlin zoologist, C. G. Ehrenberg (1795–1876), began to publish his researches. His chief contribution to protozoology was published in 1838—a monumental folio volume of more than 550 pages, accompanied by an atlas of 64 coloured plates. This is still one of the classics of the science. It contained much that was new and much that was true, everything of note that his industrious reading could find in the works of his predecessors, and withal a mass of mistakes to which he clung tenaciously—in spite of violent contradiction and criticism—to the end of his days.

Ehrenberg's most dangerous opponent was a Frenchman, Félix Dujardin (1801–60). In 1841, with an octavo volume of some 680 pages, but only 23 plates, he undermined the foundations of the big folio, and thus overthrew, for all time, many of the favourite theories of his German antagonist.

Since the time of Dujardin only one really exhaustive work on the Protozoa as a whole has been written. This is the great monograph by Otto Bütschli (1848–1920) of Heidelberg, published in 1880–9. It is significant of the vast modern development of protozoology that no work on a like scale, by a single individual, has since been produced.

The Modern Science.—Since the middle of the 19th century biological theory and practice have undergone profound changes; and in more recent years protozoology, with the rest of zoology, has largely changed its character. This period has seen—to note but a few of its more striking developments—the establishment of the theory of organic evolution, the rise of the cell theory, the foundation of histology and cytology, and the unfolding of physiology and embryology and medicine as experimental sciences. Protozoology has been profoundly influenced by all these new growths, and has itself contributed not a little to them. An attempt has been made, and has already been partly successful, first, to discover all the Protozoa there are, both living and fossil; then to investigate their structure in the minutest detail and to ascertain how they live and develop; and finally, to understand their relations to other organisms and their place in nature.

Before proceeding, we may note some of the peculiar difficulties which differentiate protozoology from the rest of zoology. The animals with which it deals are, speaking generally, invisible to the naked eye. Consequently, they cannot be studied and anatomised by ordinary methods. The protozoologist has first to become a master in the use of the microscope and to learn its limitations as an instrument of research. When he has become proficient he must learn or devise methods for catching, watching, breeding and preserving those Protozoa that he wishes to study, and must thus become familiar with a peculiar and varied technique adapted to the investigation of the lives and habits of animals invisible to the unaided eye. He must then acquire the power of correctly interpreting what he sees under these peculiar conditions. If he is an efficient microscopist and a good observer, endowed with abundant patience and ingenuity, and if, at the same time, he is a good zoologist and sound philosopher, then, with experience and diligence, he may hope some day to become a good protozoologist. From the very nature of the subject, therefore, it will be obvious that it is easier to make mistakes in protozoology than in most other branches of zoology; and there can be little doubt that the writings on the Protozoa, taken as a whole, contain a larger percentage of error than those on any other group of animals. Protozoology is, indeed, still in its infancy, and learning slowly and painfully by the method of making mistakes.

Protozoology, like most other sciences, is important from two different standpoints, which may be called the theoretical and the practical. On the theoretical side we have to consider its relations to the rest of zoology, and the value of its contributions to biological philosophy; on the other side, we must consider the utility of its practical applications, which are chiefly medical. In other words, we must look at protozoology as a pure science and as an applied science.

The Pure Science.—The theoretical importance of protozoology is not what it appeared towards the end of the 19th century. It has not fulfilled some of the high hopes then entertained for its future. In that earlier period the writer of an article such as this would have begun, in all probability, by declaring that the study of the Protozoa would lead to the solution of most of the outstanding general problems of biology. He would have pointed out that these animals were of the greatest importance in connection with the two chief biological generalisations of his time—the cell theory and the evolution theory—and he would probably have ended by saying that a lack of detailed knowledge alone prevented protozoology from answering most of the fundamental questions of biology. Though we have now an abundance of the sort of information then regarded as requisite, yet the great problems are still, for the most part, where they were. It is both interesting and instructive to inquire how this has come about.

The cell theory was first definitely formulated, in Germany, by Schleiden (1838) and Schwann (1839), and was modelled into its modern form by Max Schultze (1861): that is to say, it took shape at the time of the reformation of protozoology by Ehrenberg and Dujardin, when the science was still feeling for a foothold. According to the cell doctrine, all organisms, both animals and plants, are built up of structural units, called "cells," in much the same way as a house is built of bricks (*see* CYTOLOGY). Schultze defined "a cell" as "a little lump of protoplasm with a nucleus inside it," and this definition was generally accepted. It should be noted that this proposition, so far as the larger animals and plants are concerned, is not a "theory" at all, but a statement of fact easily verifiable by means of the microscope. The body of a rabbit or a cabbage is, for the most part, actually composed of "cells" as conceived in the definition. The "theory" was introduced when the proposition was held to apply to all organisms at all stages in their development. Dujardin had shown that the Protozoa are soft-bodied animals composed of "sarcode"—the "protoplasm" of later workers—in which no constituent "cells" are discernible. Like "cells" Protozoa contain "nuclei," but unlike the large animals, they show no internal differentiation into cellular units. It was thus necessary to introduce some new conception if the cell theory was to become universally applicable.

The extension of the theory, so as to enable it to include the Protozoa, was made by von Siebold. Each individual protozoon, he said, is itself a "cell." It is comparable with a single one of the innumerable units of which the bodies of large animals are built. The Protozoa are "unicellular" animals, all others "multicellular." According to this doctrine, therefore, a protozoon is not comparable, as an individual, with a whole multicellular animal, but with one of the cells in its body: or, the other way about, a multicellular animal is not an individual of the same sort as a protozoon, but a colony of such individuals.

This conception appeared so plausible—owing, it must be supposed, to the backward state of protozoology and cytology at that date—that it found ready acceptance; and, in spite of the cogent objections which have been raised against it by Huxley (1853), Whitman (1893), Sedgwick (1894), Dobell (1911) and others, it has prevailed down to the present day.

When the cell theory was being founded, another great biological generalisation was just emerging, the doctrine of organic evolution (*q.v.*). Charles Darwin's great work, which appeared in 1859, created a revolution in biological thinking. Although Darwin's own work, and his statement of the theory, appear to be unexceptionable, the doctrine miscalled "Darwinism" developed along extravagant lines—chiefly, as is now evident, owing to the wild speculations and dominating influence of E. Haeckel and other German writers. The "cell theory" was immediately subpoenaed to give evidence for these "Darwinists." They wrongly believed that the evolution theory required the presence of some "most primitive" and "elementary" animals—from which all the "higher" forms had been derived—on the earth at the present day; and the shaky syllables let fall by the cell theory were eagerly seized upon, interpreted and ultimately incorporated as incontrovertible facts in the case of the "Evolutionists." "Unicellular" organisms, such as the Protozoa, thus became the starting-point of evolutionary speculations. The Protozoa were obviously the "simplest" animals, since less was known about them than about the others; and

they were clearly the "most elementary," each individual representing but one of the structural elements of which the others were composed. Their insignificant size made them the "lowest" forms on earth, and their position—according to the "theory"—at the bottom of the "*Scala Naturae*," made them the "most primitive." It thus became easy to show, by specious arguments and "question-begging epithets," that protozoology occupied a position of fundamental importance in biology. By studying the Protozoa the earliest stages in evolution would be revealed, the beginnings of life would be laid bare; while physiology and morphology, stripped of all confusing detail, would appear in their elemental forms. But it is now become clear that protozoology was placed in a false position by the devotees of the cell doctrine and the dogmatic evolutionists. Let us look at the fundamental conception of the "unicellularity" of the Protozoa from another angle, and see how it appears in the light of modern knowledge.

In the first place it is clear that the Protozoa cannot properly be described as "unicellular." Every protozoal animal has an independent existence. It has its own peculiar structure, exercises its own proper functions, leads its own life—often, indeed, a very complex one. As an animal it is, from every standpoint, as much an "individual" as a man is. One protozoon is one whole animal, just as one man is one whole animal. From the standpoint of common sense, no less than from that of modern zoology, the whole organism is the unit of individuality. But when we examine a protozoon under the microscope we still see—as Dujardin saw—that its body is not differentiated internally into cells, as is that of a man. Its body is often surprisingly complex in structure, but it is never composed of cells. It is clear, therefore, that we can contrast the body of a man with that of a protozoon by saying that the one is cellular in structure, the other *non-cellular*. To call it "unicellular" and thus compare one whole animal with a minute differentiated fraction of another, is obviously absurd. It is as though a man who had only seen houses built of bricks were suddenly to encounter one constructed, all of a piece, of concrete; and then, being unable to find the familiar individual bricks in its fabric, were to declare that the concrete house is not a house—in the sense that the brick house is—but one large and peculiarly modified brick.

When once it is realised that the Protozoa are not, in any sense, "elementary" or "unicellular" animals, but a group of peculiarly constructed creatures, adapted in a special way to particular conditions of life, then it will also be realised that we have no reasons—apart from preconceived ideas derived from unsound generalisations—for believing that they represent "primitive" or "first" forms of life. That they are not "simple" we now know. It is true that they display, on the whole, less visible structural differentiation than most of the larger animals; but physiologically they are very complex. That they are able to perform all the chief functions of "higher" animals, but with fewer instruments, does not make their mechanism easier to understand; and it is thus hardly conceivable that the Protozoa can ever offer us the easiest way of approach to physiological problems. They offer us, indeed, the most difficult field in animal physiology, owing to their microscopic size and apparent simplicity of structure.

As a point of historic interest, it may be noted that the Father of Protozoology and his immediate followers had none of the extravagant later notions regarding the "unicellular" and "elementary" nature of the Protozoa. For Leeuwenhoek the Protozoa were animals like any other animals, but delightfully and marvellously little; and he thus saw more clearly and naturally than many of his later successors.

There are probably few biologists who now cherish any hopes of seeing the fundamental problems of biology solved by the study of the Protozoa, though the majority still speak and write in the optimistic language of last century. For these mental survivals there is a psychological basis, which seems worth noting before we go on to consider the true status and value of protozoology. There is a curious disposition, apparently inherent in the human mind, to suppose that by studying the most minute creatures we can come nearer to first principles. And it is the same with the study of the larger organisms. As the cytologist probes into the structure of an animal with higher and still higher powers of the microscope, he feels that he is gradually "getting to the bottom" of his problems. He feels that when his microscope has resolved the larger animals into their smallest component parts and has revealed every detail of the smallest living thing, he will be face to face with fundamentals. It does not require much thought to realise that this is a fallacy. The deeper we delve, the more detail we discover. But it is all of the same sort; we add to the quantity and not to the quality of our knowledge. With the highest possible magnification we shall obtain no information which is qualitatively or fundamentally different from that to be derived from the study of large organisms and their gross anatomy, with the naked eye.

The mental bias just mentioned seems to be responsible for many popular—and not a few "scientific"—notions about the Protozoa. It appears, for example, to be at the back of the unreasonable but common belief that the Protozoa are "elementary" and "primitive" animals. Although few biologists now believe in spontaneous generation, yet many are able to believe that living things must have been spontaneously generated from lifeless matter in the past; and to those who hold this belief it still appears self-evident that the organisms so generated were microscopic. Consequently, these biologists feel that the Protozoa must, in some way, be nearer than other animals to "the beginnings of life," and they find no difficulty in conceiving that the first animals were "Protozoa." In the same way, when these same biologists come to consider evolution, and the relations of living animals to one another, they find in the Protozoa the easiest starting-point for their speculations. The Protozoa are "the simplest" animals, and the human mind works most readily from simple to complex conceptions. Consequently, evolution is pictured as necessarily moving in the same direction—the simply constructed creatures coming first, and the complex developing from them. But it is surely a poor philosophy which would constrain Nature to order her infinite events in that particular sequence in which thoughts happen to follow one another most easily in the mind of man.

What, then, it may be asked, is the theoretical interest or value of protozoology? Clearly it is this. Biological theory is sound in proportion to the truth of its generalisations. When all the facts are known about all animals and plants, we shall be able to make true general propositions about them. Before we know the facts our generalisations can be but partial and premature—more or less lucky guesses, based upon incomplete knowledge. All biological theory is at present in this condition, and therefore the careful study of any animal or group of animals, such as the Protozoa, will, if it yields new facts for generalisation, be valuable ultimately as a contribution to biology. At present we cannot hope to do much more than collect facts, by means of accurate observation and apposite experiment. When we have collected and critically analysed them, we can sometimes make tentative generalisations of a lesser order. But the larger and truer generalisations will come later.

It may be said that if this is all that can be expected from protozoology, then it is no more important than any other branch of zoology: there is no reason why we should study the Protozoa rather than any other group of animals. All this is true and reasonable; but there is also a reason why protozoology is likely to yield results of particular interest. The Protozoa are a group of animals organised on a different principle from the rest. They are, as we have just seen, non-cellular animals with peculiar lives and habits. Structurally and functionally they differ, in many ways, from all other animals. Now all the chief biological generalisations—almost all general propositions relating to such phenomena as birth, growth, development, sex, reproduction, heredity, variation and death—have been derived from observations made upon the larger multicellular animals. When general ideas were formulated on such subjects the Protozoa were practically left out of account. When the more important facts about the Protozoa are firmly established, we shall be able to recast many of our biological theorems in

a more satisfactory form. The Protozoa offer us, in other words, a new world of animals for generalisation, and a new standpoint from which to survey our old-world zoological knowledge.

The Applied Science.—The chief practical applications of protozoology are to medicine. Certain of the Protozoa live as parasites in the bodies of men and animals and thereby cause diseases. Some of these are so important that they are widely known—for example, malaria and sleeping sickness—and the elucidation of such diseases is one of the most interesting and recent chapters in biology (*see* PARASITOLOGY).

The founder of protozoology was the first to find Protozoa inhabiting the living bodies of other and larger animals. In 1681 he described one such "animalcule" which was living in his own intestine. In 1683 he described and depicted others from the intestine of the frog. All these are recognisable, with fair certainty, at the present day. Leeuwenhoek did not suggest that these "parasites" were in any way concerned in the causation of disease and it is probable, indeed, that the forms which he observed are not. But already at that date the "microbe" theory of disease-production was in existence, for it was guessed at long before any "microbes" were discovered; and consequently we find that, even in Leeuwenhoek's lifetime, the suggestion was put forward that his "little animals" might be the "causes" of certain disorders. We find, for example, an early fellow of the Royal Society remarking, in 1683, of a "murren" which had raged among cattle in central Europe, and of which the cause was undiscovered: "I wish Mr. Leeuwenhoek had been present at some of the *dissections* of these infected *animals*. I am persuaded he would have discovered some strange *insect* or other in them." Mr. Leeuwenhoek's successors have, on many a like occasion, fulfilled the expectations of "the ingenious Fred. Slare, M.D., and F.R.S.," but his "strange insects" they now call "Protozoa" or "Bacteria."

Our knowledge of protozoal diseases—diseases colloquially said to be "caused" by protozoal parasites—really begins as recently as the middle of the 19th century, when Louis Pasteur (1822–95) began his researches on a disease of silkworms called *pébrine*. Applying to the investigation of this disease the genius which stamps his work on "microbes" generally, Pasteur first discovered its causes and then deduced methods for its prevention. The "cause" he found to be a microscopic parasite, now called *Nosema bombycis* and classified among the Protozoa. Although Pasteur did not know that the parasite was a protozoon, his work on *pébrine* and other microbic diseases was of fundamental importance for protozoology, because it demonstrated the *methods* by which such diseases can be studied and elucidated. It is common knowledge that Pasteur founded modern bacteriology; but in so doing he also laid the foundations of medical protozoology.

To the casual reader it may seem strange that the study of silkworms can have any bearing upon medicine, or could in any way contribute toward the alleviation of human suffering. But there was another practical result of Pasteur's work which everyone will immediately appreciate, since it can be expressed in pounds, shillings and pence. Before *pébrine* attacked the silkworms of France the silk industry yielded an annual revenue of 130,000,000 francs to the state. After the disease had raged for a dozen years the revenue had fallen to 8,000,000 and the industry was on the brink of ruin. To have discovered the causes of the disease and to have devised, as a direct consequence, means for its control, and, as a further consequence of this, to have rehabilitated the whole silk industry—these are practical results which everyone can understand. One has but to remember that protozoal diseases may affect man himself and his larger domesticated animals, not merely silkworms, to realise the practical possibilities of protozoology.

Toward the close of the 19th century medical protozoology became linked up with another branch of zoology—entomology, the science which deals with insects (*see* ENTOMOLOGY, MEDICAL). This connection has nothing to do with the silkworms just mentioned, but arose through the discovery of the part played by certain other insects in the causation of protozoal diseases. The discoveries in this field began, once more, with the investigation of a disease of domesticated animals; but the pioneer was not, in this case, the Frenchman Pasteur, but the Scotsman David Bruce. His work is of such importance that we must notice it at this point.

The Work of Bruce.—Some parts of Africa are the home of certain large blood-sucking flies called "tsetse." The "Fly Country" is uninhabitable except for wild animals; and long before its full significance was understood, the fly itself was recognised as a serious obstacle to the opening-up of Central Africa. Livingstone, the greatest of all African explorers, was so impressed with the fly's importance in this connection that he put a vignette of a tsetse on the title-page of his *Missionary Travels* (1st ed., 1857). Livestock taken into the "Fly Country" rapidly succumbs to a disease which is called "nagana" in Zululand, where Bruce's original investigations were made. The disease was also called "tsetse-fly disease," since it was believed by the European settlers to be caused by the bite of the fly. The natives believed, however, that it was "caused by the presence of large game, the wild animals in some way contaminating the grass or drinking water."

Bruce began his work in Zululand—after an abortive attempt in 1894—in September 1895 (the month of Pasteur's death). His full report on his researches is dated May 1896. In this almost incredibly short space of time he demonstrated that nagana is caused by a protozoal blood-parasite—since named *Trypanosoma brucei*, after its discoverer; that the parasite lives normally in the blood of big game, without harming them; and that it is conveyed from animal to animal by the tsetse. When the fly sucks the blood of an infected animal it becomes itself infected with the trypanosomes, which are subsequently re-inoculated into other animals by the fly when it sucks their blood. If these other animals are domestic stock, such as oxen or horses, they become infected with trypanosomes, contract nagana and die. If they are wild game, such as antelopes, they also become infected, but develop no disease. In nature the trypanosome lives in the game and the flies alternately, the fly acting as an intermediary in the spread of infection from antelope to antelope.

Bruce thus succeeded in extracting the elements of truth from both the European and the native beliefs, and was able to combine them into a true theory of the causation of nagana. At the same time he threw a flood of light on many other protozoal diseases, and suggested all sorts of possibilities concerning their causation and prevention. He forged new links between protozoology and medicine and between entomology and protozoology. It is true there were other lights and other links before. Trypanosomes were known, and known to cause diseases, before Bruce went to Zululand. Two Welshmen, Timothy Lewis and Griffith Evans, had observed similar parasites in India more than a decade earlier; and two Americans, Theobald Smith and Kilborne, had demonstrated in 1893 that the disease of cattle known as "Texas fever"—a disease also caused by a blood-inhabiting protozoal parasite—is transmitted from beast to beast by the agency of ticks. But Bruce's work was solid, complete and demonstrative. By clean experiments and right reasoning he contributed more to science in a few months than hundreds who have followed up his work have since been able to contribute in many years.

The following-up of Bruce's discoveries and the working-out of details and consequences have led to the accumulation of an immense amount of new knowledge—protozoological, entomological and medical. We can do no more than mention it here. We must, however, notice one of the first fruits of his labours—the application of his results to the study of human diseases. This application was made mainly by Bruce himself. A few years after he had done his great work on nagana he attacked the problem of sleeping sickness, a human disease which has depopulated large areas of Central Africa. Bruce and his collaborators were able to show that this disease is similar to nagana. It is likewise caused by a trypanosome, which is conveyed to man by the bite of a tsetse-fly, and which is capable of living in other animals. In this case the parasite had been previously seen by Forde and Dutton and by Castellani. But its relation to human disease, and the part played by the tsetse in its transmission, were first clearly demonstrated through the work of Bruce. (*See* PARASITOLOGY; SLEEPING SICKNESS.)

Malaria and Other Diseases.—We must now notice another disease, which is known by name to all—malaria, "the scourge of the tropics." This disease, as we now know, is also carried from

man to man by the agency of a blood-sucking fly—in this case a mosquito; and it is also caused by a blood-inhabiting protozoal parasite, though it is one very different from that which causes nagana. Moreover, this parasite lives in men and mosquitoes only. After undergoing a peculiar development in the blood of a human being, it is sucked up with his blood by a mosquito when it feeds upon him. Provided that the mosquito is of the right sort, the parasites in the blood—if they are in the proper stage of development—undergo further remarkable changes in the mosquito's body. Thereafter the mosquito is able to infect other men with the parasites, which it injects into their blood in the process of sucking. And so the life of the parasite continues.

The foregoing is the briefest synopsis of a very complicated story, in which almost every event has been worked out in great detail. Hundreds have contributed to this work, though some of them can hardly be said to have co-operated in it. Indeed, such bitter fights have taken place among them that it has now become almost impossible to mention the names of some workers without offending others. Fortunately, however, the names of the leading discoverers are now known to almost everybody, and their individual achievements are no longer in dispute. Even the " general reader " is familiar with the name of Laveran (1845–1922), the great Frenchman who, in 1880, discovered the malarial parasites in human blood; of Patrick Manson (1844–1922), the founder of modern tropical medicine, who divined, in 1894, the part played by the mosquito; of Ronald Ross, who, inspired by Manson, first worked out in 1898 the complete development of the malarial parasite of birds; and of Grassi (1854–1925), and his fellow-workers in Italy, who immediately confirmed Ross's work and extended and successfully applied his results to the study of malaria in man. When the 19th century ended the story was almost complete. (*See* MALARIA.)

It will be evident that malaria, nagana and similar diseases are not purely protozoological problems. It will also be obvious that such diseases might be prevented by attacking either the protozoal parasites which " cause " them, or the insects which transmit them, though there could have been but little hope of success in coping with such diseases before the life-histories of the parasites were discovered. The practical importance of protozoology in cases such as these is self-evident. The facts speak for themselves.

Malaria is a far commoner disease than nagana, and the discoveries relating to it have therefore made a far wider appeal to the public. It intrigues the public to hear that there would still be no Panama Canal but for the great discoveries in connection with malaria. It would excite them but little to hear that some obscure tribe of Zulus could now keep cattle in places where it was previously impossible. But the advancement of science is not measured in such terms, and science values most highly those who discover and enunciate new principles. Already we can observe that the problems presented by nagana and malaria are similar, and that most of the generalisations which their solution can give us are, indeed, the same. We can see, too, that history, in the end, is generally just. Consequently, we may hazard a guess that in years to come the historian of science, in his impartial search for beginnings and great names, will not fail to note the sequence of the discoveries which we have just considered, and will apportion his praise accordingly.

The War Period.—Medical protozoology, like many another branch of science, received a powerful stimulus from the War of 1914–8. Not only was much of the previously acquired knowledge put into practice, but this practical application in turn revealed or emphasised the gaps, defects and errors in many current conceptions, and so led ultimately to the prosecution of new researches and the acquisition of much new knowledge. Surveyed from the most general standpoint, the War appears to have taught us little that was new regarding malaria and the other protozoal diseases already mentioned. Its chief protozoological contribution has been to our knowledge of those Protozoa which live in the human intestine, and more especially to the elucidation of the disease called amœbic dysentery. We may therefore say a few words on this subject at this point. (*See* DYSENTERY.)

The Protozoa known as amoebae form a large and interesting group. Most of the species live independently in such places as ponds, ditches or the soil; but some of them live in the bodies of other animals, and one of them—called *Entamoeba histolytica*—was already known before the War to live in the human bowel and " cause " amœbic dysentery.

This parasite was first described by Lösch in Russia as long ago as 1875. Its real relation to dysentery, however, was not made clear, though much debated, until just before the War, when the admirable researches of two American workers in the Philippine Is.—E. L. Walker and A. W. Sellards—were published. During the War their results were confirmed and greatly extended, chiefly by the investigations of British workers. As a consequence, we now know as much about amœbic dysentery as we do about malaria or the diseases due to trypanosomes.

No less than five different species of amoebae may live in the intestine of man, though only one of these—the " dysentery amoeba " already mentioned—ever does him any harm. Moreover, amœbic dysentery is a comparatively rare disease. There are many different kinds of dysentery, and the kind due to amoebae is far from being the commonest. Before the War amœbic dysentery was generally recognised as a disease more or less restricted to the tropics, though certain other kinds of dysentery occur all over the world. The curious fact brought into prominence by the War is that the dysentery amoeba itself is very common almost everywhere. This parasite, which can cause, by its presence in the bowel, a violent and sometimes fatal form of dysentery, usually does no such thing. Very many people in all parts of the world are infected with it, but very few ever suffer any appreciable harm from its presence. The parasite and the person who harbours it are usually suited to one another in such a way that they can live together comfortably, oblivious of the existence of one another. There are, for instance, in the British Is. at this moment at least 2,000,000 people who are infected with these potentially disease-producing parasites, and yet enjoying perfect health.

Another curious feature of amœbic dysentery is the circumstance that the disease cannot be contracted from a person suffering from it. The people responsible for the spread of infection are those who harbour the parasite but themselves suffer no ill consequences from its presence. The explanation of these seemingly contradictory facts is really quite simple, now that we know the life-history of the amoeba and its relation to disease. It is a popular fallacy to suppose that any parasite is the sole " cause " of any disease. A disease is a joint result of many antecedent factors, and in the present case it would probably be nearer the truth to say that the person who harbours the amoeba, rather than the amoeba itself, is the " cause " of amœbic dysentery. For dysentery results only when the infected person happens to be abnormally sensitive to infection with the amoeba, and the condition is as harmful to the parasite as it is to the patient. Normally man and amoeba fit one another, and there is no trouble. Abnormally there is a misfit, and amœbic dysentery is the consequence.

The foregoing considerations will serve to show once more the value of protozoology in the study of human diseases. What hope could there ever be of eradicating a disease such as amœbic dysentery if we remained in ignorance of the life-history of the parasites connected with it? We might cure every case of the disease—we might conceivably prevent the death of every patient who contracted it; but even if we did, it is now clear that this would have no effect whatever upon the continuance and prevalence of the disease itself.

It has been supposed for so long that the parasites which produce protozoal diseases are peculiar to tropical or sub-tropical countries that the discovery of the dysentery amoeba in Britain may seem surprising. It is really not so surprising as the circumstance that nobody, until quite recently, had thought of looking for it here. And there are many equally remarkable parallels. To mention only those diseases and parasites which we have already noted, we can now say that malaria occurs indigenously in Britain—though this was hardly suspected until recently; and that parasites closely similar to those which cause nagana and Texas fever have now been discovered in British sheep and cattle. How far these observations are of practical importance the future will show, but already they clearly indicate that medical and veterinary protozoology may be studied with profit at home no less than abroad. This, in fact, is being done to a very large extent.

REFERENCES.—The literature relating to Protozoology is so vast that it is impossible to give adequate references in a few lines. The works listed below are therefore merely a selection of the more important memoirs referred to in the preceding article, together with a few others likely to be of service to the reader desirous of pursuing the subject further. Of recent monographs dealing with the Protozoa as a whole the most trustworthy are those of Doflein (1916) and Minchin (1912), both of which contain copious bibliographies.

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PROUST, MARCEL (1871–1922), French man of letters, was born in Paris on July 10 1871. His father was a professor of medicine, and his mother was of Jewish extraction. He was educated at the lycèe Condorcet, and about 1892 he was for some time associated with Lèon Blum, Louis Mirhlfeld and Tristan Bernard on the *Revue Blanche*, a periodical conducted by a select group of intellectuals, mostly Jewish. Becoming a favourite in the salons—especially those of Mme. de Caillavet and Madeliene Lemaire—he wrote a number of society love-stories (collected in 1896 under the title *Les plaisirs et les jours*) distinguished by their psychological subtlety. He also attained reputation as a clever writer of *pastiches*. He became an enthusiastic admirer of John Ruskin and translated several of his works into French, including the *Bible of Amiens*, to which he contributed a valuable preface.

In 1902 Proust's health began to fail. Thenceforward he was reluctantly obliged to lead an extremely retired and careful life, and for many years it looked as if he had altogether abandoned literature, in which his name hitherto had not been known outside a small circle of friends. He was reading and writing a great deal, however. The interminable discursiveness of Ruskin, which French readers do not suffer gladly, was to him a constant source of delight, and Saint-Simon, ever one of his favourite authors, exerted a powerful influence upon him at this time. Thus it came about that, having unlimited time at his disposal, he embarked upon a long and leisurely work, full of minute detail, in which was imprisoned, as in a net, his whole experience of life; in which the *salon* life he loved was revived in all its details and observances like the court life in Saint-Simon's memoirs; in which the people he had known provided the materials for new, fuller and richer characters (M. de Charlus, for example, is a blending of three different people of Proust's acquaintance), and in which the author sought out and lived the past over again. Hence the general title given to the 15 volumes of the series, *A la recherche du temps perdu* (1913, etc.).

This lengthy work had almost been completed when Proust published the first part, *Du côté de chez Swann*, in 1913. The freshness and minuteness of the recollections of childhood attracted some attention, but none the less Proust, who had had to publish the first part at his own expense, had difficulty in finding a publisher for the second, *L'ombre des jeunes filles en fleurs*. When it did appear its qualities were at once appreciated by Léon Daudet, whose enthusiastic articles, followed by the award of the Prix Goncourt in 1918, brought Proust's name prominently before the public, and he was read, discussed and criticised everywhere. Two more parts appeared during Proust's lifetime—*Le côté de Guermantes* and *Sodome et Gomorrhe*, both in 1921. When he died in Paris, Nov. 18 1922, he left three parts still in manuscript—*La prisonnière*, published in 1924, *Albertine Disparue* (1926) and *Le temps retrouvé* (1926).

Proust's influence, especially since his death, has been considerable. He introduced into the novel an analytic method which has a superficial resemblance to that of Meredith, but is more properly comparable with that of Freud. That the name and notion of time should appear in the general title of his great work is not without significance. By a curious coincidence he was related by marriage to Bergson, the philosopher of "creative time," and the term "creative time" aptly describes the psychological time which Proust explores, seeks and recovers. His people are never given as "characters" in the fashion of La Bruyère or Balzac; they are always in process of development, change and continual creation.

Part of Proust's success was due to the very thing that is likely to tell against his lasting reputation, viz.: the fact that his characters, beginning with the "I" of the book, are exceptional, an erotic and mysterious group having little in common with the generality of mankind. This is true not only of *Sodome et Gomorrhe* and Proust's emphasis upon homosexuality, but also of the idle life and ultimate nothingness of the people of his world, their lack of all interests other than those of social life, and the indifference that the ordinary reader must always feel as to their fate. On the other hand, there will be a taste for Proust so long as there is a taste for pyschology as an end in itself, and so long as the play of memory, the searching and brooding that pertain to the conquest of the past, afford to some men a sufficient reason for living or a romantic manner of not living. The following translations by R. Scott Moncrieff appeared in English: *Swann's Way* (1922); *Within a Budding Grove* (1924); *The Guermantes Way* (1925).

See *Marcel Proust, an English tribute*, collected by C. K. Scott Moncrieff (1923); "Hommage à Marcel Proust, 1871–1922," *La Nouvelle Revue Française*, No. 112 (1923); L. Pierre-Quint, *Marcel Proust: sa vie, son oeuvre* (1925). (A. TH.)

PROVIDENCE, R.I., U.S.A. (*see* 22.510), increased in population only 5·9% in the decade after 1910, and 12·8% in the five years 1920–5. The figure for 1920 was 237,595 which included 5,655 negroes and 69,895 foreign born; for 1925 (state census), 267,918. Its varied and important factory products were valued at $120,241,000 in 1909; $267,629,000 in 1919; $170,116,661 in the year of depression, 1921; $215,654,286 in 1923, when there were 890 establishments, employing 45,495 wage-earners. Extensive harbour improvements were initiated in 1918, in co-operation with the state and Federal governments. The water supply was increased by the construction of the Scituate reservoir. A zoning ordinance was adopted in 1923. Providence has a relatively high amount of child labour (11·7% of all children between 10 and 15 years of age being wage-earners in 1920). Providence College, a Roman Catholic institution, was established in 1917, and had 517 students in 1925. Brown University had 2,013 on the register in 1924–5, including 428 in the women's college.

PRUSSIA (*see* 22.518), a free state and territory of the German Reich (Freistaat Preussen). The area is 113,833 sq. m. and the population (1925) 38,750,000; these figures include the Prussian part of the Saar district with estimated population.

Political History 1910–25.—Up to 1918 Prussia was a federated State of the German Reich (since 1871) and a monarchy, with constitution dating from Jan. 31 1850. The King of Prussia was also German Emperor. The reigning dynasty was the Hohenzollern. The people were represented through two

Chambers: the Upper House (Herren Haus) composed of members whose seats were hereditary and others appointed by the King for life; and the Lower House (Haus der Abgeordneten) composed of members elected by direct voting according to the "three-class system" (*see* 22.521). The principal political agitation before and during the War centred round the abolition of this undemocratic electoral system, which was loudly demanded by the mass of voters and promised, but not granted, by the King at Easter 1917.

On Nov. 9 1918 the King abdicated; on Nov. 10 the monarchy was abolished and the Republican form of State proclaimed. The power rested at first with the Workmen's and Soldiers' Councils: the executive authority was exercised by a plenary council, under whose orders a provisional government took over the conduct of the Prussian Government. During this period there was no popular representation; the lower house had been dissolved, the upper house abolished. On Jan. 26 1919 the elections to the constituent Prussian Assembly were held; on March 5 the Assembly met. The final constitution was perfected on Nov. 30 1920. Meanwhile, Prussia's relations to the new republic of the German Reich had been regulated by the constitution of the German Reich of Aug. 11 1919 (*see* GERMANY: CONSTITUTION) which had put an end to the dominating position which Prussia had enjoyed in the German Federation, partly through the position of her King as German Emperor. If Prussia predominates in the German Reich to-day, this is due to her size and the fact that she has successfully preserved her unity.

Constitution and Administration.—The constitution of the Prussian Free State includes 11 sections: the State, the executive power, the Landtag (Diet), the State Council, the Ministry of State, the legislative power, finance, self-administration, religious orders, state officials and temporary and final provisions. The section "State" declares that Prussia is a republic and a member of the German Reich. The national colours remain black and white. The authority of the State rests in the people as a whole. It can enunciate its will directly by referendum, or indirectly through the constitutionally appointed organs. The franchise is general, equal, secret and direct. The Diet is the supreme organ of legislation, subject to the people's right of direct "popular initiative" or "popular decision." The Diet has the right to decree legislation. It consists of deputies of the Prussian people, elected for four years. After the elections of Dec. 7 1924 there were 450 deputies (114 Social Democrats, 109 German Nationalists, 81 Centre, 45 People's party, 44 Communists, 27 Democrats, 17 Economic party, 11 National Socialists and 2 Poles), the President being a Social Democrat, Bantels.

The Council of State (Staatsrat) exists to approve or to raise objections to the decisions of the Landtag. It consists of representatives of the provinces, elected from the provincial Diets. New elections are held after the new elections of the individual provincial Diets. In 1925 the Council of State consisted of 77 members: its President was Dr. Adenauer, Oberbürgermeister of Cologne. The Ministry of State is a supreme executive and directing organ of the State. It consists of the Minister President, who is elected by the Landtag, and the Ministers of State, whom he then nominates. The Ministry of State consisted in 1925 of Braun (Social Democrat), Minister President; Dr. A. M. Zehnhoff (Centre), Minister of Justice; Severing (Social Democrat), Minister of the Interior; Hirtsiefer (Centre), Minister for Popular Welfare; Dr. Becker (non-party), Minister of Science, Art and Education; Dr. Hopker Aschoff (Democrat), Minister of Finance; Dr. Schreiber (Democrat), Minister of Trade and Industry; Steiger (Centre), Minister of Agriculture, State Domains and Forests.

The principles of the administrative organisation were not changed by the revolution. Prussia is divided into 13 provinces (formerly 14), each under an Ober-Präsident: East Prussia, Brandenburg, Pomerania, Berlin City, the Posen March (West Prussia), Lower Silesia, Upper Silesia, Prussian Saxony, Schleswig Holstein, Hanover, Westphalia, the Rhenish Province, and Hessen Nassau. Each province, except Berlin City, is divided into districts, each under a "Regierungspräsident" and these again into cantons, urban cantons and rural cantons, each under a Landrat. The rural cantons are at the same time communal organisations. The Landrat controls the country communes and districts. The urban communes are directly under the Regierungspräsident.

Area and Population.—Under the Treaty of Versailles, Prussia ceded: to Lithuania (Memel District) 2,656 sq. km., with 141,238 persons (Census of 1910); to Poland, 46,142 sq. km., with 3,854,971 persons; to Czechoslovakia, 316 sq. km., with 48,446 persons; to Denmark, 3,993 sq. km., with 166,348 persons; to Belgium, 1,036 sq. km., with 60,003 persons; to the Free State of Danzig, 1,914 sq. km., with 330,630 persons; or 56,058 sq. km. in all. In some cases these cessions were preceded by plebiscites. They affected nine provinces: the heaviest losses were incurred by Posen, Westphalia and Upper Silesia. East Prussia was separated from the mother country by the creation of the so-called Polish Corridor as an adit to Danzig. On April 1 1922 Pyrmont (65.6 sq. km., 10,443 inhabitants) was incorporated in Prussia (*see* RHINELAND; RUHR; SAAR).

At one time (1920) 27,572 sq. km. of Prussian territory with over 8,500,000 inhabitants, were occupied. The demilitarised Prussian territory on the Rhine consists of 32,487 sq. km. with nearly 10,000,000 inhabitants. The territorial provisions of the Treaty of Versailles, therefore, affect in all almost 90,000 sq. km. of Prussian soil, with over 14,000,000 inhabitants. The population of Prussia was 36,700,000 in 1919, but at the census of June 16 1925 had reached 38,180,000; including the Saar district, about 38,750,000. The surplus of births over deaths fell from 552,961 (1913) to 400,348 (1920); 438,778 (1921); 324,633 (1922); 270,036 (1923); 324,533 (1924). In the first half of 1925 it was 187,841. Even taking into account the diminution of territory, these figures show a considerable reduction in the natural increase of population. This surplus of births was due solely to a great reduction in the death-rate, for the birth-rate itself has fallen heavily and steadily since 1913. Emigration has been exactly balanced by repatriation and immigration.

The losses of territory were most important for Prussia from the economic point of view. In Upper Silesia, Prussia lost one of her most valuable industrial districts; and in the Provinces of Posen and West Prussia, the districts which produced the largest agricultural surplus. In 1913 the part of Upper Silesia which is now Polish produced 33,100,000 tons of coal, 440,000 tons of zinc (68% of the entire German production of zinc); the blast furnaces of Upper Silesia produced 500,000 tons of pig iron; the smelting works delivered 1,000,000 tons of steel; and the rolling mills manufactured 900,000 tons of finished goods.

Agriculture and Industry.—Prussia's economic character has not, however, been essentially changed. Large districts in East and North Prussia are still preponderatingly agricultural, equally large districts in West and Southwest Prussia are exclusively industrial. On the whole, however, the industrial character preponderates. East Prussia, Silesia, Pomerania, the Posen March, West Prussia and Hanover are mainly agricultural. The whole area under cultivation in Prussia (plough, meadow, pasture and vineyards) was 18,200,000 hectares in 1925.

The predominantly industrial districts of Prussia are Brandenburg, Upper Silesia, Saxony, Westphalia, the Rhineland and parts of Hanover and Hessen Nassau. There are no exact data about the distribution of the various branches of industry within Prussia and in the different provinces. The results of the census of occupations and undertakings have not yet been published. According to the last census of occupations but one, 1907, the undertakings were distributed as follows:—

Occupations

	Undertakings	Subsidiary Establishments	Persons Employed
Gardens, livestock and fisheries	31,413	5,333	90,452
Industry, including mining and building	1,034,359	81,681	5,870,991
Trade and transport, including hotels	678,724	192,938	1,794,349
Music, theatres and exhibitions	13,779	2,201	50,596
	1,758,275	282,153	7,806,388

The most important branches of industry are represented as follows:—

Industrial Establishments

	Main Undertakings	Subsidiary Establishments	Persons Employed
Mining, blast furnaces, salt mines	3,721	565	673,315
Quarries	21,073	1,420	412,916
Metal working	80,518	5,957	544,565
Machinery and instruments	45,155	5,696	625,945
Chemical industry	5,448	183	101,430
Lighting industry	2,951	417	53,316
Textile industry	44,375	4,246	437,029
Paper industry	8,454	686	106,501
Leather industry	24,832	1,616	107,142
Wood and carving	96,455	11,944	375,841
Foodstuffs	156,805	18,034	642,488
Clothing	362,013	16,637	704,178
Cleaning	63,237	4,270	134,347
Building	104,264	9,150	832,547
Printing, etc.	9,776	585	105,164
Arts and crafts	282	275	14,267

Since the middle of 1924, all industry alike passed through a process of contraction, which adapted the apparatus of production and distribution, which was swollen during the period of the War and the currency inflation, to the reduced needs of the world market.

Natural Resources.—The importance of Prussia's industry as a whole is chiefly based on Prussia's own natural resources, coal, iron and potash. Prussia has the richest deposits of any country of the German Reich. The most valuable coal-fields, the Ruhr district and Upper Silesia, are entirely Prussian, the Saar district partly so. The richest lignite fields, those of Central Germany, the East Elbe and the Rhine are mostly Prussian. The most important iron ore districts are in Peine and Salzgitter and in Siegerland, also in Prussia. The potash fields are mostly confined to Central Germany in the North and South of the Harz, the districts of Fulda and Werra in the Province of Hanover, principally Prussian districts. The refining industry is closely connected industrially and territorially with the production of raw materials. (*See* also GERMANY.) (W. GR.)

PRYOR, ROGER ATKINSON (1828–1919), American jurist and politician (*see* 22.533), died in New York City March 14 1919. In 1912 he published a volume of *Essays and Addresses.*

PRZEMYŚL, SIEGES OF.—The Galician town of Przemyśl on the San was first fortified in 1854, when war between Russia and Austria appeared imminent. The line of the rivers San and Dniester is the first natural barrier to a Russian invasion of Galicia, so that the fortification of the principal crossings seemed a wise precaution.

State of the Fortress.—In 1914 the town was protected by a ring of forts 36 m. in circumference. Some of the forts were of recent construction, but the fortress as a whole was not strictly up-to-date. The history of fortresses in the World War shows, however, that an exaggerated importance had been attached to works of concrete and steel, and that improvised field fortifications were almost equally effective in resisting assault. To clear the foreground in front of the fortified line no fewer than 18 villages and some 5 m. of forest were levelled to the ground on mobilisation. The armament of the fortress included four large modern howitzers of about 12 in. calibre and some 9 in. and 6 in. howitzers of older pattern. There were in all about 1,000 guns in the fortress, but more than half of these were old, short-range weapons of little value except for close defence. There were 114 machine guns, of which two-thirds were mobile.

The eventual garrison left in the fortress when the Austrian armies retreated from the San on Sept. 18 1914 consisted of: 61½ battalions (of which 40½ were Landsturm), 7 squadrons, 4 field batteries, 43 fortress artillery companies, 48 Landsturm artillery brigades, 8 sapper companies, and various technical and administrative units. The total strength was approximately 130,000 men and 21,000 horses. Provisions were available for three months.

The First Siege.—The Austrian armies withdrew from the San on Sept. 18; by Sept. 24 the investment of the fortress was complete. On the southwest front Kusmanek held a line a mile or two in advance of the ring of forts, elsewhere the line of the forts was held. The siege of the fortress was undertaken by Radko Dimitriev's III. Army. While the arrival of the siege artillery material was still delayed by the state of the communications, the Austrians renewed the offensive in the early days of Oct. (*see* VISTULA-SAN, BATTLES OF THE). In the hope of capturing Przemyśl by a *coup de main* before the progress of the enemy offensive compelled the raising of the siege, Radko-Dimitriev carried out several violent assaults between Oct. 5–8 against the Siedliska group of works to the southeast of the town. These assaults broke down with heavy loss, and the approach of the Austrian III. Army necessitated the withdrawal of the investing forces. The fortress was entered by Austrian infantry of the field armies on Oct. 11, on which date Radko-Dimitriev's III. Army retreated to the east bank of the San.

Period Between the First and Second Sieges.—During the Austrian attempts to force the San line, which lasted throughout Oct., the fortress lay in the centre of the battle line and its garrison took an active part in the operations. Its reserves of supplies and material were also largely drawn on by the field armies to make good the deficiencies caused by the poor working of the lines of communication. During their retreat the Russians had systematically destroyed the railways and bridges, and the continued wet weather had rendered the roads almost impassable. Thus it was natural that the reserves of Przemyśl should be used for the benefit of the field armies, from whose operations great results were expected at the time. But when the offensive proved fruitless and Russian pressure necessitated a retirement which would leave the fortress again isolated, special efforts were made hastily to reprovision it. They were so far successful that the fortress was enabled to hold out for 4½ months in the second siege.

Second Siege, Nov. 6 1914–March 22 1915.—The strength of the garrison was approximately the same as in the first siege,

but a detachment of aeroplanes had been added. Kusmanek had now laid out new entrenched positions from one to two miles in advance of the line of forts, to give more depth to the defence and to keep the Russian siege artillery at a greater distance. On Nov. 9 the investment of the fortress for the second time was complete. The siege was now undertaken by a specially formed XI. Army under Gen. Selivanov, consisting of four divisions of second-line troops. It had been decided to reduce the fortress by blockade rather than by assault. During Nov. and Dec. such fighting as occurred was initiated rather by the sorties of the garrison than by the attacks of the besiegers.

During Feb. and the first half of March the Austrian field armies made repeated efforts to advance to the relief of the fortress, but unsuccessfully (*see* CARPATHIANS, BATTLES OF THE). Meanwhile the Russians had gradually closed in and had commenced a systematic bombardment of the fortress. On March 13 they carried the advanced positions on its north front. Kusmanek's situation was now desperate; his supplies and munitions were almost exhausted, and the final effort of the field armies to come to his rescue had definitely been abandoned. He determined on an attempt to save a portion of the garrison by a break-through to the east. The effort was made on the morning of the 19th, but was soon brought to a stand. The fate of the fortress was now sealed. On the morning of March 22 Kusmanek surrendered, after destroying the works and military stores as far as possible. The numbers of the garrison then amounted to about 110,000.

Recapture of the Fortress.—The Russians did not hold the fortress for long. At the beginning of May Mackensen's offen-

sive on the Dunajec broke through the Russian line and drove their armies back to the San (*see* DUNAJEC-SAN). On May 30 the Austrians attacked on the southwest and the Germans on the north of the fortress. The former made little progress, but the German heavy artillery, which included 42 cm. howitzers, made short work of the northern group of forts. On the night of June 2 the Russians abandoned the fortress.

Conclusions.—Przemyśl was the only land fortress of the World War which stood a prolonged siege after complete investment. No conclusions as to the value of permanent fortifications in modern war can, however, be drawn from this fact. Gen. Townshend in Kut held out for longer behind hasty field entrenchments. The length of Przemyśl's resistance was due to the Russians' lack of efficient siege artillery, as is proved by the speed with which Mackensen's heavy guns reduced the forts at the time of its recapture. Nor can it be admitted that the fortress served any strategical aim commensurate with the efforts expended on its defence and attempted relief. It is true that its resistance during the first siege was of value to the Austrians when their armies again advanced to the San, in assuring to them a bridge-head over the river. But during the second siege Przemyśl was an embarrassment rather than a source of strength and led to several ill-considered efforts at relief which cost the Austrian field armies dearly. The fortress did not control any line of supply vital to the Russian armies operating west of it towards Cracow, since there was a railway available through Jarostow. The Russians could therefore afford in the second siege to resort to a simple blockade by second-line troops, so that the fortress did not even weaken their field armies to any appreciable extent. On the whole then, Przemyśl may be considered no exception to the general experience of the World War, that permanent peace fortifications proved of very limited strategical value.

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PSYCHIATRY, a special branch of medical science dealing with the causes, symptoms, course and treatment of disorders and diseases of the mind. The ultimate aim of this branch of medicine should be to ascertain the best means to promote normal thought and action individually and collectively, and to apply the knowledge so obtained to the causation and prevention of mental defects, disorders and diseases. Hitherto, unfortunately, little attention has been directed towards prevention, and not much, beyond detention, for the cure of the above.

Mind and Body.—There is a general feeling among the profession and the public that psychiatry should be more closely associated with general medicine than has hitherto been the case. As long as the psyche, the soul and the mind were used as synonymous terms, traditional belief that the psyche is an invisible intangible spirit that leaves the body at death dominated all our ideas of mental diseases and their treatment—or rather lack of treatment. Body and mind cannot be separated, for there can be no mind without memory and no memory without body, and all psychic processes are dependent upon physiological processes. Although the brain is the organ which stores the memory of past experiences and the bonds that unite and recall them, thus enabling the individual to adapt himself to environment in the struggle for existence, yet strictly speaking the mind is directly dependent upon the vital activities and harmonious interactions of all the organs and tissues of the body; for how could the brain make adaptations to environment without the receptor peripheral sense organs and the nerves which connect them with the spinal cord and brain? These are the avenues of intelligence, as is clearly recognised in the famous dictum: *Nihil in intellectu quod non fuerit prius in sensu,* [One cannot conceive of anything that one has not previously experienced through one's senses]; which should, however, be expanded by the addition of *et in motu* for every feeling, thought or desire causes a nervous discharge; to voluntary and involuntary muscles and their visible or invisible activation.

Personality.—Another fundamental function of the brain besides that of the life of external relation is the consciousness of the individual's own personality, his states of feeling, his appetites and his desires, which are due in great part to the organic and bodily sensibility. The ego is aware of his individual personality by the continuum of subjective feelings arising from the entire body in relation to its integral parts and as a whole to the external world. He is continually attending to alterations of this external and internal sensory continuum, and reacting instinctively, habitually or consciously, according to a judgment of value based upon past experiences. The sentiments and passions may be regarded as the outcome of the evolution and interaction of the primitive emotions connected with self-preservation, propagation and the social instincts. They are associated with specific and characteristic expressive reactions in the " mind muscles " of the eye and face, as well as in gesture, in postural attitudes and in inarticulate vocalisation.

This emotional language is similar and common to all human beings; for whereas articulate speech is entirely imitative and mainly intellectual and acquired, emotional language is an innate and untaught acquisition of the species *homo sapiens.* It has a much deeper significance than articulate language. It cannot be feigned when absent or hidden when present. It, therefore, reveals the real state of mind of an individual more truly than articulate speech. Repressed sentiments and passions find their expression in the " mind muscles " of the eye and face, and their study will often reveal the motives and secret dispositions of men. Moreover, a change in their reactions to thought and feeling may be the first outward sign of the onset of a mental disorder.

" The Unconscious Mind " and the New Psychology.—Dr. Carpenter in his work on mental physiology first called attention to the importance of the subconscious mind by giving examples of what he termed unconscious cerebration. He affirms: " The emotional state seems often to be determined by circumstances of which the individual has no ideational consciousness." Sigmund Freud (*see* PSYCHOANALYSIS) first propounded a theory of the subconscious mind and demonstrated the dominating influence of the " love instinct " (libido) in its widest acceptation as a great " life impulse " of vast significance in connection with the psychoneuroses and psychoses. This is shown, moreover, in the fact that the onset of the psychoneuroses and the psychoses especially occur when the sex instinct matures—adolescence; and wanes—climacterium—in both sexes. The mental conflicts associated with this " life impulse " bear a close relationship to the prevailing unrest of modern life, especially among women of the middle and upper classes to whom marriage in a majority and maternity in a still larger proportion are denied.

Disharmonies.—When the " life impulse " existing in the deeper levels of an individual's personality do not find a natural outlet and the means of adaptation to environment, there exists a disharmony between physiological and sociological conditions, which is ever increasing in the most cultured races. The non-gratification of this instinctive desire may be the source of a mental conflict, accompanied by fear and anxiety in a large number of men and women, especially the latter. Members of the medical profession constantly find a sexual basis for the mental trouble in the history and behaviour of their patients who are suffering from either a psychoneurosis (for example, hysteria, hypochondriasis, or neurasthenia) or a psychosis (for example dementia praecox, religious manic-depressive insanity and involutional melancholia). The frustration of the complete " life reaction," and its corresponding failure of release of emotional tension, profoundly influence all the functions of the involuntary and glandular structures of the body. The causes of these disturbances are inexplicable to the patient.

Conflicts and Primal Instincts.—The maternal " life reaction," as expressively symbolised by the Madonna and Child, is unfulfilled and incomplete in the majority of women, especially in the upper and middle classes. The mere gratification of the sexual passion is but an incomplete product of the instinct of preservation of the species; the complete fulfilment of which is to love, to

be loved, to give birth to children and to nourish and cherish them. It has been assumed that women would be happy if they were able to enter into all the pursuits and occupations of men, but modern psychology tends to show that these primal instincts still dominate, though hidden to our conscious feelings. When there is an antagonism between a primal instinct and the social instinct a mental conflict occurs which is thrust out of consciousness; it remains in the subconscious mind and, as Freud has shown, can be revealed by the investigation and interpretation of dreams; by psychoanalysis by free association; and by the method of word association and time reaction of Jung, who also applied the psychogalvanometric reflex to word association as a method of discovering a mental conflict in the subconscious mind.

The more complex society becomes, the more liable are these mental conflicts to occur. When there are conditions which tend to an inherited mental instability and lack of development of the highest control, psychoneuroses and psychoses proportionally become more prevalent. The fact, nevertheless, remains that human beings of every social grade and belonging to all races of men have in the past suffered and still suffer from the same types of psychoneurosis and psychosis.

Effects of Civilisation.—The mental conflicts brought about by the disharmony between physiological and sociological instinctive conditions of the " life reaction " and the morbid reactions they induce occur much more frequently in highly civilised races as compared with primitive races. There are, therefore, many reasons why psychoneuroses and psychoses should occur with much greater frequency in the former. The onset, course and symptoms are, however, fundamentally the same, the only difference being that the hallucinations and delusions and their mode of activation (behaviour) are coloured by the habits, customs, social usages and beliefs which constitute the greater part of the individual and collective furniture of the mind.

The late Dr. Mercier always maintained that mental diseases should be studied from the behaviourist point of view, and his work on *Disorders of Conduct* embodies his teaching. The behaviourist doctrine has especially flourished in America, where the investigations, experiments and observations of Prof. J. B. Watson on the behaviour of animals and infants have been of great value in teaching psychiatrists the importance of viewing their cases as problems of behaviour, although his explanations of abnormal behaviour are to most psychiatrists inadequate.

The psychiatric student who wishes to study conduct must take into account not only what a man says and does, but the circumstances or " setting " at the time. Thus a prosperous butcher, who on Saturday night is seen standing outside his shop in apron and shirt sleeves inviting people to come in and buy, would be considered a lunatic if he conducted himself in exactly the same manner outside his respectable suburban villa next morning. A man is regarded as insane who on account of mental disease no longer thinks, feels and acts in accordance with the usages and customs of the society to which he belongs, and is not held responsible for his behaviour if he does not know at the time the nature and quality of his acts.

Causes of Mental Disease

The causes of mental disorders and diseases are never single, but they naturally fall into two great groups: (1) Endogenous (from within) and (2) Exogenous (from without). They may be somatic, psychical or social. The hereditary factor is the most important endogenous cause.

The Endogenous Factor of Mental Disorders.—The life of the individual begins at the moment of conception, *i.e.*, at the conjugation of the male and female germ cells. The raw material of character is a complex of inherited tendencies and dispositions impressed upon the individual by sex, species, race and ancestry, giving each individual a specific predetermined plasticity to receive and store stimuli and react to them in a particular way. Like tends to beget like—as Galton's *History of Similar and Dissimilar Twins* shows, in the dispositions and temperaments of the offspring.

A well-balanced mind is due to an inherent equipoise of the latent potentialities of character, and its efficient activity depends upon the potential psychophysical energy derived from the parental stocks. The study of heredity (1) by statistics, (2) by pedigrees and (3) by experience shows the importance of this factor in the causation of the true insanities which are not due to organic brain disease, where chance counts for everything and heredity for little or nothing. The raw material of mentality is conditioned by the innate potentialities of the fertilised ovum as it starts its course in life. At later stages of development, the fertilised ovum is influenced by pre-natal and post-natal exogenous environmental factors in addition to the hereditary factors.

Pre-natal Exogenous Factors.—Much may happen while the embryo is developing in the mother's womb. Owing to abnormal conditions of growth, interfering with the circulation and nutrition of the great brain, various degrees of arrest of development of the highest and latest evolutional structures of the brain may occur, viz., the cerebral hemispheres, which by their size especially distinguish the brain of man from the lower animals, and to which he owes his superior intelligence, may suffer from various congenital effects. Abnormal dynamic conditions of the cerebral vessels and of rate of growth of brain and *dura mater* may lead to anencephaly, microcephalic idiocy or low-grade imbecility (*see* article Neuropathology, 19.429). Again, pathological conditions may arise by which the cerebrospinal fluid secreted in the ventricles of the brain cannot escape, causing arrest of growth by pressure and (water on the brain) hydrocephalic idiocy. The embryo, during development, may become infected by the spirochaetes of syphilis circulating in the blood and lymph streams of the mother, resulting in abortion or congenital syphilis causing arrest of development of the brain and idiocy, or later in life of cerebral syphilis and general paralysis. Various poisons introduced into the body of the mother, *e.g.*, lead and alcohol, may cause abortion, and presumably may have a devitalising effect upon the developing embryo.

Again, absence of the thyroid gland in the embryo, or even hypothyroidism owing to goitrous disease of the gland with a failure of thyroxin in the blood (the essential element of which is iodine) may cause cretinous idiocy. The brain cells owing to this deficiency are arrested in their growth and fail to function, but if the cause is diagnosed in early infancy, and thyroid gland be administered, then the brain cells develop and grow and function normally. This cretinous idiocy is due to the absence of iodine in the environment. In districts far remote from the sea goitrous cretinism is common, *e.g.*, in Switzerland and certain districts of the United States (*see* Goitre). The addition of iodide of sodium in the water or table salt has greatly reduced the numbers afflicted with this disease. What more striking proof can we have that the mind depends upon the harmonious interaction of all the organs and tissues of the body, since a chemical substance containing iodine is essential for the growth of the brain and mental development and for its proper function. Particularly in women about the climacteric period, a condition known as myxoedema, due to hypothyroidism, occurs, resulting in a slowing of thought and speech and often mental symptoms which disappear by administration of the gland.

A curious form of idiocy, associated with blindness, is only met with in Jewish children. It is characterised by a racially unique degenerative biochemical condition of all the ganglion cells of the sympathetic and cerebrospinal nervous systems. The convolutional pattern of the brain has a normal appearance quite unlike that of a low-grade imbecile or idiot; it is, therefore, a late congenital or post-natal racial morbid condition.

Arrest of the growth of the brain may arise from pre-natal causes previously stated; likewise prolonged labour or unskilful use of instruments may damage the brain and arrest growth. It has been calculated that 25% of the cases of idiocy and imbecility are due to non-inherited conditions. The remaining 75% of cases of mental deficiency are truly hereditary, and due to an innate lack of *vis propria* of the fertilised ovum, which leads to an arrest of development of the highest and latest evolutional level of the brain.

Hereditary Factor in Relation to Psychoses and Psychoneuroses.—Study of the hereditary factor in psychoses and psychoneuroses by the construction of a large number of pedigrees extending to three, four and five generations with collaterals, and by a card system of 4,000 relatives who were or who had been in the London County Council asylums, proves that heredity plays a very important part in neuroses and psychoses.

Neuroses may be classified as follows: (1) hysteria, (2) neurasthenia, (3) obsessional psychasthenia, (4) epilepsy and (5) migraine; and psychoses as (1) paranoia (systematised delusional insanity), (2) dementia praecox, (3) manic-depressive insanity, of which there are several types, viz.: alternating periods of excitement and depression (*folie circulaire*) and recurrent periods of maniacal excitement or of melancholic depression, alternating with periods of sanity, (4) involutional melancholia occurring at the climacterium in women, also in men between the ages of 55 and 65, though less frequently met with than in women. Both the latter forms of mental disorder may terminate in dementia.

These three last-named types are in some ways related to one another, and their onset is associated with the maturation or waning of the sex instinct. An involutional melancholic or senile dement may have offspring in whom manic-depressive insanity or dementia praecox may occur in adolescence, or a parent with manic-depressive insanity may have one or more offspring with dementia praecox. This phenomenon together with the fact that not infrequently several members of the same co-fraternity suffer with either dementia praecox or manic-depressive insanity or an atypical form, coming on at puberty or adolescence at about the same age, shows antedating and hereditary predisposition as the important factor. There may be atypical cases in some respects resembling both these forms of mental disease, and it is a matter of opinion to which category a particular case should belong. This shows how fallacious classifications may be. The many changes which Kräpelin has made in his classification emphasise the fact that each case must be regarded as a biological problem with two factors to consider; viz.: what an individual was born with; and what happened after fertilisation of the ovum—that is, pre-natal and post-natal conditions. There is, it seems, a causal correspondence in these three types of insanity connected with the "life reaction" of the primal instinct of propagation.

Disintegration of Psychic Unity.—The biological concept of mental disease propounded by Hughlings Jackson in his *Theory of Evolutional Levels* will help in the understanding of the causes and symptoms of insanity—dissolution of the highest level bringing into relief lower levels. Thus a negative condition of the highest evolutional level of control permits of over-action of the lower level of ideation, *e.g.*, the delirium of fever. In mental disorders there may be a negative condition of the highest level of control with disordered ideation manifested by hallucinations and delusions, owing to partial disintegration of the psychic unity. Such hallucinations and delusions may determine various active uncontrolled and irresistible impulses—disorders of conduct. When the disease has sunk to a lower depth of dissolution of evolutional levels there may result emotional indifference and apathy reflected in a mask-like expression, and motor inertia or katatonic stupor with *flexibilitas cerea*. Stuporose states with mental confusion indicate a more diffuse toxic influence on evolutional levels and are more hopeful of recovery than the persistence of hallucinations and delusions, the mind remaining clear.

Post-Natal Exogenous Causes.—These do not play an important part *per se* in the production of the true insanities. They may, however, act as exciting or contributory causes in individuals with an hereditary latent tendency. Stress *per se* from disease and disasters of every kind cannot be the important factor believed to be in the production of the true insanities as distinct from organic brain disease, *e.g.*, general paralysis and lethargic encephalitis. This was clearly shown during the War by the fact that Bonhöffer, an eminent Austrian psychiatrist, only found five insane among 10,000 Serbian prisoners.

Organic brain disease may cause various symptoms of irritations such as fits, headaches, pains, stiffness of muscles, and delirium or drowsy stupor, loss of memory, paralysis and dementia, according to the pathological process and the structures affected.

General Paralysis of the Insane.—General paralysis was formerly believed to be an insanity; it is now known to be due to the invasion of the tissues by the Spirochaeta pallida, *i.e.*, the specific organism of syphilis (*see* Venereal Diseases). That a positive Wassermann reaction of the cerebro-spinal fluid is found in practically every case is an indication that the spirochaete of syphilis in the brain is multiplying and producing a toxin that sets up a chronic inflammation followed by destruction of the neurone. The dementia that ensues is proportional to the degree of decay and destruction of the cerebral cortical grey matter. Serological methods have enabled a diagnosis of this disease to be made in 97% of cases, whereas prior to the employment of laboratory methods the diagnosis was correct in only 75% of cases, when controlled by post-mortem examination. This disease is preventable, and ought to be prevented, for it is found that it claims its victims from among the best physically and mentally in all grades of society. Chance is everything and heredity nothing in this disease. There is first the chance of infection and next the chance that the spirochaete lodges in the brain and colonises there.

Lethargic encephalitis (*see* Encephalitis Lethargica) may be followed by serious mental disorders; especially does it affect the moral sense in children and young adolescents.

Mental Hygiene

Many advances were made in the practical sphere of action in the decade 1915–25. *A Mind that Found Itself* (1908), a book written in America, produced a great impression in that country on account of the author's vivid description of his personal sufferings as inmate of a mental hospital and of the manner in which everything except the right thing was done to restore him to health. Subsequently in the United States the author of the book, Mr. Clifford Beers, was instrumental in founding in 1916 "The National Committee for Mental Hygiene," having amongst its aims "the conservation of mental health"; the "prevention of nervous and mental disorders and mental defect"; the "raising of the standards of care and treatment of those suffering from such disorders and defects; the dissemination of reliable information upon these subjects."

A valuable periodical, *Mental Hygiene*, first issued in 1917, is published quarterly by the society, containing records of its work and recent advances in knowledge. Such an organisation has a potent influence for good, for it affects those suffering from mental disorder or defect and those also who through mental causes are unable so to adjust themselves to their environments as to live happy and efficient lives. Societies of mental hygiene have since been founded in France (Dept. of Seine) and in England on similar lines to that in America.

Reforms in Treatment.—A royal commission on Lunacy and Mental Disorder was appointed in Nov. 1924, to inquire into certain statements regarding illegal detention and ill-treatment and cruelty in asylums. For some time past dissatisfaction at asylum conditions had been prevalent amongst certain sections of the public which led to the formation of a National Society for Lunacy Reform supported by many distinguished persons.

The royal commission also investigated "the need of extending as a whole the privilege of treatment of insanity without subjection to the legal formalities of the Lunacy Acts," and of extending such other reforms as were embodied in the Medical Treatment bill 1923. This bill constituted a recognition by the authorities of the necessity long recognised by the medical profession for fresh legislation for the provision of funds for early treatment and research.

Mental disease is primarily a medical question, a part of general medicine, the fundamental principles of which are (1) to prevent disease, failing that (2) to cure or arrest the progress of disease, and failing that (3) to prolong life and relieve suffering. Till recently the ratepayers' money has been spent in building huge and sometimes palatial institutions, useful in the main for the detention and prolonging the life of certified chronic lunatics and senile cases. Little money has hitherto been expended in the endeavour to find out the causes of insanity by clinical, psychological, sociological and pathological research. Relatively few satisfactory efforts have been made

by the authorities to treat mental diseases in the early and curable stage, upon hospital lines.

Treatment on Hospital Lines.—During the War the public insisted that no soldier should be sent to an asylum unless proved to be suffering with an incurable mental disease or until after a probation of twelve months the disease was regarded as incurable. The same regulation applied to ex-service men under treatment by the Ministry of Pensions. This principle could not be applied to the civil population, because the conditions are different, since a man in the army or an ex-service pensioner is under control. The success of this method of dealing with mental disease in the army led the Board of Control to reconsider the question of the early treatment of insanity.

The Maudsley Hospital.—When Dr. Henry Maudsley, a great philanthropist, psychiatrist and philosopher, offered to the London County Council in 1907 £30,000 if they would build a hospital in London for the study and treatment of mental diseases in the early and curable stage, a real effort was made to deal with insanity on modern rational lines. The offer was accepted, and five years later a suitable site at Denmark Hill was found. The War came in 1914 before the hospital was finished. The building was completed in 1916, at the direction of the War Office, and served as the central nucleus of the Neurological Clearing Hospital for London. Dr. Maudsley died in 1917, and the council received by his will a further sum of £10,000. It was his expressed wish that this money should be expended in pathological investigation and research. For a time this hospital served as a neurological hospital for ex-service men under the Ministry of Pensions, and in 1922 it was taken over by the London County Council.

The Maudsley Hospital has an out-patients' department, and 150 beds for males and females. It has an adequate, efficient and highly qualified staff of medical officers. Early in the War the central pathological laboratory for the London County Council mental hospitals was removed from Claybury Asylum to the Maudsley Hospital, where routine clinical laboratory and serological investigations are carried out, thus affording excellent opportunities for research.

The Maudsley Hospital is a recognised school of the London University, and a course of lectures, together with practical instruction, is given to medical men who are desirous of qualifying for the Diploma of Psychological Medicine. The London County Council give study leave to their medical officers of asylums, and now require officers who apply for senior appointments to possess a University Diploma of Psychological Medicine or a diploma of the Conjoint Board of the Royal College of Physicians and Surgeons. Opportunities for research in the pathological laboratory are afforded to suitable applicants by the committee.

The Maudsley Hospital being a rate-aided hospital is primarily intended for those who have a London settlement, and the charge made varies according to the means of the patient. All inmates of the hospital are voluntary and uncertified. This allays the fear of the patients that they may be made permanent inmates, and inspires them with confidence in their treatment. Out-patients are thereby encouraged to attend the hospital, and in this way a more favourable prognosis is secured, for mental disorders and diseases are thus observed and treated in their incipient stages. This is advantageous to the patients, and it enables medical men to learn and understand the symptoms and early stages of mental disease. Too frequently the descriptions in text-books have been drawn from the more serious, the chronic and the incurable cases of disease seen in asylums; thus knowledge of the initial stages of mental disease has been inadequately taught. It is on these early cases, which either are, or ought to be, outside the asylums, with their large chronic incurable population, that the ratepayers' money can be expended with advantage, not only from a medical and social but also from an economic point of view.

Another move in the right direction, as regards research into the causes of insanity, has been made by the establishment of a Joint Board of Research of the Corporation and University of the City of Birmingham, and the establishment of an adequately staffed and equipped pathological laboratory. These opportunities for early treatment and research might with advantage be adopted by large cities on the lines of the Maudsley Hospital. Other schemes are embodied in the Memorandum to the Royal Commission on Lunacy and Mental Disorders by the Medico-Psychological Association of Great Britain and Ireland.

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PSYCHICAL RESEARCH (*see* 22.544).—The increase of interest in psychical research all over the civilised world was signalised by the institution of international congresses, the first of which, attended by representatives of 12 countries, was held at Copenhagen in 1921, while 17 countries were represented at the Warsaw Congress in 1923. At these congresses the curious fact emerged that interest on the Continent was mainly concentrated on physical, in the United Kingdom and America on mental or psychological phenomena.

Telekinesis and Teleplasmy.—Physical phenomena can be grouped under two main heads: *telekinesis*, or the movement of objects at a distance otherwise than by ordinary physical means; and *teleplasmy*, or the extrusion from the body of the medium of a substance, sometimes amorphous, sometimes resembling portions of the human body or even complete figures. Phenomena of both these kinds have long been familiar, but it was only as the result of the investigations of J. Ochorowitz (*Annales des Sciences Psychiques*, from 1909 on) that the connection between the two was observed, and those who accept the reality of the phenomena believe that teleplasm is the mechanism behind telekinesis. Among the more famous "physical" mediums may be mentioned Stanislava T, Stanislava P, Guzik, Kluski, Franczek (all from Poland), Frau Silbert, Willy and Rudi Schneider, Eva C., Kathleen Goligher and Mrs. Crandon. Numerous scientific men of high standing investigated them and declared their conviction of the reality of the phenomena, but without so far obtaining general acceptance for their view either in the scientific world or among the public.

Conditions of Research.—The unbeliever argues (1) that the conditions usually demanded by mediums (*e.g.*, dim light, refusal to permit the teleplasm to be handled or portions detached) facilitate deception; (2) that few investigators, however eminent otherwise, are skilled in the technique of detecting fraud, and (3) that, even so, practically all the well-known mediums have sooner or later been detected simulating phenomena, or at least have come under grave suspicion. All this the candid psychic researcher will admit, but he will join issue when the further claim is made that this disposes of the whole question: he will point to the investigations by the Society for Psychical Research of Eva C. and Willy Schneider (to name only two that have taken place in this country) as evidence that, under rigorous control exercised by investigators with full knowledge of fraudulent methods, results can be obtained which, if not absolutely demonstrating the reality of telekinesis and teleplasm, at any rate make out a very strong case for further inquiry.

The subject will not, however, obtain the serious consideration it deserves until an agreement be reached by all researchers (1) not to publish any report on a medium until he or she has been investigated by a committee of experts in detecting fraud, who report that they have witnessed phenomena *prima facie* genuine; (2) not to publish any report which does not set out in full detail all material facts as to persons present, methods of control, precautions to prevent fraud, measures to ascertain whether fraud in fact occurred, etc. The voluminous literature on the subject would be considerably reduced if all reports falling short of the latter standard were eliminated.

Until the phenomena are better authenticated it would be idle to refer at lengths to theoretic explanations of their origin. The continental observers generally reject the hypothesis of spirit action, and believe that the teleplasm is moulded in accordance with the subconscious ideas of the medium, and possibly the sitters.

Psychic photography is the one form of physical mediumship which has "caught on" in Great Britain; but, as Professor Richet, a not unduly sceptical critic of physical phenomena, remarks, "despite many attempts nothing reliable has been proved."

In addition to the physical phenomena produced by regular mediums there are the curious cases, reported from time to time in the Press, of mysterious noises, breakages of furniture, etc., in houses. Such *poltergeist* cases, as they are called, are particularly baffling, mainly because the enterprising journalist usually arrives on the scene before the trained researcher, and makes all serious investigations impossible. In most instances there will be found amongst the occupants of the house some person in a state of mental or nervous instability, often a child at the age of puberty, with whose removal the manifestations cease. Trickery, not necessarily deliberate or even conscious, but often very skilful, explains many of the cases, but it is not clear that it covers them all. Where there is trickery, the motive may be merely love of mischief or a desire for notoriety, and the apparent psychological affinity between the principal actors in poltergeist cases and regular physical mediums must be borne in mind when considering the question of deception, whether conscious or unconscious, on the part of regular mediums, especially when no normal motive for fraud can be traced.

Mental and Physical Phenomena.—Before passing from physical to mental phenomena it may be useful to consider what, if any, connection there is between them, beyond the historical one. In the early days of the spiritualist movement, down to the time of Home and Stainton Moses, the association was close. The same mediums produced both classes of phenomena, and both were attributed to spirit agency by those who accepted them. As, however, investigations became more scientific, a division developed: so far as concerns reasonably well-authenticated phenomena, the physical mediums came to form one group, the mental mediums another, and the temperamental differences between typical mediums of the two groups are striking. Were it not that both classes of phenomena appear to require for their production either trance or some less complete form of dissociation on the medium's part, there would seem to be no reason why they should continue to be treated as both subjects for the same branch of research.

Mental Phenomena.—Telepathy has probably gained wider acceptance than any other hypothesis connected with Psychical Research, and both in its spontaneous and experimental manifestations continues to be extensively studied. The most notable experiments in recent years are Professor Gilbert Murray's two series (*S.P.R. Proc.*, vol. 29 (1918) and 34 (1924) and Dr. Coover's experiments at the Leland Stanford Junior University, California (1917). In the Gilbert Murray experiments attempts were made to transmit complicated ideas or conceptions, *e.g.*, of pictures, scenery, incidents from literature, imaginary and often fantastic occurrences, and a proportion of successes was obtained very largely exceeding what can reasonably be attributed to chance. In Dr. Coover's experiments with 100 students from his university it was sought to transmit the correct denomination of playing cards, and, taking all the students together, the successes only slightly exceeded the proportion attributable to chance; individual students, however, had results much above the average. The apparent discrepancy between the results of these two groups of experiments can be reconciled if the natural inference is drawn that subjects which arouse the interest or curiosity of the experimenters are more easily transmitted than mere numbers or pips on a card, and that subconscious boredom was at the bottom of the failure of the Californian students.

The Gilbert Murray experiments cannot be considered absolutely conclusive evidence of telepathy, as the conditions did not exclude the possibility of auditory hyperaesthesia, *i.e.*, of Professor Murray having, subconsciously of course, overheard the agents discussing the subject to be transmitted. The records, however, especially of the later experiments, contain a good deal of evidence tending to negative this hypothesis, and it is to be noted that the experiments of Miss Miles and Miss Ramsden (*S.P.R. Proc.* vol. 21, 1907–9) were not prejudicially affected by the distances (in some cases hundreds of miles) separating agent and percipient.

Spontaneous Telepathy.—As regards spontaneous telepathy, evidence of the kind so carefully collected and discussed in *Phantasms of the Living* continues to accumulate. In *S.P.R. Proc.*, vol. 33 (1923), a large number of cases reported to the S.P.R., including several very striking instances of apparitions closely corresponding with the death at a distance of the presumed "agent," are collected and classified by Mrs. Sidgwick, whose article on "Hindrances and Complications in Telepathic Communication" (*S.P.R. Proc.*, vol. 34, 1924) also deserves careful study. The combined evidence, experimental and spontaneous, although falling short of strict scientific demonstration of telepathy, raises the hypothesis to a very high level of probability.

Clairvoyance, or the supposed supernormal knowledge of matters not (as in telepathy) derived from another mind, is not so well attested, but there is a growing body of evidence in its support. Reference should be made to the experiments with Ossowiecki in reading the contents of sealed envelopes (Geley's *L'Ectoplasmie et la Clairvoyance*, 1924) and the investigations of the "psychometric" powers of a Mexican lady by Dr. Pagenstecher and Dr. Walter Prince (*American S.P.R. Proc.* vol. 15 and 16). In this connection mention must also be made of the "book-tests" received through trance-mediums. The sitter is informed that a particular portion of a specified page in a book, identified by its position in a bookcase in a house where the medium has never been, will be found to contain a message to a particular effect: in the instances reported to the S.P.R. the number of successes largely exceeded chance probability (see *S.P.R. Proc.*, vol. 32 and 33, 1921 and 1923). Book-tests generally purport to be given by discarnate intelligences, and the subject matter of the messages, which is often appropriate to the supposed communicator, suggests at least some survival of memory.

In addition to the references already given, see R. Warcollier, *La télépathie* (1921); R. Tischner, *Über Hellsehen und Telepathie* (1921); C. Bruck, *Experimentelle Télépathie* (1925).

Evidences of Survival

As the results of bereavements caused by the War the number of persons consulting trance-mediums has enormously increased. Of the communications received at sittings a great part consists either of vague generalities or descriptions of a future life which, whether true or not, have no evidential value. But facts are frequently communicated which cannot reasonably be attributed to the medium's normal knowledge, and the question arises whether such facts are derived, as they purport to be, from some discarnate mind, or whether they can be explained as telepathic impressions received subconsciously by the medium from some living mind. The problem is a difficult one, as, assuming telepathy occurs, we are ignorant of the exact limits of its action: a very able attempt to elucidate this problem was contributed by Dr. Walter Prince to the Copenhagen Congress. (See *Compte Rendu* of that Congress.)

Further evidence shows that telepathy plays an important part in communications ostensibly coming from the dead. Thus a sitter received from a medium in the form of spirit-communications (1) details consciously imagined by himself regarding an entirely fictitious person and (2) statements concerning an acquaintance believed by him to have been killed in the War, accurate in every point except that the friend was in fact alive. Some of the statements referred to events recurring after the War, and some to things which happened, curiously enough, after the date of the sitting (*S.P.R. Proc.*, vol. 35, 1925). If, then, a medium can, not only in theory but in fact, collect information from the mind both of the sitter and of a person only connected in a remote way with either medium or sitter, the difficulties in the way of establishing survival by *information* conveyed in trance seem insuperable.

Where, however, as often happens, especially in "direct control," something more than mere information is conveyed, where, for instance, the turns of speech and the habits of mind of the ostensible communicator are reproduced in a lifelike manner, those who reject the spiritistic hypothesis have to assume, in addition to telepathy, a strong, perhaps an improbably strong, power of subconscious dramatisation on the medium's part.

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Conscious Design

That telepathy impaired the evidence of survival derived from trance-communications was recognised by Myers and the other founders of the Society for Psychical Research, and it is of interest that evidence of a kind not readily explicable by telepathy first began to appear shortly after Myers' death, and ostensibly on his inspiration, in the form of "cross-correspondences" in automatic writing. It was found that several automatists, writing without knowledge of each other's scripts, would each produce fragmentary allusions to some topic. Taken separately the scripts meant little, but when compared the fragments fitted together to form a complex whole. There seemed a substratum of *conscious design*, not originating with any single automatist, or, as far as could be ascertained or imagined, with any other living mind, and accordingly supporting the claim, frequently made in the scripts, that they originated in a particular discarnate mind or group of minds (*S.P.R. Proc.*, vol. 20, 1906, *et seq.*). In one instance, however (the "Sevens" Case, *S.P.R. Proc.* vol. 25, 1911), the mind of a living person seems to some extent at least to have influenced the scripts.

Further evidence of design is afforded by the literary puzzles contained in automatic scripts of which the "Ear of Dionysius" is the most remarkable (see Mr. Gerald Balfour's paper, *S.P.R. Proc.*, vol. 29, 1918). In this case the automatic writings of a lady with little classical knowledge set out piecemeal and very allusively the story of the obscure Greek poet Philoxenus. Probably the majority of those who have taken honours in the Classical Tripos or "Mods" could not give the full story as recounted in the scripts; in fact, it is only to be found in one English book, a book never seen by the automatist, but known to have been possessed and used by the distinguished classical scholar, then dead, from whom the scripts purported to come.

These cross-correspondences and literary puzzles are difficult reading, a tangle of recondite literary allusions, but no student of the literature of survival should be deterred thereby from giving them careful consideration. If they have been correctly interpreted, they suggest the survival of a mind capable of originating and carrying out an elaborate plan, something more than the persistence of a psychic factor, which Dr. C. D. Broad is willing to concede (see *The Mind and Its Place in Nature*, 1925).

BIBLIOGRAPHY.—General. Particular volumes of the *Proc. Soc. Psy. Res.* and *American Proc. Soc. Psy. Res.* have been quoted but the whole series is important. On the Continent *Zeitschrift für Parapsychologie* and *Zeit f. Kritischen Okkultesmus* ably represent the two main schools of thought.

See also E. Osty, *La connaissance supra-normale* (1923); C. Richet, *Traité de métapsychique* (1923); M. Dessoir, *Der Okkultismus in Urkunden*, Part 2 (1925); H.Driesch, *The Crisis in Psychology* (1925). F. Schrenck-Notzing, *Materializations-Phaenomene* (1914); *Physikalische phaenomene des Mediumismus* (1920); W. J. Crawford, *The Psychic Structures at the Goligher Circle* (1921); "Reports on Eva C., Willy Schneider, etc.," *Proc. Soc. Psy. Res.*, vol. 32 (1922) and 35 (1925); G. Geley, *L'Ectoplasmie et la Clairvoyance* (1924); M. Dessoir *Der Okkultismus in Urkunden* (1925). (W. H. S.)

PSYCHOANALYSIS: FREUDIAN SCHOOL.—In the years 1880–2 a Viennese physician, Dr. Josef Breuer (1842–1925), discovered a new procedure by means of which he relieved a girl, who was suffering from severe hysteria, of her various symptoms. The idea occurred to him that the symptoms were connected with impressions which she had received during a period of excitement while she was nursing her sick father. He therefore induced her, while she was in a state of hypnotic somnambulism, to search for these connections in her memory and to live through the "pathogenic" scenes once again without inhibiting the affects that arose in the process. He found that when she had done this the symptom in question disappeared for good.

This was at a date before the investigations of Charcot and Pierre Janet into the origin of hysterical symptoms, and Breuer's discovery was thus entirely uninfluenced by them. But he did not pursue the matter any further at the time, and it was not until some 10 years later that he took it up again in collaboration with Sigmund Freud. In 1895 they published a book, *Studien über Hysterie*, in which Breuer's discoveries were described and an attempt was made to explain them by the theory of *Catharsis*. According to that hypothesis, hysterical symptoms originate through the energy of a mental process being withheld from conscious influence and being diverted into bodily innervation ("*Conversion*"). A hysterical symptom would thus be a substitute for an omitted mental act and a reminiscence of the occasion which should have given rise to that act. And, on this view, recovery would be a result of the liberation of the affect that had gone astray and of its discharge along a normal path ("*Abreaction*"). Cathartic treatment gave excellent therapeutic results, but it was found that they were not permanent and that they were dependent on the personal relation between the patient and the physician. Freud, who later proceeded with these investigations by himself, made an alteration in their technique, by replacing hypnosis by the method of free association. He invented the term "*psychoanalysis*," which in the course of time came to have two meanings: (1) a particular method of treating nervous disorders and (2) the science of unconscious mental processes, which has also been appropriately described as "depth-psychology."

Subject Matter of Psychoanalysis.—Psychoanalysis finds a constantly increasing amount of support as a therapeutic procedure, owing to the fact that it can do more for certain classes of patients than any other method of treatment. The principal field of its application is in the milder neuroses—hysteria, phobias and obsessional states, but in malformations of character and in sexual inhibitions or abnormalities it can also bring about marked improvements or even recoveries. Its influence upon dementia praecox and paranoia is doubtful; on the other hand, in favourable circumstances it can cope with depressive states, even if they are of a severe type.

In every instance the treatment makes heavy claims upon both the physician and the patient: the former requires a special training, and must devote a long period of time to exploring the mind of each patient, while the latter must make considerable sacrifices, both material and mental. Nevertheless, all the trouble involved is as a rule rewarded by the results. Psychoanalysis does not act as a convenient panacea ("*cito, tute, jucunde*") upon all psychological disorders. On the contrary, its application has been instrumental in making clear for the first time the difficulties and limitations in the treatment of such affections.

The therapeutic results of psychoanalysis depend upon the replacement of unconscious mental acts by conscious ones and are operative in so far as that process has significance in relation to the disorder under treatment. The replacement is effected by overcoming internal resistances in the patient's mind. The future will probably attribute far greater importance to psychoanalysis as the science of the unconscious than as a therapeutic procedure.

Depth-psychology.—Psychoanalysis, in its character of depth-psychology, considers mental life from three points of view: the dynamic, the economic and the topographical.

From the first of these standpoints, the *dynamic* one, psychoanalysis derives all mental processes (apart from the reception of external stimuli) from the interplay of forces, which assist or inhibit one another, combine with one another, enter into compromises with one another, etc. All of these forces are originally in the nature of *instincts;* that is to say, they have an organic origin. They are characterised by possessing an immense (somatic) persistence and reserve of power ("*repetition-compulsion*"); and they are represented mentally as images or ideas with an affective charge ("*cathexis*"). In psychoanalysis, no less than in other sciences, the theory of instincts is an obscure subject. An empirical analysis leads to the formation of two groups of instincts: the so-called "ego-instincts," which are directed towards self-preservation and the "object-instincts," which are concerned with relations to an external object. The social instincts are not regarded as elementary or irreducible.

Theoretical speculation leads to the suspicion that there are two fundamental instincts which lie concealed behind the manifest ego-instincts and object-instincts: namely (*a*) Eros, the instinct which strives for ever closer union, and (*b*) the instinct of destruction, which leads toward the dissolution of what is living. In psychoanalysis the manifestation of the force of Eros is given the name "*libido*."

Pleasure-Pain Principle.—From the *economic* standpoint psychoanalysis supposes that the mental representations of the instincts have a cathexis of definite quantities of energy, and that it is the purpose of the mental apparatus to hinder any damming-up of these energies and to keep as low as possible the total amount of the excitations to which it is subject. The course of mental processes is automatically regulated by the "*pleasure-pain principle*"; and pain is thus in some way related to an increase of excitation and pleasure to a decrease. In the course of development the original pleasure principle undergoes a modification with reference to the external world, giving place to the "*reality-principle*," whereby the mental apparatus learns to postpone the pleasure of satisfaction and to tolerate temporarily feelings of pain.

Mental Topography.—Topographically, psychoanalysis regards the mental apparatus as a composite instrument, and endeavours to determine at what points in it the various mental processes take place. According to the most recent psychoanalytic views, the mental apparatus is composed of an "*id*," which is the reservoir of the instinctive impulses, of an "*ego*," which is the most superficial portion of the id and one which is modified by the influence of the external world, and of a "*super-ego*," which develops out of the id, dominates the ego and represents the inhibitions of instinct characteristic of man. Further, the property of consciousness has a topographical reference; for processes in the id are entirely unconscious, while consciousness is the function of the ego's outermost layer, which is concerned with the perception of the external world.

At this point two observations may be in place. It must not be supposed that these very general ideas are presuppositions upon which the work of psychoanalysis depends. On the contrary, they are its latest conclusions and are in every respect open to revision. Psychoanalysis is founded securely upon the observation of the facts of mental life; and for that very reason its theoretical superstructure is still incomplete and subject to constant alteration. Secondly, there is no reason for astonishment that psychoanalysis, which was originally no more than an attempt at explaining pathological mental phenomena, should have developed into a psychology of normal mental life. The justification for this arose with the discovery that the dreams and mistakes ("*parapraxes*," such as slips of the tongue, etc.) of normal men have the same mechanism as neurotic symptoms.

Theoretical Basis.—The first task of psychoanalysis was the elucidation of nervous disorders. The analytical theory of the neuroses is based upon three ground-pillars: the recognition of (1) "*repression*," of (2) the importance of the sexual instincts and of (3) "*transference*."

Censorship.—There is a force in the mind which exercises the functions of a censorship, and which excludes from consciousness and from any influence upon action all tendencies which displease it. Such tendencies are described as "repressed." They remain unconscious; and if the physician attempts to bring them into the patient's consciousness he provokes a "*resistance*." These repressed instinctual impulses, however, are not always made powerless by this process. In many cases they succeed in making their influence felt by circuitous paths, and the indirect or substitutive gratification of repressed impulses is what constitutes neurotic symptoms.

Sexual Instincts.—For cultural reasons the most intensive repression falls upon the sexual instincts; but it is precisely in connection with them that repression most easily miscarries, so that neurotic symptoms are found to be substitutive gratifications of repressed sexuality. The belief that in man sexual life begins only at puberty is incorrect. On the contrary, signs of it can be detected from the beginning of extra-uterine existence; it reaches a first culminating point at or before the fifth year ("early period"), after which it is inhibited or interrupted ("latency period") until the age of puberty, which is the second climax of its development. This double onset of sexual development seems to be distinctive of the genus Homo. All experiences during the first period of childhood are of the greatest importance to the individual, and in combination with his inherited sexual constitution, form the dispositions for the subsequent development of character or disease. It is a mistaken belief that sexuality coincides with "genitality." The sexual instincts pass through a complicated course of development, and it is only at the end of it that the "primacy of the genital zone" is attained. Before this there are a number of "pre-genital organisations" of the libido—points at which it may become "fixated" and to which, in the event of subsequent repression, it will return ("*regression*"). The infantile fixations of the libido are what determine the form of neurosis which sets in later. Thus the neuroses are to be regarded as inhibitions in the development of the libido.

The Oedipus Complex.—There are no specific causes of nervous disorders; the question whether a conflict finds a healthy solution or leads to a neurotic inhibition of function depends upon quantitative considerations, that is, upon the relative strength of the forces concerned. The most important conflict with which a small child is faced is his relation to his parents, the "*Oedipus complex*"; it is in attempting to grapple with this problem that persons destined to suffer from a neurosis habitually fail. The reactions against the instinctual demands of the Oedipus complex are the source of the most precious and socially important achievements of the human mind; and this probably holds true not only in the life of individuals but also in the history of the human species as a whole. The super-ego, the moral factor which dominates the ego, also has its origin in the process of overcoming the Oedipus complex.

Transference.—By "*transference*" is meant a striking peculiarity of neurotics. They develop toward their physician emotional relations, both of an affectionate and hostile character, which are not based upon the actual situation but are derived from their relations toward their parents (the Oedipus complex). Transference is a proof of the fact that adults have not overcome their former childish dependence; it coincides with the force which has been named "suggestion"; and it is only by learning to make use of it that the physician is enabled to induce the patient to overcome his internal resistances and do away with his repressions. Thus psychoanalytic treatment acts as a second education of the adult, as a corrective to his education as a child.

Within this narrow compass it has not been possible to mention many matters of the greatest interest, such as the "*sublimation*" of instincts, the part played by symbolism, the problem of "*ambivalence*," etc. Nor has there been space to allude to the applications of psychoanalysis, which originated, as we have seen, in the sphere of medicine, to other departments of knowledge (such as Anthropology, the Study of Religion, Literary History and Education) where its influence is constantly increasing. It is enough to say that psychoanalysis, in its character of the psychology of the deepest, unconscious mental acts, promises to become the link between Psychiatry and all of these other fields of study.

The Psychoanalytic Movement.—The beginnings of psychoanalysis may be marked by two dates: 1895, which saw the publication of Breuer and Freud's *Studien über Hysterie*, and 1900, which saw that of Freud's *Traumdeutung*. At first the new discoveries aroused no interest either in the medical profession or among the general public. In 1907 the Swiss psychiatrists, under the leadership of E. Bleuler and C. G. Jung, began to concern themselves in the subject; and in 1908 there took place at Salzburg a first meeting of adherents from a number of different countries. In 1909 Freud and Jung were invited to America by G. Stanley Hall to deliver a series of lectures on psychoanalysis at Clark University, Worcester, Mass. From that time forward interest in Europe grew rapidly; it showed itself, however, in a forcible rejection of the new teachings, characterised by an emotional colouring which sometimes bordered upon the unscientific.

The reasons for this hostility are to be found, from the medical point of view, in the fact that psychoanalysis lays stress upon psychical factors, and from the philosophical point of view, in its assuming as an underlying postulate the concept of unconscious mental activity; but the strongest reason was undoubtedly the general disinclination of mankind to concede to the factor of sexuality such importance as is assigned to it by psychoanalysis. In spite of this widespread opposition, however, the movement in favour of psychoanalysis was not to be checked. Its adherents formed themselves into an International Association, which passed successfully through the ordeal of the World War, and at the present time comprises local groups in Vienna, Berlin, Budapest, London, Switzerland, Holland, Moscow and Calcutta, as well as two in the United States. There are three journals representing the views of these societies: the *Internationale Zeitschrift für Psychoanalyse*, *Imago* (which is concerned with the application of psychoanalysis to non-medical fields of knowledge), and the *International Journal of Psycho-Analysis*.

During the years 1911–3 two former adherents, Alfred Adler, of Vienna, and C. G. Jung, of Zürich, seceded from the psychoanalytic movement and founded schools of thought of their own. In 1921 Dr. M. Eitingon founded in Berlin the first public psychoanalytic clinic and training-school, and this was soon followed by a second in Vienna. For the moment these are the only institutions on the continent of Europe which make psychoanalytic treatment accessible to the wage-earning classes.

BIBLIOGRAPHY.—Breuer and Freud, *Studien über Hysterie* (1895); Freud, *Traumdeutung* (1900); *Zur Psychopathologie des Alltagslebens* (1904); *Drei Abhandlungen zur Sexualtheorie* (1905); *Vorlesungen zur Einführung in die Psychoanalyse* (1916). Freud's complete works have been published in Spanish (*Obras completas*) (1924), and German (*Gesammelte Schriften*) (1925); the greater part of them has been translated into English and other languages. Short accounts of the subject-matter and history of psychoanalysis will be found in: Freud, *Ueber Psychoanalyse* (the lectures delivered at Worcester, U.S.A.) (1909); *Zur Geschichte der psychoanalytischen Bewegung* (1914); *Selbstdarstellung* (in Grote's collection *Die Medizin der Gegenwart*) (1925). Particularly accessible to English readers are: A. A. Brill, *Psycho-Analysis* (1922); Ernest Jones, *Papers on Psycho-Analysis* (1923). (S. FR.)

PSYCHOLOGY (*see* 22.547b, also PSYCHIATRY; PSYCHOSIS; PSYCHOTHERAPY).—The most important influence affecting recent developments of psychology has been the widespread use of experimental methods of investigation, and a general acceptance of their implications.

Experiment in psychology is, as C. S. Myers points out, "at least as old as Aristotle." But its systematic and unrestricted application to psychological problems, and particularly a recognition of all that this involves with regard to the general nature of psychological theory, are a comparatively recent growth. These, more than anything else, have brought psychology into line with the other biological sciences, have transformed its questions from those of descriptive analysis to those of function, have contributed most powerfully to the destruction of the purely introspective, atomistic or mosaic psychology of the past and have encouraged and rendered possible the important practical applications of psychology which have characterised the period under review, and are particularly vigorous at the present time.

Behaviourism.—This account of general theoretical developments may begin by a reference to behaviourism, itself a direct result of the application of experiment to psychology. The early behaviourists were all interested mainly in animal conduct. They studied, not merely the reactions of particular parts of an organism, but the response of the organism as a whole; not merely the effects of particular isolated stimuli, but the influence of what they called the "whole situation," including in the latter the past history of the organism itself. They tried to show how more complex forms of response (*e.g.*, instinct and habit responses) may grow up out of combinations of simpler reaction (*e.g.*, tropisms and reflexes), and they made a great amount of use of Pawlow's principle of "conditioned reflex," erecting it into the most important explanatory principle of complex forms of conduct. They then applied exactly the same methods to the study of human behaviour. They tended at once to become philosophical, and to assert that there is no such thing as consciousness, thereby opening up a large amount of fruitless and violent controversy. All that their method demanded they should assert was that consciousness need not be invoked as a determining condition of any form of response with which the psychologist must deal. Perhaps no psychologist has yet provided a thoroughly convincing refutation of this position, but the attempt to establish the precise functions of consciousness in human conduct—whether stimulated directly by behaviourist writings or not—has produced much important research.

Relations with Physiology.—Experimental physiologists have made striking advances in our knowledge of the physics and chemistry of muscular contraction, of the effects of glandular secretion, of the conditions and character of the conduction of nerve impulses, and of the functions of peripheral nerves and of the central nervous system. These have all helped to delimit the range of psychology, to show, that is, precisely where the psychological problems emerge. Of the most direct significance to the psychologist have been the researches of neurologists—provided with unrivalled experimental material in the course of the World War—into the effects of localised injuries to the brain and spinal cord. Perhaps the most significant of these is the work of Henry Head, who has carried further his investigations of the functions of the afferent sensibility by a thorough study of the "high level" responses involved in the use of language. His work represents the first attempt to carry out a searching investigation of the problems of aphasia by the systematic application of specifically psychological tests.

Psychical Activity.—Broadly speaking the result of all this work seems to show that conditions which at present, at any rate, have to be treated as definitely "psychical" play an efficient part in the determination of all highly developed conduct, and that the most fundamental of these have to do (a) with the emergence of *meaning* as a factor in response, (b) with the development and functions of *images* and (c) with the growth and reactive significance of the various forms of *feeling*. Thus although the methods of control of pre-conscious and conscious reactions may be the same, the factors in control appear to be different.

Gestalt Theory.—More purely psychological paths of approach seem to converge toward the same conclusion. What is known as *Gestaltheorie* has had a great influence upon recent psychological formulations. This, developed by Wertheimer and his associates, was in the first place concerned with the psychology of perception. Its central contention is that all of the material (or "objects") dealt with at the level of psychological responses are *Gestalten*, (wholes, forms, configurations—there is no exact English equivalent) diversified or complex, but in no sense capable of expression in terms of the parts which they may seem to contain. It is perhaps not unfair to say that the whole of this important movement is concerned with an elucidation of the character and functions of *meaning* in psychological responses.

Imagery.—Another active development is connected with the names of Jaensch and of his collaborators and pupils. Jaensch claims to have discovered a new and important type of imagery, photographically accurate, projected, coloured and abnormally resistant to the usual wearing effects of time. Such imagery is common in early life, but later is overlaid or outgrown, and is called *eidetic*. These workers try to show that all psychological problems centre in the use and functions of *images*.

Psychoanalysis.—Most prominent of all, particularly outside strict academic circles, has been the influence of a variety of views which are generally rather loosely put together and referred to as "psychoanalysis" (*q.v.*), Freud, Jung, Adler and a host of enthusiastic followers in all countries, have developed and promulgated its doctrines. Probably most psychologists would maintain that the practical significance of psychoanalysis outweighs its theoretical importance, but a convinced psychoanalyst is rarely willing to admit that this is the case. This movement, in all its many, and often conflicting forms, has conclusively demonstrated the enormous part which may be played

in the determination of human response by factors which remain totally outside the range of normal waking consciousness. Here also, we have at its height the tendency to concentrate upon *feeling* as the predominant psychological factor in the explanation of conduct.

Social Psychology.—Social psychology, largely under the influence of the writings of McDougall, and also affected to a considerable extent by modern psychopathology, has been very much to the fore. Lately attempts have been made in various directions to bring social psychology more immediately into touch with ethnology, history and economics, and so to check its hitherto marked tendency to wide and rash generalisation.

Experimental Psychology.—These more general and inclusive movements, though all largely influenced by experimental method, contain many features that can hardly be said to have a definite experimental basis. If we turn to a survey of the field of experimental psychology proper, we are met by a bewildering diversity of effort. There is hardly any problem over the whole range of individual conduct which some experimentalist has not attempted to tackle. Probably the chief impression to be obtained is that even in the field of sensorial reactions there is comparatively little that has been treated as completely and finally established. Yet more obviously is this true of the psychology of perception, of recall and memory, of imaging, of thinking in all its forms, and of feeling and willing. But in all these fields alike evidence is accumulating to show that no formulation of the conditions of reactions which confines itself to physical and chemical and to physiological terms is adequate to account for the complexity of life at the human level. On the whole, for example, the James-Lange hypothesis of the causation and character of emotions becomes less, rather than more certain, as research progresses.

Applied Psychology.—Particularly striking developments have occurred in the realms of applied psychology. The most important of these have concerned (*a*) education, (*b*) industry, (*c*) medicine and (*d*) law.

Education.—The psychological problems which have taken the most prominent position in relation to education have concerned the theory and application of intelligence tests (*q.v.*). In every country numerous groups of tests of intelligence have been proposed and used. At the same time the theoretical study of the relation of these tests to the nature and functions of intelligence has been pushed much further. There is still frequent and vigorous controversy as to the nature of "general intelligence," or of a possible "general factor" in intelligence (*see* INTELLIGENCE, HUMAN). In this, modern psychology has made great use of statistical methods. In many quarters intelligence tests have been employed to supersede or to supplement the common written examination. Numerous attempts have been made to render the tests more immediately practical by adapting them to groups rather than to individual children. Apart from intelligence tests proper, tests of capacity for practically every kind of specific ability involved in educational attainment, from "low level" motor activities to the most complex co-ordinations of mechanical and intellectual skill, have been developed and applied. The enthusiasm of the mental test devotee has, in fact, probably far outrun his discretion. At the same time the practical application of psychological principles to methods of teaching has been much emphasised, and in particular there has been a persistent and widespread effort to co-ordinate the treatment of mental defect in children with its precise experimental study. The psychoanalytic movement has had a profound influence in most countries upon methods of education particularly of young children.

Industrial.—America led the way in the application of psychology to industrial organisation and administration. But the movement spread rapidly and at present England, France, Italy, Germany, Holland and other countries all have strong and active institutions concerned with the study of the human element in industry. In the main the problems dealt with are of three types: (*a*) those of vocational guidance and selection (*see* JOB ANALYSIS); (*b*) those of industrial fatigue (*see* INDUSTRIAL PSYCHOLOGY) and (*c*) those of motion study, vocational guidance and selection is definitely related to the mental test movement, and is directed to the avoidance of misfits in industry, and to the guidance of individuals into those industrial occupations for which their special abilities particularly fit them. The study of industrial fatigue is directed to an amelioration of working conditions so as to avoid undue irritability, overstrain, weakening of interest and general loss of capacity, and at the same time to retain and increase industrial productivity. Motion study is directed to the elimination of unnecessary movements in manual work, and to the discovery of paths of movement and methods of work which are alike agreeable to the operative and economically desirable. A very important branch of the third of these movements is the study of the human factor in industrial accidents. Standardised diagnostic tests for the "accident prone class" are in process of rapid formation. Closely related to its industrial application is the use made of psychology in naval and military organisation. This was greatly stimulated by the demands of the World War, and is now widely recognised.

Medicine.—The War, again, had a large influence in arousing increased interest in psychological medicine. Modern trench fighting enormously increased the incidence of mental and nervous disorders in the forces engaged, and consequently the tremendous social importance of the treatment of psychopathological states has been forced upon the public attention. In every civilised country the psychological genesis and nature, as well as the frequency, of numerous disorders possessing obvious physical symptoms are now widely acknowledged, and training in the recognition and treatment of mental disease is far more generally a part of medical education than has ever before been the case.

Legal Problems.—This once more has important and immediate applications to legal procedure. The relation of the study of mental disease to the problems of legal and moral delinquency is now freely admitted. Modern theories of the causation of abnormal conduct are applied to an understanding of the behaviour of the criminal. The general aim here is to be able, within limits, to control behaviour in the directions which are recognised as legally and socially desirable. A beginning has also been made—mainly by the use of modern experimental methods of the registration of emotional expression—in the development of a psychological technology for the detection of crime. Not much work has been accomplished in the application of psychological theories and methods of explanation to problems of religious and aesthetic experience.

Conclusion.—This brief survey of contemporary psychology shows the diversity of its interests, and the many-sided development which it has undergone. Such development was, indeed, inevitable. For psychology is a systematic attempt to understand the responses which man makes to his environment, and consequently has vital significance in relation to all branches of human effort. What has emphatically characterised psychological developments during the period under survey, is the tendency to make of psychology a science more concrete, more realistic, more closely in touch with actual human responses as they can be observed under definite conditions of reaction. At the same time the older, more purely introspective, more philosophical psychology has been far from inactive. In the main it has been preoccupied with problems of an epistemological order, and particularly with elaborate analyses of the factors which enter into perception as a form of knowledge (*see* KNOWLEDGE, THEORY OF). Everywhere in psychology the main drift appears to be away from atomistic and mechanical types of explanation toward a recognition of the unique, though complex, activities and patterns of activity which govern and direct all highly developed human conduct and feeling, and gradually build up the constructions of human knowledge.

BIBLIOGRAPHY.—The period surveyed has been one of extraordinary literary activity. Nothing more is here attempted than the selection of a few representative books. The order follows that adopted in the above article; only books having a predominant psychological interest are mentioned.

Behaviourism: J. B. Watson, *Behaviour: an Introduction to Comparative Psychology* (1914); *Psychology from the Standpoint of a Behaviourist* (Philadelphia and London, 1918). For a completely opposed point of view see W. McDougall, *Outline of Psychology* (1923).

Gestalttheorie: K. Koffka, *The Growth of Mind* (1924); W. Köhler, *The Mentality of Apes* (1925); M. Wertheimer, *Drei Abhandlungen zur Gestalttheorie* (Erlangen, 1925).

Eidetic Imagery: G. W. Allport, "Eidetic Imagery," *Brit. Jour. of Psychology*, vol. 15 (1924), with bibliography.

Psychoanalysis: etc.: C. G. Jung, *The Psychology of the Unconscious* (1917); E. Jones, *Papers on Psychoanalysis* (1923); C. G. Jung, *Psychological Types* (1923); A. Adler, *The Practice and Theory of Individual Psychology* (1924); S. Freud, *Collected Papers* (1924–5).

Social Psychology: M. Ginsberg, *The Psychology of Society* (1921); W. H. R. Rivers, *Psychology and Politics* (1923).

Experimental Psychology: C. S. Myers and F. C. Bartlett, *A Text-Book of Experimental Psychology*, Parts 1 and 2 (Cambridge, 1925). See also current psychological periodicals. (F. C. B.*)

PSYCHOSIS (*see* 22.554).—Strictly speaking, the term psychosis means a state of mind, a concrete psychical process or a mental act; but is now generally used to signify an abnormal state of mind. This definition needs qualification, however, since the technical use of the term in psychiatry is confined to certain forms of mental disorder which can be distinguished from states of congenital mental deficiency on the one hand, and from "borderland" conditions or neuroses on the other. A distinction should be made between "psychosis" and "insanity," which in popular and legal language signifies that an individual, owing to his state of mind, is unable to manage himself or his affairs, is in need of care and control and is not to be held accountable to society for his actions.

Psychosis, on the contrary, is a strictly medical term; it refers to a type of mental illness with certain intrinsic characteristics, assuming various forms, and due to a variety of causes. It does not necessarily lead to serious disturbances of behaviour, and there are many individuals who though not insane in a legal sense are nevertheless the subjects of a pyschosis from the standpoint of psychiatry.

Psychological Considerations.—Though it is convenient to divide mental disorders into different categories based upon their causation, clinical characteristics or course and outcome, so many transformations of the clinical syndromes occur that no hard and fast division into separate disease entities is possible. One broad division is that made between the psychoses proper and the neuroses, a term embracing such morbid conditions as hysteria and obsessional neurosis. The difference between the two types of reaction is intuitively sensed by society for reasons which become evident when their psychological characteristics are contrasted. One of the essential features of a neurosis is the retention of what may be called the "herd-sense," and a psychosis is marked by its diminution or loss. In a neurosis the patient is oriented to realities and has an intelligence alive to his own needs; his symptoms tend to be provoked by external circumstances, and he is sensitive to changes in the social atmosphere; he sees facts as they are but meets them in a faulty way. He does not seriously offend against the conventions, and however exacting his conduct may be his *entourage* still regard him as akin to themselves—as, indeed, he is, since all persons are apt to exhibit mild neurotic symptoms when life becomes too complex and difficult.

In a psychosis, however, the irruption of images, feelings and cravings into consciousness leads to distorted views of reality and to falsification of facts; the sentiments and habits of the patient undergo a change, and his conduct becomes inexplicable and (apparently) unmotivated; he becomes indifferent to public opinion and impervious to solicitations from without; briefly, he loses touch with common life and lives in a world of his own. Such attitudes naturally provoke uneasy tensions in normal people; they feel themselves to be in the presence of something uncanny and outside the range of their experience. It is disconcerting to deal with an individual whose conduct fails to be influenced by the methods hitherto found effective in dealing with other human beings, and no doubt the fear of the biologically abnormal has something to do with the attitude of society towards the psychotic.

Psychosis and Neurosis.—A psychosis is thus a malady of more serious import than a neurosis. The latter is a regressive and infantile mode of adjustment to reality—an act of adaptation that has failed (Jung). In a neurosis, fears, obsessions, doubts, ruminations, day-dreams and crises of agitation—incomplete, exaggerated and unproductive mental operations involving but little effort—serve as substitutes for efficient action. Some years ago Freud described the neuroses as defence mechanisms, and the validity of this conception was demonstrated in the War neuroses, where the conflict between duty and the instinct of self-preservation was solved without the sacrifice of social esteem by the automatic development of tremors, paralyses and anxiety states, which, as Rivers showed, were modifications of those instinctive processes by which all the higher forms of animal life were accustomed to react to danger.

Protective Function of Neuroses.—Here the neurosis clearly served to protect its subject from the situations for which he lacked the proper personal adaptation; it acted as a structure of compromise between himself and society; and it symbolised the nature of the instinct which demanded an outlet and gratification. The neuroses of peace have a similar mechanism and fulfil a similar function, though the nature of the instinctive need which finds an outlet in neurotic symptoms is the subject of considerable controversy. Freud traces it to the sexual impulse, while Janet discovers in the behaviour of a neurotic a means of gaining power and love which he lacks the capacity to earn by vigorous and effective action.

Psychosis and Destruction.—In contrast to a neurosis which acts to the advantage of the individual by protecting him from an uncongenial environment, a psychosis always acts in the long run to the disadvantage of the individual, and tends to bring him into conflict with society. It is destructive rather than protective, and tends to eliminate rather than to conserve the individual as a social unit. A psychosis originates in the depths of the organic life. The images which flood the psychic life are stimulated by subtle changes in the vital processes responsible for the evolution of the personality, and remain until the organic balance is restored. Hesnard names this process *organic symbolism*, pointing out that just as the sensation is the symbolic translation or *meaning* of the exciting stimulus and not this stimulus simply transmitted, so the psychosis is the psychic interpretation of organic occurrences. This formula may be applied to the psycho-physiology of hunger, which Torro aptly describes as an "echo of physiological distress and at the same time the dawn of psychic life." A morbid instance of this process occurs in the climacteric psychoses, in which the patient often complains of being dead, of ceasing to exist, or of being a shadow without life (delusion of negation). Here the biological changes heralding the termination of reproductivity are clearly symbolised in the content of the psychosis. The delusions and hallucinations of the psychotic should thus not be regarded as fancies; they are the symbols of organic actualities. The patient is right in adhering to his beliefs; he knows and feels them to be true, and has more reason on his side than the psychiatrist who would vainly persuade him to the contrary.

Two Groups of Psychosis.—The differentiation by Kraepelin of the psychoses into two broad groups—manic-depressive insanity and dementia praecox—has been of inestimable service to psychiatry, though his view that these should be regarded as distinct disease entities has not been established. It is more in accordance with clinical facts to regard them as two reaction types which sometimes occur in pure form but more often as mixed. The manic-depressive reaction is characterised by severe and irregular fluctuations of mood in the directions of excitement and depression with intervals of normality. The psychosis is an exaggeration of the "cyclothymic" reaction of some normal people in whom the mood fluctuates between euphoria and depression more or less independently of circumstances. Dementia praecox tends to pursue an unfavourable course, and is characterised by a peculiar and often complete disorganisation of personality with predominant changes in the affective life and will.

Schizophrenia and Paraphrenia.—As the disease does not always proceed to dementia, and may develop at any age, Bleuler prefers to apply to it the term *schizophrenia* (splitting of mind). Jung has stated that the essence of dementia praecox consists in the fact that the unconscious to a large extent replaces the conscious, and the validity of this formulation is clearly exemplified in those schizophrenics to whom the term *paraphrenia* is given. This psychosis is marked by the exuberant development of fantastic delusions and hallucinations, which appear all the more extraordinary as the personality is so preserved as to enable the patient to make a normal reaction to social life on occasions. The morbid mental products in these cases can properly be regarded as an echo of the ultimate realities of organic life. As Blondel observes: "*La conscience morbide s'exprime en dehors des lois de la conscience sociale par des procédés, non plus seulement prérationnels, mais prénormaux, qui manifestent l'individuel pur.*" In the schizophrenic there is an hypertrophy and distortion of the instinctive life, and the delusions and hallucinations symbolise or reveal crudely the elemental cravings which seek expression. The psychosis has thus an important biological function, affording a means by which the inward craving can be actualised and freely expressed; it brings about a state of biological equilibrium by permitting a release of organic tension. These paraphrenic cases are of the highest psychological interest. It is possible at times to watch the growth of organised hallucinatory systems which assume the characteristics of omnipotent and god-like personalities, symbolising, as it were, the ruthless and impersonal forces of nature. The interactions between the personality of the patient and the forces which control it are often as dramatic as those between the mythological characters of Greek tragedy; and the psychosis, like the latter, fathoms the depths of human life.

Causation and Treatment of Psychoses.—A psychosis is a disorder of behaviour, and represents a failure of function at the psychological level. Psychiatry (*q.v.*) thus differs in its subject-matter from general medicine; the former deals with disturbances in the reactions of the organism as an integrated whole, and the latter with disorders of special systems of organs. Since the behaviour of an individual, whether normal or abnormal, depends upon an infinity of factors—the nature of his life situations, the state of his organism, and the whole of his past history, both personal and ancestral—it is impossible to select one factor as explanatory of the total reaction. The problem of causation in the psychoses is thus dissolved in relativity, and in each case an endeavour is made to seek out, and remove where possible, any factors, either physical or mental, which seem to be exerting an unfavourable influence upon the behaviour.

Mode of Approach.—There is now a general tendency to approach the problems of mental disorder from the standpoints of biology, pathology and general medicine, as it is recognised that the psychoses must be the outcome of a malfunctioning organism. Many psychoses, indeed, have definite relationships to diseases of the nervous system and of the bodily organs, as well as to general disturbances due to infections, exhaustion and drug intoxications. The causal significance of foci of chronic infections from the nose, throat, teeth, uterus or intestines has recently been emphasised and investigations along these lines make it evident that the whole resources of medicine should be utilised in the treatment of mental disorder. Mind cannot be regarded as an entity and detached from the body, and the secrets of disordered personality cannot be discovered by confining researches to the brain. The mind is not merely a function of the brain; it is a function of the whole organism having its roots in the viscera, the endocrine glands, the vegetative nervous system and the musculature. Clinically, the biogenetic psychoses, the general characters of which have been outlined above, appear primarily due to deterioration and distortions of the affective and instinctive rather than of the intellectual functions, and such impressions are confirmed by the researches of Mott in relation to dementia praecox, showing that the disorder is the expression of an inborn lack of durability throughout the body, but most manifest in the organs of reproduction.

Biogenetic Psychoses.—In contrast to the toxic-exhaustive group of psychoses or an organic psychosis such as general paralysis, which are accidental episodes in the life of normal people, the biogenetic psychoses are the outcome of an hereditary or constitutional predisposition to mental disease. The psychotic episodes may be excited by mental or physical stresses, but the tendency already exists. The different forms assumed by these psychoses are independent of any specific pathogenic agent and dependent upon the personality, make-up or inborn psychic constitution. Thus a manic-depressive psychosis is considered to exhibit an exaggeration of a pre-existing cyclothymic or extraverted temperament, and dementia praecox of a pre-existing schizophrenic or introverted temperament. Kretschmer has noted a relationship between certain forms of physique and these psychic types. He finds that the cycloid types show a biological affinity with a pyknic body-build, while the schizoid types are related to asthenic and athletic body-builds, together with certain dysplastics. This work sheds light on the organic foundations of temperament, and has an intimate bearing on the problem of the biogenetic psychoses.

Treatment Problems.—The psychoses do not offer a fertile field for the application of formal psychotherapeutic procedures, such as hypnotism and psychoanalysis; their subjects lack insight and sense of illness, and tend to be non-co-operative and impenetrable. Indirectly, however, psychological treatment plays a large part in the prevention, cure and amelioration of psychoses. Thus re-education, the elimination of faulty habits of reaction and the stimulation and exteriorisation of interest by work and recreation are essential elements in treatment. Every administrative act intended to increase the amenities of patients in a mental hospital is mental treatment, and results in an improvement in the reactions of the patients as a whole. The more the freedom allowed, the more the institution corresponds to the conditions of ordinary life, and the more the contacts with the outside world the more normal the patients become. Individual peculiarities and unsuspected sensitivities (conditioned responses) must be noted. Thus a relapse may be provoked by the visit of a wife; an inaccessible schizophrenic may break into blushes, smiles and loquaciousness when visited by her father; or a patient may exhibit a negativistic attitude to one nurse and respond with friendliness to another.

Influence of Psychogenetic Factors.—Psychogenetic factors thus largely influence for better or worse the reactions of a psychotic. Jung points out that a normal introvert in a thoroughly congenial environment expands and relaxes towards complete extroversion; conversely, a sensitive shut-in child may regress into a mild psychotic state in what (to him) constitutes an unfriendly environment where he is not understood. Such observations have an important bearing on the problem of heredity. Some psychiatrists suggest that the continual association of a child from birth with exacting psychopathic parents (psychic trauma) is responsible for the development of psychoses later in life, but no doubt the inborn predisposition is an essential element in the causation of such cases. Psychogenetic factors are certainly in part responsible, however, for breakdowns of the dementia praecox type, and many such might perhaps be avoided if the significance and dangers of an inborn sensitivity were more generally appreciated.

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PSYCHOTHERAPY.—The method in psychotherapy that especially characterises the period since 1910, is the method of psychoanalysis devised by Sigmund Freud, and the theory based upon its findings bulks largely in all modern discussions.

Modern Developments.—Leaving aside this modern method of psychoanalysis, (*see* PSYCHOANALYSIS, FREUDIAN SCHOOL OF) we find that with many other workers in psychopathology and psy-

chotherapy there has been a steady movement away from the employment of hypnotism, whether for the investigation of the mind or for its treatment. Pierre Janet and Morton Prince alone among the older workers have continued to employ hypnotism in selected cases. Dubois, of Berne, has modified the suggestion treatment of Liébault and Bernheim in the direction of an appeal to reason in the patient rather than to mere automatism. In this method we find the arts of persuasion developed to the utmost on the conscious plane. The patient is encouraged to look at himself sincerely, to see himself exactly and to find out what is wrong with himself, what is the cause of his symptoms, and then is persuaded to change his mental outlook. The symptoms may be helped sometimes by philosophical disquisitions and exhortations. Dejerine advocated a similar method of analysis and persuasion, in which through a series of talks with the patient, the doctor induces him to admit what is really wrong with him, and encourages him to get out of his difficulties and so dispense with his symptoms. Babinski holds a simple theory of the nature of hysteria, according to which it is caused by suggestion and therefore curable by persuasion. The methods of persuasion which he indicates are of the simplest.

Analytic Psychology.—C. G. Jung and A. Adler have broken away from the direct Freudian line of thought. Jung calls his method that of analytic psychology, and emphasises the special need of analysing the present situation of the patient, interpreting his past in the light of his present, quite as much as conversely. He does not accept the Freudian view of the sexual etiology of the psychoneuroses, and although he uses the word libido in his general theory, this means for him general emotional energy, not specifically sexual energy. His general theory is one of indeterminism in contrast with the rigid determinism of Freud.

Self-Assertion.—Adler emphasises the important part played in the formation of nervous symptoms by the fundamental instinct of self-assertion—the will to power. In his view many neurotic symptoms are compensatory, representing the patient's (unsuccessful) striving " to become a complete man "—that is the phrase he uses—and to hide his insufficiency from himself as well as from others. The patient constructs a safety net, as it were, around himself, so as to prevent his sensitive ego from being unduly pained by the consciousness of its inadequacy. Adler would explain many cases in which a sexual etiology seems more obviously involved as really caused in this other way, through disturbance of the self-assertive instinct. The patient's self-assertive instinct cannot realise itself in ordinary ways, so it realises itself in a round-about way. All the time there is a tendency for the person to conceal from himself his own inadequacy, or to prevent himself from facing a situation where his own inadequacy might become too obvious. He may become ill in order to escape having to face a task to which he knows that he is inadequate. The feeling of inadequacy is translated into a feeling of illness. This inadequacy may show itself in various ways. Adler claims that the psychological essentials of a case may often be revealed in a single interview.

War Cases.—During the World War various forms of psychoneurosis were produced by the conditions of warfare in thousands of cases, and some of Pierre Janet's most fundamental views on the nature of hysteria were verified. Among the numerous cases of shell shock a certain proportion suffered from hysterical symptoms, and it was found that these hysterical cases were easily hypnotised, and through hypnosis the man could be re-associated, and his hysterical tendencies thereby diminished. In other words the scientific validity of Janet's use of hypnosis in special cases, was confirmed by the investigation and treatment of hundreds of such cases in the battle area. In ordinary medical practice these cases are not numerous. The ordinary medical man sees only a few cases a year, but when they are seen by the hundred as during the War, general conclusions can be drawn about them, they can be distinguished definitely from other cases, and cases of so-called natural somnambulism were most quickly cured by the production of artificial somnambulism under special safeguards. In other cases suggestion treatment is beneficial.

Hypnotic Treatment.—There is thus still a place for hypnotic treatment in psychotherapy. It should be limited to the treatment of pronounced cases of hysteria with loss of memory and crude automatisms like somnambulism, hysterical attacks and fugues. In such cases it removes the symptoms, and diminishes the hysterical tendency also. To correct the hysterical tendency still more adequately, it would seem desirable to give the patient a certain amount of analytic treatment, discussing his past life with him, sorting out his past experiences, and helping him to see the relation of these past experiences to his present mental state (*autognosis*).

Suggestion.—The method of suggestion in the waking or sub-waking state, without hypnosis, has been re-introduced into practical psychotherapy by Emile Coué, Baudouin and others. The special characteristic of the method is that it emphasises the auto-suggestion element in all suggestion—emphasises the general fact that auto-suggestion is fundamental in all suggestion treatment, and that auto-suggestion may be encouraged, so that it takes the place of hetero-suggestion. Patients should be encouraged to treat themselves by auto-suggestion; and to do so they should put themselves into a passive state of concentration without effort (*contention*), in which state any suggestion they give to their own sub-consciousness has more opportunity of becoming realised.

Isolation.—Besides these more specific mental methods of treatment there are certain physical methods, which may be classed as psychotherapeutical methods, since they are devised for their mental effect upon the patient. One such method is that of isolation, applied, *e.g.*, by Dejerine, in whose clinic isolation was often made as complete as possible. A curtain was drawn round the patient's bed, and he was allowed to see no one but the doctor. Another subsidiary method of treatment is that during the first fortnight of this isolation treatment, the patient is put upon a milk diet (*see* WEIR-MITCHELL TREATMENT, 26.803).

Work Cure.—The rest cure has its antithesis in a work cure advocated by some doctors, but the work cure is obviously only applicable in special cases, and where the work is congenial and does not make too large demands upon the patient's energy it should be very effective. Pottery-painting, mat-weaving, chair-making, carpentry, metal work, etc., have been found very helpful to certain types of patients. Simple mental exercises are also helpful.

Exercises.—Massage and relaxation exercises are sometimes important, and still more important are active exercises such as golf, riding, tennis and other games of skill, which can be a great help in getting patients back to the normal. In cases where there is a lowered psychological tension which has to be corrected the patient needs distraction and stimulation. Stimulation is also needed where a patient is so lethargic that his fatigue is due not to outgoing energy but to failure to create energy. There are some lethargic patients who will not make any effort, and suffer from not developing sufficient energy, and in these cases stimulation is needed in one form or another. Cases on the verge of severe depression, where the tendency is to sit still and do nothing, are sometimes greatly helped if they take up riding, a stimulant that can raise the psychological tension sufficiently to take them out of themselves. Motoring and motor cycling are also useful. They involve great concentration of attention, and certain types of patient obtain much help from this continuous concentration of mind, who have become so scatter-brained and distracted that they have lost the power of steady concentration. If the mind is concentrated in one direction it receives a fillip towards concentration and unification in other directions also.

Treatment Difficulties.—It is quite obvious that these diverse methods, many of which seem to be contrary in their results, should be recommended with discretion. Different methods are applicable to different cases, and to the same cases in different stages of illness. The practical thing in psychotherapy is, to a great extent, skill in the choice of means. Where skill can be shown is in the careful choice of means for different patients and for the same patient at different times. This is not a matter of routine, it cannot be described satisfactorily in a set of written

instructions, but it is gradually acquired by the physician in the course of practice.

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PUBLIC HEALTH (*see* 22.627).—The main object should be to prevent disease rather than to cure it. The one is easy and cheap, the other difficult, expensive and often impossible. As the open air sanatorium does so much for the rickety and tubercular, this should be the model for the bringing up of all children. The open air school with the floor gently heated—as the ancient Romans heated floors by the hypocaust—should replace the indoor schools, while factories should move to garden cities as far as possible and have attached playing fields and allotments for gardening.

Ventilation Problems.—For air to feel fresh it must have such cooling and evaporative power as suffices to keep the head pleasantly cool and the skin free from sensible perspiration. Movement of the air is of great importance, because it prevents stagnation of air which is made warm and humid by the body and is entangled in the clothing, and greatly promotes loss of heat from the skin by convection and evaporation. In occupied rooms not contaminated by coal-gas leaks or poisonous fumes arising from manufacturing processes, natural ventilation, set up by differences of temperature inside and outside, suffices to keep the air chemically pure enough, even though all doors and windows are shut. There is normally 5 to 6% of carbon dioxide and 14½% of oxygen in the depths of the lungs, and the physiological regulation of breathing is such as to keep these amounts constant. Increase of carbon dioxide or diminution of oxygen, which in the worst ventilated rooms does not amount to more than ½% has then no effect.

The importance of keeping the percentage of carbon dioxide in rooms very low is to insure a ventilation sufficient to cool the body and evaporate moisture from it and to keep down the number of dust particles and microbes exhaled by carriers of catarrhal or other diseases. Most uncomfortable conditions due to heat stagnation may be found when chemical purity of the air is very high, and comfortable conditions, *e.g.*, in a submarine cooled by the sea, when owing to long submergence chemical purity is worst. The amount of oxygen breathed in each pint of air is much lower at Alpine health resorts owing to the tenuity of the air at great heights, than in stuffy, crowded rooms in a city on the plains—a further proof, if it were wanted, that the slight diminution of oxygen percentage in such rooms is of no importance.

The commonly accepted opinion that there are chemical poisons in exhaled air has been negatived by exact experiment. Stuffy air of crowded rooms is contaminated with microbes explosively exhaled from the respiratory passages in coughing, sneezing and speaking, and dust from soiled clothes. Such microbes directly inhaled by others may disseminate catarrhs, sore throats, tuberculosis of the lung, etc. The number of such microbes is very greatly reduced by open window ventilation. In several schools ventilated by the plenum system time lost by children through catarrhs was on the average six times greater than in a school ventilated by open windows. Confined air of rooms is also greatly polluted with dust stirred up by people, and in cities with soot. Some dusts, such as free silica and lead, are poisonous, and have a most deleterious effect.

The breathing of free silica dust by tin and gold miners, by sandstone, granite, and flint workers, and by gritstone grinders causes slow degeneration of the lung, ending generally in a tubercular infection. The death-rate from tuberculosis in such workers has been extremely high, and special precautions against dust must be taken to lower it (*see* MINERS' PHTHISIS). The breathing of chalk, coal, and animal or vegetable dust such as bone meal and flour are relatively harmless, but may produce shortness of breath in later middle life.

Some people are hypersensitive to certain animal or vegetable dusts and get hay fever or asthma from breathing such, *e.g.*, from dandruff of horses, dogs, cats, from dust of feathers, from pollen of grasses, from spores of moulds such as aspergillus. They are relieved by going to dust-free places as in the Alps, or to sea, or by sleeping in a special dust free room.

The inhaled air is exhaled, heated up to almost body temperature and saturated with water by the respiratory membrane. It is important for the health of this membrane that it should receive an ample supply of arterial blood and lymph, and secrete plenty of fluid to cleanse itself, with the aid of its ciliated epithelium, of dust and microbes. Cool air contains very little moisture, even when saturated, and can take up much from the lungs and so act favourably compared with the warm moist air of crowded, stuffy rooms. The natural conditions which pertain out of doors are a cool breeze moving round the head and the feet kept warm by the ground.

In stuffy, artificially heated rooms there is a draught on the floor while the head is surrounded with warm, stagnant air. As a result, the nasal membrane becomes congested, the air-way through the nose constricted, and stuffy feelings and headache are occasioned. Warming the feet and cooling the head by a fan at once relieves these feelings. While there is no evidence that "ionisation" of the air has any influence on our feeling or health, the adequate cooling of the body is most important in keeping up the tone of the muscles and the body heat production. The body should be stimulated to keep up its own heat by combustion of food, and the "fire of life" kept burning actively. Greater depth of breathing, more active circulation of blood, better appetite, digestion and absorption of food result; constipation is avoided by greater muscular tone and the deeper breathing induced by exercise taken to keep warm, and the bowels are kept clear of bacterial poisons owing to the more complete use of food, and more active circulation through and tone of their walls. General health and resistance to disease are thus promoted. Warm, moist atmospheres lower working efficiency and vigorous health. The body heat production of native students in Singapore is not more than half that of an athletic English student. The native of Singapore can do very little work. (*See* HEATING AND VENTILATION.)

Food Problems.—Ill-nutrition may arise because food is deficient in energy value or in quality, or because the environment depresses the fire of life and reduces the healthy action of the bowels and the appetite, or because the body is over-fatigued, and the expenditure of nerve energy leaves insufficient for the digestive and absorptive functions. Those who carry out in factories skilled hand operations seem more liable to illness than heavy workers, *e.g.*, coal-miners, smiths and foundry men and agriculturists. The skilled hand-workers lead a far more caged life, using their hand muscles to make many small, fine movements, not using their big body and leg muscles, not breathing deeply, not having a high rate of food oxidation. The chest is fixed to make skilled hand movements, and this modifies their breathing. The number of fine skilled movements they have to make brings about nervous fatigue, while, their food oxidation being relatively low, and breathing shallow, the onset of fatigue is not resisted as it should be by a high rate of nutrition. The relatively warm environment brings too much blood into the skin of the factory workers, and does not tone up the body as the open air life does. Infection with catarrhal complaints is far more spread among them, and their respiratory membrane is not kept in a healthy state as it is in those who deep-breathe cool, dry air. Children who are over-crammed for examinations come under this category, so too college students and clerks. In some occupations 40% of the workers may be away from work each year for some period owing to sickness, while the number of cases seeking medical relief may number 100% of the workers or even more each year.

Housing Problems.—Millions live in one to three-roomed tenements, and the cinema and a sensational Press take the place of fun and frolic in the open air. The crowded life of the tenement lowers the vitality and exhausts the nervous system. Ill-feeding comes on top of this, the workers having no garden to give them fresh vegetable foods. An enormous economic loss results from their having no chance of spending their leisure hours in gardening and in improving their homes. Civilised man has to have a book some hundreds of pages long merely to catalogue his diseases. McCarrison describes in the remote Himalayas a tribe of magnificent physique, amongst whom there is no dyspepsia or neurasthenia, no gastric or duodenal ulcers, no appendicitis or mucous colitis, little or no cancer.

Food Requirements.—We must have in our food, first, sufficient fuel value, or energy, to keep up our body heat and to do muscular work on. Next we must have proteins which will yield us on digestion all those amino-acids into which proteins are split on digestion, which are required to build our tissue, and to secure these we want variety of both animal and vegetable proteins. Some proteins, for example, zein in maize, fail in one or other of the required constituents, and disease results from restriction to such. Then we need carbohydrates and fats, mainly to provide fuel, but also to help build body substance. In addition, we must have certain salts, and particularly chloride and phosphate of sodium, potassium, calcium and magnesium with traces of iron and iodine, on which the processes of life intimately depend.

Lastly, the food must contain vitamines (*q.v.*), traces of certain vital substances which have hitherto not been separated but are known to exist by feeding experiments. The vitamines have been compared with the sparks which fire the petrol in a motor engine.

A mixed diet of fresh meat, milk, butter, eggs, fruits, honey, molasses, vegetables and wholemeal bread, such as our ancestors ate, supplied all, but now this food is largely replaced by the products of the miller and canner, by white bread and polished white rice, cornflour, sago, tapioca, tinned meat, sterilised milk, sugar, margarine made out of nuts, egg substitutes, tinned or bottled fruits. Tea, sugar, white bread, margarine, and low-quality jam are the staple foods of the very poor. The effect of preservatives and refining processes has been to lessen the vitamines and essential salts, often with disastrous effect to growth, health and breeding power. Now, the growing of salads, which might be possible in gardens and courts, in window boxes and on roofs in cities, is stopped by smoke pollution; this, too, damages the fields, gardens and allotments, and lessens the supply of vegetable food and of milk of cows fed on fresh young grass, and makes these things costly to city people (*see* SMOKE PREVENTION).

Solar Radiation.—The radiant energy of the sun tempered by the atmosphere keeps going the manifestations of life. Plants energised by the sun, and using, as a transformer of energy, the green chlorophyll, build up their substance out of inorganic materials. This substance is the food of the animal world. Modern theory suggests that all chemical change, vital and non-vital, is touched off by radiant energy, by light or heat, and that the speed of such change is determined by the intensity of radiation. The sun rays which are most active on living cells, killing these if too strong, are those beyond the violet, insensible to us, and called ultra-violet. These rays act also most powerfully on a sensitised photographic film. The visible rays, in part reflected from the skin, in part penetrate and are absorbed by the cutaneous blood and warm that. They are absorbed by the epidermis and scarcely penetrate to the blood beneath. The red rays penetrate through to deeper tissues and warm these.

The skin can stand, without being scorched, twice as much radiant energy per unit of time in the form of visible sun rays as it can of dark heat rays, because the visible rays largely penetrate, and, warming the blood locally, are carried away as heat to cooler parts of the body. The dark heat rays, absorbed by the surface of the skin, make us feel warm and stuffy indoors. Out of doors, on the other hand, the blood circulating in the naked skin is warmed by the sun which penetrates to it, while the surface of the skin is fanned and cooled by the breeze (*see* HELIOTHERAPY).

The biologically active ultra-violet rays are filtered off by glass. Exposure in rooms lighted by windows is not the same as exposure to light out of doors. In heating our rooms with hot water and steam pipes we expose ourselves to infra-red rays; fires give us chiefly infra-red and visible rays; incandescent electric light visible rays. A coal fire fouls the sky with smoke and cuts off sunlight; we must, therefore, take to gas or smokeless fuel fires. These and open windows give us the most healthful conditions. The dark heat of steam pipes and the stagnant warm air of shut-up rooms depress health, expose us to a more massive infection, and make us less resistant to catarrh, pneumonia, etc. Over-heating of tubercular, and particularly febrile, patients should be avoided. Exposure should not be in hot sun boxes, but in cool open air and to sky-shine or early morning direct sun.

Sunstroke.—Sunstroke may be caused by local heating of the head, while heat stroke results from heating the whole body through failure of the sweat mechanism. A wet sheet and a fan supplying this mechanism artificially prevent heat stroke.

Sunburn of the skin is not produced by the high sun, which on clear days contains rays with a wave-length as short as 300–295 millionths of a millimetre; but ultra-violet rays with wave-length of 310–300 $\mu\mu$, if intense enough, may produce severe sunburn, and it is these rays which act most in the English atmosphere, with its high content of dust, smoke and vapour. With arc lamps, probably no rays shorter than 240 $\mu\mu$ penetrate the horny layer of the skin; but such short rays penetrate into and are absorbed by microbes and kill them.

According to modern physical theory, the ultra-violet rays act in quanta and displace electrons from their orbits in the atoms. This sets up, in living cells of the epidermis and in nerve endings which lie among these, a secondary molecular chemical action, which after a latent period produces erythema, oedema, etc. Only those rays which are absorbed by the living substance have action.

The various artificial sources of ultra-violet radiation, carbon arc, mercury vapour, lamps, etc., have an effect on the skin similar to the sun, the amount of subsequent pigmentation depending on the intensity and depth of penetration of the ultra-violet rays. The haemobactericidal power of the blood, tested *in vitro*, usually increases when the dose of ultra-violet radiation is sufficient to produce erythema. The area of skin which has to be exposed to produce this effect is not large. Excessive sunburn damage is harmful, a small amount stimulating and useful. If the body is fighting an acute disease, reactions in the skin set up by irradiation may be harmful, while most useful in chronic infections and states of debility.

The brown pigment, melanin, which forms in particles within the cells of the epidermis, acts as a screen protecting the epidermic cells and the blood from over-radiation. By absorbing and converting rays into heat, melanin brings about stimulation of the nerve endings in the epidermis, and this excites sweating, which in its turn protects from over-heating.

Some immunity to a second exposure is set up in the epidermis of a white person within a few hours after irradiation, and long before pigmentation takes place. This is due to a thickening of the horny cells, which a few days later peels off. Just after desquamation the skin is again sensitive. These facts are borne in mind when arranging the periods of light treatment. In the choice of a garment, if any is to be worn during light treatment, an artificial silk made of acetyl cellulose, thin and open-meshed, screens off least ultra-violet rays, but with even such the loss may be 50 per cent.

Smoke Pollution.—Window glass, clothing and smoke pollution screen off almost all ultra-violet radiation from citizens in winter, and their food is deficient in vitamins. Hence the development of rickets and depression of health in winter. Owing to smoke pollution in big cities, the ultra-violet rays are cut down to one-third of the value which pertains in clean country places.

Every effort should be made to prevent smoke pollution and to secure adequate exposure of the skin to ultra-violet rays. While securing the use of smokeless fuel, arc lamp baths should be instituted not only in hospitals but in schools and public

baths. Round a long-flame arc taking 2 to 3 kilowatts with "white flame" carbon poles (metal cored), and fitted with a wire screen a yard away, children could sit for 10 minutes, wearing only a loin cloth. Two such baths a week in winter would work great good as a preventive of rickets, tuberculosis, rheumatic fever, catarrhs, skin diseases, etc., and as a stimulator of vigour. Goggles must be worn and a trained nurse be at hand.

Modern Hospitals.—To build brick hospitals is out of date; all hospitals should be one-storeyed bungalows with wide verandahs. The beds can then run easily from the ward to the verandah and to the open court outside. Nurses must be suitably dressed so as to enjoy the open air life. Only receiving stations should be in cities, with ambulances to convey patients to the bungalow hospitals in the open country. Open air and ultra-violet radiation should be used to prepare patients for operation and to hasten their cure after operation. It has been asserted that artificial light treatment cannot approach heliotherapy in curative effect. By the wise use of arc lights and sufficient exposure to open air and good feeding, progressive cure of surgical tuberculosis can be brought about in winter even in our English cities. To eliminate tuberculosis from cattle, the shutting up in badly ventilated dark byres should be prohibited. Cattle no less than children might be given arc light baths in winter.

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PUBLICITY: *see* ADVERTISING.

PUBLIC SCHOOLS.—The claim made for the public schools, using this term in the English not the American sense, that, whatever their shortcomings may be, they are at any rate successful in producing sound character and public spirit was put to a severe test on the outbreak of War in 1914 and triumphantly sustained.

Not only did the Old Boys at once join the colours in large numbers, but the boys who should have returned for another school year enlisted freely, and every public school reassembled in Sept. 1914 with numbers much depleted. Of those who served, one in every five fell, and the Rolls of Honour with striking similarity generally contain as many names as there are boys in the school. During the War, owing to the loss of many masters, and the lack of the leadership of boys over 18, the work of the schools was carried on with increasing difficulty. But their tone continued sound, and the boys maintained the standard surprisingly, considering the demands made upon their time by intensive military training and the disturbing effect of the near prospect of active service.

Contrary to general expectation, the schools emerged from the War filled to overflowing, and with waiting-lists so long that places could clearly not be found for all the aspirants. This was due to the success in leadership of boys trained in the schools, to an increased sense in the nation at large of the value of education, and particularly this form of education, and to a wider diffusion of wealth, which made possible a public school course for the sons of many who would not have been able to afford it before. Since 1918 the schools have remained full. Stowe, Canford and others have been opened to meet the demand, and there is probably room for more.

These years have seen a profound change in the curriculum and outlook of the public schools, of which the most striking sign has been the abolition of compulsory Greek at Oxford and Cambridge. This has, however, not been followed by the disappearance of classical studies (*see* CLASSICAL EDUCATION); on the contrary, they are again increasing in favour. The certificate examiners of that authority which examines most of the public schools reported 830 candidates in the summer of 1923, 981 in 1924 and 1,087 in 1925, in the school certificate only, and nearly all these are serious students. The school certificate itself is the most important development of the years under review. Its basic principle is that it is the business of the schools to give a general education in which (*a*) English and allied subjects, (*b*) a foreign language or languages, (*c*) mathematics and science shall be represented, though science has not established itself as a compulsory subject. It is designed for average boys of 16, and it is assumed that till then boys follow approximately the same course of study. The examination, when passed in the right subjects at a sufficient standard, admits to matriculation at the universities, and to entrance into most of the professions (*see* EXAMINATIONS). The new system has undoubtedly had a marked effect in improving the work of the average boy, in giving a new spirit not only to him but to his teachers, and in rendering impossible the existence of whole classes of boys, who, being without object, and without heart, were often made the reproach of the schools in the past. To bring the army examination into line with this system, candidates without a school certificate are not at present allowed to sit.

To boys above this level the schools offer to-day a greater variety of advanced courses and a greater choice of intellectual interests. Science has come greatly to the fore, and aesthetic studies, particularly music, have advanced considerably and will probably make still greater claims in the future. Though the public schools were never more popular than they are to-day, they are nevertheless segregated. Their masters stand outside the national pension scheme; they seldom transfer from school to school; the schools themselves are accessible to a limited class only. These are privileges not without their dangers. (C. N.)

PUBLISHING (*see* 22.628).—The period 1910–25 saw first a brief time of prosperity, then, during and following the World War, a decade of extreme disorganisation in book publishing. The year 1910 was a prosperous one in the book market, as publishers are apt to remember. New books and reprints were in good demand and were readily supplied under normal conditions. Four years later and those conditions were violently disarranged.

Effects of the War.—The World War, which raised the cost and the market value of many staple commodities, had a specifically stringent effect on book production and the book market all the world over. The book, of all manufactured articles, is most subject to the caprices of popular taste and one of the most sensitive to any change in the normal economic conditions or the ratio of supply and demand. It is not, like food and clothes, an absolute necessity, nor is it to the idle rich what a great sybarite called an "essential luxury." The process of recovery after a war does not affect books, any more than works of art, with the economic certainty that we observe in boots and shoes, for instance, or in the cotton trade. At the same time certain forms of literature, which offer an escape from actuality and the newspaper, are bound, after a war, to be in growing favour. It is interesting to examine on both counts the post-War returns of books published in Great Britain.

Some Figures.—In 1918, when the War ended, the number of new books printed and published was 6,750, the number of reprints 966, which together give us a total of 7,716. In 1924, six years later, the new books had risen to over 9,500, while the reprints, which had suffered badly during the War because of the cost of production and the impossibility of supplying cheap books at a profit, showed a startling recovery. They had increased to over 3,190, actually 255 volumes more than the number of reprints in the year that immediately preceded the War—1913. The total number of new books was not quite so large as in the earlier year, whose October output—a test month in book publishing because of its nearness to the Christmas season—had established a record, namely 1,699 volumes, new books and reprints included. The October return in 1924, it is significant to note, was only 180 behind that figure.

Books in Demand.—The increasing vogue of the reprint is remarkable. During the War a new taste for reading grew up among the soldiers who had leisure days to pass in hospital or at the base. Some millions of volumes were collected and sent over to the army huts under the auspices of various societies organised for the purpose, or under the seal of the Red Triangle. The editor of one popular series supervised the collection in London and the dispatch to France of over 2,000,000 volumes, new and old, obtained from a house-to-house canvass of the metropolis. This popularising of literature at large helped to increase the available reading public. But certain classes of books did not maintain their hold on the public when peace came again. In technology, for instance, whose manuals were specially required while the ex-soldiers were seeking work in the skilled trades, the demand fell off noticeably in the succeeding years. The analysis of books in *The English Catalogue* for 1923–4 marks a decrease in the latter year of over 100 published works in technology. In science the decrease was not very far short of that figure. History, medicine and geography also showed a decrease; on the other hand, fiction—easily first—biography, travel and guide books, including what we may call picturesque topography, poetry and the drama, religious books, sports and games and sociology all showed an increase of circulation.

A Ten-Year Survey

If we take a ten years' survey, we discover some curious fluctuations in the returns. In 1914 fiction came first, religion second and science third. Sociology and technology followed close. Poetry, juvenile literature, travel and topography, literature and criticism, history, biography and finally naval and military books, complete the list of a dozen sections, named in the order of their relative popularity. In 1924 fiction was still at the head. Juvenile literature had advanced from the seventh to the second place in the list. Religion was third. Science had fallen from the third to the seventh place. Poetry had advanced while technology had lost a point. Biography, thanks in part to the interest in characters and personalities who had come into prominence during the War, or because of some new reaction to its sharp stimulus, had gained markedly. It is harder to explain why, in that case, history books should have dropped in the comparative scale. Books of travel and books dealing directly or indirectly with literature had also declined slightly.

It would be easy to make too much of these differences. As between one year, or one publishing season, to another, it is necessary to allow a margin for accidental delays owing to strikes, as in the winter season of 1925–6, when the packers caused a serious break in the ordinary supply of books and periodicals, or for diversions of the public interest, as at the time of political excitement or of general elections. But after every allowance has been made, we find the yearly average in every class of book offers a very fair test of popularity. But as we note the startling preponderance of the first of those classes—fiction, especially the novel—we are driven to consider again how deceptive are the signs of success, and to recognise the notorious discrepancy between the seasonal and the permanent result.

The Publishing of Novels.—We have it on the authority of one large firm of London publishers, that nine out of every 10 novels published are comparative failures; that is, they show no decided profit to author or publisher. Another firm put the percentage of failures still higher, and it has been estimated that the average life of a market novel is no more than a month, and that very few survive the year of their birth. In an essay written by Andrew Lang on "The Last Fashionable Novel," he lamented that the type of story in which lords and ladies were favourite characters as during the Victorian vogue, had ceased to exist. That fall from favour serves to remind us that the novel, whether viewed as one of a group or as a single product, is the most perishable of all quasi-literary commodities, and that the producers of such books are tempted to inflate their selling value artificially. It was so when the three-volume novel was given the absurd price of 31s. 6d. It is so when the novel is put upon the market at a net price of 7s. 6d.

Great Britain and the United States: A Comparison

The trade organ in New York that corresponds to *The Publishers' Circular* in London, namely, *The Publishers' Weekly*, does a like service in collecting annually the returns of new books and reprints that are issued from the press. In 1924 the number of new books published in the United States—or "new titles," as the register more precisely terms them—written by American authors, was 6,380. In addition, over 600 English and foreign works were printed and manufactured in America, and over 1,700 were imported. Roughly summarised, the American production, that is so far as it is comprised in the New York returns for the whole book trade, is compared with that of Great Britain in the ratio of eight to six. More to our present purpose is the comparison instituted in the *Publishers Weekly* between the book returns for 1923–4 in America with a further recast to the year 1910. There was effectively a 2% increase in 1924 over 1923, but the new titles registered in 1924 were only on a par with those of 20 years before 1904. Six years later, in 1910, the number of new titles was 11,671, or nearly double that of 1924.

As regards the comparative popularity in America of the different classes of books, in 1924 fiction was at the head of the list, but not with anything like the preponderance it showed in the British book trade. Religion came second, poetry and the drama together came third, with a total of 13 new titles more than those registered in Great Britain. Science stood relatively low in the scale and showed a decrease from the figures of the preceding year. Juvenile books, too, lost a point or two; but biography, as in the London book market at the same period, marked a distinct rise. Business books, which are rather an American speciality, also had appreciated in the scale.

Conditions in Other Countries

Certain wider questions which affect book production and the writers, publishers and sellers of books can only be treated summarily. We must turn to the *Bibliographie de la France* if we would estimate the signs of recovery in the French book market since the War. In 1923 the returns give a total of 8,784 books, a pro rata advance since 1918, steadily maintained year by year, but not so marked in recent seasons. At the same rate of progression, the returns for 1924 should give a total of books registered slightly ahead of that for the year when the War broke out—1914.

In Germany the returns are noticeably higher than in any other country, displaying a total for 1923 of over 35,000 publications. But that includes miscellaneous publications which are not counted as books in the returns for other book-producing countries. In the Italian census furnished by the *Bolletino delle Publicazioni Italiane*, the lists for 1921 and 1922 are relatively encouraging, and in the international scale show an unusually high percentage of educational text books and manuals. In the former year, for example, the number of works of fiction issued from the press was 580, while in social science the number was 660, and students' manuals are little behind that high figure. Poetry and the drama together number 477 volumes, religion only 206. Philology, surprising to say, stands higher than history. Philosophy is well placed, but cannot compete with the science of words. In the returns for the following year these classes preserve very much the same comparative position, but fiction and religion lose ground; history and biography gain. So do volumes dealing with the fine arts, and also those with military and naval science. Among other European returns may be noted those for Norway, Spain and Switzerland, as marking a slight advance in 1922 from the figures of the year previous.

The Present Position.—In the republic of books all the world over the signs are in the main encouraging, and disclose a healthy state of recovery from the War years of stagnation. In a 25 years' review and retrospect, the publishers' organ in New York pointed to several notable factors in the increased power of the

book and the widening of its market since the opening of the 20th century. The better ordering and specialising of the bookshops, the greater intelligence of the booksellers and the national development of children's libraries, have all contributed to that advance.

England might learn some practical lessons from America in these things. Nevertheless, by the establishment of such associations as the National Book Council and the Society of Bookmen she has shown herself of late years newly alive to the cordial co-operation of publishers, booksellers, authors and bookmen. A recent writer, alluding to the book fairs in Florence, Frankfurt and Paris, advocated a similar yearly event in London itself. Paris had two book fairs in 1925, one at the Universal Exposition, the other, a smaller, more specialised bibliophilic festival, was held in connection with the time-honoured Fair of Saint-Germain. Either of these might be imitated, with an English or American difference, in London or New York, with good effect in stimulating the interest of the public and the activities of the book producers and publishers.

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PUCCINI, GIACOMO (1858–1924), Italian composer (*see* 22.632), died in Brussels Nov. 29 1924. His later works include *La Fanciulla del West* (The Girl of the Golden West, 1910); *La Rondine* (1916); *Il Tabarro, Suor Angelica* and *Gianni Schicchi* (1918). The opera *Turandot*, on which he was working at the time of his death, was finished by Sig. Franco Alfano under the direction of Sig. Toscanini, and was produced at Milan in April 1926.

PUGILISM: *see* BOXING.

PULITZER, JOSEPH (1847–1911), American editor and newspaper proprietor, was born in Mako, Hungary, April 10 1847. His father was Magyar-Jewish; his mother Austro-German. His father was a substantial grain merchant, who retired from business when the boy was six years old and went to Budapest to live. Here young Pulitzer was privately educated. He determined to embark upon a military career, but was excluded from the Austrian Army because of physical defects, and failed also in an attempt in Paris to join the Foreign Legion. In Hamburg, on his way home, he was induced by an American agent to emigrate to the United States as a prospective recruit for the Union Army, and on arriving in Boston harbour in Aug. or Sept. 1864 he swam ashore at night so that he, instead of the agent, might collect the enlistment bounty. Making his way to New York City, he enrolled in Company L. First New York Lincoln Cavalry, for a term of one year, and joined his regiment at Pleasant Valley, Maryland, in November. Discharged on July 7 1865 in New York City, he looked for work there but found none. In the autumn he started west for St. Louis, where he arrived penniless.

In St. Louis, with its large German population, Pulitzer's progress was rapid. While making his living by odd employments, he studied for the bar, and was admitted in 1867. On March 6 of that year he was naturalised. His studious habits and tireless energy made him known to the leading German citizens, and in 1868 he entered journalism as a reporter on the *Westliche-Post* staff. His labours as correspondent at the state capital drew his attention to politics, and in Dec. 1869, he was elected to the Lower House of the Legislature. Here he distinguished himself by leading a successful movement to reform the corrupt county government of St. Louis; and during his first month of service clashed with a county office-holder whom he shot in the leg. When the revolt against Grant led to the Liberal Republican movement in 1871–2, Pulitzer's reform zeal and his friendship for Gov. B. Gratz Brown, who in 1870 had appointed him one of the three Police Commissioners for St. Louis, made him an early adherent. He helped organise the Liberal Republican party in Missouri, and was one of the secretaries of the Cincinnati convention which succeeded in nominating Greeley for President.

As a sequel to the Liberal Republican campaign, Pulitzer entered the field of newspaper proprietorship. Some of the owners of the *Westliche-Post* sold him a share on liberal terms. This he soon resold for $30,000, using part of the proceeds for an extended tour of Europe. On his return he executed a profitable business stroke by purchasing a moribund German daily, the St. Louis *Staats-Zeitung*, for a song, and selling its Associated Press franchise to the *Globe* for $20,000. In 1876 he took an active share in the presidential campaign, breaking loose from all his Republican associates.

On June 19 1878 he married Miss Kate Davis, a distant relative of Jefferson Davis. On Dec. 9 of the same year he laid the foundation for his fortune by purchasing at auction the worn-out St. Louis *Dispatch*, paying $2,500 cash and giving a $30,000 lien. This newspaper he merged with the *Post*, owned by John A. Dillon, as the *Post-Dispatch*, which immediately began to pay and soon dominated the St. Louis evening field. It was independent in politics and devoted to hard money and tariff reform. In 1880 Pulitzer purchased Dillon's share and became sole owner. He laboured with unremitting energy, and the profits were soon running from $40,000 to $85,000 a year. Unfortunately in Oct. 1882 his chief editorial aid, Col. John A. Cockerill, shot and killed a lawyer, Col. Alonzo W. Slayback, in a bitter quarrel of political origin. The case did not come before the courts, but public reprobation was so great that the *Post-Dispatch* lost revenue and Pulitzer thereafter felt unwelcome in St. Louis. He departed for the East in the spring of 1883, and bought the New York *World* for $346,000, taking possession May 10.

In 1884 he was elected to Congress from the Ninth District, a position he resigned before his term expired. Under its new management *The World* won an immediate prosperity. It was aided by a quarrel in which its rival, the *Herald*, became engaged with the newsdealers, and by the *Sun's* disastrous decision in 1884 to support Benjamin F. Butler for the Presidency. By 1886 the annual earnings of *The World* were more than $500,000. With these resources Pulitzer in 1887 established the *Evening World*, which lost $100,000 the first year, but by 1890 was highly profitable. William R. Hearst's purchase of the New York *Journal* in 1895 brought the *World* a powerful competitor, and it met the challenge on Feb. 10 1896 by reducing its price from two cents to one. The daily circulation of *The World* quickly rose to 300,000, and its Sunday circulation before the end of 1896 reached 623,000 copies. To *The World*, as to the *Post-Dispatch*, Pulitzer gave a tone of aggressive editorial independence. The paper earnestly supported Cleveland in his contests for the Presidency in 1884, 1888 and 1892. It was sympathetic to labour, and in 1892 took the side of the striking steel workers at Homestead, Pa. It opposed Bryan for the Presidency in 1896. A year later *The World* became an advocate of war with Spain, for Pulitzer's sympathies were warmly aroused by the Cuban struggle for liberty.

Meanwhile Pulitzer's health, always precarious, had in 1889 become so bad that specialists forbade him to continue his daily editorial labours. The following year his eyesight suddenly failed him, and his vision thereafter was dim and uncertain. His nerves also were shattered, and he suffered from hardening of the arteries. Though compelled to live the secluded existence of an invalid, he kept in intimate touch with *The World* and exercised absolute control over its policies until within a few weeks of his death, in Charleston, S.C., Oct. 29 1911.

During his lifetime Pulitzer had given liberally. In 1903 he endowed the School of Journalism of Columbia University, opened in 1912. In his will he established a series of prizes, to be awarded annually, in the interests of letters, the drama, music and newspaper work, and bequeathed sums for other purposes. These are known as the Pulitzer prizes.

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PUMPS (*see* 22.645).—The principal developments in the science of pumping since the year 1910 consist mainly in improvements in the design of the centrifugal and reciprocating pumps for pumping large volumes of water and sewage, the special forms of pumps for pumping crude and refined oils and petrol due to the rapid growth of the motor and fuel oil industries, improvements in pumps for handling highly viscous substances such as tar, glycerine and molasses, and in pumps for dealing with highly corrosive substances, mine waters and liquors used in the treatment of ores for the extraction of metals.

Large Volume Pumps.—For pumping, the centrifugal pump is practically universal. The high-pressure turbine pump has undergone considerable development in simplicity of construction, ease of manufacture and efficiency and an enormous increase in the pressures involved. A turbine pump has been produced to replace the three-throw hydraulic ram pump with the accumulator. The pumping of boiler feed water has resulted in the production of the long-stroke pump, which has gradually given way to the turbine pump, where a single pump can be used, to pump hot water at different pressures to suit different boilers. The turbine pump is now made in two distinct varieties, the non-regulating type and the regulating type. The roturbo and sunturbo pumps automatically prevent the sudden demand for power when the load is taken off. The turbine pump is employed for deep well pumping, but difficulties arise chiefly from the confined nature of the space into which the pumps are placed and to the impossibility of using oil for lubricating the bearings. The problem of designing bearings for this type of pump cannot as yet be said to have been solved. Such bearings are lined with lignum vitae, or various forms of rubber.

The Pumping of Oil.—The first successful oil pump, introduced by Worthington, is characterised by its lost motion device. It is now employed in most industries for occasional work where certainty of operation is required without skilled attention. Most of the successful oil pumps are of the reciprocating type, designed more or less on the Worthington principle. As oil is viscous and its resistance to flow is greatly affected by temperature, the pumps are designed with very large valve chambers and provided with steam cylinders capable of coping with the high pressures necessary. The rotary pump has been considerably developed for this class of work.

The pumping of hot oils during the process of refining has produced several special forms of pumps. In one type the hot oil does not enter the actual pumping cylinder, but a buffer of cold oil separates the working cylinder from the valve box. The difficulties in pumping petrol lie in its extreme limpidity in contrast with the high viscosity of fuel and crude oils. The semi-rotary and the rotary pumps are common forms for this purpose. The roadside pump is a modern feature and is designed to deliver measured quantities of, say, 1 to 25 gal. to motor cars on the road. The convenience of obtaining petrol in this manner is sufficient to overcome the inaccuracies of the methods employed, to correct which improvements are being made. One ingenious roadside pump uses the pressure of a high level water tank to force the petrol through an ordinary water meter into the purchasers' tanks. This method avoids loss due to evaporation and the danger of fire. Displacement systems for handling inflammable liquids in order to reduce the fire risks have been developed.

The pumping of oils from mines is a recognised difficult operation. It is usual to bale out oil from a deep well, but it is now possible to pump sand and oil without the danger of the sand eroding the pump barrel. In one form of pump the valves lie deep down among the sand-laden oil, and the pump barrel itself, operated by mechanism at the top, works in a buffer of clean water and oil.

Corrosive Liquids.—Before 1910 the ordinary acid egg was almost the universal appliance for raising corrosive liquids, and improvements in pumping first showed themselves in attempts to make the acid egg an automatic and self-acting machine. In spite of several automatic elevators it cannot be said that this method of pumping is a success. Then came the acid resisting alloys of the iron silicon type. Many pumps were made of these alloys, but owing to the high cost and the brittle character of the alloy success was limited. A distinct advance was the use of an ordinary pump acting on an inert substance which separated the acid to be pumped from the working mechanism, such as the Ferraris, in which a buffer of mineral oil is used. Leakage at the gland of an acid pump must be avoided and many attempts have been made to produce a glandless pump.

In one type the resistance of an annular film of acid round the pump rod is relied upon to control leakage within small limits, suitable means being taken to collect the flow and return it to the suction side of the pump. The use of ebonite for making pumps has undergone very little change. Diaphragm pumps separating the working mechanism from the acid side have not shown much development. Improvements in the compounding of rubber enable the design of a bellows pump free from all gland leakage to be perfected. The centrifugal pump for corrosives is made of lead and some forms are lined with rubber and ebonite. An ingenious earthenware acid pump, made of a mixture capable of resisting heat, has been produced. The acid-egg type of pump has been adopted for pumping sewage in level districts. The apparatus works automatically and can be left for long intervals without attention. For pumping acid fumes the Nash-Hytor pump consists of a rotor working in an elliptical chamber and so arranged that the inlet and outlet sides are separated by a layer of water, which is kept to the surface of the chamber by the centrifugal action set up by the rotor, no valves being necessary. It is being used to compress air for operating the sewage ejector pumps in the streets.

The pumping of solid-laden liquids has been successfully accomplished by the Gwynne-Pennell trap, in which the solids are ingeniously trapped and conveyed to the suction side without having to pass through the pump. Constantinesco uses a rapidly operated pump for the production of waves in any fluid in a closed system for the transmission of power from point to point (*see* TRANSMISSION GEAR, VARIABLE). First used for firing a gun on the Fokker plane, its use has been extended to the working of rock drills in mines.

Air-lift.—The air-lift has received considerable attention. In an extensive series of tests made on a mine in California efficiencies of 70% were obtained. The researches of Dr. Owen, investigated by Swindin, show that the air-lift has possibilities of high efficiencies provided care is paid to the correct design of the footpiece. The use of the air-lift for pumping molten metals is progressing and its action is seen in the latest type of submerged flame burner. In an ingenious form of chain pump, a development of the old rope pump, by the application of the principle of surface tension a series of cells attached to a travelling band can be filled with water. A curious combination of the displacement pump has recently appeared under the name of the "Hydrautomat," in which a large quantity of water falling through a short distance raises a portion of itself to some greater height. It performs the same function as the well-known hydraulic ram and works by alternately compressing and exhausting air in a series of containers. Michell's studies in lubrication have revived the old swashplate, and pumps having this as a vital element are now appearing. Pumping by direct explosion of a combustible mixture in contact with the water has been the subject of investigations by Humphrey.

In the artificial silk industry (*see* ARTIFICIAL SILK) special small pumps are used; usually small rotary appliances similar to the sud pump on automatic machine tools are used for squirting viscose solutions through the dies into the coagulating bath.

Pipe-lines, etc.—Much ingenuity has been shown in the study of pipe-lines, tubes, hose and the manner of making joints. The difficulty of making a satisfactory joint in a pipe for petrol still attracts inventors. The best known method at present seems to be to use metal-to-metal joints and to rely on extreme good workmanship. Joints in the large mains are made by means of screwed couplings made to gauge. Petrol hose is now manufactured and some forms consist of a metallic lining reinforced with rubber and canvas. The "Victaulic" joint has rendered possible the making of pressure and vacuum tight joints at low

cost and with great ease. Slight irregularities in the alignment of pipes do not affect this type of joint.

Theory.—On the theoretical side the Reynolds-Stanton law of viscous flow has been developed in a form suitable for use by ordinary hydraulic and chemical engineers. Dr. Ing. Bruno Eck has applied the theory of aeroplane lift and drag (Lanchester and Prandtl) to the design of turbine and centrifugal pumps. The theory and practice of centrifugal and turbine pumps are at variance and cannot be reconciled by the old hydrodynamic theories, but Eck has shown that the streamline theory of Lanchester and Prandtl can be applied to the working of these pumps and thus account for the divergencies. The older theory depended upon the principle of a non-viscid frictionless fluid, but the Reynolds theory and its extension by Prandtl have put the element of viscosity into the theory with the result that the performance of centrifugal pumps can be explained on theoretical grounds. Much light has been thrown on this subject by the researches of Camichel and M. M. L. Escande and M. Ricaud at the Toulouse University, who have rendered visible the stream lines, thus facilitating enormously the ease of study. Photographic study of the problem is also being made by Prasil and Oertli at Zürich. Photographs of streamlines round the impeller blades of a turbine pump reveal the causes of the loss of efficiency. Reference should be made to the work of Prof. Th. von Kármán and his methods of turbine design. In his view turbine design is much more difficult than the study of the correct design of an aeroplane wing.

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(N. S.)

PUNISHMENT (*see* 22.653a).—Punishment is the deliberate infliction of suffering on a wrongdoer. Originating in the primitive lust for reprisal for an injury suffered, it has been rationalised into a well-nigh universal conviction that it is the best if not the only means of bringing the sinner to repentance.

The new psychology, which sees deeper roots than naughtiness or wickedness in childish wilfulness and adult criminality, is doing something to undermine this faith in the universal efficacy of punishment. Wrongdoing must be corrected, but the correctional treatment must be based on a diagnosis of the individual. If the misconduct is due to invincible ignorance or to a neurotic constitution or to a morbid emotional state, the infliction of punishment may only aggravate the underlying cause of the objectionable behaviour. Perhaps in any case there is a wiser alternative to punishment.

In the treatment of the criminal, as in that of the child, the concept of punitive justice still dominates action and feeling. To the common mind justice is punishment. This sentiment gains powerful support from a modern school of philosophic thought which maintains that it is only by the punishment of the offender that human society can maintain its moral integrity, a view which finds its most dramatic expression in the words of the late Mr. Justice Fitzjames Stephen in his *History of the Criminal Law in England*, to the effect that it is morally right to hate the criminal and that exemplary punishments are necessary to express and confirm that hatred.

The popular attitude is further reinforced by an undying faith in the deterrent effects of hard legal penalties. In the United States, at least, Beccaria's maxim, that it is not the severity but the swiftness and certainty of punishment that gives it its deterrent effect, falls on deaf ears. We seek by severity to compensate for the discreditable delays and uncertainties of our criminal justice. It is in England, perhaps, more nearly than in any other country, that Beccaria's principle is being reasonably applied.

The great humanitarian tradition which was born of Beccaria's epoch-making pamphlet and forwarded by the heroic labours of Romilly, Bentham and Howard, has, in England, achieved the all but complete abolition of the death penalty and a general mitigation of prison sentences. But, while the same generous sentiment has, since the coming of William Penn, never failed to command distinguished support in America, it has apparently been far less effective in America than in England. Here the county jail of John Howard still survives, and in many American states such crimes as rape, arson, robbery and burglary, as well as murder, are still punishable by death. Consonant with these survivals is the extent to which the infliction of punishments is left to the arbitrary and capricious discretion of the judges, who frequently impose sentences of incredible severity on offenders convicted of the more serious offences. Sentences of 10, 20, 30 and even 60 years are not infrequently imposed on offenders who in England would rarely receive more than the statutory term of five years.

But in the United States, as in the England of Romilly and Bentham, humanitarianism has its illogical but effective revenge. As in that older day when, in the mother country, the multitudinous death penalty hung in the balance, there is at present in the United States the scandalous spectacle of prosecuting officers compromising with the offender, of witnesses disappearing between indictment and trial, of juries refusing to convict, of appellate courts resorting to tricky technicalities to reverse a judgment of conviction and of governors exercising the pardoning power like spendthrifts. "Thus," as Romilly says, "the law defeats its own ends and becomes the abettor of its own violation." Punishments must be brought into conformity with the conscience of the people.

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(G. W. K.*)

PUNJAB, UNIVERSITY OF THE (*see* 22.655).—Since 1919 in conformity with the wise policy of developing higher teaching the university, which had mainly been concerned with examinations, has instituted honours schools in Arabic, Persian, Sanskrit, botany, zoology, mathematics and chemistry. Nineteen Institutions are affiliated to it in medicine, education, agriculture, arts and science. In 1924 the chemical laboratory, which cost Rs. 450,000, was completed.

PUPIN, MICHAEL IDVORSKY (1858–), American inventor, was born in Idvor, Hungary, Oct. 4 1858. He went to America in 1874, and graduated from Columbia University in 1883. The first to hold the John Tyndall fellowship at Columbia 1886–8, he later studied physics and mathematics at Cambridge University and under Von Helmholtz at the University of Berlin (Ph.D., 1889). He was instructor in mathematical physics, at Columbia, 1890; and was appointed adjunct professor of mechanics, 1892, becoming professor of electro-mechanics there in 1901 and later director of the Phoenix research laboratories. By means of inductance coils placed at predetermined intervals of the transmitting wire, he greatly extended the range of long-distance telephony, particularly over telephone cables. The patent for this invention was acquired in 1901 by the Bell Telephone Co. and by German telephone interests. He has made several other inventions in electrical wave propagation, electrical resonance and multiplex telegraphy. He discovered secondary X-ray radiation in 1896 and invented in the same year means for short exposure X-ray photography by the interposition of a fluorescent screen. He was active during the World War aiding Serbia and the United States. He wrote *From Immigrant to Inventor* (1923).

PUTNIK, RADOMIR (1847–1917), Serbian general, was born on Jan. 25 1847 at Kraguyevats. Like many other prominent figures in the life of his country, he came of a family which had emigrated to the Banat during the Turkish conquest and returned to Serbia after the expulsion of the Turks. Passing through the military school at Belgrade (which afterwards became the Serbian military academy), he obtained his commission in a line regiment. In 1876 he commanded a brigade in the war against Turkey, and when war was renewed in 1877 became chief-of-staff of the Shumaja Division. In the Serbo-Bulgarian War of 1885 he held a similar post in the Danubian Division, and in 1889 was made deputy-chief of the general staff, and taught as professor at the military academy in Belgrade. In common with other brilliant officers, he suffered from the favouritism which Kings Milan and Alexander had introduced into the Serbian Army and from the consequent atmosphere of intrigue and personal rivalry. He was placed on the retired list, and it was only after the military revolution which destroyed the Obrenović dynasty in 1903 that he obtained his real opportunity of service. In that autumn he was appointed general and chief of the general staff. In 1906 he succeeded Gen. Gruič as Minister of War, and again held that office in 1912, during the period when the military convention with Bulgaria was negotiated.

On the outbreak of war with Turkey Putnik was made *voivode* or marshal (being the first holder of that title) and commander-in-chief, and was responsible for the rapid success of the Serbian arms at Kumanovo, Prilep and Monastir. It was largely owing to his vigilance and foresight that the treacherous night attack by which the Bulgarians opened the second Balkan War (June 29 1913) was so complete a failure, and the battle of the Bregalnitsa was won. When the World War broke out, he was undergoing a cure at an Austrian watering place, and was at first placed under arrest, being later released by special order of the Emperor Francis Joseph and conveyed to the Rumanian frontier. His impaired health did not prevent him from resuming the position of Serbian generalissimo and he inflicted upon the forces of Gen. Potiorek three successive defeats—the battles of the Yadar (Aug. 16–20), of the Drina (Sept. 8–19) and of Rudnik, which ended on Dec. 14 1914 with an Austrian rout and the complete evacuation of Serbia. Putnik retained the supreme command during the triple invasion of Serbia by the German, Austro-Hungarian and Bulgarian Armies in Nov. 1915, and shared the retreat of the Serbs through Albania. When, however, the exiled Government established itself at Corfu, he and most of his staff were placed on the retired list. He himself withdrew to France. He died on May 17 1917 at Nice.

PYLE, HOWARD (1853–1911), American artist and writer (*see* 22.679), died in Florence, Italy, Nov. 9 1911.

QUANTUM THEORY.—The quantum theory is essentially a theory based upon the assumption that changes in a system with periodic motion are finite in magnitude, the steps being governed by empirical quantum rules, and the energy changes being in general multiples of a quantum of energy $h\nu$, where h is a constant (Planck's constant) and ν is the frequency of the (or an) associated motion. Previous to its formulation it was thought that the energy of a vibrating electron or of a vibrating atom, the energy of radiation emitted or absorbed by an electron or by an atom, might have any value whatever. Changes were regarded as taking place continuously and in infinitesimal amounts.

The quantum theory, on the other hand, as far as it goes, assumes that any change when once it starts is not terminated until the transfer of a full quantum of energy is effected. The time necessary is very minute, but neither this nor the mechanism of the operation is known. If observed sufficiently minutely the process might, of course, appear as a continuous change, but by reason of its suddenness and the inevitable nature of its conclusion, it is spoken of as a discontinuity. The continuities of the classical theory are thus on the Quantum Theory replaced by so-called discontinuities. Such rules certainly apply to changes of a definite kind, but to regard them as universal in their application is a faith rather than a rational doctrine, for the evidence is that these rules are definitely limited in their application.

Heat Radiation.—The theory originated in an attempt by Planck to explain the constitution of heat radiation, *i.e.*, to explain the distribution of energy among the constituent wave-lengths in the radiation proceeding from hot "black bodies." Classical theory has failed to do this, notably in that the possibility of continuous interchange of energy between vibrations in matter and vibrations (waves) in the surrounding ether, as assumed in the classical theory, could only result in the continuous pouring of energy into the ether with its infinite possibility of vibrations. This would happen even in a small volume of ether enclosed by matter; whereas experiment seems to show that an equilibrium state is arrived at, when the energy transferred from matter to the enclosed ether is just balanced by the transfer of energy from the ether to matter. The enclosed radiation is then said to be at the temperature of the surrounding matter, *i.e.*, there is statistical equilibrium with that matter.

More precisely, as Rayleigh and Jeans showed, the energy stored at absolute temperature T in unit volume of the ether in the forms of waves of length between λ and $\lambda+d\lambda$ should be expressed by $8\pi k\,\mathrm{T}\lambda^{-4}\,d\lambda$, that is $k\mathrm{T}$ for each of the $8\pi\lambda^{-4}d\lambda$ independent vibrations, where $\frac{3}{2}k\mathrm{T}$ is the average energy of monatomic molecules of a perfect gas at temperature T, *i.e.*, $\frac{1}{2}k\mathrm{T}$ for each degree of freedom. This expression shows that the greatest amount of energy would be found in the radiations of shortest wave-lengths. But measurement of the energy (by its heating effect) for a given small range of wave-length throughout the spectrum shows a definite maximum and a falling off in energy for both shorter and longer waves (Lummer and Pringsheim).

Endeavouring to find a system giving closer agreement with experiments, Planck assumed that the oscillators in matter which emit heat radiation (electric waves) contain energy in definite quanta, the indivisible unit of energy in an oscillator being proportional to its frequency of oscillation, *i.e.*, $\mathrm{E}=h\nu$. This unit, however, varies for oscillators of different frequency. What is fundamental to all is the constant h—a quantity which, divided by the period of oscillation, gives the energy unit. Planck's indivisible constant is thus a quantum of "action"—a quantity of the dimensions of angular momentum. The quantum of energy, however, may be infinitely small, if the frequency is infinitely small, so is not fundamentally atomic.

Imposing such an imaginary condition changes the average energy of an oscillator from $k\mathrm{T}$ to $k\mathrm{T}\frac{h\nu/k\mathrm{T}}{e^{h\nu/k\mathrm{T}}-7}$, *i.e.*, $\frac{h\nu}{e^{h\nu/k\mathrm{T}}-1}$, with the result that the energy with the given range of wave-lengths $d\lambda$ becomes $8\pi\lambda^{-4}\frac{h\nu}{e^{h\nu/k\mathrm{T}}-1}d\lambda$. This was found to agree almost perfectly with the distribution of energy in the spectrum as found by Lummer and Pringsheim. The same formula has since been obtained from somewhat different assumptions, as by Planck assuming continuous absorption but quantum emission; by Einstein on the hypothesis that *changes* of energy in a molecule are only possible by a jump from one definite state to another, involving the absorption or liberation of energy equal to the difference between the energies of these states though these energies are not necessarily in quanta; others assume that an integral number of quanta exist in the radiation itself. But in general there appears somewhere the assumption of "discontinuities"; and Poincaré has shown that the experimental distribution of energy can be satisfied only by quantum laws.

By comparison of the formula with experiment, h is found to be $6{\cdot}55\times10^{-27}$ erg $\times$ second. This gives the value for a quantum of energy of visible light, say sodium light, as equal to the kinetic energy of 60 atoms of monatomic gas at 0° C. and equal to the vibrational energy of about two atoms of a solid heated to emit yellow light most strongly. Thus the quantum laws, while necessary and successful in explaining the features of black-body radiation, do not indicate the mechanism of an energy change. That the process of heat radiation should be explosive in nature and should occur in amounts $h\nu$ was certainly new and startling but not necessarily so revolutionary as to preclude the possibility of the process being perfectly continuous.

Specific Heat.—The application of the quantum rules in the apparently unpromising region of the heat content of bodies themselves, particularly of solids, has had marked success. Thus, observations show that the heat necessary to raise unit mass of an elementary substance through one degree of temperature (the specific heat) varies approximately inversely as the atomic weight of the element (Dulong and Petit's law). This expresses the fact that the average heat absorbed per atom is independent of the mass of the atom. In addition, the heat absorbed per atom is found to be double that absorbed per atom of monatomic gas. This is explained by assuming that each atom of the solid is capable only of vibration as a whole, the average energy being double that for a monatomic gas on account of the potential energy of vibration being equal to the kinetic energy determining the temperature. Thus N atoms of monatomic gas at absolute temperature T possess energy $\frac{3}{2}\mathrm{N}k\mathrm{T}$, and N atoms of a solid possess energy $3\mathrm{N}k\mathrm{T}$ where k is the molecular gas constant. The approximate laws are therefore in accord with the classical theory. It had been observed, however, that light elements as boron, diamond and silicon, especially at low temperatures, have a much lower specific heat than is given by the above law. Nernst and Lindemann more recently found that the specific heat of *all* substances diminishes rapidly at low temperatures, and this is most marked in light substances. But, as Einstein showed, if the energy of vibration of atoms is governed by quantum laws the average energy of atoms depends on this frequency of vibration (ν) and the total energy becomes $3\mathrm{N}\frac{h\nu}{e^{\frac{h\nu}{kT}}-1}$. From this it follows that the specific heat diminishes with temperature in a manner similar to that found by experiment. The agreement, however, is not close.

A great advance was made by Debye by regarding the motions of all the atoms as due to superposed systems of waves through the solid—waves of compression and waves of distortion. He assumed each independent vibration into which the whole motion could be resolved had energy $\frac{h\nu}{e^{\frac{h\nu}{k\mathrm{T}}}-1}$ as given by the

quantum laws above, and limited the number of such vibrations to the number of degrees of freedom of the constituent atoms. But the frequency equals velocity ÷ wave-length, and as the velocity of waves depends upon elastic constants of the solid, these constants were introduced into the expression for the specific heat. Quite good agreement was found between the calculated and the experimental results, and it was shown that at very low temperatures the specific heat c_v should vary as the (absolute temperature), a result which was experimentally confirmed by Kamerlingh Onnes for temperatures approaching absolute zero.

Further, the variation in the specific heat of gases, particularly diatomic gases, has been explained in qualified measure, by assuming that changes both in vibrational and rotational energy take place in precise quantities.

Spectra.—The greatest triumph of the Quantum Theory, however, is in its application to spectra, especially those of the simplest atoms hydrogen and helium. Rutherford had given good reasons for his theory that an atom consists of a highly concentrated positively charged nucleus, with negative electrons circulating around it, and that the positive charge of the nucleus, expressed in fundamental units and the number of negative electrons outside, were alike and equal to the atomic number, viz.: for hydrogen 1, helium 2, lithium 3. According to classical laws, if an electron rotates—if it is accelerated in any way—it emits a radiation in the form of electric waves, and by emission of energy its own energy diminishes. Such an electron would thus approach nearer to the nucleus and its frequency of rotation would gradually increase. From a large number of atoms in different states, the frequencies would have all values between wide limits. This is contrary to experimental fact, for the line spectra of substances indicate definite unchanging frequencies, with wide intervals between, for which no frequencies are observed. Here evidently was a chance for a quantum theory such as Bohr provided in his quantum atom. First considering the hydrogen-like atom consisting of a positive nucleus with one electron rotating around it, he boldly assumed the following important facts:—

that the electron obeys the ordinary dynamical laws during rotation in the circular orbit round the nucleus but does not radiate;

that the orbit may change suddenly to an inner orbit of smaller energy;

that when it does so change the mechanical energy lost is all emitted as monochromatic radiation;

that the frequency of the radiation is governed by the quantum laws, *i.e.*, $E_1 - E_2 = h\nu$, where E_1 and E_2 are the energies in the initial and final orbits;

finally, that the possible orbits are limited to those in which the angular momentum is an integral multiple τ of the constant $h/2\pi$.

This is equivalent to postulating an integral number of fundamental units of magnetic induction linked with the orbits (H. S. Allen).

These assumed numerical relations limiting the orbits and governing the frequency, combined with the simple dynamics of a rotating particle, give the radius of the circular orbit as $\frac{\tau^2 h^2}{4\pi^2 m\epsilon e}$ where m is the mass of the electron and e the electric charge on the nucleus of the atom. Thus, only orbits of radii proportional to τ^2, *i.e.*, $1^2, 2^2, 3^2$, etc., are possible. And the frequency ν of the radiation is given by $\nu = \frac{2\pi^2 m\epsilon^2 e^2}{h^3}\left(\frac{1}{\tau_2^2} - \frac{1}{\tau_1^2}\right)$ where τ_1 and τ_2 are the integers—the quantum numbers for the initial and final orbits. Thus, also, only certain frequencies of radiation are possible. Corresponding, for instance, to the fall of an electron from the 3rd, 4th or 5th orbits into the 2nd orbit the frequency of radiation is $\frac{2\pi^2 m\epsilon^2 e^2}{h^3}\left(\frac{1}{2^2} - \frac{1}{3^2, 4^2, 5^2, \text{etc.}}\right)$. As for the hydrogen atom $\epsilon = e$, all the quantities in the above expression are known from independent measurements, and the theoretical frequencies of the spectral lines may be calculated with considerable precision. Such a series of lines as the above is the well-known Balmer series. Other series of lines corresponding to the falls from outer orbits into those of quantum numbers 1, 3 and 4 have since been observed. The constant $\frac{2\pi^2 me^4}{h^3}$, as calculated, agrees perfectly with the Rydberg constant which was found from spectroscopic observations long before the theory was put forward. Similarly, spectral lines due to ionised helium, *i.e.*, helium atoms with a nuclear charge $2e$, with one electron rotating around it, have frequencies found by writing $\epsilon = 2e$ in the above formula.

A remarkable extension of Bohr's theory was made by Sommerfeld by assuming that the electronic orbits are in general elliptical in shape, like those of the planets round the sun with the nucleus at the focus. In this case, however, each orbit needs two quantum numbers to define it, one radial, the other azimuthal, the total quantum being the sum of the two. This does not affect the above expressions for the frequency of the emitted radiation if τ_1 and τ_2 stand for the total quantum numbers, but it provides the possibility for a given spectral line being produced by the fall of the electron both from and to various alternative elliptical orbits. Owing, however, to the relativity variation of mass with velocity, the energy of an electron in two orbits of the same total quantum number differs slightly, with the consequence that the change of energy from orbit to orbit, and thus the frequency of emitted radiation differs slightly among the various members of the system with the same initial and final total quantum numbers. Each spectral line as given by the simpler theory therefore consists of a number of neighbouring spectral lines. Such a fine structure of the lines has been observed by instruments of high resolving power in the spectrum of hydrogen, and the theory has been beautifully confirmed from measurements of the more clearly separated lines of the helium spectrum.

The further extension of the theory of spectra to more complicated cases is in general based upon the hypotheses of (*a*) stationary states or energy levels, (*b*) Bohr's relation $h\nu = E_1 - E_2$ for the frequency of the radiation emitted in transition from one state to another, (*c*) a general quantising relation applied to each degree of freedom to determine the possible states (expressed $\int p\,dq = Th$, where q is a generalised co-ordinate and p the corresponding momentum). A "principle of selection" is also introduced permitting only certain transitions between the stationary states regarded as possible by the quantising rules. The selection principle or "principle of correspondence" of Bohr assumes that for high quantum numbers the results obtained from the Quantum Theory for radiation emitted during transition must merge into those obtained from the classical theory for radiation emitted during orbital motion.

The effects of both electric and magnetic fields on the radiating atoms (Stark and Zeeman effects) can then be very satisfactorily explained.

Applications to X-ray spectra similar in nature have also had marked success.

Bohr's theory of the atom was, of course, designed to agree with experiment, yet the assumptions made were simple and of a very general nature. To explain the complexity of spectra in great detail by such simple postulates, is an achievement which seems to indicate for the model some approximation to reality. Yet it is merely a skeleton atom; the postulates are a convenient summary of certain properties; they give no indication of the physical processes by which the observed conclusions are reached; indeed, there is little doubt that the actual atom has not the rigid or precise configuration which the model demands (*see* ATOM).

Whether the quantum phenomena will ever be explained without the discovery of further properties of electricity to supplement those on which classical theory has been built is questionable. Useful though the quantum rules are, their application has appeared to suffer from an inconsistency which success alone could partially justify. A new theory has, however, been formulated by Heisenberg which, whether fruitful or not, promises to put quantum mechanics in much more logical form. Its physical significance, however, is not apparent. To the physicist, quantum theory needs an infusion of new and simple experimental facts such as will, without doubt, be obtained in the near future.

Emission and Absorption of Radiation.—The most intimate acquaintance with the quantum rules is made in a study of the processes of excitation and of absorption of X-rays and of light, especially the former. Thus, when X-rays are produced by shooting electrons onto a target (anticathode), radiation of a particular frequency ν appears in the spectrum only when the kinetic energy of the generating electron is equal to or greater than one quantum of the radiation *i.e.*, $\frac{1}{2}mv^2 \geqq h\nu$. $\nu = \frac{\frac{1}{2}mv^2}{h}$ is the limiting frequency. The emission of light of frequency ν characteristic of a vapour, say mercury, can also be produced by the impact of electrons with energy $\frac{1}{2}mv^2$ equal to $h\nu$, but not by more slowly moving electrons. To excite a characteristic X-radiation, consisting of a group of spectral lines, $\frac{1}{2}mv^2$ must be just greater than one quantum of the highest frequency constituent. These relations seem to indicate that one electron generates one quantum of radiation. On Bohr's theory this is interpreted as that the energy of the moving electron must be sufficient to displace an electron in the atom from one orbit to another of greater energy. When this falls back, this energy is re-emitted as one quantum of radiation. To excite characteristic X-rays an electron must be moved from an inner ring, not to the next possible orbit, which is already occupied by other electrons, but to the surface of the atom; and various frequences are produced by electrons falling back from other energy levels.

Conversely, when X-radiation of frequency ν is absorbed it ejects electrons which, when measured have energies $\frac{1}{2}mv^2$ varying from $h\nu$ downwards, but with a number of well-defined energies $h\nu - E_n$ where E_n has one of a number of possible values for any particular element, being on Bohr's scheme the energy necessary to raise the electron from a definite energy level to the surface of the atom. It is *presumed* that all other velocities obtained are due to loss of energy in escaping from the material experimented upon. (There is some doubt of this when E_n is almost equal to $h\nu$.)

The fact that the energy $h\nu$ must be put into an atom to produce radiation of frequency ν, and that an equal amount should reappear in an absorbing atom, is not so startling as that the number of these energy units should seem to be the same. Thus, the number of high-speed electrons ejected by a given beam has been found independent of distance from the source, independent of the absorbing substance, and unaffected even by the radiation being almost completely scattered in all directions. Also, there is strong evidence that the number of electrons ejected by a characteristic X-radiation is equal to the number of atoms which emitted that radiation; and more particularly that one quantum of radiation from one atom can be visibly effective in only one atom, as appears from C. T. R. Wilson's condensation experiments. This suggests either that a spherical wave-train emitted by an atom (in the classical theory) is effective along only one definite ray, or alternatively that absorption at *any* point renders the remainder ineffective. The latter is not in agreement with experiment when *many* such trains are present.

Such evidence leads directly to a quantum theory of radiation which postulates the existence of discrete particles of radiation, each moving along a single continuous path—J. J. Thomson's waves along discrete tubes of force, Einstein's light quanta, and J. J. Thomson's recent combined quantum-wave theory.

On the other hand, the phenomena of scattering of X-rays and light, including all the interference phenomena of scattered radiations, are explicable only on the assumption that the potential activity of a wave spreads out in all directions. The energy, the distribution and the polarisation of the scattered X-rays are all *precisely* as predicted in the classical spreading wave theory and on no other. The theory is that every extra-nuclear electron in the matter traversed contributes its share of scattering not in quanta, but in almost infinitesimal amounts. The electrons, even in the quantum-atom, are thus radiators on the classical theory when the energy is supplied to them by the primary radiation and leaves the energy of the atom untapped. The "quantum theory of scattering" (unfortunately named) has been given by A. H. Compton to explain not scattering but the production of a second (displaced) spectral line sometimes observed with the scattered X-radiation. He applies the principles of the conservation of energy and of momentum to an incident quantum of radiation which, on encountering an atom, ejects an electron and causes the emission of a quantum of secondary radiation. This, having less energy than the incident quantum, has lower frequency for $\nu_2 = \frac{E_2}{h}$. If such a phenomenon actually occurs it is certainly subject to some unidentified condition (compare Barkla's J phenomenon with Compton's quantum scattering theory). Also, the phenomena of reflexion or diffraction of X-rays by crystals show that the secondary waves are not effective except in certain definite directions in which waves would be expected to reinforce one another. Where waves interfere, there the effects of radiation disappear. (Similarly, in optical interference phenomena in which complicated intensity distribution is involved.) It is what may be called microscopic examination which shows definite amounts of energy to appear only at certain points, and the problem is to show how it arrives there in quantities much greater than is carried by the waves passing over the absorbing atom.

A natural assumption to make is that when an atom reaches a certain unstable state the properties of the surrounding medium are completely changed and energy pours into the atom from the surrounding region. Theory makes no provision for this; nor is this surprising, for this is an unexplored region in which anything may happen. The subject is one for experimental study.

But already we know—(J phenomenon)—that quanta of radiation are not independent entities in radiation, for a slight addition to, or a slight elimination from, a complex X-radiation completely changes the electron emission and absorption of that radiation. Thus a quantum of radiation does not operate alone. There is thus neither need for, nor is there any room for a quantum of radiation as a distinct entity in addition to a quantum-atom. Assuming the quantisation of electronic orbits or its equivalent, it is but a short step to the quantisation of atomic vibrations, for the bonds holding an atom are electronic bonds: quantised vibrations are probably inevitable. But the conception of the rotational energy of a molecule changing in the precise way governed by quantum rules is a difficult one, unless the duration of the energy transfer is at least comparable with the period of molecular rotation. Though many other applications of quantum laws have been attempted, and with varying success, they contribute little to fundamental knowledge. The atom is certainly a quantum-atom; its internal structure and processes are governed by quantum-laws. For the present we can only accept these as empirical facts.

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(C. G. B.)

QUEBEC (City), Canada (*see* 22.727), had a population of 95,193 in 1921, estimated at 110,500 in 1924. Nine-tenths of the population are French and Roman Catholic. Quebec had for some years before 1911 been displaced by Montreal in the shipping trade, but after 1911 the older port steadily improved its commercial and industrial position. As a manufacturing centre Quebec has profited by the cheap electric power supplied from the Shawinigan and Montmorency Falls. The harbour has been improved, and the largest drydock in the world has been built.

Important factors contributing to the increased commercial importance of Quebec were the successful completion of the Quebec bridge and the building of the Grand Trunk Pacific Railway (now merged in the Canadian National system), from Prince Rupert on the west coast of Canada to Quebec on the east. The distance from Quebec to Winnipeg by this railway is 145 m. shorter than that via Montreal to Winnipeg. The Quebec bridge, connecting the north and south shores of the St. Lawrence river at Cap Rouge, 9 m. from the centre of the city, was completed in 1917. This achievement marked the end of more than 10 years of effort, two accidents to portions of the huge structure having delayed the work in 1907 and in 1917. The completion of the bridge made possible the running of six railways simultaneously into Quebec from the south shore (*see* BRIDGES).

Quebec has always been a base of supplies for a large region of mines, lumber camps and farms, but has gained further importance owing to the rapid development of the water supplies of the province for purposes of electric power, particularly for the manufacture of wood pulp. A large Government technical school has been erected, and the basilica of Notre-Dame, the mother church of Quebec, which was burnt down in 1922, has been rebuilt. A large area of the Plains of Abraham has been made into Battlefields Park. The old portion of the Château Frontenac hotel was destroyed by fire in 1926. A war memorial cross has been erected in front of Montcalm Market, and a monument to Hébert, the first settler of Quebec, in City Hall Square.

QUEBEC (province), a province of the Dominion of Canada (*see* 22.724). Through the addition of Ungava in 1912, its area was increased to a total of 706,834 square miles. The population was 2,361,199 in 1921, an increase of 17% over 1911; about 96% are Canadian born. In 1921, 1,889,277 were of French and 357,108 of British origin; the number of Indians was 11,566. The chief cities and their populations in 1921 were: Quebec, the capital, 95,193; Montreal, 618,506; Verdun, 25,600; Hull, 24,117; Sherbrooke, 23,515 and Three Rivers 22,367. The population of Shawinigan Falls, an important centre of power development, increased from 4,265 in 1911 to 10,625 in 1921.

The Government consists of a lieutenant-governor, a legislative council of 24 members appointed for life and a legislative assembly of 86 members elected for five years. Quebec is the only Canadian province in which women are not enfranchised. The province is represented in the Federal Parliament by 24 senators and 65 members of the House of Commons. The legislative grants for higher education and elementary schools are apportioned according to population; of the grant for normal schools, however, the Protestants receive one-third. The elementary school grant is supplemented by local municipal taxation through trustees. After 1920 the provincial government, with the assistance of a Federal grant, did much towards the development of technical education.

Production and Industry.—The leading field crops and their values in 1925 were: hay and clover, $58,517,000; oats, $32,946,000; and potatoes, $35,692,000; barley, wheat, rye, peas, buckwheat, beans, root crops, alfalfa and fodder corn are also grown. The area under crops in 1925 was 6,828,700 ac.; the total value of field crops was $150,253,000. Apples, plums and other fruits are produced in large quantities. Between 1914 and 1925 the province spent a large amount annually on the development of the dairying industry, which showed marked expansion. The value of dairy products in 1925 was $26,527,647.

In 1925 there were about 200,000 sq. m. of forest land in Quebec. Of this enormous area but a small proportion has been cut over; the estimated cut for 1925–6 was 1,500 million feet. Pulp and paper production are of growing importance: in 1924 pulp production was valued at $44,090,213, and paper production at $62,523,583. The maple sugar industry is of considerable importance, the average annual value of sugar and syrup produced approximating $4,000,000. The forests, especially in the northern part, abound in game, both fur-bearing and otherwise: 174,000 sq. m. have been set apart for the preservation of fish and game by the provincial government. Quebec ranked second to Ontario in the value of its fur trade in 1923, which amounted to $3,049,656. The fisheries are important, the annual value of the catch being approximately $2,220,000. The mineral production of the province in 1924 was $18,429,872, a decline of nearly $3,000,000 from the preceding year. The decline was chiefly apparent in the production of asbestos, mica, magnesite and cement, but copper, zinc, lead and molybdenite showed an increase in production.

Manufactures and Communications.—There were 7,142 manufacturing establishments in the province in 1923, with a capital of $1,009,898,982, employing 163,622 persons, and with a gross production value of $811,103,396. Rapid expansion of the use of water power for commercial purposes, especially at Shawinigan and Valleyfield, has contributed greatly to industrial progress. The chief manufactures are pulp and paper, textiles, boots and shoes, tobacco and cigars and machinery. Quebec had 5,254 m. of steam and electric railway in 1923. The headquarters of both the Canadian National Railway and the Canadian Pacific Railway are in Montreal. Of the 45,374 m. of highways in 1924, 2,516 were of gravel and some 2,000 of macadam or concrete. (*See* CANADA.) (S. LE.)

QUEENSLAND (*see* 22.732), a State of the Australian Commonwealth. Area 670,500 square miles. In 1925 the population was 855,214, an increase of 249,401 since 1911. Brisbane, the capital and principal port, had on Dec. 31 1924 a population of 245,015.

Political History.—Queensland is one of the strongholds of the Labour party, and Labour Governments were in power from 1915 to 1926. The Legislative Council was abolished in 1922. Several state enterprises were established, including sheep and cattle stations, butchers' shops, fish supply, a coal-mine and a State Insurance Department. Much of the legislation passed was of an experimental nature. The Primary Producers Organisation Act, passed in 1922, aimed at the organisation of the agricultural industries in a completely unified national organisation, and under the Primary Products Pools Act 1922 power was given for the creation of boards to control the marketing of any commodity. Capital punishment was abolished in 1922. The Lands Act Amendment Act, passed in 1920, which was regarded as repudiating the conditions under which leases had been granted for pastoral development, was strongly criticised in Great Britain. Queensland is the only Australian State which has developed its railway system from several maritime centres instead of from one capital city.

Production and Industries.—Essentially a pastoral country, in 1924 the State carried 19,028,252 sheep and 6,454,653 cattle. There has been a considerable development in dairying, the production of butter having nearly doubled between 1913 and 1925. Despite the "White Australia" policy, the sugar industry has made great progress in north Queensland. The labour employed is largely southern European, of which there was a considerable influx after the War. The output of sugar increased from 162,136 tons in 1919–20 to 519,017 tons in 1925. The action of the Commonwealth Govt. in guaranteeing the price of the yield for the three years 1920–2 induced mill-owners to make additions to plant and farmers to put new areas under cane. After 1920 there was a revival of cotton-growing. In 1919, 72 ac. were under cotton: in 1925 the acreage was 60,000, with a yield of 24,000,000 pounds. In order to encourage the industry, the Commonwealth and Queensland Governments advanced up to 5½d. per lb. on all seed cotton delivered at ginneries during the seasons 1923–4 and 1924–5. The production of ratoon or perennial cotton was at first prohibited, but later allowed under certain conditions. The value of the mineral production in 1924 was £2,305,963, of which £985,542 represented coal, £380,025 copper, £459,710 gold, £167,469 silver and lead, and £175,509 tin. (*See* AUSTRALIA.)

RACES OF MANKIND.—The study of the varieties of the human race has occupied the attention of thinkers from early times. Two entirely different forms of classification have been employed, one based on the study of the skull, the second, and more generally used method, on superficial characters, such as skin and hair, which may be observed on the living man. To a certain extent these two methods have been combined in modern times.

Cranial Form.—Apart from Sergi, who elaborated a method of classification based on *cranial form*, the shape being estimated by viewing the skull from on top, most anthropologists have preferred to take measurements, especial importance being attached to the cephalic index—the percentage ratio of the length to the breadth—but numerous other measurements have been made, mostly of little value for classification. W. L. H. Duckworth suggested the combination of three characters on the skull, the cranial capacity (which is obtained by filling the brain case with shot or rape seed and then pouring the seed into a graduated measure), the cephalic index and the degree of prognathism (measured by taking the angle which the most projecting part of the jaw makes with the forehead). On the basis of the possible combinations of these criteria Duckworth divided mankind into seven different groups.

Coefficient Method.—Karl Pearson devised a method, termed the coefficient of racial likeness, which aims by a method of averaging at including a very large number of measurements in a single figure. The method is complex, and depends on the difference between a series of measurements taken on a set of skulls belonging to one race, and those taken on a second set. There is less difference in those closely allied than in those more distantly related, and the coefficient is correspondingly smaller or bigger. The rather complex mathematical processes involved are the chief disadvantage of the coefficient, which is still in the experimental stage.

Colour Groups.—As regards the superficial characters observed on the living subject, certain criteria have found acceptance for a considerable time, but opinions differ as to the relative value of these criteria. The oldest grouping of mankind, which is still in popular use, is that of skin colour. It has been suggested that the degrees in pigmentation of the human skin are due to the effects of environment, either to sunlight or humidity or a combination of both, the evolutionary changes which took place at an earlier date having become part of the heritage of the races we know to-day. Although the darkest skins are to be found in the tropics, whereas the fairest occur in the temperate climate of western Europe, attempts to correlate skin colour and environment break down when specific cases are considered. Some exceptions can be explained by recent immigration, others again, especially in the individual, by racial admixture, for where races are mixed we may find members of the same family who are very differently pigmented. On the whole the average value of the skin colour in various groups is correlated with other criteria, which appear to be good bases for classification.

One of the most important of these is the cephalic index. Taking the length as 100, the proportion of the breadth seldom falls below 70 or over 90, and it is usual to describe those peoples with an index below 75 as *dolichocephalic* (long-headed), those above 80 as *brachycephalic* (short-headed), the intermediate group being *mesocephalic*. Taken by itself, either in the individual or the race, the cephalic index is by no means a certain guide. We find brachycephalic, mesocephalic and dolichocephalic groups in all the greater divisions of mankind. In the individual, a series of 6,000 Japanese contained one man with an index of 69, and one of 96, and in a continuous series between these two extremes over 700 (about 12%) having indices between 80 and 81, the average being just under the latter figure.

Of the characters generally in use, however, the cephalic index shows most consistently the lowest *relative* variation within small groups. It is therefore of great value for classifying smaller units within the wider divisions, but deductions can only be drawn from the average of a reasonably large number of individuals, at least 50 of the same sex. The practice of artificial deformation may to a certain extent obscure the true head form, and where it occurs the cephalic index is often of little value.

Usually long heads are associated with long faces and vice versa, the face being then termed harmonic. A certain use of this fact has been made for classificatory purposes. There are other features of facial form which appear to be characteristic of different races, but though often easily recognisable are difficult to measure exactly.

Stature and Nose Form.—Stature is a very variable character, depending on many conditions, of which food and habit seem to be the most important. In spite, however, of this variation in individual cases the *average* stature of a group is a useful criterion. The form of the nose is estimated by an index formed by taking the length from the root to the junction with the upper lip as 100 and expressing the breadth across the nostrils as a proportion of this.

Professor Thomson, to whom the idea was originally due, and Buxton have shown that the nasal index tends to be high in those countries where the air is moist and hot and low where it is cold and dry, the various combinations of these two factors being associated with corresponding nasal indices. The correlation is high with certain very marked exceptions, of which the most important is the Australian aborigines. It seems probable that they migrated from a hot, moist climate, and that they have retained the form of nose most appropriate to such a climate. The evolution of any character needs the time factor, especially when, as in this case, evolution by elimination has played an important part. While the nasal index may be ultimately related to environment, it is still of considerable value for classification.

Hair Form.—On the basis of the form of the hair, mankind may be divided into straight-haired (*leiotrichous*), woolly-haired (*ulotrichous*) and an intermediate group of wavy or curly-haired (*cymotrichous*). Certain types are difficult to define, but usually the distinction is clear-cut. All types of hair may occur in the same population, where racial admixture has taken place, but normally the variation is slight in the same group.

In sections the woolly hair is flat and ribbon-like, straight hair is round, wavy and curly hair showing an elliptical form. Here also there may be a certain correlation with environment. The woolly hair occurs for the most part in the Tropics and may form a protection against the sun, being associated with special sweat-glands. The evolution of the hair form has taken place at a comparatively remote period, so that it remains the most convenient basis for the ultimate classification of the great groups of man, the other criteria being subordinated to it. In this classification physical criteria alone have been used; all cultural or linguistic terms have been avoided. Owing to historical reasons certain peoples have been named after the languages they speak, and subsequently these terms have been applied to physical types. Terms like Malay, Dravidian, Mongol and Bantu are used as if they could be applied to races and not merely to peoples speaking certain groups of languages.

Other Classifications.—The classification given below is based on the anatomical characters already discussed; attention has, however, been recently directed towards certain physiological characters as a basis of racial differentiation. Several criteria have been put forward, amongst them the different reactions of the blood sera in divergent races and the effect of the ductless glands on the macroscopical anatomical characters. Although great stress has been laid on the latter, especially by Sir Arthur Keith, neither this nor other physiological criteria have to the present time been sufficiently investigated to form a basis for a novel classificatory method.

FIGS. 1 and 4. Papuo-Melanesian. FIGS. 2 and 5. Andamanese (male and female). FIGS. 3 and 6. Australian (N.S.W.).
FIG. 7. Negro. FIG. 8. Paroean (Malay). FIG. 9. Southern Chinese (female). FIG. 10. Modified Nordic.
FIG. 11. Eskimo (female). FIG. 12. Indian (Hopi).

(For acknowledgment of photos, see text.)

Straight-haired Groups.—The straight-haired peoples correspond to a large extent to the races called by some writers Mongol or Mongoloid, or "the Yellow-Brown Race." All these peoples possess cheek-bones of a greater or lesser degree of prominence. In most cases the face is flattened, often markedly so. The skin is usually yellow, shading into a coppery yellow or brown on one side, and on the other, especially in women, a pale almost white yellow tinge. In Asia the cephalic index tends to vary between mesocephaly and brachycephaly, with some marked cases of the latter form. In America the Eskimo (fig. 11 on plate) are dolichocephalic and a wide range of mesocephaly and brachycephaly occurs among the other tribes.

While Haddon divides this race into three groups on the basis of a cephalic index, it is probably more convenient to adopt a primary geographical division and to separate the Leiotrichi into an Asiatic and American group, since the latter have been separated from their kinsmen in Asia for a long time and have to a certain extent specialised.

Asiatic Groups.—There are three groups in Asia, a northern or Arctic group, a central group, the Pareoeans (the Dwellers beside the Dawn) and a southern or Proto-Malay, it being possible that the two latter groups, formerly included under the term Southern Mongoloid, should be classed together.

The northern group is rather indeterminate, and includes a number of tribes living in the circumpolar regions of Asia and extending even as far west as northern Scandinavia, where they are represented by the Lapps. Most of these peoples have mixed with other races, to which fact their diversity is due, but they certainly include a mesocephalic and a round-headed subdivision. In eastern Asia at least there is a more northerly group, living in the most easterly extension of the continent and a more southerly group, but the difference is probably due to racial admixture, consequent on the intrusion of the peoples who brought in the Turko-Mongol culture from the west and thus divided the northern and central groups of the straight-haired peoples.

In Korea there is a narrow belt which forms a connecting link between the northern and the Pareoean peoples. The latter differ most strikingly from their northern neighbours in having less prominent cheek-bones and a broadish nose. In the north of China they are often tall; in the south, where the type is found in greater purity, they are short and more stockily built (fig. 9 on plate). The Japanese represent a special variety of this type; they have mixed considerably with the Ainu, and this, at least in some cases, has altered their physical type.

The southern extension of these peoples, the Proto-Malays, are widely spread in southeastern Asia and in the islands. They are seldom found in an unmixed state, but have been brought so much in contact with the various other peoples of this region that it is often difficult to distinguish them except by their broader heads (see fig. 8).

The straight-haired peoples also extend into Central Asia, where they are known as Turks and Mongols. These terms are cultural and linguistic, and cannot be used in a racial sense. Great racial admixture has undoubtedly taken place in this region and much of the population is closely connected with the peoples of the west, but types frequently occur with straight hair, very prominent cheek-bones and folds over the corners of their eyes, all of which characters show affinities with the Arctic group already discussed.

Most remote from the straight-haired peoples and showing certain relationships to them are the Polynesians, who live on the islands of the Pacific from Samoa to Easter I. and Hawaii to New Zealand. They probably represent an old mixture between the Proto-Malays and a group of the curly-haired people called Nesiots (islanders, *see* below), but other admixture has taken place and their position is difficult exactly to determine.

The Amerinds.—As regards the American aborigines, for whom the term *Amerind* has become conventionalised, it has been disputed whether they should be considered to belong to one race or not. The Eskimo, who to-day inhabit the Arctic coast of America, with a western extension into Asia, and an eastern into Greenland, once lived as far south as the coast of Massachusetts, and survived near Quebec till comparatively recent times. They differ from the other inhabitants of America in many respects notably in having extremely long skulls (the western Eskimo differ somewhat in this respect), which are compressed laterally and are very high-pitched. They have broad faces, an unusual feature in people with a long skull, and very narrow noses. The jaws are exceptionally well-developed and the individual teeth are very large, possibly owing to the nature of their food (fig. 11 on plate).

The Amerinds themselves vary considerably in most of those characters usually considered to be of racial significance. Hrdlicka, however, believes that they all belong to the same race. Verneau has recently affirmed the concurrence of types akin to the Melanesians, a view previously held by others also. Haddon suggests with every degree of probability that side by side with the straight-haired peoples there is a cymotrichous type, which he has called Palaeo-Amerinds.

The subdivisions of the true straight-haired Amerinds are somewhat complicated and need not be discussed in great detail. The best basis for division is the cephalic index, but stature and other features must be taken into consideration. The nasal index, it should be noted, increases towards the centre of the two continents (fig. 12 on plate).

The peoples of the northwest coast are most closely allied to the inhabitants of Asia, and are distinguished from the other Amerinds by their lighter skin colour. East of the Rockies and extending over the great plains and into the woodland area there is a group of tall tribes with mesocephalic heads, of whom the Sioux are a typical example. On the east coast in ancient times there was a different type with longer, narrower heads. On the American plateau and extending into central and southern America there is a round-headed type, of short stature and with straight noses, to whom the Maya of ancient times were akin. The Aztecs were more long-headed and their relationship with the more northerly peoples can be traced through some of the inhabitants of northern Mexico today.

The ethnology of South America is as yet not fully established, but several types can be distinguished, one akin to the Maya peoples and a different type, with a round head and tall stature, who live in Patagonia, of whom the Fuegians, familiar since Darwin's *Voyage of the Beagle* (1845) are a branch. Side by side with those straight-haired peoples there exist traces of a curly-haired race, the significance of whose presence in South America is discussed below. With the exception of the Palaeo-Amerinds the distribution of the straight-haired peoples is continuous, the Bering Strait forming the division between the Asiatic and American branches.

Woolly-haired Groups.—The woolly-haired people have an extremely discontinuous distribution, namely, an eastern habitat which stretches from the continent of Asia to Fiji, and a western, the greater part of Africa. Attempts have been made to bridge this gap. Hüsing believes that in ancient times short dark curly-haired peoples occurred on the Persian Gulf in localities where negroes are still found. These negroes are, however, the descendants of imported slaves, and there is no information of a definite character to support Hüsing's contention. Some of the jungle tribes of south India are said to have negroid characters, but at present no evidence has been collected to bridge the gap between the two groups, and the characters which link them may be due not to community of ancestry but to the effects of a tropical environment. In the absence, however, of any definite proof of this contention the two groups may be linked together, with the caveat that the links which should connect them have as yet not been discovered. While the original centre of dispersion of these peoples is at present uncertain, there are almost certainly secondary centres of dispersion in northeast Africa and eastern Asia.

In addition to woolly hair all these peoples have the following characters in common: dark skins sometimes almost black, broad noses, usually a rather small brain in relation to their size, especially among the taller members of the group, with forearms and shins proportionately long. In the skeleton there is a smooth-

ness of contour which even in adults often recalls the bony form of a child, and among some members of the group the forehead has that prominent and smooth form which is so characteristic of the infant of our own race. In both eastern and western groups there is a division which includes some very small or pygmy peoples and another of medium or tall-statured tribes.

Eastern Group.—The eastern group may be divided on this basis into the pygmy Negritos and the taller Papuans and Melanesians. The former are all dark-skinned and have heads which are slightly rounded, the cephalic index varying from just under 80 to about 83. There are slight local differences due to the extreme isolation to which these peoples have been subjected. Four separate geographical groups occur, one in the Andaman Islands (the Andamanese), one in the central regions of the Malay Peninsula and eastern Sumatra (the Semang), a third in various parts of the Philippine Is., usually called after a well-known tribe, the Aeta and a fourth group called after a tribe in the western mountains of Dutch New Guinea, the Tapiro, who have left traces in other parts of New Guinea and probably also in parts of Melanesia. All these groups are isolated from one another and occupy as it were almost the circumference of a circle. The Andamanese occupy a very special position, both racially and geographically; they have been isolated for a long period and until recently were not in contact with any other race. Such measurements as have been taken indicate that these people are remarkably true to type and show little variation from the average. They are probably the one human group which can be considered a " pure " race (figs. 2 and 3 on plate).

The Papuans and Melanesians are distinguished from the Negritos by their greater stature and narrower heads; the former probably represent the original stock. At one time they had a wide distribution throughout all Melanesia, probably to Australia, and the extinct Tasmanian aborigines seem to have been a variety of this stock. To-day Papuans are found in New Guinea and in some of the most easterly of the Indian Archipelago islands. They may be distinguished from their kinsfolk by their retreating forehead, prominent brow-ridges and the form of their noses, which are often prominent and rounded, with a down-turned tip (figs. 1 and 4 on plate).

The Melanesians are extremely variable and include a variety of racial elements, though the basis of the stock is Papuan. The racial mixing which has taken place will account for the fact that, although they are usually woolly-haired, all varieties of hair are found. Stature is equally variable, although the average height is under 5 ft. 3 inches. The prominent brow-ridges so characteristic of the Papuans is not common and the nose is usually smaller than in these peoples. The Melanesians have a wide distribution from the coastal regions of New Guinea and the neighbouring islands to the Pacific from New Caledonia to the Admiralty Is., and as far eastwards as Fiji; formerly they seem to have extended over most of the Pacific.

The Bushmen.—The Bushmen, who belong to the second group of the woolly-haired peoples, are also short, though not of pygmy stature; they differ from the other Ulotrichi in having yellowish skins. Now restricted to the Kalahari desert, they formerly ranged over the whole of south Africa and possibly over a much wider area. Their hair is short and curls into little tufts like pepper-corns, giving the appearance of bald patches. The head is small and low and there is little or no forward projection of the jaw. The most distinctive character of the Bushmen is a great development of the buttocks (*steatopygia*); this feature is specially developed in the women. The Hottentots are closely allied to the Bushmen and possess most of the characters already described. They represent a cross between the latter and other negroid stocks.

True Negroes.—The true negroes inhabit the Guinea Coast, but their original range seems to have been over most of tropical Africa. They are tall with black or dark brown skins, long narrow heads and retreating foreheads and prominent jaws. The lips are thickened and everted and the nose is very broad. They have mixed with other elements and have produced hybrid stocks (fig. 7 on plate). In the upper Nile valley numerous tribes, called Nilotes, are to be found; they are characterised by a very tall stature, a slender build and extremely narrow heads. There is also a more round-headed strain, due probably to an early admixture with some curly-haired people. Most, if not all, of the Nilotes have been considerably altered by contact with other non-negro peoples. In central and southern Africa there are numerous negroid tribes characterised by a variety of physical form, due no doubt to racial admixture. The majority are long-headed with considerable variation in stature.

The Pygmies.—In the equatorial forests certain pygmy tribes live. These Negrillos differ from the tall negroes not only in their stature but also in the lighter colour of their skin, which is often yellowish and covered by a light down, and in the more rounded form of the head; the nose is broader even than that of the negro.

Curly-haired Groups.—The third great division of the human race, the curly-haired or Cymotrichous, occupies in many ways an intermediate position between the other two groups. Its distribution is world-wide, and it includes both undifferentiated and highly differentiated groups of mankind. The white races belong to this class. The centre of dispersion of the group was probably somewhere in Asia, but the precise limits of this cradle land have not yet been determined.

The hair varies from wavy to curly, and, whereas in other races it is, with but few exceptions, black or dark brown, in this group every shade occurs from a dead black to a fair straw colour; the brown, however, predominates. The skin colour is equally variable. Most members of this race have a fairly large brain in relation to their body size, but some of the more primitive members are extremely small-brained. The forehead in the males has usually a well-marked prominence over the eyes, the so-called " bar of Michael Angelo." The face is never flattened nor are the lips everted. The stature is very variable, but no pygmy types are found.

Every degree of cephalic index is found, and this still remains the most convenient method of simple classification. The race, however, contains certain sub-races which appear to be more primitive than others and the division into primitive and more advanced groups brings out certain points which may otherwise be overlooked. The primitive which survive are the Proto-Nordics, the Proto-Indics and the Australian aborigines. The Palaeo-Amerinds also probably belong to this class. The more advanced peoples include a dolichocephalic group, a mesocephalic and a brachycephalic group.

Proto-Nordics.—The Proto-Nordics appear at one time to have had a wide distribution over northern Asia. Some of the present inhabitants of the Turkoman steppes present this type in an undifferentiated form. The Ainu, who have within comparatively recent times been driven out of the main islands of Japan, and who still inhabit the northern island (Hokkaido) Saghalien, and to the south the Riukiu islands. This curious people are of medium stature, very stockily built, with large heads and a marked bar across the forehead. They have an abundance of hair on the head and body and long, wavy beards. Their eyes are straight as in Europeans and their general appearance contrasts very strongly with the Japanese who to-day live amongst them.

Proto-Indics.—The Proto-Indics may be classed geographically into three, possibly four, divisions: first, the jungle tribes of southern India (some of the more primitive tribes of northern India also have affinities with this stock); secondly, the Vedda, the most primitive of the inhabitants of Ceylon; and thirdly, some of the more primitive peoples of the southern part of the Malay Peninsula, of whom the best-known are the Sakai and Senoi. In Sumatra and Celebes and possibly elsewhere in the Malay Archipelago there survive tribes who may be considered as a fourth division of the Proto-Indics, but here they have for the most part been mixed with other stocks. In much of south-eastern Asia there is a racial background of Proto-Indics who have been overlaid by other invaders, but the stock has survived in a relatively pure state in the places enumerated above. The Proto-Indics have curly hair, very dark and often nearly dead black skins, a short stature and extremely broad noses.

The Australian Aboriginal.—The Australian aborigines almost certainly belong to the same stock, but they possess some special characteristics which may be due to the length of time they have been isolated from the parent stem. The skin is usually of a dark chocolate brown, the hair, which is somewhat variable but usually curly, is frequently very abundant on the face and body. The stature is medium, the nose very broad, and their most distinctive feature is the great bony development of the skull, including a great massing of bone over the eyes and a big development of the jaws and teeth (see figs. 3 and 6). Whereas the Proto-Indics, notably the Veddas, have extremely small skulls, those of the Australians, though often containing an extremely small brain-case, are always massively built, and the beetling brows, low forehead and projecting lower part of the face give the males a very characteristic appearance.

Advanced Long-headed Types.—The long-headed peoples of less primitive type can be divided into several groups, but it seems extremely probable that all belong to the same stock; most of them can be distinguished from the Proto-Indics by their greater stature, and all by the narrower form of the nose. Local groups of these peoples have become separated into sub-races which breed true.

Eastern Groups.—The most easterly representatives of these stocks in Asia are the *Nesiots*, who are found mixed with the straight-haired, round-headed Proto-Malays in the Malay Archipelago, in the Philippines, sporadically in southeastern Asia and in the interior of southern China; the exact extension of these peoples is not yet fully known. In southern India a large proportion of the population belongs to a second group, *Chersiots* (mainlanders, as opposed to *Nesiots*, islanders). They are here much mixed with Proto-Indics and round-heads. In the northern part of India the proportion of the round-heads is much greater, and in the northwest the round-headed element predominates. In Rajputana and in the Punjab there is another group of long-heads, to be distinguished from the Chersiots by their taller stature, fairer skins and narrower noses. These Haddon terms Indo-Afghans.

Western Groups.—Further west, in the horn of Africa and the desert between the Nile and the Red Sea, this stock is dominant in the population, though frequently mixed with negroes. These tribes represent the modern descendants of the Proto-Egyptian population. Among the groups of this stock with a white complexion several varieties may be distinguished: one, the *Eurafrican*, seems only to occur in isolated spots in north Africa and western Europe, including part of the British Isles, another is met with among the Bedouin Arabs, while the third or Mediterranean race forms the fringing population of the Mediterranean sea and the western Atlantic seaboard of Europe. In the eastern Mediterranean it is inextricably mixed with the Armenoid peoples.

Among the Mesocephals Haddon includes three groups; two, however, the Pyrenean and the Atlanto-Mediterranean are probably hybrids. The third, the Nordic, is more clearly marked and is characterised by fair skin and hair, blue eyes and a tall stature (fig. 10 on plate). To-day they form one element in the population of the British Isles and northern France, Belgium and Holland, and northern Germany. They predominate in Scandinavia.

The Round-headed Group.—The great round-headed branch of the Cymotrichi is conveniently called Eurasiatic. It extends all along the great mountain chain from the central plateau of France on the west to the Himalayas on the east. The Alpine branch of the family is distributed along the central massif of Europe into central and even Eastern Asia, the Armenoid or Illyrio-Anatolian has a more limited range in southeastern Europe and western Asia. They may be distinguished by the extreme flatness and height of the head. In the Pamirs, in Persia, and extensively in central Asia and in India, a separate branch of this race, the Pamiri, is found, while locally in western Europe isolated examples of two early groups, the Prospectatores and the "Beaker Folk" still survive. They probably resulted from early crossing of round-heads with Mediterranean and Nordic man respectively. All these peoples are marked by the roundness of their heads, their brown, auburn or black hair and somewhat sallow or olive skins. The eyes vary from brown to hazel, but blue eyes are found.

Most of the migratory movements which resulted in the present distribution of mankind took place too far back in history for us to estimate their exact course, but in all probability human stocks were evolved near the places where we first find them recorded in historic times. Some migrations belong to the domain of ancient history, but it is very doubtful how far these movements have actually affected the physical type. In all probability ethnological history has consisted chiefly of the gradual extension of dominant types (see A. C. Haddon, *Races of Mankind*, 1924). (L. H. D. B.)

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RACING: *see* HORSE RACING.

RACQUETS (*see* 22.780), a game which, although standing as high as ever in the estimation of players, is so expensive that, except at the public schools, the tendency is toward less play than formerly. Indeed, more than one court has lately been converted into courts for the inexpensive game of squash racquets, which is becoming very popular. At the public schools, however, the number of racquets players is, if anything, increasing and the keenness is as great as ever.

The world's championship in 1910 was held by W. Jansetji, the Parsee player, but he was deprived of it soon afterwards by Charles Williams, then professional at Harrow School. He, in his turn, was beaten shortly before the War by Jock Soutar, an English born player attached to the Philadelphia Club. Soutar was the holder in 1925, having again defeated Williams at Philadelphia and New York. The open championship of England was won in Jan. 1925, by Charles Read, of Queen's Club. The leading amateur players in the period 1910–25 in England were E. M. Baerlein, who has established a record by winning the amateur championship nine times, B. S. Foster, H. W. Leatham, Hon. C. N. Bruce, J. C. F. Simpson and R. C. O. Williams. As a double pair Simpson and Williams, who visited America to play matches in the spring of 1925, were particularly good.

The British Army has, during the same time, had several good players, notably Gen. S. H. Sheppard, Col. W. E. Wilson-Johnston, Maj. A. C. G. Luther, Capt. T. O. Jameson and Col. A. J. H. Sloggett. C. C. Pell and Stanley Mortimer have been the leading American amateurs. Pell, on his visit to Great Britain in 1925, was successful, being the first American player to win the amateur championship.

The public schools competition, at Queen's Club, Kensington, is the central event of the English season. The winners of this since 1910 have been as follows: 1910, 1912 and 1914, Charterhouse; 1911, 1923 and 1924, Rugby; 1913 and 1921, Wellington; 1919, Marlborough; 1920, Malvern; 1922, Eton. The Charterhouse pair of 1910, H. W. Leatham and H. A. Denison, were one of the finest ever seen in the event, while D. S. Milford of Rugby in 1923 and 1924 was a brilliant individual player.

The Tennis and Racquets Association in 1923 undertook the remodelling of the rules of the game as played in the British Isles. In America and Canada there are some slight differences, the chief being that, whereas in the English rules two services are allowed, in the United States and Canada a player who delivers a fault is put out at once. With a view to cheapening the game, various efforts have been made to produce composition balls and racquets with metal frames, but at present nothing has been found adequately to replace the old conditions. (E. B. N.)

RADEK, KARL (1885–), Russian politician, was born in Lvov (Austrian Poland) and educated at the universities of Cracow and Berne. In 1904 he became a member of the Social Democratic party of Poland and Lithuania. During the revolution of 1905 he spent a year in prison, and subsequently became a member of the editorial staff of social democratic newspapers in Poland, Leipzig and Bremen which supported the left wing of the German Social Democrats. During the World War, after some

months of illegal anti-militarist activity in Germany, he had to leave that country and established himself in Switzerland where he wrote for the Berne *Tageblatt*. He took part in the Zimmerwald and Kienthal internationalist conferences in Sept. 1915 and April 1916. After the Russian revolution of March 1917 he crossed Germany, together with Lenin, Zinoviev, Martov and others and remained in Stockholm as the representative of the central committee of the Bolshevik party, issuing a weekly bulletin on the Russian revolution in French and German. After the second revolution, in Nov. 1917, he took part in the Brest-Litovsk peace negotiations. When the German revolution broke out in 1918 he made his way illegally to Germany, where as a representative of the central committee of the Russian Communist party he took a very active part in reorganising the German Communist party, working in its central committee after the murders of Karl Liebkneckt and Rosa Luxemburg on Jan. 16 1919. He was imprisoned in Germany from Feb. to Dec. 1919. While still in prison in Berlin he was visited by Talaat Pasha and as a consequence relations between Russia and Turkey were re-established.

On his release from prison Radek returned to Russia, where he became one of the leading members of the praesidium of the Communist International. He returned illegally to Germany, however, and took part in the organisation of the joint congress of German Communists and Left Independents. As delegate of the Russian trades unions he attended the international conference of trades unions concerned with questions of the War. He was made a scapegoat for the failure of the German Communists to seize power in the autumn of 1923, and, on account of his support of the "Right" groups of the German Communists, he lost his authority in the Communist International, losing his place in its central committee and in the central committee of the Russian Communist party. He was a most prolific writer in the Russian Press on various questions of international politics. In 1925 he was appointed Rector of the Sun Yat Sen University for Chinese students in Moscow.

RADIATION: *see* ELECTRIC RADIATION.

RADIO: *see* BROADCASTING; WIRELESS.

RADIOACTIVITY (*see* 22.793d).—Among points of special interest that have arisen since 1910 may be mentioned the preparation of metallic radium by Mme. Curie and Debierne by electrolysis of a radium salt with a mercury cathode. Radium resembles metallic barium, melts at about 700° C, and is rapidly attacked when exposed to the air.

Radium.—The atomic weight of radium (*q.v.*) was found by Mme. Curie to be 226·45, using for the purpose about 0·4 gr. of pure radium chloride. A careful redetermination by Hönigschmid with about one gr. of radium gave a value 225·9, and is probably correct to 1 in 1,000. An international radium standard consisting of about 22 milligrammes of pure radium chloride has been prepared by Mme. Curie (*q.v.*), and is preserved in the Bureau International des Poids et Mesures at Sèvres, near Paris. Secondary radium standards have been issued to all governments who wished to purchase them. These have been calibrated by γ-ray methods both in Vienna and Paris, and are supposed to be correct within 1 in 200. The purchase and sale of radium have generally been conducted on certificates given in terms of this international standard.

The wide use of radium for therapeutic purposes, and its high cost—from £15 to £30 per milligramme element—have led to close search for uranium deposits. The amount of radium in an old mineral is always proportional to its content of uranium in the ratio of 3·3 parts of radium by weight to 10,000,000 parts of uranium. Consequently, an old mineral containing 1,000 kgm. of uranium should contain 330 milligrammes of pure radium. Initially several grammes of radium were separated from the uraninite deposits in Joachimsthal, Bohemia, and some of the material, which was the property of the Austrian Govt., was generously loaned to representative workers in radioactivity in England. A part of this radium is in the charge of the Radium Institute of Vienna, which is specially devoted to radioactive investigations.

The increasing demand for radium led to the working of low-grade ores, containing on an average only about 2% of uranium oxide, of which there are extensive deposits in Colorado and other parts of the United States. Until 1922 the greater part of the world supply of radium was produced in America, but in that year very rich deposits of uranium ore, containing about 20 times as much radium as the American ore, were found in the Belgian Congo, and the American production practically ceased. Large quantities of radium were employed by the Allies during the World War for night compasses, gun-sights, etc. The radium is mixed with phosphorescent zinc sulphide to form a paint which becomes continuously luminous but, owing to the destruction of the zinc sulphide by the rays, this luminosity gradually decays.

Radium Emanation.—The atomic weight of the radium emanation is now known to be 226–4 = 222, as was inferred earlier. This was confirmed by direct weighing with microbalance by Ramsay and Gray.

The radium emanation has proved of great service not only in radioactive researches but also in therapeutic work. The radium salt is dissolved in an acid solution and the emanation is pumped off with the large quantity of hydrogen and oxygen liberated by the action of the radiations on water. After sparking the mixture, the emanation can be purified by condensation with liquid air. A very intense source of β and γ radiation can be obtained by introducing the purified emanation into fine capillary tubes. Such emanation needles have been widely used for therapeutic purposes, while the use of very thin-walled tubes provides a powerful line source of α-rays. The β and γ activity of such tubes rises to a maximum about four hours after introduction of the emanation, and then decays with the period of the emanation, viz., 3·85 days. The quantity of emanation liberated from one gramme of radium is called a *curie* and from one milligramme a *millicurie*. The quantity of radium emanation in a tube can be accurately determined by comparison of its γ-ray activity with that of a radium standard, since the penetrating γ-rays, both from the radium and the emanation in equilibrium, arise mainly from the same product radium C.

As regards other radioactive substances, large quantities of mesothorium have been obtained as a by-product in the separation of thorium from monazite sands. This substance, which is half transformed in about 6·7 years, emits only β-rays, but gives rise to radiothorium and subsequent products which emit α-rays and penetrating β- and γ-rays. As a source of powerful β and γ radiation, this substance is very analogous to radium and can be obtained in about the same concentration. Since radium and mesothorium are isotopic elements, they are always separated together. Most commercial sources of thorium contain also uranium and radium, and consequently radium is always separated with the mesothorium and in relative amount depending upon the proportion of uranium to thorium in the mineral. Since mesothorium has a radioactive life short compared with radium, it commands a smaller price. The amount of mesothorium is standardised by comparison of its γ-ray effect with a radium standard.

Mme. Curie separated the polonium from several tons of pitchblende and obtained an exceedingly active preparation of a few milligrammes, but was unable to obtain it in a pure state, although several of its spectrum lines were detected. It was hoped by this experiment to decide whether polonium was transformed directly into lead, but this was found difficult to establish owing to the presence of impurities with the very small quantity of polonium.

The three types of radiation, known as the α-, β-, γ-rays, emitted by radioactive substances are analogous in many respects to the types of radiation observed when a discharge passes through a vacuum tube, but are of much more penetrating character. It may be noted here that for the electrons in a vacuum tube to attain the velocity of the swift β-rays from radium, a potential difference of at least 2,000,000 volts would have to be applied. The very penetrating γ-rays are identical in all respects with X-rays of very short wave-length. Intense γ-rays are only observed in substances which emit swift β particles, and apparently owe their origin to the rearrangement of the nucleus after the emission of the β particle. To produce X-rays as penetrating as the γ-rays, about 2,000,000 volts would have to be put on the discharge tube.

The α-rays, shown in 1903 by Rutherford to consist of a stream of positively charged atoms projected with high velocity, are now known to consist of charged atoms of helium which are projected with velocities of about 10,000 m. per second. While the majority of products break up with the expulsion either of an α particle or a swift β particle, in a few cases no detectable radiation was observed. Such products were at first called "rayless" products, but the sequence of chemical properties, discussed later, shows that a β particle must be liberated but at too low a speed to detect with certainty. Actinium is now the only example of such a product.

A number of new products have been discovered, particularly in the uranium and actinium series. The results are included in the table of radioactive elements which will be found on the following page.

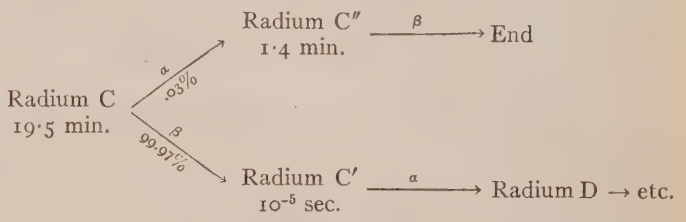
Table of Radioactive Elements

Element	Atomic Wt.	Atomic No.	T	Rays	Range cm. α-Rays (15° and 760 mm.)
Uranium-Radium Series					
Uranium I.	238·18	92	$4·5\times10^9$ yr.	α	2·50
Uranium X_1	234	90	23·8 days	β, γ	..
Uranium X_2	234	91	1·15 min.	β, γ	..
Uranium Z	234	91	6·7 hr.	β	..
Uranium II.	234	92	about 2×10^6 yr.	α	2·90
Uranium Y (3%)	230	90	24·6 hr.	β	..
Ionium	230	90	about 9×10^4 yr.	α	3·07
Radium	226	88	1,700 yr.	α	3·52
Radium Emanation	222	86	3·85 days	α	4·16
Radium A	218	84	3·05 min.	α	4·75
Radium B	214	82	26·8 min.	β, γ	..
Radium C	214	83	19·5 min.	α, β, γ	6·94
Radium D	210	82	16 yr.	β, γ	..
Radium E	210	83	4·85 days	β, γ	..
Radium F (Polonium)	210	84	136·5 days	α	3·83
Radium G (end-product uranium-lead)	206	82	..	..	..
Thorium Series.					
Thorium	232·1	90	$2·2\times10^{10}$ yr.	α	2·72
Mesothorium I.	228	88	6·7 yr.	β, γ	..
Mesothorium 2	228	89	6·2 hr.	β, γ	..
Radiothorium	228	90	1·90 yr.	α	3·87
Thorium X	224	88	3·64 days	α	4·30
Thorium Emanation	220	86	54 sec.	α	5·00
Thorium A	216	84	0·14 sec.	α	5·70
Thorium B	212	82	10·6 hr.	β, γ	..
Thorium C	212	83	60 min.	α	4·80 8·60
Thorium C″	208	81	3·2 min.	β, γ	..
Thorium D (end-product thorium-lead)	208	82	..	..	..
Actinium Series.					
Protoactinium	230	91	about 10^4 yr.	α	3·31
Actinium	226	89	20 yr.	β	..
Radioactinium.	226	90	19 days	α	4·6
Actinium X	222	88	11·2 days	α	4·26
Actinium Emanation	218	86	3·9 sec.	α	5·6
Actinium A	214	84	·002 sec.	α	6·3
Actinium B	210	82	36 min.	β, γ	..
Actinium C	210	83	2·16 min.	α	5·15
Actinium C″	206	81	4·76 min.	β, γ	..
Actinium D (end-product actinium-lead)	206	82	..	..	..

In the table T is the time-period of a product or the time required for the product to be half-transformed. It will be seen that the value of T, which is a measure of the relative stability of atoms, varies between $2·2\times10^{10}$ years (Thorium) and ·002 second (Actinium A). The atomic weights and atomic numbers of uranium, radium, uranium-lead, thorium, thorium-lead have been directly determined. The atomic weights and atomic numbers of the others are deduced on the assumption that the expulsion of an α particle (helium atom) of charge 2 and mass 4 lowers the atomic number of the succeeding element by two units and the atomic weight by four. The expulsion of a β particle raises the atomic number by one unit, but it is not supposed to influence the atomic weight to a detectable degree.

Branch Products.—In the great majority of cases each of the radioactive elements breaks up in a definite way, giving rise to one α or β particle and to one atom of the new product. Undoubted evidence, however, has been obtained that in a few cases the atoms break up in two or more distinct ways, giving rise to two or more products characterised by different radioactive properties. A branching of the uranium series was early demanded in order to account for the origin of actinium. While the latter is always found in uranium minerals in constant proportion with the uranium, Boltwood showed that the activity of the actinium with its whole series of α-ray products in a uranium mineral was much less than that given by a single α-ray product of the main radium series. The head of the uranium series is believed to be uranium Y, the branch product of the uranium series first observed by Antonoff. The branching is supposed to occur in the product uranium X_2, 3% going into the actinium branch and the other 97% into the main uranium series. The atomic weights of actinium given in the table are calculated on this basis. The more recently discovered product *protoactinium* is the hitherto missing link between uranium Y and actinium.

The most striking cases of branching occur in the "C" products of radium, thorium and actinium, each of which breaks up in two or more distinct ways. In the case of radium C, a new substance called radium C″ was obtained by recoil from a nickel plate coated with radium C. This product emitted only β-rays and had a period of 1·4 minutes. Fajans estimated that the amount of the product was only $\frac{1}{3,000}$ of that of radium C. To account for these results the following scheme of transformation has been proposed:—



where in the main branch a β particle is first expelled, giving rise to radium C′, which emits an α particle. The reverse process is assumed to take place in the other branch. Radium C′, which emits a swift α particle, has an exceedingly short period of transformation, which has been measured approximately by Jacobsen, and found to be about 10^{-5} seconds. It is uncertain whether the radium C″ branch ends after the expulsion of a β particle. The resulting product is an isotope of lead like radium D in the main branch.

In the case of thorium C, two sets of α particles are observed, one-third of the total number having a range of 4·8 cm. and the remainder 8·6 cm. Here, as in radium C, the main series goes by a β-ray change to the C′ product. In actinium C, which also shows a dual transformation, Marsden found that 99·84% of the C atom change with the emission of an α particle of 5·15 cm. range to the C″ product, the remaining 0·16% going to C′, which gives α particles of 6·4 cm. range. Rutherford and Wood found that the thorium C group emitted another set of α particles of the great range of 11·3 cm., but of very small amount, about $\frac{1}{10,000}$ of the total number. This result suggests that thorium C is even more complex than has been supposed. Evidence has been obtained of similar long range α particles from radium C and actinium C. It is quite possible that a close examination of radioactive substances may reveal other examples of such complex methods of transformation, for, after the violent explosion that occurs during the breaking-up of an atom, more than one state of temporary equilibrium may be possible for the residual atom.

Relation between Range of α-Rays and Period of Transformation.—We have seen that each α-ray product emits α particles of characteristic velocity which have a definite range in air. It was early observed that there appeared to be a connection between the period of transformation of a product and the velocity of the α particles emitted. The shorter the period of transformation, the swifter is the velocity of expulsion of the α particle. This relation was brought out clearly by the measurements of Geiger and Nuttall, where it was shown that if the logarithm of the range was plotted against the logarithm of λ, the constant of transformation, all the points lay nearly on a straight line.

A similar result has been observed for the thorium and actinium products. This relation, when carefully tested by Geiger appears to be only a rough approximation. It is still of great interest as indicating a possible relation between the stability

of the radioactive nucleus and the velocity of the expelled helium atom. This relation has proved very useful in forming estimates of the period of transformation of ionium and other substances before the results of more direct determinations were available. From this relation also the change which gives rise to the swift α particle of radium C was believed to be exceedingly rapid. This has been confirmed by the detection of radium C′ and measurement of its period. A similar conclusion is drawn for the product emitting the very swift α particles from thorium C.

Chemistry of the Radioelements (*see* CHEMISTRY).—Apart from uranium and thorium, and a few special cases like radium and polonium, the radioactive products of short life exist in too small quantity to examine by the ordinary chemical methods; but by the use of the radioactive method of analysis, it was possible to form some idea of their chemical behaviour. Certain very interesting points soon came to light. Soddy found that the two elements, radium and mesothorium, although quite dissimilar in radioactive properties, were chemically so identical that it was impossible by chemical methods to separate one from the other. Other cases of this kind had long been suspected, viz., thorium and radiothorium, thorium and ionium and radium D and lead. He named such inseparable elements isotopes, since they appeared to occupy the same place in the periodic classification of the elements. (*See* ISOTOPES.)

Following the chemical study of the radioelements by Soddy, Fleck and von Hevesy, an important generalisation connecting the chemical properties of the radioelements was announced independently in 1913 by Russell, Fajans and Soddy. After the expulsion of an α particle from a radioactive substance, the resulting product shifts two places in the direction of diminishing mass when the elements are arranged in families according to the Mendeleeff classification.

The expulsion of a β particle causes a shift of one place in the opposite direction. For example, by the loss of an α particle from ionium of group IV., the resulting product, radium, belongs to group II., while the loss of another particle gives rise to the emanation which occupies the group O, and so on. By this method the chemical properties of all the known radioelements can be predicted from a knowledge of the radiations emitted from the products. This generalisation can be viewed from another important standpoint. From the work of Moseley, the properties of an element are defined by the atomic number which is believed to represent the resultant positive charge on the nucleus. The loss of an α particle of mass 4, carrying two positive charges, lowers the atomic number by two units, while the emission of a β particle raises it by one unit. On looking through the table of the radioelements on preceding page it will be seen that many of them can be grouped under the same atomic number. These represent the radioactive isotopes of which some of the more important are given below, preceded by the atomic numbers:—

81. Thallium (204), thorium C″ (208), actinium C″ (206).
82. Lead (207), uranium-lead (206), thorium-lead (208), radium D (210), thorium B (212), radium B (214), actinium B (210).
83. Bismuth (208), radium E (210).
84. Polonium (210), thorium A (216), radium A (218), actinium A (214).
86. Radium emanation (222), thorium emanation (220), actinium emanation (218).
88. Radium (226), thorium X (224), mesothorium I (228), actinium X (222).
90. Thorium (232), radiothorium (228), ionium (230), uranium X_1 (234), uranium Y (230), radioactinium (226).

It will be seen that many of the radioactive elements are isotopic with known chemical elements. These radioactive isotopes differ not only in atomic weight but also in radioactive properties. The isotopes of lead are of special interest as they include the end-products of the uranium, thorium and actinium series—a question that will be discussed more fully later. It is of interest to note that polonium, actinium and protoactinium are new types of chemical elements which have no counterpart among the ordinary inactive elements.

Transformation of Uranium.—In 1900 the late Sir W. Crookes found that the β-ray activity of ordinary uranium could be removed by a single chemical operation and concentrated in an active residue. This is due to the separation of the product uranium X, of period 24 days, which emits β-and γ-rays. A complete analysis of the transformations of uranium has been a matter of much difficulty. Boltwood showed that the α-ray activity of uranium was about twice as great as that of a corresponding α-ray product in the uranium-radium series, indicating that uranium contained two successive α-ray products. This was confirmed by Geiger, who showed that the α-rays from uranium consisted of two groups with ranges 2·5 and 2·9 cm. respectively. These two α-ray substances, called uranium I. and uranium II. are isotopic, atomic weights 238 and 234 respectively. The latter, whose period is estimated at about 2,000,000 years, exists in relatively very small quantity compared with uranium I. Following the generalisation connecting the radiations and chemical properties of the series of radioelements, Fajans predicted the presence of a new product with properties analogous to tantalum, and promptly succeeded in isolating it experimentally. The new product uranium X_2 sometimes called brevium, has a period of 1·15 minutes and emits swift β-rays. The series of changes is thus:—

$$\text{Ur I.} \rightarrow \text{Ur } X_1 \rightarrow \text{Ur } X_2 \rightarrow \text{Ur II} \rightarrow \text{Ionium.}$$

We have seen that Antonoff discovered another β-ray substance called uranium Y, separated with uranium X_1, which has a period of 24·6 hours. This exists in too small quantity to be in the main line of succession, but is to be regarded as a branch product of uranium X_1, and is believed to be the first element of the subsidiary actinium series.

Rutherford and Geiger found the number of α particles emitted per gramme of uranium per second to be $2{\cdot}37 \times 10^4$. From this the period of uranium is calculated to be about 6,000,000,000 years.

Thorium.—The first product observed in thorium was the emanation of period 54 sec., and this gives rise to the active deposit, which has been shown to consist of at least four successive products called thorium A, B, C, C″. The emanation, after the emission of an α particle, changes into a product of very short life emitting α-rays. Its period was found by Geiger and Moseley to be about $\frac{1}{10}$ second. The succeeding product, thorium B, emits only weak β-and γ-rays with a period of 10·6 hours, changing into thorium C of period one hour. We have seen that thorium C breaks up in a complex way, emitting three distinct groups of particles. Thorium C″ is readily separated from C by the method of recoil. It emits penetrating β-and γ-rays with a half-period of three minutes. The active deposit as a whole decays ultimately with the period of thorium B, viz., 10·6 hours.

A special interest attaches to the product thorium X, first separated by Rutherford and Soddy, since experiments with it laid the foundation of the general theory of radioactive transformations.

A close analysis of thorium has led to the discovery by Hahn of a number of other important products. When the thorium X is separated from a thorium mineral or old thorium preparation, there appears with it another product called mesothorium I, of period 6·7 years, which is transformed with the emission of weak β-rays into mesothorium 2, of period six hours, which emits swift β particles and penetrating γ-rays. This changes into an α-ray product, radiothorium, of period two years, which is transformed into thorium X.

Radiothorium is an isotope of thorium, while mesothorium I is an isotope of radium. The radiothorium can readily be separated from a solution of mesothorium and obtained in a concentrated form. Mesothorium when first separated would show a very weak activity, but in consequence of the growth of its subsequent product radiothorium, its activity would increase for several years. After reaching a maximum it would ultimately decay with the period of mesothorium, viz., 6·7 years.

Actinium.—Actinium of period about 20 years is believed to emit weak β-rays changing into radioactinium, an α-ray product of period 19 days, first separated by Hahn. This changes into actinium X, an α-ray product of period 11 days, discovered by Godlewski. Then follows the actinium emanation of period 3·9

sec., which gives rise to four further products named actinium A, B, C, C″. Actinium A has the shortest life of any product whose rate of transformation has been directly determined. Its period, as determined by Geiger and Moseley and Fajans, is ·002 second. After emitting an α particle, A changes into B, a product of period 36 minutes emitting weak β- and γ-rays, analogous to thorium B. Actinium C of period 2·16 minutes undergoes a complex transformation, giving rise to two distinct groups of α particles. The main branch gives rise to actinium C″ of period 4·8 minutes, which is readily isolated by the recoil method. Actinium C″, which emits β- and γ-rays, is analogous in all respects to thorium C″.

In the above discussion on branch products it has been shown that the parent of actinium, called *protoactinium*, has been recently isolated by Hahn and Soddy. This substance emits α-rays and has an estimated period of 10,000 years. We have seen that the actinium series is believed to have its origin in a dual transformation of uranium X. The first branch product, representing about 3% of the total, is believed to be uranium Y, a β-ray product of period one day. This is directly transformed into protoactinium.

While very active preparations of actinium have been made, it has not been found possible to separate it entirely from the rare earths with which it is mixed. Protoactinium exists in much larger amounts and should be ultimately obtained in a pure state.

End-Products of the Transformations (*re-stated*).—After the radioactive transformations have come to an end, each of the elements uranium, thorium and actinium should give rise to an end or final product, which may be a known element or an unknown element of very slow period of transformation. Since the expulsion of an α particle lowers the mass of the atom by four units, and there are eight α-ray products, the atomic weight of the end atom should be $238-8\times4=206$. The atomic weight of radium by this rule should be $238-3\times4=226$, a result in good accord with experiment. The atomic weight of the end-product of uranium is close to that of lead, viz., 207, and Boltwood early suggested that lead was the end-product of radium. Since in old minerals the transformations have been in progress for intervals measured by millions of years, the end-product should collect and be an invariable companion of the radioelement. Boltwood showed that lead is always present in old radioactive minerals, and in amount to be expected from their uranium content and geologic age.

This problem has been definitely attacked in the light of the chemical generalisation already given. It was clear from this that the end-products of uranium, thorium and actinium should all be isotopes of lead but with atomic weights 206, 208 and 206 respectively. In other words, uranium-lead if uncontaminated with ordinary lead should show a smaller atomic weight than ordinary lead (207), while thorium-lead should give a higher value. By the work of Richards, Soddy and Hönigschmid, these conclusions have been definitely confirmed. The lowest value for uranium-lead is 206, and the highest for thorium-lead 207·7.

Since any admixture with ordinary lead tends to give a value nearer 207, these results may be considered as a definite proof of the nature and atomic weight of the end-products. In minerals containing both uranium and thorium the atomic weight of the mixture of the isotopes will depend on the relative amounts of these two elements and their relative rates of transformation. In unaltered minerals the determination of the amount of lead coupled with its average atomic weight allows us to determine the amount of uranium-lead even if some ordinary lead be present. In this way it should be possible to make a reliable estimate of the age of selected minerals and thus indirectly the age of the geologic strata (*see* GEOLOGY). The amount of helium in the mineral gives a minimum estimate of its age, for, except in the most compact minerals, some of the helium must undoubtedly escape.

Nature and Properties of the α-Rays (*re-stated*).—Although the α-rays from active substances are of small penetrating power compared with the β- or γ-rays, they are responsible for most of the energy evolved by radioactive substances and contribute most of the ionisation. Rutherford showed in 1903 that the α-rays were deflected in a powerful magnetic and electric field and consisted of positively charged particles projected with high velocity. From the first it seemed probable that the α particle was an atom of helium, and this was subsequently confirmed in a number of ways. The value of e/m—the ratio of the charge on the particle to its mass—and the velocity can be determined from observations on the deflection of the pencil of rays by a magnetic field and electric fields. In this way Rutherford and Robinson showed that the α particle, whether from the radium emanation, radium A or C, gave a value of $e/m=4820$ e.m. units, while the electrochemical value of $e/m=4826$, assuming that the mass of the helium atom is 4·00 and that it carries two unit positive charges. The magnitude of the charge carried by each particle was measured by Regener and Rutherford and Geiger, and found to be twice that carried by the electron. The velocity of the α particles expelled from radium C (of range 7·06 cm.) was found to be $1\cdot92\times10^9$ cm. per sec., or about $\frac{1}{15}$ the velocity of light. From this result the velocity of expulsion of all α particles can be calculated from the relation found by Geiger, that $V^3=KR$ where V is the velocity of the particle and R its range in air. The evidence indicates that the α particles from active products are in all cases atoms of helium. The α particles from a given product are all emitted with constant velocity, which is characteristic for that product. We have already mentioned that the velocity of expulsion appears to be connected with the period of transformation of the element. The laws of absorption of the α particle were first worked out by Bragg and Kleeman. On account of its great energy of motion, the α particle travels in nearly a straight line through the gas, producing intense ionisation along its track. The effects produced by the α particle, whether measured by ionisation, phosphorescence or photographic action, vanish suddenly after the α particle has traversed a definite amount of matter. This definiteness of the end of the range of the α particle of given velocity is remarkable. The range of the α particle is usually expressed in terms of cms. of air traversed at 15° C. and 760 mm. pressure.

On account of its great energy of motion the effect due to a single α particle can be detected in a variety of ways. Sir William Crookes first noted that the α-rays produce scintillations when they fall on a screen of phosphorescent zinc sulphide. It is now known that each of these scintillations is due to the impact of a single α particle. The number of scintillations can be counted with the aid of a suitable microscope, and this method has proved of great utility in many investigations. Scintillations due to α-rays are observed in certain diamonds, but they are usually not so bright as in zinc sulphide. Kinoshita has shown that a single α particle produces a detectable effect on a photographic plate. When the α-rays fall on a plate nearly horizontally the track of the α particle is clearly visible under a high-power microscope. By the expansion method developed by C. T. R. Wilson, the track of the α particle through the gas is made visible by the condensation of the water on each of the ions produced. In a similar way the track of a β particle can be easily shown. The photographs of these trails bring out in a striking and concrete way not only the individual existence of α and β particles, but the main effects produced in their passage through matter.

Properties of β- and γ-Rays (*re-stated*).—We have seen that the β particles, which are emitted by a number of radioactive products, consist of swift negative electrons spontaneously liberated during the transformation of active matter. The velocity of expulsion and the penetrating power of β-rays vary widely for different products. For example, the rays from radium B are much more easily absorbed by matter than the swift β-rays from radium C. Moseley showed that in the case of these two products each disintegrating atom gave rise usually to one β particle.

There is undoubtedly a close connection between β- and γ-rays, and swift β-rays are usually accompanied by penetrating γ-rays. For example, radium C, which emits very swift β-rays, some of which reach a velocity more than 0·98 of the velocity of light, gives rise to the most penetrating γ-rays observed in the uranium-radium series. There is one very notable exception, viz.,

radium E, which emits swift β particles but weak γ-rays. Gray has shown that β-rays in passing through matter give rise to γ-rays, and that these in some cases correspond to the characteristic X radiations observed by Barkla. The absorption of the γ-rays has been determined by the electrical method. Radium B has been found to emit several groups of γ-rays which differ widely in penetrating power. The greater part of the rays from radium C consist of penetrating γ-rays which are exponentially absorbed by matter. The ionisation in an electroscope falls off according to the equation $I/I_0 = e^{-\mu d}$, where d is the thickness of matter traversed and μ the coefficient of absorption. When lead is used as an absorbing material the value of $\mu = 0{\cdot}5$ for the most penetrating γ-rays from radium C. The absorption coefficient for different kinds of matter is roughly proportional to the density, indicating that the absorption depends only on the mass of matter traversed.

The detailed study of the β-ray spectra discussed below has led to the conclusion that the γ-rays are characteristic radiations emitted from the radioactive nucleus in its rearrangement after the ejection of the β particle. These radiations from the nucleus in their passage through the atom excite the characteristic radiations of the external electronic system. Thus the total γ radiation of a radioactive atom consists not only of the γ-rays from the nucleus, which are generally far more penetrating than any type of radiation observed in an X-ray tube, but also of the characteristic X-rays of the atom.

Rutherford and Wooster have re-examined the spectrum of the γ-rays from radium B by reflection from rock-salt and calcite crystals. They found that the lines of the characteristic "L" spectrum corresponded to an atom of number 83, while the atomic number of radium B is 82. The γ radiation must therefore be emitted after the ejection of the β particle of disintegration and the change of charge of the nucleus. This conclusion has been confirmed by independent methods by Black, Ellis and Wooster, and Lise Meitner. The wave-length of the most penetrating γ-rays is much too short to resolve or detect by the crystal method. In order to excite such rays in an X-ray tube potential differences of the order of 2,000,000 volts will be necessary.

When the β-rays from a product like radium B or radium C are bent by a magnetic field and fall on a photographic plate, a kind of magnetic spectrum is obtained. Superimposed on the continuous spectrum due to particles of all velocities (between certain limits) certain sharp lines are observed, each of which represents a definite group of β-rays which are emitted at the same speed. The velocity corresponding to each line in the spectrum has been determined for a number of β-ray products by Hahn and Lise Meitner. The magnetic spectrum of radium B and radium C was examined in detail by Rutherford and Robinson, and more than 50 lines were observed, representing β particles projected over a wide range of velocity. The appearance of these lines in the spectrum appears to be connected with the emission of γ-rays and is believed to be due to the conversion of the energy of the γ-ray of definite frequency into the energy of an electron according to the quantum relation. When a thin layer of absorbing material is placed over the source, the primary β-rays diminish in velocity and the lines become broad and diffuse. At the same time, however, new groups of β-rays are formed by the conversion of γ-rays into β-rays in passing through the absorbing material, and these give well-marked bands on the photographic plate, occupying very nearly the same position as those due to the primary β-rays before absorption. The study of these primary and excited β-ray spectra by Ellis, Meitner and others has given important results on the conversion of γ-rays into β-rays, and has furnished accurate measurements of the wave-lengths of the γ-rays emitted by several products.

Production of Helium (*q.v.*).—Since the particle is an atom of helium, all radioactive matter which emits α particles must produce helium. This has been found to be the case for every α-ray product that has been examined. The rate of production of helium by radium in equilibrium has been measured with accuracy by Dewar, Boltwood and Rutherford. In terms of the international radium standard, the rate of production of helium by one gramme of radium in equilibrium with its three α-ray products has been found to be 164 cu. mm. per year. This value is in excellent accord with that calculated from the rate of emission of α particles, viz., 163 cu. millimetres. The rate of production of helium by the radium emanation, ionium and polonium has been found by Boltwood to be in fair agreement with calculation. Soddy has observed the production of helium by purified uranium, while Strutt showed that the rate of production of helium in uranium and thorium minerals was in perfect accord with calculation.

Strutt has made a systematic examination of the amount of helium present in many minerals and rocks which contain minute quantities of radium, and has utilised the results to estimate the age of the geological deposits. On account of the tendency of the helium to escape from minerals in the course of geologic ages, this method gives only a minimum estimate of the age of the mineral, except in the case of very dense and compact specimens. The measurement of the lead content should ultimately prove a more reliable method of estimating the age.

Heat Emission by Radioactive Matter.—As was stated earlier, there is no doubt that the evolution of heat by radium and other radioactive matter is mainly a secondary phenomenon, resulting largely from the energy of the absorbed radiation. Since the particles have a large kinetic energy and are easily absorbed by matter, all of these particles are stopped by the radium itself or by the envelope surrounding it, and their energy of motion is transformed into heat. The evolution of heat from any type of radioactive matter is thus proportional to the energy of the expelled α particles, together with the energy of the β- and γ-rays absorbed in the envelope. The energy supplied by the recoil of the radioactive atom after the expulsion of an α particle is about 2% of the energy of the α particle.

These conclusions have been confirmed by the measurements of Rutherford and Robinson, who found that each of the α-ray products gave a heating effect proportional to the energy of the α particle and absorbed β-and γ-rays. The emanation and its products when removed from radium were responsible for three-quarters of the heating effect of radium in equilibrium. The heating effect of the radium emanation, radium A and radium C, decayed at the same rate as their activity. From their measurements they found that the total heating effect of radium in equilibrium surrounded by sufficient material to absorb the α-rays was 134·7 grammes-calories per hour per gramme. Of this, 123·6 grammes-calories were due to the α particles, 4·7 to the β-rays and 6·4 to the γ-rays. The energy of the β-and γ-rays comes from radium B and radium C, but on account of their great penetrating power it is difficult to measure the γ-energy with accuracy. The results, however, show that the energy of the γ-rays is even greater than that of the β-rays, and the two together are equal to about 28% of the energy of the α particles from radium C.

Measurements have been made of the heating effect of radium, uranium and thorium, and of uranium and thorium minerals. In each case the evolution of heat is of about the magnitude to be expected from the energy of the radiations.

Radioactivity of Ordinary Matter.—Apart from the wellknown radioactive elements of high atomic weight, only two other elements have been shown to exhibit radioactivity to a detectable degree, viz., potassium and rubidium. Campbell showed that these elements emit only β-rays and in amount small compared with uranium. This property appears to be atomic, but no evidence has been obtained of any subsequent changes. If the β particle comes from the nucleus of the atom, potassium should be transformed into an isotope of calcium, and rubidium into an isotope of strontium.

Radium and thorium have been found to be distributed, but in very minute amount, in the surface rocks and soil of the earth. The emanation from the soil diffuses into the atmosphere and causes a small ionisation which can be readily measured. A penetrating γ radiation, no doubt due to the presence of radium and thorium in the earth's crust, has been observed near the earth's surface, but becomes very small over a lake or the sea.

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(E. RU.)

RADIO RECEIVER (*see* also BROADCASTING; WIRELESS TELEGRAPHY AND TELEPHONY).—The ideal radio broadcast receiver would be one so sensitive that any desired station could be picked up and its performance reproduced with perfect acoustic fidelity, in any desired sound volume, to the exclusion of all other signals and disturbances, with substantially no effort in operation or maintenance on the part of the owner. Such a perfect machine can only be approximated in some respects by existing receivers. From the standpoint of the listener five qualities of commercial broadcast receivers may be distinguished and used in rating particular types of sets as to merit, namely: (*a*) sensitivity; (*b*) selectivity; (*c*) quality of reproduction; (*d*) magnitude of undistorted power output; (*e*) convenience of operation and maintenance.

(*a*) *Sensitivity.*—A receiver must be several hundred times more sensitive, *i.e.*, capable of extra radio frequency amplification in that ratio, if it is fed from a small loop rather than an outdoor antenna. This follows from the fact that the loop picks up a relatively minute amount of energy from the passing wave. The loop is more convenient and adds somewhat to the selectivity of the set, as for maximum signal strength, it must point in the direction of the station to be received, and at right angles to this orientation the signal is a minimum.

It is not unusual for radio receivers to have a voltage amplification in the thousands, corresponding to an energy amplification of the order of tens or hundreds of millions. At present there is no standard rating of receivers according to sensitivity or amplifying power. Roughly, the amplifying power depends on the number of vacuum valves, not necessarily in the geometrical ratio which one might expect, however, for one set may utilise its stages of amplification more effectively than the other, with the final result depending on an intricate concatenation of design factors. The radio salesman's rating is even more indefinite, as he refers to a receiver as having a normal range of so many hundred or thousand miles, with reference to a transmitting station of given power. In practice, inordinate sensitivity is useless, inasmuch as nothing is to be gained by amplifying a signal below the " noise level " at the location of the receiver.

(*b*) *Selectivity.*—Like amplifying power, selectivity with respect to frequency may be numerically expressed. The waves of transmitting stations are measured in metres of wave-length, corresponding in a fixed relation to oscillating frequency in kilocycles per second. One station may transmit at a mean wave-length of 400 metres, corresponding to a frequency of 750 kc. per sec., while another is set at a wave-length of 450 metres (666 kilocycles). In order to respond to either of these transmitters the receiver is tuned to the appropriate frequency. The ability to hear the performance of one without picking up an appreciable signal from the other depends on the width of the band of frequencies, likewise expressed in kilocycles, which the receiver will admit at any given setting. Dr. Alfred N. Goldsmith has proposed the following scale for expression of receiver selectivity:—

(1) Poor selectivity: equal signals become inaudible 80 kc. off tune.

(2) Good selectivity: equal signals become inaudible 30 kc. off tune.

(3) Very good selectivity: equal signals become inaudible 10 kc. off tune.

(4) Excellent selectivity: equal signals become inaudible 5 kc. off tune.

Condition (4) oversteps the limit of desirable selectivity, if the factor of quality of reproduction is to be kept in sight. The wave radiated by the broadcasting station is not confined to a single frequency, but has itself a certain width, normally about 10 kc., which cannot be clipped by the receiver without losing some of the essential component vibrations of speech or music. The receiver must accordingly admit a band 10 kc. in breadth, corresponding to zero audibility 5 kc. off tune, if serious distortion is to be avoided, and where interference conditions permit a 20 kc. receiver admittance is to be preferred. In other words, close juxtaposition of frequency bands of broadcasting stations tends to impair quality of reception by (1) forcing receiver designers in the direction of excessive sharpness of tuning; and (2) interference between stations in spite of (1).

(*c*) *Quality of Reproduction.*—The human ear responds, by no means with equal facility, to air waves between certain limits of frequency, ranging from a few oscillations per sec. to an upper limit as high as 20,000 vibrations per sec. in some individuals. Actually this is a greater range than required, and an organ responding to from 10 to 10,000 cycles will take in all the fundamental tones and essential overtones of speech and music. This is about the width of the acoustic spectrum which the best broadcasting stations and the best receiving sets try to reproduce. To a greater or lesser extent, however, they tend to lose the end frequencies—those of very low and very high pitch. When the low notes are dropped out, the result is " tinny "—high-pitched, shrill, mechanical, lacking in body. If the high notes are discriminated against, the output of the set is " drummy "—lacking sharpness, intelligibility, and characteristic timbre of voice and orchestral instruments. In the intermediate band which is transmitted there may be over- or under-emphasised frequencies, which stand out unnaturally or are lacking in the final result. All these lapses may occur in either the amplifying system or the electroacoustic converter (telephone receiver or loud speaker) of the receiving system, as well as in the corresponding portions of the transmitting equipment. A properly designed system is " flat," *i.e.*, indiscriminatory, over a sufficiently wide auditory band. At the present time, a receiver and reproducer covering a band of from 60 to 6,000 vibrations per sec. is considered satisfactory, and does indeed afford a reproduction close enough to the original to satisfy critical taste.

(*d*) *Magnitude of Undistorted Power Output.*—The output of a radio receiver, in terms of a fraction of a watt of sound energy, is a finite quantity and overloading reveals itself by distortion of the acoustic output, a distortion distinct from that caused by unequal amplification of different audio frequencies, as discussed under " Quality of Reproduction," but just as important if pure reproduction is required. Overload distortion causes a characteristic splitting or cracking of strong notes and emphasised syllables, sometimes to the point of unrecognisability. Harmonics or partial tones, not present in the original, are generated in the receiver. The accompaniment in music, and extraneous noises such as microphone hiss at the transmitter, atmospheric disturbances, etc., are brought up out of proportion, since the thermionic machinery of the receiver is " saturated " for the passages which were louder in the original performance.

The fact that must be kept in mind is that the vacuum valves used in receiving sets, particularly the last or output tube, have a definite and limited capacity for undistorted reproduction. A small valve, drawing moderate energy from the receiver power supply, can only deliver a few hundredths of a watt to the loud speaker—enough to fill an ordinary room comfortably. If greater volume is desired, larger tubes, with adequate power supply, must be employed. Some of the amplifier-loud speaker combinations have tubes as large, and consume as much power, as small broadcasting stations. By this means an undistorted reproduction as loud as the original is rendered available.

(*e*) *Convenience of Operation and Maintenance.*—In the matter of convenience of operation the present trend is toward reduction of the number of controls. Some early models of multi-tube receivers carried from six to 10 controls, but the problem of tuning them proved too much for the average unskilled listener. The average number of tuning controls at present is probably three, with some auxiliary handles which do not require frequent adjustment. For local station selection, however, " uni-control " accomplished by turning a single knob or drum, has been developed. For reception of distant stations finer adjustments, involving auxiliary or " vernier " controls, are generally required. A " volume control " for setting the loudness of the received signal at the desired level is necessary in addition to the tuning selectors. The best modern receivers show an increasing intricacy of internal equipment, with a surprising development of simplicity of control in inverse ratio.

The principal maintenance problem in the radio receiver is in connection with the power supply, and this disappears where power for the receiver is derived from the electric-light mains. The crystal, in the case of crystal receivers, and tubes, in tube receivers, require occasional renewal. For the rest, continuity of operation depends largely on the reliability of the manufacturer and the effectiveness of his testing and inspection arrangements. In the mechanism of the receiver proper there is nothing to wear out.

Crystal Sets

Types of Receivers.—The simplest of broadcast receivers is the crystal type, which consists of a single tuned circuit including the antenna and ground, with the crystal, bridged across the tuning inductance or a portion thereof, delivering audio frequency energy to the telephones.

Except in a few instances where the listener is located a fraction of a mile from an extremely powerful broadcasting station, a crystal set is incapable of giving a loud speaker signal. In these isolated cases a long antenna in combination with a crystal of large surface and current-carrying capacity, such as carborundum, may be used to operate a loud speaker. Usually the crystal set feeds a pair of telephones at low or moderate volume. The possibility of distortion in such a simple device is necessarily far less than in valve receivers.

Various crystals are used in radio reception. The most common is galena (lead sulphide), with a fine wire, generally called a " cat-whisker," resting lightly on one surface. This combination is sensitive and fairly stable, but a jar is apt to interrupt reception, and the frequent readjustment necessary is one of the outstanding defects of the crystal receiver. Some pieces of the ore, however, abound in sensitive spots and require relatively little attention on the part of the listener.

" Fixed " crystals, adjusted at the factory, have been developed, and in some instances hold a fairly good adjustment for months. The process consists in sealing the wire and crystal together, and sometimes in the use of a multiplicity of contacts. The sensitivity is usually less than that of a good crystal used with an adjustable contact.

No matter how carefully the tuning circuits are designed, the resistance of a crystal, being low compared with the input impedance of a tube, prevents sharpness of tuning. Hence the crystal receiver is scarcely of use in congested radio neighbourhoods. It fills the need for a cheap, easily handled piece of equipment within 25 m. of a station, and where the operator is content to listen on head phones. In the British Islands the crystal still holds a prominent position, in that distances from stations are less and the demand for the more realistic reproduction of large tube receivers appears to be more moderate than in the United States, where the crystal outfit has fallen into a position of commercial unimportance.

Tube Receivers

(1) *Non-Regenerative.*—The non-regenerative single tube receiver is more selective but a rarity. It is only slightly more sensitive than a good crystal. In many instances a non-regenerative rectifying tube is used in multi-tube receivers.

(2) *Regenerative.*—The principle of regeneration in tube circuits is described under Wireless Telegraphy and Telephony (*q.v.*). In receiving circuits regeneration affords an inexpensive form of radio frequency amplification. A single tube, regenerating, serves both as a rectifier and very effective radio frequency amplifier. At a wave-length of 400 metres, which is a common value in the broadcast band of many countries, a single tube with maximum regeneration, short of full oscillation, gives about as much signal as two radio frequency tubes and a straight rectifier, coupled through broadly tuned transformers with regeneration substantially suppressed.

A common form of receiver is one in which the antenna tuning circuits are followed by the regenerative tube and one or two stages of audio amplification. This suffices for local (10-20 m. from a 0·5 kw. station) reception on loud speaker, and reception of distant (up to 1,500 m.) stations on telephones, or faintly on the loud speaker, when two audio stages are employed, under average conditions. If regeneration is carried far enough the radio frequency amplification secured is very sizable, but there is a tendency to impair quality of tone by cutting off the side-bands. The result is a characteristic muffled sound. By somewhat detuning the circuit just before the detector, it is possible to lose grave tones, on the other hand, and to " equalise " the signal to a degree (*i.e.*, to correct for loss of high frequencies). A similar effect may be present in some super-heterodyne receivers, as described below.

One of the salient disadvantages of the simple regenerative receiver lies in its propensity to oscillate and radiate waves which cause howls in nearby receivers. This may be obviated by means of a " blocking " or one-way tube ahead of the detector. Another drawback is that sensitivity is secured more or less at the expense of quality, and that for high sensitivity careful adjustment is necessary to ensure that it remains tuned to the desired frequency.

(3) *Radio Frequency Cascade-Amplification.*—The difficulty of controlling regeneration was at first one of the principal obstacles to the construction of receiving sets with several stages of radio frequency amplification. Regeneration occurs through the coupling or interaction of the grid and plate (input and output) circuits of a tube. Even if these circuits are not deliberately coupled, the natural internal coupling between the closely adjacent grid and plate of each tube, when several radio frequency stages are used, is enough to set the receiver into oscillation, with the usual resultant squeals, distortion, etc., and methods were developed whereby these internal capacitive couplings could be balanced out or " neutralised." In the usual form the receiver designed on this principle has two steps of radio frequency, a rectifier tube and two stages of audio frequency. However, by careful shielding (enclosure in metal boxes) of individual stages still further to reduce stray couplings, it is possible to employ three or even four radio frequency stages.

Balanced receivers—also called " neutrodynes "—are nearly always operated on open antennae, although in one or two cases they have been built for sufficient amplification for use on a loop. The number of handles is generally three, for the antenna and two stages of radio frequency. One type of neutralised receiver having six tubes, with three stages before the detector, requires only two knobs, one for the antenna and the other for the three radio frequency stages. Another type of balanced receiver has been built, using five dry-cell tubes, including two stages of radio frequency without regeneration, controlled regeneration in the detector and two stages of audio. Another type of radio frequency receiver controls oscillation by biasing the grids of the radio frequency tubes positively, thus introducing losses which tend to brake the regenerative action and to suppress oscillation. The usual number of tubes is five; an outdoor antenna is desirable, and, unless carefully handled, the receiver may fall into oscillation and radiate strongly.

(4) *Intermediate Frequency Amplification: The Super-Heterodyne.*—In the super-heterodyne receiver the incoming wave is mixed with that of a local oscillator, producing, after rectification, a lower frequency which is the difference of the two component frequencies, and which is more readily amplified than the oscillations received directly from the station. This " intermediate frequency " is subjected to one to three stages of amplification, rectified a second time, producing telephone currents, which are then amplified at tone frequency in the usual manner.

Besides the facility of tuned radio frequency amplification at the intermediate level, which is commonly 50,000 cycles per sec., the super-heterodyne method has a peculiar advantage in development of selectivity. When two waves of different frequency enter this type of receiver, the percentage difference in frequency, and hence the separability, are much greater after heterodyning than before. For example, let the local oscillator have a frequency of 500,000 cycles per second. Two waves are admitted to the set, of 530,000 and 550,000 cycles respectively. The percentage difference in frequency is less than 4%. After

FIG. 1. A portable 6-tube super-heterodyne; loop antenna, batteries, and loud speaker, all self-contained. Photograph shows the outfit open, ready for operation, with addition of a battery box permitting use of larger cells for other than portable service. Usual American wave-length range. Dry cell tubes. Dual control for tuning. FIG. 2. Cone type loud speaker. FIG. 3. 8-tube super-heterodyne of the desk type, completely self-contained with exception of loud speaker. (Legs and battery chamber omitted from this picture.) Single control for tuning local stations; dual control for distance reception. Loop antenna on top; batteries in cabinet. Dry cell tubes, with power valve output. Wave-length range 200–550 metres. FIG. 4. (Internal view of Fig. 8.) Shows shielding of radio stages and gang condenser for parallel tuning of circuits. Two tuning controls; usual American wave-length range. Indoor or outdoor antenna. FIG. 5. A 6-tube receiver (three stages radio frequency; detector; two stages of audio amplification) with single dial tuning. Usual American wave-length range. Storage battery tubes; loud speaker operation. Indoor or outdoor antenna—preferably latter. FIG. 6. Internal view of a 5-tube receiver combining neutralised radio frequency amplification, regeneration and audio frequency amplification after detection. This set is built by home constructors according to plans furnished by a radio periodical. May be used with indoor or outdoor antenna and will operate loud speaker. Storage battery operation. Usual American wave-length range. FIG. 7. Cone type loud speaker with power amplifier enclosed. Operates on 60-cycle alternating current on first audio stage of radio receivers, giving extremely high output without distortion. FIG. 8. A cabinet model receiving set, with built-in loud speaker and space for all batteries required and for storage battery charger. Six storage battery tubes, the last being a power tube for increased output. Circuit includes three stages of neutralised radio frequency, detector, and two stages of audio amplification. (For internal view, see Fig. 4.) FIG. 9. Combination electric talking-machine and super-heterodyne radio receiver, employing a cone type loud speaker which may be switched at will from the phonograph to the radio output. Completely self-contained and operates without batteries on alternating current, 120 volts, 60 cycles. Power tube output for both radio and phonograph reproduction. Loop antenna in one of doors, with usual directional effect. Turntable of talking-machine is electrically driven. American wave-length range.

(*Figs. 1, 3, 7, Radio Corporation of America; Figs. 2, 4, 8 Stromberg-Carlson Telephone Mfg. Co.; Fig. 5, Atwater Kent Mfg. Co.; Fig. 6, Doubleday, Page & Co.; Fig. 9, Victor Talking Machine Co.*)

RADIO RECEIVERS

FIG. 1. Two-valve regenerative receiver capable of operating a loud speaker within 15–20 m. of a normal broadcast transmitter. Wave-length range, 250-5,000 metres, depending on the coils plugged in. May be used with dry or storage battery tubes. One of the valves is a high-frequency amplifier and detector; the other a transformer coupled note frequency amplifier. Intended for use with outdoor antenna. FIG. 2. A crystal set, wave length range 250-2,000 metres, suitable for reception on head telephones within 20 m. of an ordinary broadcast station and 100 m. from a high-power transmitter. Intended for use with outdoor antenna. FIG. 3. Horn type loud speaker. FIG. 4. A seven-valve super-heterodyne receiver, operated on a frame antenna, without ground connection. Two frames are provided, one covering the 250-550 metre wave-length range, the other 1,000-2,000 metres. Storage battery operation, last two valves being of the power type. Designed for loud-speaker output. FIG. 5. Four-valve receiver with one stage of radio frequency, detector, and two stages of audio frequency amplification; wave-length range of 150–4,000 metres. Takes storage battery tubes with power valve in output. Plate battery contained in base. Intended for use with outdoor antenna and loud speaker; head telephones for distant stations. Photograph shows appearance open.

(Figs. 1, 2, 3 and 4, Burndept Wireless, Ltd. Fig. 5, Falk, Stadelmann & Co., Ltd.)

heterodyning and rectification, the two intermediate frequencies are 30,000 and 50,000 respectively, a percentage difference of 66%. It is then very simple to discriminate between the two waves by means of an intermediate frequency amplifier tuned to, say, 50,000 cycles. In that case the 530,000 cycles station will be the one suppressed. Inasmuch as the local beating frequency is variable, the other station may be suppressed with equal ease, and the 530,000 cycle wave admitted. The super-heterodyne is really a fixed frequency receiver, with means of converting the wave of any desired station to that frequency.

Super-heterodyne receivers average eight tubes, operate readily on a small loop, with one or two tuning controls and may be made completely portable and self-contained. They constitute the most expensive class of radio receiver, and afford the maximum selectivity and amplification of any type as yet developed.

Tuning Mechanisms.—In the United States, with a relatively narrow band of wave-length (200–550 metres) to be covered, the usual form of tuning is with a fixed inductance and variable condenser. In British practice, with a 200–1,700 metre band in England, if the high power Daventry station is to be included, and Continental telephone channels up to 4,000 metres, it is necessary to vary the inductance as well, in order to cover wave-length ranges of this order. Hence sets employing inductance taps, interchangeable lattice-work coils and the like devices, are more popular in British broadcast reception.

Reflexing.—It is possible to use one or more tubes in a radio receiver for both radio and audio frequency amplification. For example, given two valves, the first may be used as a radio frequency amplifier, the second as a rectifier and the audio currents sent to the first tube again, with the low frequency output of the same feeding the telephones. Tube number one is then said to be "reflexed." In this way thermionic valves may be employed economically, but the application of the method is limited if good selectivity, quality of reproduction and stability are desired. As a rule, if reflexing is resorted to, only one tube in a receiver is so employed, although sets have been constructed with three tubes reflexed, and the term has been used to denote a separate receiver classification.

Combinations of Types.—The characteristics of the forms of sets described above may be combined in various ways. For example, a super-heterodyne receiver may utilise a stage of neutralised radio frequency amplification before the heterodyne operation, or reflexing, regeneration and neutralisation may be combined.

Power Supply.—Vacuum tubes may be classified according to filament consumption, whether intended for storage or dry battery operation. The filament of a storage battery tube will consume about one watt, as compared with 0·2 w. for a dry battery valve. Three or four of the latter may be run on three-standard dry cells. The storage battery tubes, being larger, yield more amplification per stage. In general, for moderate volumes dry cell tubes will give equivalent service to storage battery tubes. When the filament power is derived from a chemical source, plate power is usually drawn from small dry battery blocks. For very loud reproduction, it is necessary to resort to power tubes with energy supply from the alternating current mains, through suitable transformers, rectifiers, and "smoothing out" filters for converting the bi-directional voltages into a direct or uni-directional flow. The same devices may be used for smaller outfits as well, in place of batteries.

Choice of a Receiver.—The choice of a receiver is determined largely by the capital to be invested, as well as the operating conditions to be met. For example, if the prospective buyer is unable to erect an outdoor antenna, because of a landlord's prohibition or other reason, and insists on receiving distant stations, it will probably be necessary for him to purchase a super-heterodyne receiver operating on a loop. But if the location is in the country, with an efficient outdoor antenna available, and no broadcasting stations sufficiently near to require first-rate selectivity in reception, a cheaper receiver may be considered. Again, a receiver required to give strong, undistorted reproduction, to fill the ballroom of a residence, for example, will necessarily be more costly than one which only serves a few persons in a small room.

As in other fields, if one is dealing with a reputable firm the returns depend roughly on the amount expended. A sane procedure is to invest first in a small set of one or two tubes, and to become familiar with radio conditions before buying a larger outfit.

Home Construction.—Instead of purchasing receivers, many listeners buy the parts and assemble them at home. With the increasing intricacy and decreasing cost, per unit of value, of radio equipment, it is scarcely worth while for amateurs to assemble their own receivers. The product of extensive research, professional design, systematised manufacture and inspection, and large scale production, is likely to be superior to the results of untrained individual initiative, and not very much more expensive, even if the expenditure of the home-builder's time is not charged. For those listeners who wish to construct their sets, out of a desire to give rein to their creative energy, the best advice is to build equipment recommended by some well-known radio periodical possessing a laboratory where ideas are thoroughly tried out before being allowed to get into print, and to follow closely the directions given. In all such enterprises changes are made at the changer's risk. In the nature of radio design, a single substitution or slight alteration in wiring will sometimes entirely spoil the performance of a set.

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RADIOTHERAPY AND RÖNTGENOLOGY (*see* 28.887).—The discovery of X-rays by Röntgen in the autumn of 1895 marked an advance in the history of science, which, even yet, is not appreciated by the average individual. Röntgen himself realised immediately the value of his discovery to the science of medicine, and communicated it to the Physico-Medical Society of Wurzburg. Since then, if one excepts the years of the World War, hardly a month has passed without some innovation.

In 1910 the X-ray tube had varied but little from the original tube used by Röntgen and Crookes, the improvements in focusing and increasing the intensity of the rays being due to the labours of Campbell Swinton and chiefly to Prof. Jackson in 1896; indeed the modern focus tube (gas tube) has not materially changed since then. In this tube, the current is carried across the tube by a certain amount of gas, which is left behind in the process of evacuation. The current, impinging on a tungsten target, under a pressure of anything over 80,000 volts, results in the production of X-rays, which rays are now known to be electromagnetic impulses of very short wave-length. The only disadvantage of this tube is that individual control of the current and voltage is not absolute owing to fluctuations in the amount of residual gas. Despite this, however, it is largely used and for many purposes possesses advantages over the Coolidge tube.

The Coolidge Tube.—At a later period Dr. Coolidge of New York discovered that a glowing body emitted electrons, and at once designed a new type of bulb in which the current was carried across the vacuum by a stream of electrons from a hot tungsten wire. The hotter the wire the greater the current which

passed across the bulb. This, of course, solved the problem of separate control of the voltage and the current and thereby the problem of being able to reproduce exact working conditions at any interval. Unfortunately the hope, raised at first by the production of this tube, of obtaining an absolutely homogeneous beam of X-rays, was not realised.

Production of Rays.—The intensity of the X-rays depends upon the voltage employed to produce it and as the manufacture of high-potential generators (induction coils and step-up transformers) has improved out of all recognition since 1910, we can now produce rays of very great intensity, far greater indeed than are needed for radiographic purposes.

On the photographic side, improvements in technique have been very noticeable, the most noteworthy improvements being the use of intensifying screens to shorten exposures, double-coated films to increase the contrast of the negative and the Potter-Bucky diaphragm, the latter an ingenious contrivance for the purpose of cutting out secondary radiations and thereby sharpening the resulting picture.

Use in War Therapy.—During the years 1914–8 science was more or less subservient to the claims and the necessities of warfare, but even in this limited field X-rays were of enormous help. The localisation of bullets and shrapnel, which by any other means would have been impracticable, if not impossible, was carried out by numbers of experts, and to the untiring energies of these men a host of soldiers practically owe their lives.

Use in Diagnosis.—The past few years have been ones of very great activity in the X-ray world. Improvements in technique previously mentioned have brought the use of X-rays into much greater prominence in the study and the diagnosis of internal diseases (*see* DIAGNOSIS). Sciagrams of the lungs, which were difficult to make and still more difficult to interpret, are now of the very greatest possible value in the study of diseases of the heart (*q.v.*) and lungs. It is no exaggeration to say that no diagnosis of disease of either of these organs is complete without an X-ray examination.

This advance is seen in the large hospitals for diseases of the chest, where formerly only a few hundred examinations were made, now the number amounts to thousands in the year. Whereas the air-filled lungs showed up clearly against the more dense, blood-filled heart and solid thoracic walls, the abdominal organs, that is to say the hollow viscera, being all of the same density, were all penetrated equally by X-rays and consequently were not readily differentiated on a plate. For a long time this difficulty appeared to be unsurmountable. Many substances were known to be opaque to X-rays but none of them could be taken with safety. Haudek, of Vienna, made careful experiments with bismuth sulphate mixed with jam and watched its progress through the oesophagus, but completely forgot to look for it in the stomach.

Use of Bismuth.—In 1901 Becker gave small doses of the same material and was the first to publish anything definite about the radiology of the alimentary tract. His results were confirmed in the same year by other workers, but the danger of poisoning (chiefly from metallic impurities in the bismuth) was so great that not sufficient could be given for diagnostic purposes, and nothing of any special value resulted. Somewhat later, the publication of a paper on the treatment of gastric catarrh by large doses of bismuth inspired Rieder, of Munich, to give large doses of bismuth in order to examine the stomach and intestines by means of X-rays.

Some few cases of poisoning were later reported, but with the help of the chemist an absolutely non-toxic preparation of bismuth carbonate came into use. The production of this non-toxic preparation of bismuth was difficult and it never attained to universal popularity. In 1910 experiments were made with barium sulphate—which was found to be almost as opaque as bismuth and not only much more readily freed from inorganic impurities but infinitely cheaper to use. With very few exceptions radiologists use some form of this salt in diagnoses.

The Gastro-intestinal Tract.—The production of a safe and suitable method of making the gastro-intestinal tract opaque very greatly stimulated the investigations which were being carried on as to the condition of the alimentary tract in health and in disease. The study of both is still far from complete but, even with the results so far attained, diagnosis of intra-abdominal conditions has been greatly improved and numerous complaints previously described as "indigestion" and "gastritis," for example, are now readily classified.

Cancer and Gastric Ulcers.—Cancer of the stomach gave fairly typical X-ray evidence, but gastric ulcer proved almost as elusive to the radiologist as to the clinician. Certain investigators had observed a "niche" or recess on the wall of the stomach but its significance was not appreciated. In the same year (1910), Haudek and others, but chiefly the former, produced definite evidence that the "niche" was in reality an ulcer on the gastric wall filled with barium. Since then many other signs indicative of gastric ulcer have been noted and now the diagnosis of this condition is not a difficult matter. Ulceration of the duodenum, thanks to the labours of Carman and Milier in particular, and to Gregory Cole and Barclay, this region of the intestinal tract is becoming an open book to the radiologist.

Apart altogether from the value of X-rays in the investigation of disease, many new facts of physiological and anatomical (*see* ANATOMY) interest have been elucidated. Actual kinematograph films of the movements of the stomach and intestines during the process of digestion have lately been exhibited at a congress held in London, and on the Continent the writer has seen films of the heart and lungs showing their movements. By injecting the blood-vessels after death with a salt of lead in suspension, much valuable information to anatomists in the study of the vascular system has been secured by means of sciagrams.

Therapeutic Values.—From the earliest days of the discovery of X-rays, they were known to have certain curative properties, and scientists all over the world have been experimenting to place this form of treatment on a sound and scientific basis. Intractable skin diseases (*q.v.*) which resisted every other remedy often responded to X-rays, and it was noticed that some forms of malignant disease disappeared after treatment by irradiation. Means of accurately measuring the dosage of the rays were not known, but cancer had become so terrible a scourge that they were utilised indiscriminately for its relief, and at times with disastrous results. From 1905 onwards methods of measurement improved and in 1914 a dose could be administered with a certain amount of accuracy, the risk of burning became almost negligible, and we are now in possession of instruments capable of giving precise knowledge as to the amount of X-rays falling upon a given area. A spectroscope is used which takes a photograph of the X-ray spectrum. From it the wave-length can be ascertained and, the wave-length and the intensity of an X-ray beam being synonymous terms, it follows that the shorter the wave-length the more intense the X-ray.

Most of this work was carried on in Germany, where the idea prevailed that it was only necessary to get an intense enough ray and to measure it carefully in order to kill cancer. Apparatus for the production of these very intense rays was soon devised and before very long a great number of patients were undergoing treatment, so rapidly did this idea stimulate the popular imagination. In the early stages of this new form of X-ray therapy the results appeared to be most encouraging and the conquest of cancer was thought to be within reach. Subsequent statistics showed relief to be merely temporary. Great credit is, however, due to the early German workers and to our own specialists in Britain for the ingenuity and skill shown in standardising and rendering accurate the dosage of X-rays; but as a method of treatment of cancer we are getting no better results than were obtained in 1910. Russ and Colwell (in an illuminating book, *Radium, X-Rays and the Living Cell*) put the matter thus: "In radiology applied to biological problems there is a double difficulty, for the intensity of the radiation used, whether it be X-rays or Radium is a quantity which under many experimental conditions presents very considerable difficulties in its accuracy of measurement, *and the animal itself provides a complex which refuses to be reduced to simple terms.*"

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RADIUM (*see* 22.807d) is an element of atomic weight 226, the highest term in the alkaline earth series, calcium, strontium, barium. It is a metal having many analogies with barium and it is also a "radioactive substance", *i.e.*, a substance that suffers a spontaneous disintegration accompanied by the emission of radiation (*see* Radioactivity). This radioactive property confers on radium a special importance for scientific purposes or for medical use, and is also the cause of the extreme rarity of the element. Though radium is only one of numerous radioactive substances, being neither the most radioactive nor the most abundant, its rate of decay and the nature of the products of its disintegration have proved particularly favourable in the applications of radioactivity, and make it the most important of radioelements.

Chemical Properties

Spectrum.—If we do not consider the chemical actions of the radiations it emits, radium has exactly the properties that can be expected from its place in chemical classification. Radium is placed by its atomic weight 226, in the second column of the Mendelyeev table. With an atomic number 88, it is the last term of the alkaline earth series. The salts of radium are colourless and nearly all soluble in water; the sulphate and carbonate are insoluble. Radium chloride is insoluble in concentrated hydrochloric acid and in alcohol. Radium and barium salts are isomorphous.

Preparation of Radium.—Metallic radium has been prepared in the same way as metallic barium, by electrolysis of a radium salt with a mercury cathode, mercury being eliminated by heating the amalgam in dry hydrogen. The metal is white and melts at about 700°. It attacks water and is rapidly altered by the contact of air. The atomic weight can be determined by the methods used for barium, *e. g.*, by weighing the anhydrous radium chloride and the equivalent silver chloride or bromide.

Optical Spectrum.—The optical spectrum is composed, as with the other alkaline earth metals, of a relatively small number of lines of great intensity; the strongest line in the limit of the violet spectrum is 3814·6Å, and this line is a very sensitive test for the presence of radium; but spectral analysis is little used in the detection of radioelements, the radioactive properties offering a considerably higher degree of sensitivity. The high frequency spectrum is in accordance with the prediction for the element of atomic number 88.

Radioactive Properties

Radioactive Elements in General.—The theory of radioactive transformation has been established by Rutherford and Soddy (*see* Radioactivity). If n is the number of atoms of a radioelement, the proportion of the atoms destroyed in a certain time t is always the same, whatever n may be; the number of atoms decreases with the time t according to an exponential law,

$n = n_0 e^{-\lambda t}$ where λ is the radioactive constant of the substance.

The reciprocal of λ is called the "average life" of the element; the time T necessary for the transformation of the half of the atoms is called the "period" and related to the constant λ by the expression $T = \log_e 2/\lambda$.

Radioactive substances emit three kinds of rays known as α-, β- and γ-rays. The α-rays are helium nuclei carrying each a positive charge equal to double that of the elementary charge; they are expelled from the nuclei of the radioactive atoms with a great velocity (about $1{\cdot}5 \times 10^9$ to $2{\cdot}3 \times 10^9$ cm./sec.). The β-rays are electrons of various velocities which may approach the velocity of light. The γ-rays constitute an electromagnetic radiation of the same kind as light or X-rays, but their wave-length is generally much smaller and may be as short as 0·01Å. While the emission of some radioelements consists almost entirely of α-rays whose penetrating power is very small, other radioelements emit β- and γ-rays which are able to penetrate a considerable thickness of matter.

Uranium-Radium Family.—Radium is a member of the uranium family, *i.e.*, one of the elements resulting from the transformation of the uranium atom; its period is about 1,700 years. We give here the list of the radioactive elements of the uranium-radium family, the mode of their disintegration (α- or β-rays), the atomic number and the period.

Element and its disintegration	Atomic Number	Period
(Uranium) UI	92	$4{\cdot}6 \times 10^9$ years
$\alpha\downarrow$		
UX_1	90	24·5 days
$\beta\downarrow$		
UX_2	91	1·14 min.
$\beta\downarrow$		
UII	92	$1{\cdot}2 \times 10^5$ years
$\alpha\downarrow$		
(Ionium) Io	90	$7{\cdot}4 \times 10^4$ years
$\alpha\downarrow$		
(Radium) Ra	88	$1{\cdot}7 \times 10^3$ years
$\alpha\downarrow$		
(Radon) Rn	86	3·82 days
$\alpha\downarrow$		
RaA	84	3·0 min.
$\alpha\downarrow$		
RaB	82	26·8 min.
$\beta\downarrow$		
RaC	83	19·5 min.
$\beta\downarrow$		
RaC	84	10^{-6} sec.
$\alpha\downarrow$		
RaD	82	16 years
$\beta\downarrow$		
RaE	83	4·85 days
$\beta\downarrow$		
(Polonium) Po	84	139·5 days
$\alpha\downarrow$		
(Lead) RaG	82	

The atoms of each element are formed out of the destroyed atoms of the preceding element. None of these atoms can exist in nature otherwise than in uranium minerals, unless recently transferred from such minerals by a chemical or physical process. When separated from the uranium mineral they must disappear, their destruction not being compensated by their production. Only uranium and thorium are radioelements of so long a life that they have been able to last through geological times without any known production.

According to the laws of radioactive transformation, in very old minerals a state of equilibrium is attained where the ratio of the number of the atoms of the different substances is equal to the ratio of their average life. The ratio radium/uranium is about $3{\cdot}40 \times 10^{-7}$ in the older minerals; accordingly we cannot expect to find a mineral containing a high proportion of radium. Yet pure radium can be prepared in ponderable quantities while the other radioelements, except the slowly disintegrating uranium and thorium, are not capable of preparation in quantity, most of them because they exist in much smaller quantities. The quicker the disintegration of a radioactive substance, the smaller is its proportion among the earth's minerals, but the greater its activity. Thus radium is several millions of times more active than uranium and 5,000 times less than polonium.

Radiation of a Radium Tube.—Small quantities of radium are frequently kept in sealed glass tubes called "radium tubes." Radium emits only α rays and a feeble β-radiation; the penetrating radiation emitted by a radium tube comes from the disintegration products gradually accumulated by the radioactive transformations of radium; first, radon or radium emanation, a radioactive gas, the next term to xenon in the series of inert gases; secondly, radium A, B, C, called "active deposit of rapid change"; thirdly, radium D, E and radium F or polonium, called "active deposit of slow change"; finally, inactive lead, and also helium generated in the form of α-rays.

The strong penetrating radiation of a radium tube is emitted by radium B and C. When pure radium salt is sealed in a tube, the activity increases during about a month, till a state of equilibrium is attained between radium, radon and the active deposit

of rapid change, when the production of each of these elements is compensed by their destruction. The penetrating radiation consists in β-rays and in γ-rays, the latter particularly known by its valuable use in therapy.

The quantity of radon in equilibrium with one gramme of radium is called the " curie." If the radon is extracted and sealed separately in a tube, radium A, B, C, will accumulate and the penetrating radiation for one curie of radon will be the same as for one gramme of radium. But the activity of the radon tube decreases to half its value in 3·82 days, the period of radon, while the activity of a radium tube remains practically constant after equilibrium has been attained; the decrease is only 0·4% in 10 years.

Effects of Radiation.—Radiation of radium produces all the ordinary effects of rays (*see* RADIOACTIVITY); ionisation of the gases, continuous production of heat, excitation of the phosphorescence of certain substances (zinc sulphide, etc.), colouration of glass, chemical actions (decomposition of water for instance), photographic actions, biologic actions. Radium compounds observed in the dark exhibit a spontaneous luminosity, which is particularly bright in freshly prepared chloride or bromide, and is determined by the action on the salt of its own radiation.

Activity of Radium.—The α-rays belonging to radium itself have a range of 3·4 cm. in air at 15° C. and normal pressure. The number of α particles emitted by radium was measured by different methods of numeration (scintillations or counting chamber); the result varies from $3{\cdot}40\times10^{10}$ to $3{\cdot}72\times10^{10}$ particles per sec. and per gram of radium; from this data the average life of radium can be deduced. Three other groups of α rays, of ranges 4·1 cm., 4·7 cm. and 7 cm. are emitted by radon and the active deposit, radium A, B, C. The heat produced by radium itself is about 25 calories per hour and per gramme. For a tube of radium in equilibrium with the disintegration products of rapid change, the production of heat is about 137 calories per hour and per gramme. This heating effect is principally due to the absorption of the energy of the α-rays.

Discovery of Radium

In the year 1896 H. Becquerel discovered that uranium emits spontaneously a radiation that produces an impression on a photographic plate through a sheet of black paper, and ionises the air. Mme. P. Curie proved that this property, later called *radioactivity*, is characteristic of the atom of uranium and is possessed also by thorium. But she found that uranium minerals were much more active than could be predicted from their uranium content. By the hypothesis of the existence of a very radioactive unknown substance present in very small quantity, she undertook, with Pierre Curie, research for this substance in the uranium mineral called pitchblende.

The method they used in that work was entirely new; the result of the separations made by the ordinary process of chemical analysis was controlled by tests of the *activity* of every fraction; the activity was measured quantitatively by the current produced by the substance when placed in a special " ionisation chamber." Thus concentration of the radioactive property was traced in two fractions of the treatment, the fraction containing bismuth and the fraction containing barium.

In July 1898, P. Curie and Mme. Curie published the discovery of *polonium*, the element accompanying bismuth; in Dec. 1898, P. Curie, Mme. Curie and G. Bémont published the discovery of *radium*. Though the existence of these new substances was certain, they were present only in a very small proportion in the products obtained at that time; yet Demarçay was able to detect in the barium-radium mixture three new lines belonging to radium.

Only in 1902 did Mme. Curie succeed in preparing the first decigram of pure radium salt and made a determination of its atomic weight. The separation of barium was made by a process of fractional crystallisation. The work proved exceedingly difficult in practice on account of the great quantities of material that had to be treated. Later Mme. Curie made a new determination of its atomic weight and prepared metallic radium.

The new method used by P. Curie and Mme. Curie for the discovery of polonium and radium—chemical analysis controlled by measurements of radioactivity—has become fundamental for the chemistry of radioelements; it has served since for the discovery of many other radioactive substances. The discovery of radium and the preparation of the pure element has had very great importance in laying the basis of the new science of radioactivity. The identification of its spectrum and the determination of its atomic weight have been decisive facts for convincing chemists of the reality of the new elements.

Industrial Production of Radium

Radium has been manufactured in several countries. The first factory was started in France in 1904, not six years after the discovery of radium.

Minerals.—Radium is to be found in all uranium ores; however only those that have been mined in sufficient quantity for the extraction will be here mentioned.

Pitchblende or Uraninite.—Uranium oxide more or less impure. Mines in Bohemia and Belgian Congo.

Autunite.—Double phosphate of uranyle (UO_2) and calcium. Mines in Portugal, United States and elsewhere.

Carnotite.—Vanadate of uranyle and potassium. Mines in Colorado, Australia and elsewhere.

Betafite.—Niobo-titanate of uranium and calcium, with rare earths. Mines in Madagascar.

The first radium was prepared from pitchblende from Bohemia. Later the principal exploitation was that of carnotite in Colorado and of autunite in Portugal. At the present time the most important supply is extracted in Belgium from the pitchblende of Belgian Congo. A mineral containing more than one decigram of radium per ton is considered as very rich. Minerals were treated down to a few milligrams per ton.

Industrial Treatment.—The method of industrial extraction of radium, in its essential points, is still the original method that was used and described by Mme. P. Curie. The operation can be divided in three parts: dissolution of the mineral, purification of a barium-radium salt, separation of radium from barium by fractional crystallisation.

The treatment for dissolving the mineral differs from one mineral to another. Autunite and certain carnotites are soluble in hydrochloric acid, but nearly all other minerals must be attacked by more energetic agents, for instance with the aid of sodium carbonate.

When the mineral does not contain much barium, a certain quantity of barium salt is added in order to carry away the radium. The barium-radium mixture is separated. With some variations in the mode of separation of uranium and lead (always present in the mineral) or eventually vanadium, niobium, etc., the operation consists in separating barium-radium by precipitation as sulphates and redissolving these sulphates by ebullition with sodium carbonate followed by a hydrochloric attack. Generally the radium-barium mixtures pass more than once through the state of sulphates.

After the purification of the barium-radium chloride, radium is concentrated by a process of fractional crystallisation, radium chloride, less soluble than barium chloride, being concentrated in the crystals. After this first enrichment the active salt is again purified particularly by the elimination of a residue of lead, and is transformed into bromide for the continuation of fractional crystallisation (the use of bromide was suggested by Giesel). The final crystallisations are made on small quantities of salt in very acid solutions. All the operations are controlled by the ionisation method, to avoid the loss of radium. At the end of the purification, great care must be taken to protect the chemist from the action of the radiations, especially at the moment of the filling of the tubes or apparatus with the radium salt. The radon liberated in the room during the fractionation must be eliminated by a constant aeration.

Mesothorium.—Some minerals of uranium contain also thorium. In these minerals radium is mixed with another radioelement, mesothorium I, isotope of radium. Mesothorium I is much more active than radium, but has less commercial value

for the same activity, because its life is much shorter (6·7 years). Mesothorium can be used instead of radium in certain cases.

Measurements

Measurement of the quantities of radium is very important for scientific as well as for commercial purposes. The quantities to be measured vary greatly. For instance, the tubes of radium prepared for medical use contain in general from 1 to 100 milligrammes, but radium has often to be dosed in natural waters or minerals, where the quantities are of the order of 10^{-7} gr. and even down to 10^{-12} gr. per litre of water or per gram of mineral.

For very small quantities, only an ionisation method of measurement can prove successful. For relatively great quantities, radium could be weighed but it would require a careful purification of the radium salt and the precision would in general be very unsatisfactory, considering the high price (about £10 the milligramme of this element). Here also, therefore, ionisation measurements are used for the sake of accuracy.

For quantities ranging from about one-tenth of a mg. to the greatest quantities available the radium must be sealed in a tube where radon and the active deposit accumulate. Measurements are made by comparing the ionisation produced in an ionisation chamber by the penetrating rays from the tube containing the unknown amount of radium and from a standard tube placed in the same conditions. A correction is made for differences of form or of absorbing power of the two containers.

The sale of radium is made according to the certificates delivered by national technical laboratories: National Physical Laboratory (London), Radium Institute (Paris), Radium Institute (Vienna), Physikalische-technische Reichsanstalt (Berlin), U.S. Bureau of Standards (Washington). Discrimination between radium and mesothorium I in sealed tubes is rather difficult. For this purpose, of commercial interest, scientific methods have been devised, based on the different penetrating power of the γ-rays, or on the different production of heat.

An international radium standard was prepared in 1911 by Mme. P. Curie. A quantity (about 22 milligrammes) of very pure radium chloride was exactly weighed and sealed into a thin tube of glass. This standard is kept at the International Bureau at Sèvres, and secondary standards, carefully compared with this one, have been prepared for different countries.

Determination of the very small quantities of radium contained in a few grams of a mineral, or a few litres of mineral water, is made by measuring the quantity of radon it produces in a definite amount of time. The mineral is dissolved and radon removed by passing a slow current of air through the solution, then after a few days, the radon accumulated in the solution contained in a close vessel is conveyed to a special ionisation chamber, where the current produced by the α-rays of radon and radium A, B, C, is measured. This allows calculation of the amount of radium in the solution, if the ionisation chamber has been standardised by a similar operation made with a known quantity of radium. For the standardisation a very dilute solution is prepared by taking a small definite fraction of α solution containing a quantity of radium directly measurable by the penetrating rays. To facilitate the standardisation of apparatus, technical laboratories deliver standardised solutions or samples of radium-barium salt containing a known proportion of radium. The method of quantitative determination is exceedingly sensitive and can be used for amounts of radium from 10^{-6} gr. to 10^{-10} grammes.

Applications of Radium

The principal application of radium is the use for therapeutic purposes of the biological action of the rays (*see* Radiotherapy; Therapeutics). The biological action is a selective destruction of certain cells and can have very dangerous consequences, but can also be directed against nocive tissue, as for instance in the case of cancer. For medical use radium is put into tubes of glass or in platinum needles, sometimes also on flat surfaces recovered by a varnish, for the irradiation of the skin. Another form of use is to keep radium in solution and to extract from time to time the accumulated radon which, introduced into small tubes, has the same efficiency as radium till its activity has disappeared. The use of radium for pharmaceutical preparations has been frequently tried. The scientific basis, however, in this case is far from being well established. Experimentation on the improvement of the soil by small quantities of radium has been till now very limited and some favourable results in this direction have been claimed.

By incorporating radium with phosphorescent zinc sulphide it is possible to obtain luminous paints giving a weak light visible in darkness. The most important use of this paint is for watches. The quantity necessary is of the order of one-tenth of a milligramme per gramme of zinc sulphide. After several years, the phosphorescent product is altered by the action of the rays and becomes less luminous, though the quantity of radium has not changed appreciably.

Radium in Nature.—Radium exists in minute proportion in every kind of soil and water; the extraordinary sensitiveness of the methods of analysis has made it possible to ascertain this fact. If some inactive element is present in the same proportions, we are not able to detect it. The quantity of radium contained in the ordinary soil is of the order of 10^{-12} or 10^{-11} gr. of radium per gramme while a good radioactive ore contains about 10^{-7} gr. of radium per gramme of mineral.

Radium existing in the depths of the earth is sometimes dissolved by water and affects springs. Other springs dissolve principally the radon liberated by the radium and their activity dies out with the radon. This would explain why certain mineral waters are reputed to be efficient for curative effect only when used directly at the source. Some radio-active waters contain amounts of radium up to 10^{-10} gr. per litre· the amount of radon can attain 10^{-7} curies per litre.

The radium in the soil is the origin of the small quantity of radon present in the air and is partly responsible for the natural ionisation of the air which is known to be an important factor in the meteorological conditions of the atmosphere. Radium and radioactive elements in general have played an important part in the evolution of terrestrial heat. It is not improbable that the radium present at the surface of the earth in a very dilute state has some connection with the evolution of life on our planet (see Mme. Curie, *Traité de Radioactivité*, 2 vol. (1910).

(M. C.*; I. C.)

RAEMAEKERS, LOUIS (1869–), Dutch cartoonist, was born at Roermond, Holland, April 6 1869. He was educated in Amsterdam and Brussels, and began his career by painting landscapes, portraits and posters. In 1908 he produced his first political cartoons, and subsequently gained international fame by his violent anti-German cartoons in the Amsterdam *Telegraaf* and other papers during and after the World War.

RAILWAYS (*see* 22.819).—In this article the main developments since 1910 in the practice of railway engineering are described. Problems of track laying, both new construction and renovation and repair work, are discussed. New designs of locomotives are described and the substitution of steel for wood as a material for construction of coaches and wagons is recorded. The improved methods of signalling now adopted are dealt with, while the concluding section deals with the electrification of the railways, the whole being preceded by a short historical account of railway development during the years under review.

I. HISTORY

The period 1910–26 was marked by a slowing up in the rate of additions to railway mileage. There were exceptions, as in Canada where railways were extended too rapidly, and in certain parts of Africa and Asia, but elsewhere, particularly in the United States, the additions were relatively small although large sums were invested annually since 1922, in enlarging and improving existing railway facilities and equipment. The greater use of motor-trucks and 'buses on the highways has tended to take away a part of the railways short-haul traffic, thus relieving the facilities for the longer hauls and postponing the need of new trackage. The annual growth in ton-miles has been smaller in

degree than in previous periods and the passenger traffic has tended to decline in volume. War conditions and the restriction of immigration have held down the rate of growth in population and agricultural development in North America.

The period under review was marked also by increases in the extent of governmental regulation of railways. The rate structures have become less flexible. Higher wages and other rising costs have borne heavily on the carriers. Rates have been increased, but not in degree corresponding with costs. Net income has suffered, the return on railway investments has declined, and railway securities have lower market values.

In Great Britain and the United States, the two countries which have been foremost in faith in private ownership rather than government ownership of railways, it was found expedient to turn the railway over to the Govt. for unified operation during the crisis; but in both cases private ownership and operation were resumed after the War. In Great Britain the policy of consolidation was made effective and the many small companies were reduced to four. In the United States a similar policy was written into law, but little progress has been made in carrying it into effect. In Canada the financial collapse of several weak carriers led to a substantial enlargement in the nationalised system.

In no country did the War bring about greater changes in respect of the railways than in Germany. Before the War they were mostly the property of the individual States of the Empire, but in 1920 they were handed over to the Reich. The results of their operation under these conditions were far from successful, and by the end of 1923 their working expenses were seven times greater than their receipts. In 1924 it was arranged that their operation should be put in the hands of a company, the Reichseisenbahn Gesellschaft, whose concession was to run normally for 40 years, expiring on Dec. 31 1964. The capital was fixed at £1,300,000,000, made up of (1) £650,000,000 ordinary shares to be issued fully paid to the Reich; (2) £100,000,000 preference shares to be issued to the public as required; and (3) £550,000,000 Reparation bonds bearing 5% interest, with a 1% sinking fund calculated to redeem them in 40 years. The transport tax imposed in 1917 on the gross receipts of the railways was continued, its proceeds up to a maximum of £12,500,000 being paid over for Reparation purposes, for which therefore, with the sum of £33,000,000 for the service of the Reparation bonds, a total of £45,500,000 annually was charged upon the railways. Fuller details about the railway systems of the various countries will be found under the several headings, *e.g.*, GREAT BRITAIN: *Communications*; UNITED STATES: *Communications*. (X.)

II. TRACK LAYING

This article deals with: (1) the laying of track on new lines; (2) the laying of new tracks parallel to existing ones; and (3) the relaying or renewal of tracks worn out in service. Track laying on new lines has been subject to little improvement owing to the marked decrease in new railway construction. Where mechanical equipment is employed, it consists usually of a pioneering machine placed at the head of a material train, the machine comprising a combination of derricks and conveyers by means of which the rails, sleepers and fastenings are passed forward and set in place. In America, during the years 1915–25, the locomotive crane was sometimes substituted for the track laying machine because of its ready availability and its adaptability to a wide variety of other uses. The laying of new tracks in close proximity to other lines already in service imposes no particular difficulties, as the materials can be readily distributed from trains on the operated track.

Relaying Track.—The relaying of track is a process constantly under way on the entire railway mileage of the world which must be carried on without obstructing traffic. The wooden sleepers or crossties used suffer deterioration from decay and mechanical agencies. Rails are subject to wear, particularly on curves. The tread or wearing surface becomes battered at the ends by the pounding of the wheels. The most common cause for renewal is the battering of the ends. A preventive measure is to replace worn fishplates or joint bars with new ones as a means of affording a more secure joint. Heat-treated high carbon fishplates and bolts have been used for this purpose. In the United States and Canada marked economies have been effected by restoring or building up the rail surface with metal applied by means of the oxy-acetylene torch. Rails removed from track are often restored to a serviceable condition by sawing off from six to twelve inches of the ends. The adoption in America during 1925 of a standard rail length of 39 ft. instead of 33 ft. brings about a 15% reduction in the number of joints.

Rebuilding Methods.—In Europe it is customary to rebuild the entire track structure in one operation. The intervals between these "relayings" vary from two to eight years or more with the density of the traffic carried. In America and on a few railways in Europe the renewal of the rails, sleepers and ballast comprises three distinct operations, which are generally handled separately. The procedure under the European method ranges from a complete removal of the old track followed by its replacement with a new track, to the construction of a new track interlaced with the old, *i.e.*, with the new sleepers placed between the old ones and the new rails offset a few inches to one side of the old rails. Under this plan the completion of a section of the new track is followed by the transfer of trains from the old to the new track, the removal of the old track and the shifting of the new track to correct alignment.

When the rail and sleeper renewals are carried on independently, the relaying of the rails is usually completed for one line of rails at a time. The new rails are set up on the ends of the sleepers and moved over into position as the old ones are unfastened. The number of rails changed on one operation and the amount of preliminary work done preparatory to the actual change depend on the time available between trains. It has been the almost universal practice to carry on rail laying without discontinuing the use of the track by trains, even on multiple-track lines. But some of the double-track lines in the United States have greatly expedited this work by confining the movement of trains temporarily to one track for the distance between the nearest stations provided with crossovers.

Mechanical Equipment.—Much of the work of laying rails is done by hand even in America, where heavy sections are employed. Some use is being made in England and America of hoisting equipment of various kinds, particularly for loading the old rails. In America considerable use is made also of portable hoists mounted on rollers or wheels for setting the rails into position and a few of the railways employ locomotive cranes. Renewal of the sleepers is also a manual operation except as it concerns the tamping or packing, which is now being done to a small though increasing extent with pneumatic and electric tampers in both Europe and North America. In the replenishing of the ballast the most laborious operation is the surfacing or raising of the track on the new material and it is this operation rather than in sleeper renewals that mechanical tamping has had its greatest application. More recent developments in the delivery and distribution of the ballast include the use of special cars with bottom doors designed to dump the material in any amount, and ploughs or spreader cars which distribute it uniformly over the track.

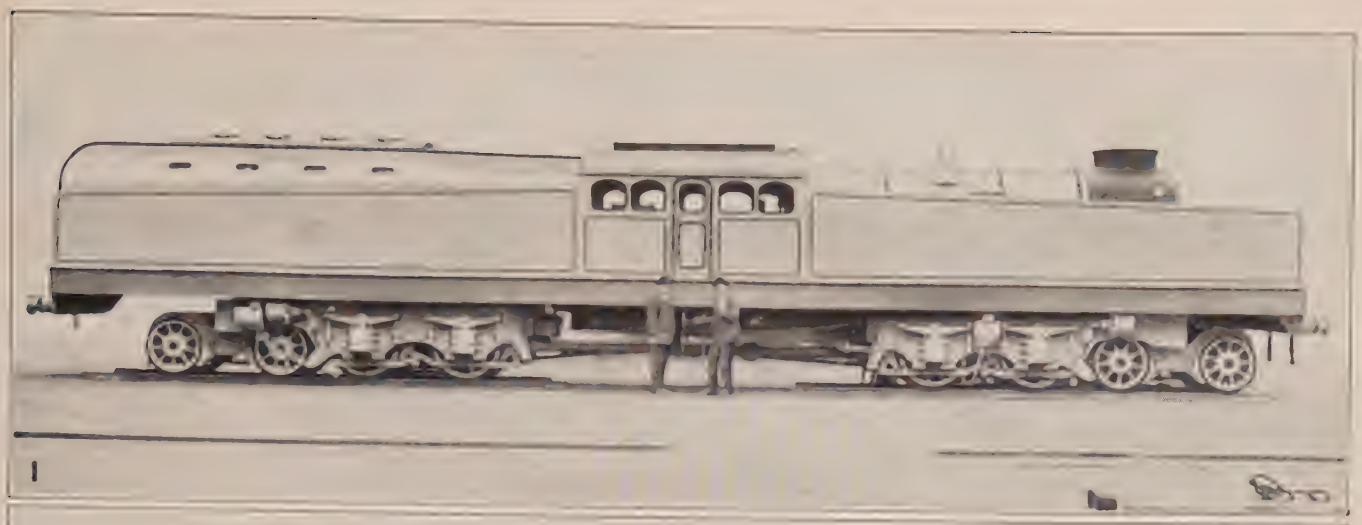
The conventional method of cleaning ballast is to scrape it out from between the sleepers and shake it up on the ballast forks to screen out the foreign matter. Sometimes it is thrown against stationary screens. Among the methods employed for accomplishing this end is a revolving power-operated screen and the use of a hoist and bucket to dump the ballast on a screen mounted on a car; a further scheme is the application of the principle of the vacuum cleaner in a large machine, which draws up the ballast through pipes into a chamber where the foreign matter is separated from the stone. (W. S. L.)

See W. F. Rench, *Roadway and Track* (1923); E. E. R. Tratman, *Railway Track and Maintenance* (1926).

III. LOCOMOTIVE DESIGN

Progress in the development of the locomotive steam engine during the period 1910–25 has been characterised by (*a*) increase in weight and power; (*b*) installation of superheated steam apparatus and feed-water heaters; (*c*) extended adoption of articulated types; (*d*) the application of the turbine engine with condenser; (*e*) the application of the internal combustion engine.

Increase in Weight and Power.—In Great Britain the 4–6–2 express engines on the L. & N. E. Rly. weigh 93½ tons and develop about 2,000 horsepower. Heavier engines of this type are in service on the Continent, while in the United States 150 tons has been reached. For freight service, the 2–8–0 type is in general use, the 2–8–2 type and the 2–10–0 have, especially in the United States, been largely adopted and the 2–12–0 has been tested.



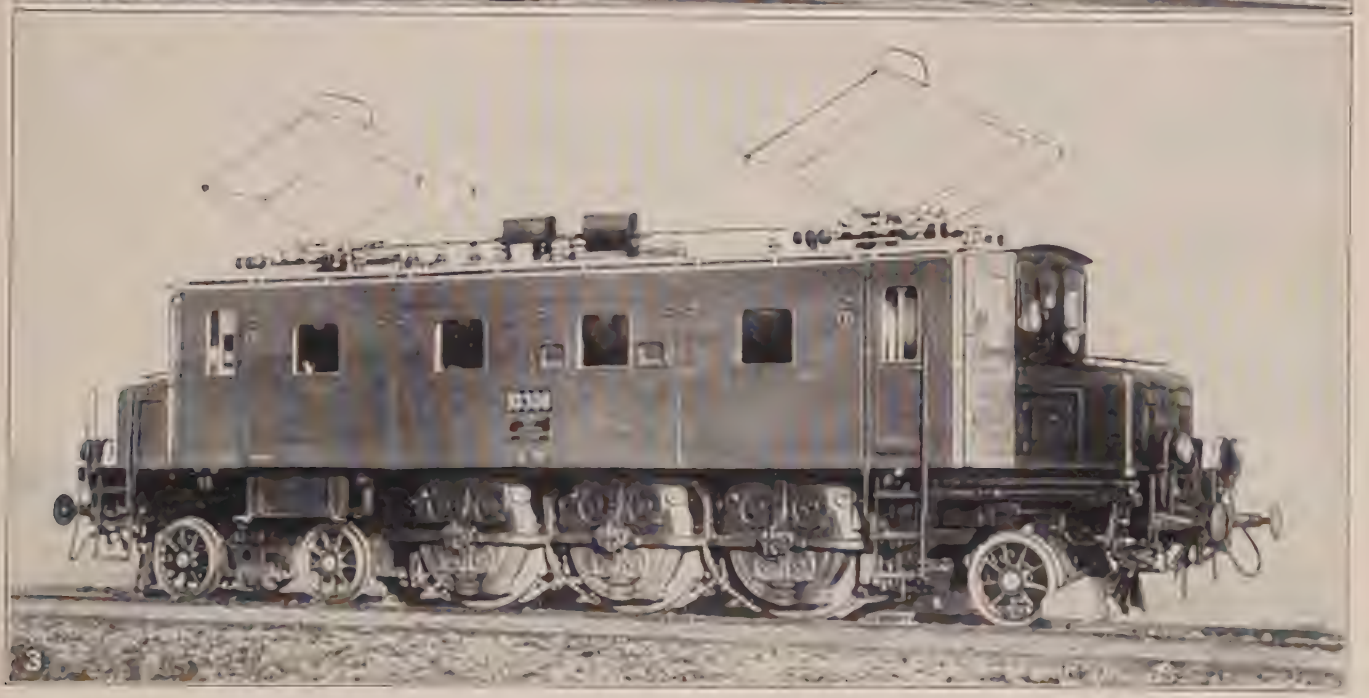


FIG. 1. "Reid-Macleod" Geared Turbine Condensing Locomotive. FIG. 2. 2-8-8-8-2 Triplex "Mallet" Articulated Locomotive. FIG. 3. Brown-Boveri Electric Locomotive, fitted with individual axle drive.

(Fig. 3. Courtesy of British Brown-Boveri, Ltd.)

Three-cylinder engines have been at work for some years on the L. & N. E. Rly. for both express and mineral traffic and are reported to be entirely satisfactory, and the system has also been adopted in the United States and in Germany. Three-cylinder engines, arranged for "simple" or "compound" (1 high pressure and 2 low pressure) working are standard practice on the L. M. & S. Rly. 4–4–0 type express engines. In France only, the four-cylinder compound engine has extensive application. The four-cylinder "simple" has had several applications in Great Britain notably on the L. M. & S. and G. W. Railways.

Boiler Power.—The great increase in boiler power, as is indicated by the provision of large grate areas, normally 18 to 30 sq. ft. but now reaching from 50 to 112 sq. ft., greatly exceeds in many cases the ability of the stoker to maintain the supply of fuel to the furnace. For such cases mechanical stokers have therefore been adopted. The use of oil fuel is still limited to countries with extensive oil producing areas, or to those in which the cost of coal is exceptionally high. Apparatus for burning pulverised fuel is now in considerable use in the United States and to a limited extent elsewhere.

Boosters.—In all locomotives, the adhesion required for "starting" purposes is greatly in excess of that required for running." If an additional temporary adhesion can be provided for "starting," much higher loads may be worked. In engines with hind carrying axles, the provision of a "booster" has this effect. A booster is an engine forming, on the locomotive, an auxiliary unit which can be attached to a carrying axle at will, to utilise the adhesive weight on that axle. Such boosters are in considerable use in the United States and are now being tentatively adopted on some engines on the L. & N. E. Rly., England.

Superheaters.—Superheating of the steam has been widely adopted on all main line engines. In the type of apparatus generally employed (introduced in Germany by W. Schmidt) the steam before reaching the cylinders is passed through a set of double-loop tube elements inserted in enlarged boiler tubes. The temperature aimed at is about 650° Fahrenheit. The economy of steam realised is from 15 to 25%. Many systems of feed-water heating apparatus have been installed on locomotives both on English and foreign railways, but as yet no system has commanded a general adoption.

Articulated Types.—In the "Fairlie" and "Kitson-Meyer" types of locomotives, the boiler, tanks and bunker are carried on a main frame below which two motor bogies are pivotted. Greater freedom could thus (owing to the short rigid wheel base of the bogies) be obtained for traversing curves, less weight per axle or per ft. run of the vehicle and double power with one engine crew.

The "Mallet" articulated locomotive now represents the heaviest and most powerful engines in the world (see plate, fig. 2). In this type, there are as in the "Fairlie," two sets of wheels, but the front set only are (in a bogie frame) pivotted or hinged on the main frame which carries the boiler, the hind set being mounted on the main frame in the usual manner. The engine is a four-cylinder compound, the two H.P. cylinders are on the main frame and drive the rear set of wheels and the two L.P. cylinders are on the bogie frame and drive the front set of wheels. The first U.S. Mallet was installed on the Baltimore and Ohio Rly. in 1905. It was of the 0–6–6–0 type, and weighed 150 tons. Mallet engines are now in service of 2–8–8–8–4 type, *i.e.*, three sets of eight coupled wheels 54 in. diameter, each set being driven by a pair of cylinders 34 in. diameter by 32 in. stroke (one pair being H.P. and two pairs L.P.) with a leading two-wheel truck and a trailing four-wheel bogie. The rear wheels (eight-wheel coupled and four-wheel bogie) also form the tender carrying wheels. The total weight in working order is 376 tons.

The "Garratt" type of articulated locomotive has, similar to the Fairlie, two free bogies (with the pivots located towards either end) but carries its tanks directly on the bogies. The "Modified Fairlie," as its name implies, embodies all the essential features of the Fairlie with girder frame and central pivotted bogies. Both of these latter types can embody a very large boiler consequent on a large extension of their wheel base, and in their carrying their tanks fore and aft of the boiler.

Turbine Locomotives.—A locomotive ("Reid-Ramsay" of 1904) with a turbine engine driving through electric transmission to motors on the driving axles and fitted with condenser was constructed and was put through a series of tests. Thereafter a more powerful locomotive (Ramsay Condenser) was constructed; this locomotive was tested on the L. & Y. Railway. Neither of these experiments indicated that the locomotive had attained the necessary combination of the requisite economy in construction, running charges and maintenance, with the requisite efficiency in operation.

The latest system, now (1926) in process of testing, is the application of the geared turbine driving direct on to the motor axles. Four types of locomotives have been built. In Switzerland by the Zoelly method ("Zoelly"), on an existing 4–6–0 type locomotive the turbine is placed transversely on the framing. The gear ratio is 30/1. The condenser is of the "surface" type with a condensate cooler of the air-cooled evaporative type. In Sweden on a locomotive of the two-vehicle type, one vehicle carries the boiler and the other, which has three-motor axles and one-truck axle, is equipped with the main driving machinery and also carries the condensing plant. The turbine (transversely placed) develops 1,800 H.P. at 9,200 R.P.M. and has a gear ratio of 22/1. The condenser is surface type air-cooled. In Great Britain (North British Locomotive Co. Ltd.) the locomotive, on the "Reid-Macleod" system is of the double-bogie type (*see* plate fig. 1). Two geared turbines are employed; the high pressure driving two-motor axles on one bogie and the low pressure on the other. The turbines are arranged longitudinally on the frame. Coupling rods between the motor wheels are not required. In Germany (Krupp) the application is in principle similar to "Zoelly's" but a new locomotive has been constructed of the two-vehicle type; one vehicle 4–6–2 type (as in ordinary locomotive practice) is equipped with the main driving mechanism and also carries the boiler; the other vehicle carries the condensate cooler in addition to the necessary supplies of coal and water.

Internal Combustion Locomotives.—Little progress has been made to the present time in respect of the application of the internal combustion locomotive to the work of railways. Installations up to 450 H.P. (Diesel-Electric) for a saloon car with trailers have been adopted for light railway work. The locomotive in the German-Swiss experiment ("Klose-Sulzer") of 1913 was of the 4–4–4 type equipped with two Diesel engines direct-coupled to the motor axles. Starting the locomotive and running up to 6 M.P.H. were effected by the admission of compressed air to the combustion cylinders. Speeds of 12 to 20 M.P.H. were reported to have been effected, but difficulties involved by the low temperature of the air exhaust seem to have proved insuperable. At the Stettin Exhibition of 1924 was shown the two-vehicle locomotive designed by Professor Lomonossoff. The main vehicle 2–10–2 type is equipped with a six-cylinder set of Diesel engines with generator and with electrical transmission to motors on the driving axle, and developing about 1,200 brake horsepower. The weight is about 120 tons. The other vehicle or tender carries the circulating water cooler. There was shown also at this Exhibition an 0–8–0 type "Linke-Hoffman-Lauchhammer" locomotive equipped with a six-cylinder Diesel engine of 400 H.P. driving through a Lentz hydraulic-transmission-gear on to a lay shaft and thence to the eight-coupled wheels.

Locomotive Types, Names and Symbols.—The following table gives the popular names which have been adopted for locomotives in general use and also their type symbols. The mid figure or letter signifies the number of wheels or axles which are coupled. In the British and American systems it signifies number of wheels; in the French, number of axles; and in the German, the letter signifies number of axles, *i.e.*, A=1, B=2, etc. The first and third letters signify similarly the number of front and hind carrying wheels or axles. In articulated engines the mid figures or letters signify the number of coupled wheels or axles, and the end ones the carrying wheels or axles. In articulated engines with carrying wheels between the coupled sets, each set is read as for non-articulated engines, thus: 2–6–2—2–6–2.

	English or American	French	German
Jenny Lind	2-2-0	1-1-0	1-A
Single Driver	4-2-2	2-1-1	2-A-1
American	4-4-0	2-2-0	2-B
Columbia	2-4-2	1-2-1	1-B-1
Atlantic	4-4-2	2-2-1	2-B-1
Reading	4-4-4	2-2-2	2-B-2
Mogul	2-6-0	1-3-0	1-C
Prairie	2-6-2	1-3-1	1-C-1
Pacific	4-6-2	2-3-1	2-C-1
Adriatic	2-6-4	1-3-2	1-C-2
Baltic	4-6-4	2-3-2	2-C-2
Consolidation	2-8-0	1-4-0	1-D
Mikado	2-8-2	1-4-1	1-D-1
Mountain	4-8-2	2-4-1	2-D-1
Mastodon	4-10-0	2-5-0	2-E
Santa-Fé	2-10-2	1-5-1	1-E-1
Centipede	2-12-0	1-6-0	1-F

Articulated Locomotives—Examples of Symbols

English or American	French	German
0-6-6-0	0-3-3-0	C-C
2-6-6-0	1-3-3-0	1-C-C
2-6-8-0	1-3-4-0	1-C-D
2-8-8-2	1-4-4-1	1-D-D-1
2-8-8-8-2	1-4-4-4-1	1-D-D-D-1
2-8-8-8-4	1-4-4-4-2	1-D-D-D-2
4-4-6-2	2-2-3-1	2-B-C-1

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IV. CARRIAGE, WAGON AND BRAKES

Broadly speaking, both in the case of carriages and wagons, the aim of designers is to secure the greatest possible capacity in relation to tare weight, due regard being, of course, paid to strength of construction. Railway companies in general attach great importance to the question of weight, due to considerations of economy both as regards hauling power and maintenance of permanent way.

Materials.—The scarcity of suitable timber for manufacturing coaches has become so serious a problem, that efforts had to be made to find a suitable substitute. Steel had already been used with success for wagon construction, but doubts were expressed as to whether passenger vehicles made of steel would be satisfactory. In the first place it was argued that steel coaches would be too heavy and secondly that they would prove entirely unsuitable for tropical countries owing to the heat conducting properties of the material. The latter was held to be a very serious objection for the shortage of timber was being most strongly felt in India, where teak was becoming more and more expensive.

A strong belief existed in certain quarters, however, that a substitute for timber had undoubtedly to be found. Considerations connected with the safety of passengers also exerted a strong influence, for it was felt that with steel vehicles the risk of fire would be reduced to a minimum and that in the event of a collision there would be much less danger of coaches telescoping. These contentions were borne out quite dearly by subsequent experience.

Steel Coaches.—The question of steel coach design, therefore, received very close attention from designers. A perfectly satisfactory vehicle was not, however, produced at once. Early designs were heavy and expensive to manufacture and the modern steel coach, which matches the wooden coach in weight, in price and in comfort, is the result of a process of careful development. According to the best modern practice, steel coaches are built in sections, that is to say, the body sides, ends and roofs are constructed on separate jigs, these parts on completion being assembled with the underframe. This method ensures that parts shall be interchangeable—a specially important point when coaches are being shipped abroad—and is economical as regards cost and distribution of labour.

The steel coach may be so designed that the body provides the necessary strength in itself, trussing on the underframe not being required. The elimination of truss rods, besides reducing the weight of the coach, affords perfect accessibility to the brake-work and the electrical gear.

In order to prevent discomfort to passengers from extremes of heat and cold, an inner lining of insulating material is so arranged that air can circulate freely up the sides and along the roof. This device very effectively solves the temperature question and steel coaches are now firmly established in such countries as India and Egypt. Corrosion is one of the chief problems where any steel structure is concerned and measures have to be taken to prevent this. At the design stage, therefore, ledges or receptacles where moisture might accumulate are eliminated as far as possible. When the constructional stage is reached, all parts, before assembly, receive an application of anti-corrosive paint, and a method of cold rivetting may be employed in order to avoid damage to this protective covering. In some instances lead-coated sheets are used as an alternative. Either wood or steel interior trim may be employed, but the former is generally preferred by British designers.

Brakes.—The principal innovation in regard to brake gear is the introduction of the automatic slack adjuster, to reduce the amount of slack due to wear and thus make the retarding action as uniform as possible.

Articulated Carriages.—Carriages built on the articulated principle are also an interesting development. According to this system two bodies may be carried on three bogies instead of four, or the system may be extended to any number of bodies. The object is to obtain smoother running with less weight and less cost. The adoption of pneumatic operating gear for doors has proved particularly useful on underground systems where it is imperative that stops at stations should be as short as possible.

Other Developments.—The modern demand for increased comfort for passengers has led to improvements in seating arrangements, increased dining accommodation, extension of heating systems, etc., and one of the designer's chief problems is how to meet this demand without undue increase in the weight per passenger carried.

Wagon Designs.—The chief object has been to obtain the maximum possible paying loads, and both bogie and four-wheeled wagons of high capacity and low tare weight have been more largely introduced in recent years. Special types of wagons have been introduced for special duties and improvements have particularly been made in the design of self-discharging wagons of the hopper and tipping type. Further interesting points are the introduction of the solid forged and rolled disk wheel, the adoption of high tensile steel for drawgear and the tendency to replace ordinary types of couplings with automatic couplers. (X.)

V. SIGNALLING

Since 1910 railway signalling (*see* 25.73) has made great strides and is now a very important part of a railway organisation. The modern signal engineer must be not only a mechanical but an electrical engineer, as both these branches of engineering play a most important part in the schemes of signalling as practised at the present time.

Mechanical Signalling.—There have been important evolutions in so far as the semaphore is concerned; the lever frame, however, remains much as it did in 1915. The system of tappet locking is in vogue in England; the so-called duplex locking is very little used, the locking being direct on the catch handle or in some instances on the lever only. The locking trays are usually fixed to the frame under the cabin floor and at an angle of 45° to 60° from the horizontal, in order to be more accessible. In Europe and America as well as the British Dominions and Colonies the same type of interlocking frame is used as in England, in so far as the general design and principles are concerned.

Semaphore Work.—The semaphore or fixed signal arms which inclined downwards to an angle of 60° for the clear position as shown in fig. 1 are gradually being superseded by those whose arms incline upward to 45° and 90° above the horizontal. The old type of semaphore is known as the "lower quadrant" and the new the "upper quadrant two-position and three-position." (See figs. 2 and 3.)

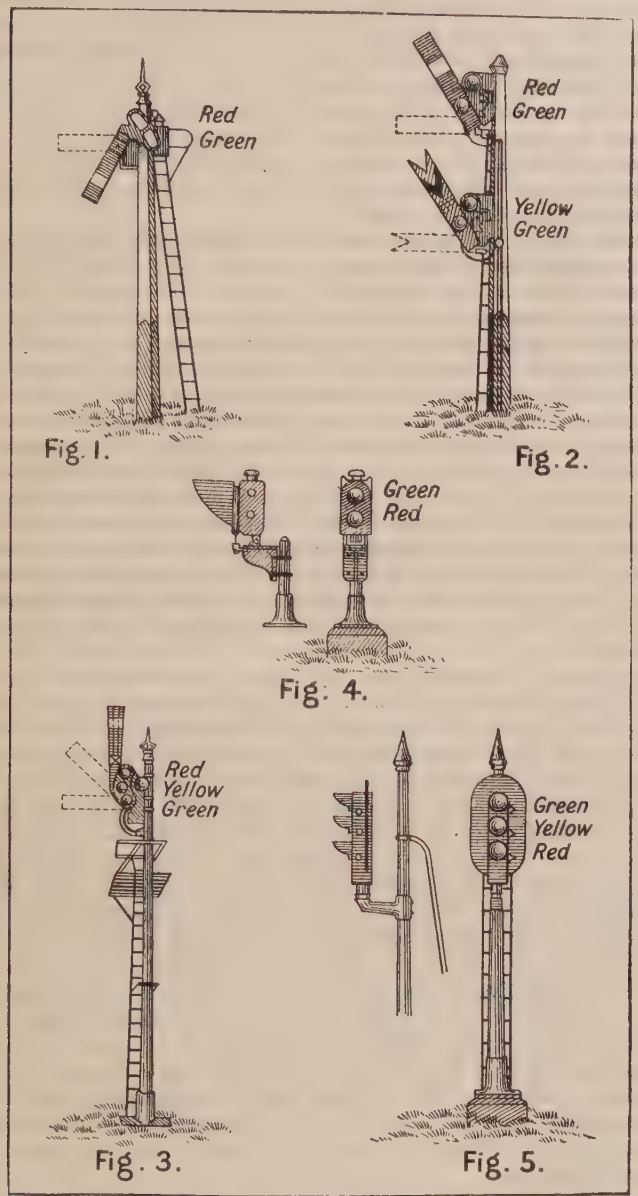

FIG. 1.—"Lower Quadrant" semaphore. FIGS. 2 and 3.—"Upper Quadrant" semaphores. FIGS. 4 and 5.—Types of light signals.

Where the two-position upper quadrant is in use, it is the general practice to fix below it, if the block sections are short, the distant signal of the home signal in advance as shown in fig. 2, but where three-position upper quadrant signals are used, this arrangement of the distant signal is not necessary.

The first mechanical two-position upper quadrant signals used in the British Empire were on the railways of the Transvaal and Orange river in South Africa in 1902. Mechanical semaphore signals in England are still moved to the clear position by means of one wire, but in many other countries, particularly in Europe, two wires are used, one to pull the signal to the clear position and the other to return it to the danger or horizontal. In America, home and starting signals are operated by rodding, and distinct signals by two wires.

Operation of Points.—Mechanically operated facing points are moved by rodding as in the past, but they may now be 300 yards away from the signal cabin or lever frame. Formerly they could not be more than 250 yards away. Points are now operated by double wires in Europe as well as in some of the British Dominions and Colonies.

Rodding transmission has been much improved in late years by the introduction of roller or ball bearings for cranks, compensators, rod rollers and chain wheels.

Electrical Work.—Safety electrical features are now added to mechanical installations. These are (1) a system of route locking to hold a certain set of points, as at a junction, until the train has passed over the facing points and is beyond the clearance point, (2) electrical disengagers which automatically set the signal to danger by the passing of a train, (3) electrical detection of facing points, which indicates in the cabin when the points are properly in position and bolt locked, (4) the use of track circuits in place of mechanical locking bars.

Power Signalling.—Power signalling such as the "All Electric" and the "Electro-pneumatic" are now very important in railway signalling. By its use points and signals can be operated a much greater distance from the cabins and very much faster. It is possible to close certain mechanically operated cabins, and in place of them operate from one centrally located power installation—with economy in operation and a more efficient service. By the use of track circuits and electrical controls on signals and points, and an illuminated diagram in the cabins, it is not essential that the signalman should have a view of the trains running over his section.

Automatic Signalling.—Automatic signalling has enabled engineers to increase their track capacity by 20% to 30% and to operate trains more cheaply than by the old system of lock and block, because by it many cabins may be eliminated. Automatic signals may be of the 2 and 3 aspect semaphore signals or the 2 and 3 aspect light signals. The fourth aspect is receiving some attention by signal engineers, and will no doubt soon be a standard on railways where traffic is dense.

Light Signals.—Light signals (figs. 4 and 5) can be seen as well in bright sunshine as at night. The long range signal for country districts has a special stepped lens 8 in. in diameter and is illuminated by a low voltage electric lamp with a special filament. The low range signal, as used for underground railways or in long tunnels, usually has a 6 in. stepped lens and the same type of lamp.

Light signals are much cheaper to instal and operate than mechanism semaphore signals and, their visibility being better than that of semaphores, they are being largely installed in the Dominions, Colonies and to some extent in England, and very largely in the United States of America.

Track Circuiting.—Track circuiting has become a necessary feature for power and automatic signalling, the most modern track circuits employing alternating current. By using this source of power, dangers from stray currents are almost entirely eliminated. (R. F. M.*)

VI. ELECTRIFICATION

Electrification.—Economic conditions during and following the War period emphasised to those countries poor in fuel supply their utter dependence on foreign countries for the fuel necessary for steam railway operation. Immediately after the Armistice many European countries decided to electrify their trunk lines without delay, and rapid strides are being made toward electric operation in such countries as France, Switzerland, Austria, Germany and Czechoslovakia. The advantages of railway electrification, the elimination of smoke, dirt and steam in tunnels and terminals, the increased capacity of track and the multiple unit feature of operation, are still important factors in favour of electrification, sometimes one and sometimes another being the controlling one.

The argument over the question of the best system to be used for electrification, which for many years retarded electrification, has been settled in many of the countries of Europe, either by governmental decree or by a mutual agreement of the railroads. In the United States of America, however, where so much has

been done to develop both the continuous-current and the single-phase systems, the question is still unsettled. So many factors enter into the problem, the data as to first cost and operating costs are so conflicting and the relative values of the advantages possessed by the different systems are still so much a matter of opinion, that thus far no body of engineers has been able to make a decision on the subject that could be universally accepted. Local conditions and engineering, commercial and political considerations, all affect the decision in any particular locality, so that in America each railroad has thus far decided the question for itself.

Systems in Use

There are three systems in general use for the electrification of railways, depending on the kind of current used: 1. The three-phase alternating-current system. 2. The single-phase alternating-current system. 3. The continuous or direct-current system. Each one has some advantage that appears to outweigh any possible handicaps or disadvantages that it may have.

The Three-phase System.—The three-phase system was the first real factor in trunk-line electrification, because when it first appeared there was no continuous-current railway in operation using more than 750 volts, universally admitted to be unsuitable for trunk-line work, and the single-phase motor had not yet been born. To Dr. Koloman von Kando of Budapest belongs the credit for the development of the three-phase system. It is used extensively and successfully in Italy, but in spite of the excellence of the equipment and the fine work that is really being done by over 400 three-phase locomotives, the verdict of the rest of the world seems to be against it. Engineers were attracted to it initially by the three-phase induction motor and the alternating-current transmission. The induction motor could be wound for the full line potential of 3,000 v. selected, and it had what appeared at that time to be the great advantage of a motor without a commutator. Alternating current on the trolley permitted the use of simple transformer substations which required no attendants.

The chief objections to the three-phase system lie in the double overhead contact lines which become very complicated in yards, limiting the potential to the order of 3,000 or 4,000 volts, and in the constant speed characteristics of the three-phase motor. The complications of the double-contact system are apparent, although they may easily be overestimated. The potential of 3,000 volts in general use is too low for an alternating-current system carrying heavy loads because the inductive drop in the lines causes too much fluctuation in line voltage unless very frequent transformer stations are used.

The constant speed, especially where each locomotive has two or three such speeds, is well suited to some classes of service but not to others. It facilitates adherence to schedules regardless of train load and grades. On the other hand there is danger of unequal division of load between motors, especially where a number of motive-power units are operated in the same train. Driving-wheel diameters must be maintained at the same diameter or the motors operated with resistance in the circuit. It is inflexible and gives a very bad load factor on a line where the grade changes frequently, since for any speed the load varies almost directly with the grade. On the other hand it has a special advantage in grade work, since in descending a grade the motors automatically become generators and the locomotive holds the train at a uniform speed by "regenerating" power which is returned to the line.

The Single-phase System.—The predominating advantage of the single-phase system lies in its utilisation of a single overhead contact wire from which alternating current at high potential may be collected. The prevailing potential in Europe is 16,500 volts, while in the United States of America 11,000 volts predominates with two trial instances of 22,000 volts. These voltages are so high that very little copper is required in the distributing circuits and the sub-stations require simply lowering transformers which may be, and usually are in modern installations, of the outdoor type. The single-phase system was made possible through the invention by the late Benjamin G. Lamme of the low-frequency series compensated commutator type single-phase motor. On this motor or its modifications the system has always depended.

Single-phase Commutator Type Motors.—From the very nature of things, this is a difficult type of motor to build. Having an alternating field, the entire magnetic circuit must be laminated. In order to secure a good power factor, a small air gap and a compensating winding are essential. To avoid heavy transformer currents under the brushes at starting, which cause bad sparking and burning, the magnetic flux in the pole must be limited to a low value or resistance leads used between the armature winding and the commutator bars. All of these features combine to make a complicated construction with relatively large dimensions, great weight, low efficiency and high initial and maintenance costs.

With these limitations understood, thoroughly satisfactory and reliable motors have been developed. The difficulties decrease rapidly as the frequency is reduced. The standard frequency adopted for electrification in European countries is $16\frac{2}{3}$ cycles per sec., as originally suggested by Lamme, and is suitable only for railway electrification. In America the low-frequency gained little support and the frequency of 25 cycles, the lowest standard frequency in use, was adopted for the single-phase railway. Aside from the motor, the single-phase car or locomotive is comparatively simple in view of the fact that transformer tapping is used for speed regulation. While the commutator-type motor is still considered the "first line of defence" and is used exclusively for multiple unit car equipments as well as for many locomotives in all classes of service, both the three-phase induction motor and the low-voltage continuous-current motors are used on locomotives under the single-phase trolley in the United States.

Split-phase Systems.—The three-phase induction motor when on what is known as the split-phase locomotive gives all the characteristics of the three-phase locomotive. It runs at a constant speed and regenerates automatically on descending grades. It avoids the complicated double overhead contact system but adds to each locomotive a rotating-phase converter by means of which three-phase current is obtained for operating the motors. Split-phase locomotives are used on the Norfolk & Western and the Virginian railways, two parallel lines from the coal fields of West Virginia to the seaboard. These locomotives are used for hauling heavy coal trains. The locomotives for the Virginian railway undoubtedly exert the greatest tractive effort of any locomotives in the world. Two locomotives, each capable of developing a tractive effort of 270,000 lb., move a train of 6,000 tons (2,000 lb. each) up a grade of 2% at a speed 14 m. per hour. In this class of service, the split-phase locomotive is notably successful. The constant speed characteristic, with the automatic regenerative braking, is very satisfactory, increasing both capacity of the line and safety of operation over those of steam operation.

Motor-generator Type.—The low-voltage continuous-current motor is used on what is known as the motor-generator type of locomotive, as an alternative to the split-phase for heavy freight work and to the single-phase locomotive in all classes of service. The motor-generator type really combines the best features of both the direct-current and the single-phase alternating-current systems. It utilises the direct-current series motor at its best for driving the locomotive and the high-potential single-phase trolley for its power supply. A lowering transformer and a motor-generator set consisting of a single-phase synchronous motor and a direct-current generator connect these two. Other advantages of this type of locomotive are:—Voltage control of the generator for acceleration and speed by varying the field of the motors to give constant output of the generator; the ability to regenerate within the capacity of the generator at practically any speed down to standstill; and high line-power factor. It will be noted that both the split-phase and the motor-generator type locomotives really carry rotating sub-stations whose losses are added to that of the traction equipment.

The Continuous or Direct-current System.—The direct-current series motor is particularly well adapted to railway work by its variable speed characteristics and by its simple and rugged construction, its relatively light weight, small dimensions and high efficiency and comparative cheapness both in first cost and in cost of maintenance. About 1905 the direct-current system was limited to practically 600 volts. Large amounts of feeder copper were required in the line. The current that could be collected successfully from the overhead wire was limited to 300 or 400 amperes. Frequent sub-stations with motor-generator sets or synchronous converters were required, each with its attendants and, except in services with frequent trains, with a low load factor and consequent low average efficiency.

Under modern conditions voltages of 1,200, 1,500, 2,400 and 3,000 are in regular use with a single overhead contact line. With automatic sub-stations attendants are practically eliminated; sub-station machines are shut down when not needed; efficiency is increased and by spacing sub-stations at frequent intervals a great reduction in the amount of feeder copper required is effected. High-speed circuit breakers in sub-stations, by inserting a resistance in the circuit, minimise the damage resulting from short circuit on line or equipment. Owing to improvements in overhead construction and in current collectors, very heavy currents of as high as 5,000 amperes for experimental work and of 1,000 to 2,000 amperes are collected on the Chicago, Milwaukee & St. Paul Railway and elsewhere.

The steel tank mercury vapour converter is gaining ground for sub-stations, especially for higher voltages. This eliminates rotating machinery from the sub-stations, and has a very high average efficiency. It can take alternating current at any commercial frequency and convert it to direct current. It has been applied extensively for railway sub-stations in Europe.

The higher voltages increase the weight and cost of motors and the complications of the control equipment, particularly for voltages over 1,500, so that it is desirable, where the cost of motive-power equipments predominates in an electrification project, to use the lowest voltage that is feasible from the standpoint of current collection, especially for congested service. The mercury vapour converter, the high-speed circuit breaker and the heavy current-collecting devices have greatly increased the possibilities of the lower voltages.

A direct current of 1,500 volts has special advantages for congested service and has been adopted as standard by Great Britain, the Netherlands, France, Japan and Czechoslovakia, as well as by the Illinois Central Railroad in the United States of America. For long lines, however, with relatively infrequent trains and for very heavy trains, 3,000 volts seems to be the favourite for direct current electrification and has been adopted with notable success for several electrifications in the United States, Brazil, Chile, Spain, Mexico and South Africa. The first one of these, the Chicago, Milwaukee & St. Paul Railway in the United States has the longest route mileage electrified of any railway in the country. It crosses five mountain ranges and uses regenerative braking with excellent results. With direct current, regenerative braking may be utilised at practically any speed.

Mechanical Design of Locomotives

Drive.—A great many radical schemes have been employed for the transmission of motor torque from the driving motors to the wheels. The type of drive and the locomotive arrangement are very largely governed by the type of motor used. The direct-current motor may be used with any known type of drive. It is usually applied, however, with one motor for each driving axle, utilising either direct gearing, a gearless arrangement or some system by which the entire motor weight is spring-borne.

Both the single-phase and the three-phase motors have their limitations. The dimensions and weight of the single-phase motor—except in very small sizes—make it imperative to have the entire weight of the motor spring-borne. It is, therefore, applied either with some form of quill drive or by the use of direct or geared side-rod drive. In the case of three-phase, it is very desirable to reduce the number of motors per locomotive to a minimum. For this reason the three-phase motors have been applied exclusively with scotch yoke or side-rod drive, either geared or gearless.

Wheel Arrangement and Cab Structure.—The wheel bases and wheel arrangement of locomotives depend very largely on the type of motor and the form of drive. There are two general wheel arrangements: (*a*) a rigid frame similar to steam locomotives, with or without guiding trucks, and a cab mounted rigidly on the frame; (*b*) an assembly of two or more trucks, each with its equipment of motors, supporting a cab containing the control equipment, etc. This type is used both with separate swivel trucks like a car or with articulated trucks, the truck frames being coupled together.

The rigid-frame type has the advantage of simplicity but generally has a long rigid-wheel base. The truck type of construction has the advantage of much greater flexibility for curving and in providing better carrying springs.

Power Supply.—This varies greatly according to the local conditions in each instance. In the past a great majority of railroads have produced their own power, but for the future the tendency is toward the purchase of traction power from central station networks. This means that for the alternating-current systems a frequency for the railroad load is desirable that is an even multiple of the accepted distribution frequency. In Europe this has been secured by the adoption of 16⅔ cycles, or one-third of the standard 50-cycle system in general use. In the United States the ratio of 60 to 25 is not so satisfactory.

Diesel Electric Locomotives.—There was in 1926 very important development in progress in the application of the Diesel oil engine to rail cars and locomotives, both in Europe and in America, and several locomotives have been built with engines of 1,000 to 1,200 H.P. capacity. The favourite method of connecting the

Table of World Electrification Giving Total No. of Locomotives and Electrified Route Distance in Each Country

Country	Voltage	A.C.[1] or D.C.	No. of Locomotives	Route Distance Approx.	
				Miles	Km.
Argentina	800	D.C.	2	19	30
Brazil	3,000	D.C.	21	73	118
Canada	2,400	D.C.	3	7	11
	3,300	25 cy.	6		
Chile	3,000	D.C.	39	100	160
	2,400	D.C.	3		
Mexico	3,000	D.C.	10	15	25
United States	600	D.C.	131	..	..
	2,400	D.C.	28	..	..
	3,000	D.C.	103	1,300	2,100
	11,000	25 cy.	180	..	..
Austria	6,600	25 cy.	14	540	860
	15,000	16⅔ cy.	67	..	..
England	1,500	D.C.	11	..	..
	600	D.C.	20	485	776
	6,600	25 cy.	..	..	..
France	600	D.C.	35	620	990
	1,500	D.C.	331	..	..
Germany	6,000	25 cy.	1	498	792
	15,000	16⅔ cy.	245	..	..
Holland	1,100 to 1,200	D.C.	..	113	..
		D.C.	68	175	296
	600	D.C.	10	..	..
Italy	3,000	16⅔ cy.	..	..	..
	..	3 ph.	464	870	1,400
	10,000	45 cy.	34	..	..
Norway	16,000	16⅔ cy.	43	120	195
Spain	3,000	D.C.	12	39	63
Sweden	16,000	16⅔ cy.	114	715	1,150
Switzerland	15,000	16⅔ cy.	208	..	..
	3,000	15 cy. 3 ph.	7	840	1,340
Australia	600	D.C.	2	..	..
	1,500	D.C.	2	155	250
Japan	1,500	D.C.	90	325	525
Java	1,500	D.C.	6	15	25
New Zealand	1,500	D.C.	5	5·6	9
South Africa	3,000	D.C.	78	113	180

[1] A.C. = alternating current; D.C. = direct current; cy. = cycles; ph. = phase.

engine to the drive wheels seems to be by means of an electric generator and railway motors. This offers the most flexible and reliable means by which the speed and tractive effort may be varied to suit the conditions.

The Diesel electric system seems to be well suited for use on rail cars, where engines of 250 to 400 H.P. are required, and on slow-speed locomotives used in switching and freight service. The advantages of this type lie in fuel economy, comparative freedom from smoke, dirt and noise and in greater availability for service, it should prove to be a strong auxiliary in the electrification of the steam railways.

General.—The table on p. 293 contains a summary of the principal main line railroad electrifications of the world as they were on Jan. 1 1926. Multiple-unit car equipments are used extensively on the electrifications in Great Britain, Australia, Japan and the United States of America, and almost all of the suburban passenger traffic on the electrified railroads in the cities of London, New York, Philadelphia, Tōkyō and Melbourne is handled by such equipment.

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RAILWAY STATIONS (*see* 22.839).—The completion of the Pennsylvania (New York) and Grand Central (New York) stations, in 1910 and 1913 respectively, marked the most important epoch in the history of passenger station design. It witnessed, for cities of major importance, the passing of the old style single purpose passenger station buildings, the introduction of dual purpose buildings in locations where land values were high, and the intensive development of the so-called "air rights," thus permitting of expenditures not warranted from a purely railway operating viewpoint.

Both these stations were designed for electric operation, insuring the elimination of the smoke and gas incident to steam-operated layouts and permitting the tracks to be depressed and covered over, with the consequent practicability of the utilisation of space over the yard for private and public buildings. While the advantages of electrification have been demonstrated in the operation of these stations, recent developments in passenger station design and operation seem to have proved that many features first introduced in the electrified stations mentioned can, with proper design, be duplicated in steam operated layouts. This is particularly true of the Chicago Union station, a project which had its inception about 1910, but was completed only in June 1925.

Chicago Union Station.—As this station is the latest and one of the most interesting of all large stations, it is described here in some detail. It serves as a terminal for four railways—the Chicago, Burlington and Quincy; the Chicago, Milwaukee and St. Paul; the Pennsylvania system (these three as owners) and the Chicago and Alton (as tenant). Like the Grand Central station, the Chicago Union station is designed to serve two purposes: as a station and as an office building. It is the only station in America of major importance where passengers and baggage are handled on separate platforms, an arrangement making it possible to dispense with baggage elevators between the different trucking levels, these being connected by ramps. It embodies the most complete facilities for handling mail of any railway station in the world. Its design is marked by an entirely new type of train shed and an ingenious arrangement of interior driveways and platforms which make the use of the city street space unnecessary in the handling of mail and passengers' baggage. It is also one of the few large passenger stations in the world where the waiting-room, the concourse and the platforms are on the same level.

The over-all dimensions of the station proper, or head house, are 320 ft. by 372 feet. The main waiting-room occupies the central court. Because of the necessity of carrying the streets over the tracks, the floor of the main waiting-room is depressed below street-level, thus securing the advantages of a common level for the station and the tracks. Necessary inequalities of level are taken care of by almost imperceptible slopes in the floor of the concourse between track grids. While the design of the station provides for greater ultimate development of railway land than any similar project ever undertaken, only eight stories of office building over the station have been completed as yet. Ultimately the office structure will be carried up to a total height of 25 stories. The design is such that there is a complete segregation of station and office functions in the building, this being accomplished by the depression of the station facilities below street level, the use of six steps up from street level to the office building loggias and the provision of entrances to the office building as remote as possible from the entrances to the station. The office building loggias open into entrance lobbies at the ends of the waiting-room; the lobbies are at an elevation of about 14 ft. above the level of the waiting-room floor, giving the effect of balconies. The station is the only double stub layout in the United States, the tracks being arranged in two groups separated by the concourse. The tracks vary in capacity, accommodating 7 to 18 car trains, the track group to the south having a capacity of 191 cars, and the group to the north a capacity of 141 cars. Through tracks, east of the station tracks proper, provide connection between the two groups. This arrangement also provides access to the mail terminal tracks for trains or cars entering or leaving the station by either of the two—north and south—approaches.

A feature of the station track layout is the provision of a platform on each side of each track. Alternate platforms are used by passengers and for baggage handling. This permits giving platforms the elevations best suited to their particular uses. However, the chief advantage of the separate platforms for baggage and passengers is direct access from the baggage platforms to the baggage-room (located in the basement level) by means of ramps sufficient in width to permit the operation of baggage trains in both directions—up and down—simultaneously.

The mail terminal building is 75 ft. wide and 796 ft. long; it encloses 11 ac. of floor area and has a cubical content of 8,500,000 cu. ft.; it was designed to handle 3,000 tons of mail in 24 hours. It is distinguished by its mechanical equipment, including 65 conveyer belts totalling seven m. of belting, overhead trolley conveyer systems, spiral chutes and other devices which provide for the elimination of manual labour in the handling of mail.

The train shed provided in this layout is of an entirely new type, designed to give adequate protection from the weather, to give more than the usual headroom found in low-type sheds, and to keep the trucking platforms free from supporting columns. This involves a transverse span of nearly 50 feet. To avoid deep transverse girders to carry the roof load a heart-shaped truss was developed. With the use of such trusses over each column it was possible to secure the desired headroom, particularly efficient lighting and ventilation, and a shorter effective span of the transverse girders. To keep the passenger platforms as free as possible from obstructions, the supporting columns for the roof were spaced at nearly 42 ft. centres. A smoke slot over the centre of each track placed at a height to clear the stacks of locomotives allows the smoke and gas from engines to be dissipated into open air.

TABLE I.

Station	No. of tracks	Trains per day	Passengers per day
Grand Central, N.Y.	25	418[1]	100,000
Pennsylvania, N.Y.	21	558[1]	101,400
South, Boston	28	660	120,000
Union, Chicago	24	300	65,000
Leipzig	26	400	85,000
St. Lazare, Paris	31	1,200	250,000
Liverpool St., London	20	1,018	242,000
Waterloo, London	21	1,261[2]	140,000
Northwestern, Chicago	16	314	74,700

[1] Normal.
[2] Normal winter service (1925–6). The number is greatly increased in the summer.

British Railway Stations.—In Great Britain very little was done during the period under review (1910–26) in the way of building new railway stations; consequently no English station is included in Table II. The most considerable undertaking was the replanning and enlarging of Waterloo Station, London, the headquarters of the Southern Railway, which was opened formally by H.M. Queen Mary on March 21 1922. The platforms are about 700 ft. in length, of which 540 ft. is under cover. The area covered is 560,000 superficial feet. 1,000 tons

TABLE II.

Station	Date completed	Dimensions of main building	Cost[1]
Washington, D.C.	1907	663x211 ft.	$120,000,000
Pennsylvania, N.Y.	1910	430x784 "	115,000,000
North-western, Chicago	1911	320x218 "	24,000,000
Grand Central, N.Y.	1913	673x301 "	150,000,000
Ottawa, Canada	1912	281x141 "	..
Michigan Central, Detroit	1914	345x266 "	7,000,000
Kansas City	1914	510x150 "	55,000,000
Havana, Cuba	1914	240x80 "	400,000
Buenos Aires	1916	700x604 "	..
Tokyo	1914	1,083x132 "	1,400,000
Leipzig	1915	984 " (Frontage)	32,130,000
St. Paul, Minn.	1922	315x220 ft.	20,000,000
Union, Chicago	1925	320x372 "	75,000,000

[1] Includes entire cost of terminal development.

of glass and about 60 m. of metal glazing bars, weighing 95 tons, were used. The reconstruction scheme involved the clearance of a large area and the rehousing elsewhere of the population. The main "A" signal box is one of the largest in the world, and about 24,000 lever movements are performed every 24 hours. The traffic is both steam and electric.

Leipzig Station.—The Leipzig (Germany) station, completed in 1915, has a frontage of 984 ft. and occupies an area of 172,000 sq. feet. The train shed has a high roof of steel and glass, built in the form of six arches; it is 785 ft. long, with an area of 710,500 square ft., and covers 26 tracks. The station serves as a junction for the passenger traffic of Magdeburg, Thuringia and Dresden, and the larger part of the traffic between Prussia and Saxony passes through it. The Leipzig station is the largest, though not the busiest, station in Europe. It is smaller than the Grand Central and Pennsylvania stations in New York, and handles considerably less traffic than the Gare St. Lazare (Paris), the busiest station in the world.

Retiro Station, Buenos Aires.—The Retiro station of the Central Argentine railway at Buenos Aires, said to be the finest station in South America, was opened in the latter part of 1915. The terminal, including buildings, train sheds and approaches, occupies 744,000 sq. ft., and in point of size and design compares with any of the newer stations elsewhere.

Tokyo Central Station.—The Central railway station in Tokyo, completed in 1915, was erected at the very small cost of $1,400,000; in the West it would have cost 10 or 20 times as much. The explanation lies in the extremely low price paid for Japanese labour, 20 cents a day (of 10 to 12 hours) for common labourers, and $25 a month for carpenters and masons. Estimated in days' labour, the cost was 730,000 labourer-days. The main building is of brick and granite, 1,083 ft. long, 66 to 132 ft. wide and 54 ft. high, with a dome (152 ft.) at either end. The terminal took the place of three stations which formerly served the three main-line Government railways. (J. G. L.)

RAKOVSKY, CHRISTIAN GEORGIEVICH (1873–), Russian politician and diplomat, of Bulgarian descent and Rumanian nationality, was born Aug. 13 1873 at Kotel, Bulgaria. His father's home in the Dobruja passed after the Russo-Turkish War to Rumania and the family became Rumanian. Rakovsky's Bulgarian ancestors, especially his grandfather, had organised risings against the Turkish rule, and the revolutionary traditions of the family were revived in Christian Rakovsky. His revolutionary career began in his college days, when in 1890 on account of his socialist activities all schools in Bulgaria were closed to him. He therefore went to Geneva, where he joined the International Social Democratic Student movement and came in contact with Plekhanov and other Russian Social Democrats; and also to Germany, where he met Liebknecht. He was expelled from Prussia in 1894; went to France, where he graduated as a doctor of medicine at Montpellier, and wrote his famous thesis on *The Etiology of Criminality and Degeneration* (1897), upholding the Marxian conception of crime as a result of economic conditions, in opposition to the Lombroso theory of the atavistic criminal type. He also studied law, and took an active part in political journalism. Returning to Bulgaria, he recommenced revolutionary activities, and in *Russia in the East* (1898) denounced Tsarist politics. In 1900 he served his term as an officer in the Rumanian Army. During the peasant riots of 1907 he was expelled from Rumania, his title to Rumanian citizenship not being considered adequate, and his civil rights were only restored in 1912. The five years of Rakovsky's exile were interrupted by illicit homecomings and consequent labour troubles; the question of his citizenship became a *cause célèbre*, political parties being sharply divided on the issue, and the whole of the Radical press in Europe supported his claim.

After Rumania entered the World War Rakovsky was arrested and imprisoned in various places, and finally at Jassy, whence he was released by the Russians on May 1 1917. Kerensky's Government was hostile to him, and it was not until after the Soviets came into power in Nov. that he joined the Government. Rakovsky had lived in St. Petersburg in the past, and but for the persecution of the Tsarist government would have settled there. He was well known as a writer on political and economic subjects under the pen name of "Insarov," and a number of his books were written and published in Russia (*Modern France*, 1900; *Metternich and His Time; Turkey and Macedonia*, etc.).

Rakovsky's diplomatic career began with his appointment as head of the delegation entrusted with the peace negotiations with the Ukrainian Central Rada. In 1919 he was appointed President of the Soviet of People's Commissars of the Ukraine, and in 1922 represented Russia at the conference of Genoa. In 1924 he was the Soviet chargé d'affaires in London, and as such negotiated a treaty between the Soviets and the British Labour Government. The treaty, however, was subsequently rejected by the succeeding Conservative administration. In 1926 he was appointed Soviet ambassador to France, and became a member of the Central Committee of the Council of the People's Commissars. (Z. V.)

RAMON Y CAJAL SANTIAGO (1852–), Spanish histologist, was born May 1 1852 at Petilla de Aragon (Pamplona). He graduated at the University of Saragossa, and went in 1881 as professor to the University of Valencia, and in 1886 to Barcelona, publishing in 1889 his first important work (*Elementos de Histologia normal y de Técnica Micrográfica*). In that year he discovered "the laws which govern the morphology and the connections of the nerve cells in the grey substance." In the years 1890 and 1891 he discovered the primary changes of the neurin, and the genetic unity of the nerve fibres and the protoplasmic appendices. During this period of his career he discovered the axis cylinder of the fibres of the cerebellum and their continuity with the parallel fibrillae of the molecular covering, formulated the principle of the dynamic polarisation of the neurins, aided by Van Gehuchten, and worked upon the analysis of the sympathetic ganglia. In 1892 he took the chair of normal histology and pathological anatomy in the University of Madrid. In 1894, on the invitation of the Royal Society of London, he developed systematically his views on morphology and connections of the nervous cells of the spinal medulla, ganglions, cerebellum, retina and olfactory bulb. In 1899 he was called upon by the Clark University (Worcester) to give an exposition of his investigations regarding the cerebral tegumen, and in 1900 the International Congress of Medicine, which met in Paris, gave him the Moscow International Award. He was awarded half the Nobel Prize for medicine in 1906. His work in three volumes, *Histologie del Sistema Nervioso de Hombre y de los Vertebrados*, appeared between the years 1897 and 1904. In May 1922 he was exempted, on account of long service, from his duties in connection with the chair which he held, and, on the initiative of the Government, he founded the Cajal Institute in Madrid.

RAMPOLLA, COUNT MARIANO DEL TINDARO (1843–1913), Italian cardinal (*see* 22.877), died in Rome Dec. 17 1913.

RAMSAY, SIR WILLIAM (1852–1916), British chemist (*see* 22.880), died at High Wycombe, Bucks., July 23 1916. In 1904 he was awarded the Nobel Prize and in 1911 was president of the

British Association. In 1913 he resigned his professorship of chemistry at University College, London.

RAMSGATE, England (*see* 22.881), with a population in 1921 of 36,560 and an area of 2,306 ac., retains its picturesque features, though it is a growing place. The district beyond the West Cliff is being developed as a western suburb, and the parade nearly reaches Pegwell. Eastward it has been carried as far as East Cliff Lodge, and the cliff above laid out as gardens. A western undercliff promenade was opened in 1925, and there is a concert hall below the West Cliff promenade. Extensive measures of cliff protection have been necessary both east and west of the town. Fifty acres of land were bought for a recreation ground in 1924, and the site and money for another were given in 1925. A gun from a German submarine has been placed in Nelson Crescent, and a War Memorial erected in Albion Gardens. Chatham House, a Canadian hospital during the War, has been bought by the county education committee, and is used in part as a county school.

During the War a large aerodrome was established at Manston, two miles from Ramsgate. Both railway stations are to be closed, and a new station built at St. Laurence; 1½ m. of line, to connect with the line to Broadstairs, will be constructed and the present branch to Margate and part of the line to the Harbour Station closed. During the War 93 bombs were dropped on Ramsgate. Considerable damage was done, but casualties were light.

RANDEGGER, ALBERTO (1832–1911), Italian musical composer and conductor, was born in Trieste April 13 1832. He studied piano under Lafont and composition under L. Ricci. After conducting opera at Fiume, Venice and other Italian towns, he settled in London in 1854. He became professor of singing at the Royal Academy of Music in 1868 and at the Royal College of Music in 1896. He was conductor of the Carl Rosa Co. from 1879 to 1885 and conducted the Norwich Festivals 1881–1905. Randegger, who died in London on Dec. 18 1911, did much towards the popular revival of opera in England. His works include *Bianca Capello* (1854, opera) *The Rival Beauties* (1864 comic opera); a setting of the 150th Psalm; *Fridolin* (1873, dramatic cantata); and also a valuable *Primer on Singing.*

RANGE-FINDER (*see* 22.888).—Range-finders or position-finders, as they are sometimes called, are used both in land and sea warfare.

I. MILITARY RANGE-FINDERS

The range-finder usually consists of two main parts, viz.: a strong outer tube and an inner frame which supports the delicate telescopic system, any slight derangement of which would seriously upset the accuracy of the range-finder. The outer tube is made as strong and rigid as possible, having regard to the weight which can be allowed. The inner frame is supported in such a way that any slight bending of the outer tube will not affect it.

Some form of double end reflector is always used. This at one time consisted of a pentagonal prism, but large pentagonals are very costly; they absorb a good deal of light and are liable to slight distortion with changes of temperature. There is therefore a tendency to replace them by a combination of two silvered plane mirrors inclined to one another at 45°, and either fixed in a mount made of a metal having the same coefficient of expansion as glass, or rigidly attached to an upper and lower glass support, to prevent change in their relative positions.

The central reflectors usually take the form of two or more prisms balsamed together, and are known as the centre prism combination. Their object is to deflect the rays received through the two ends of the range-finder into the eye-piece, and to present the two images of the target in the field of view immediately above and below a thin separating line.[1]

Stereoscopic Range-Finders.—The principle of the stereoscopic range-finder is entirely different. Stereoscopic range-finders have not found much favour in the British services; but they have been extensively used by the Germans. Speaking generally, a stereoscopic range-finder contains the elements of a stereoscopic telescope rigidly mounted in a tube. It is very similar in outward appearance to a coincidence range-finder with two eye-pieces. Objects viewed through a stereoscopic range-finder are seen to stand out in stereoscopic relief; and it is comparatively easy for the observer to judge their relative distances. The actual distance of a target is obtained with the assistance of one or more marks which are seen in stereoscopic relief in the field of view. By means of suitable optical arrangements the stereoscopic relief of either the objects in the field of view or of the mark can be varied until the target and mark appear to the observer to be the same distance away from him. The range of the target can then be read off a range-scale attached.

[1] A very complete account of the construction and accuracy of this type of range-finder will be found in vol. 4 of the *Dictionary of Applied Physics.*

For Coast Defence

Coast defence range-finding instruments may be divided into classes, depending upon the nature of their bases, as follows:—

1. Depression instruments, having vertical bases (either range-finders or position-finders) the accuracy of which depends upon their height above the sea-level. It is usually considered that, to obtain ranges with an error not exceeding 1%, 100 ft. of height is required for every 5,000 yd. of range. All that the range-taker has to do is to keep a cross wire in the telescope of his instrument laid on the water line of the target.

2. Instruments having a fixed horizontal base (usually position-finders). Each usually consists of two instruments installed at the ends of a base which may be several thousand yards in length, the length required depending upon the range and arc of fire of the gun for which the instrument has been installed. The instrument at one end of the base is known as a transmitter and usually consists of a telescope mounted above an azimuth circle. It measures the bearing of the target and transmits it to the instrument at the other end of the base which is known as the receiving instrument. The bearings may be transmitted by telephone; or, as the telescope is traversed, electric impulses may cause some portion of the receiving instrument, *e.g.*, a metal arm or a dial, to move automatically. The receiving instrument is usually an accurate, solidly constructed plotter, made to a certain scale, *e.g.*, 500 yd. to an inch. In its simplest form it would consist of a base plate upon which two straight arms were pivoted, the relative positions of the pivots being, to the scale of the instrument, the same as those of the transmitter and receiving instrument. The first arm would be kept set to the azimuth angles received from the transmitter, and the second arm would be kept in line with the target by means of a telescope attached to it. The point where the two arms intersect would represent the relative position of the target. The arms being graduated in ranges and moving over azimuth scales, the range and bearing of the target from either end of the base could be read off. By means of a third arm, pivoted to the base plate in the position representing the position of the gun, the range and bearing of the target from the gun could be ascertained if the arm were brought above or below the point of intersection of the two other arms.

3. One-man range-finders used for coast defences are constructed on the same general principles as those used in the field; but, as their weight and size need not be limited to the same degree, many modifications to make them as accurate and convenient as possible are introduced. Their base lengths are usually between 9 ft. and 10 metres, but even longer bases have been considered. They are practically always of the coincidence type with both fields erect.

The Mark III. Depression Range-finder will be taken as a type of a depression instrument. In this range-finder the range-finding triangle is reproduced in the instrument on a small scale. Fig. 1 shows diagrammatically how this is effected by means of two arms.

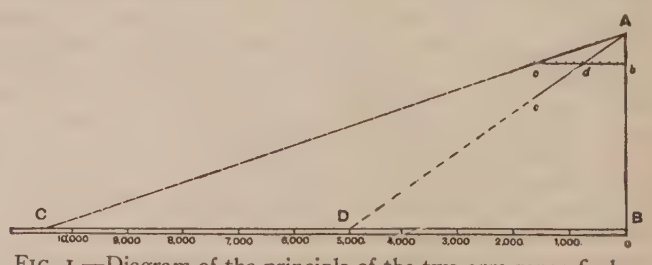

FIG. 1.—Diagram of the principle of the two-arm range-finder.

AB represents the height of the axis of the telescope above the surface of the sea BC. Ab represents the distance between the pivot of the telescope arm Ac and the range arm bc, and this to the scale of the instrument, represents the height AB. When the instrument is level, the arm cb is horizontal, and therefore parallel to the surface of the sea. cb is subdivided and graduated in equal divisions

to the scale of the instrument. Ac, which has a telescope mounted on it, is pivoted at A and can be directed on to the water-line of a target at C. The triangles ABC and Abc are similar, and the length of bc therefore represents to the scale of the instrument, which is 1,000 yd. to an in., the actual range BC. Similarly bd will represent the range BD of a target at D. If the instrument is required for use at any other height than AB, the telescope arm pivot A would be raised to a height above cb corresponding to the new height of the range-finder above the sea. In the foregoing, the surface of the sea has been considered as a plane surface, whereas it is really the surface of a sphere with its centre at the centre of the earth. Allowance for this curvature could be made by making the arm bc the arc of a circle instead of a straight line. It is, however, found to be more convenient to curve the telescope arm Ac in the opposite direction, the effect being the same. Corrections for mean refraction are made in the same way as those for the curvature of the earth, but in the opposite direction; the arm Ac being curved to allow for the combined effect of curvature and refraction.

For Air Defence

When laying a gun on aircraft, the setting of the sight is based on the height and angle of sight of the target and on the setting of the fuse. At the beginning of the World War, no height-finders were available, so existing one-man range-finders, *e.g.*, the Barr and Stroud, were used, and long-base height-finders which could be rapidly made were introduced.

One-man range-finders were usually of two metres base length, and coincidences were made on the target in the usual way. In order to convert the ranges into heights, a slide-rule attached to the range-finder was employed. One scale of this slide-rule was automatically set to the angle of sight of the target, by means of a cam, as the elevation of the range-finder was altered. The other scale was set to the range recorded by the range-finder, and the height of the target could then be read off.

Long-base height-finders usually consist of two instruments at the ends of a base about a mile in length. Sighting planes in these instruments are kept laid on the target; the triangle formed by the intersection of a vertical plane with three planes, one of which is a horizontal plane passing through the base and the other two are extensions of the sighting planes, is mechanically solved; and the height of the point where the two planes of sight intersect (*i.e.*, the height of the target above the base) is plotted at the same time.

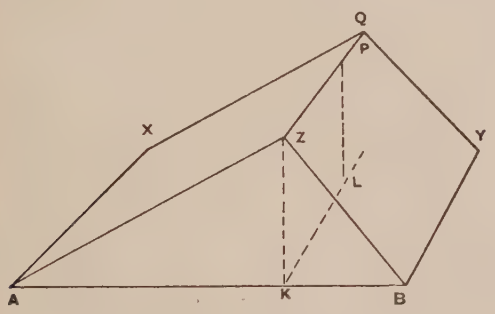

Fig. 2.—Diagram of the principle of the long-base height-finder.

The principle of this method is shown in fig. 2. AX and BY are two horizontal lines, parallel to each other. The sighting planes of the instrument would be attached to axles whose axes were on any parts of AX and BY. AXQZ and BYQZ represent planes of which the sighting planes form small parts. It is obvious that QZ is horizontal, and that ZK, PL or any vertical line between QZ and the horizontal line KL (which is parallel to the axes of the sighting planes) represents the height of an aircraft in the line QZ, say at P.

If now the two stations, A and B, make simultaneous readings of the altitude angles of P, and if one station, say B, telephones its reading to A, the height of P can be determined by a simple form of plotter.

The principal disadvantage of long base height-finders is the difficulty of getting the two instruments on to the same target.

Range- and Height-Finder.—The optical parts of this instrument are similar to those of the ordinary two-metre base range-finder, but the deflecting prism is moved by gearing so arranged that when the height of the aircraft remains constant, the coincidence will not alter, although the range may be changing. The instrument is essentially a range-finder, and in a small casing on top ranges are converted into heights by the mechanical solution of the equation $\log r + \log \sin \alpha = \log h$, where r is the range, h the height and α the angle of sight of the target; a differential gear is employed, the upper member of which is rotated in accordance with a logarithmic sine scale of angles of sight, and the lower member is rotated in accordance with a logarithmic scale of ranges, the jockey wheel accordingly revolving around the axis of the differential with a motion corresponding to a logarithmic scale of heights. It will be noted that the angle of elevation and the range are determined by the instrument, so that the duty of the gears is to convert the angle and range scales to logarithmic form and then to add them together by means of the differential gear as explained above. The conversion of the reciprocal range scale motion of the range-finder deflecting prism gear into logarithmic range scale motion, and the angular motion, of the range-finder in elevation into motion corresponding to a logarithmic scale of sines, is done in each case by means of toothed spiral gears.

(X)

II. NAVAL RANGE-FINDERS

The Barr and Stroud range-finder is now used almost universally by navies. From the description of the principle it is seen that the accuracy of the instrument depends upon the length of its base. Since fighting ranges at sea have now been increased up to the limits of visibility, there has lately been a general increase in the base length of the range-finders which are carried afloat. In the British service, the first Barr and Stroud instruments had a 4½-ft. base, and this was soon increased to 9 feet. In 1911 a 15-ft. instrument was introduced, and this became the standard for the capital ships during the World War. In some of the latest ships the base has been increased to 30 ft., these instruments being mounted in turrets and gun control towers.

The original mountings of the range-finders were simple and the 4½ and 9-ft. instruments can be worked by one man. In the larger instruments, however, it is necessary to have one man to keep the instrument "laid" upon the object whilst the observer confines himself to making the "cuts" or observations, which are as a rule transmitted electrically to the transmitting station. The Barr and Stroud range-finder stood the strenuous test of the War and was satisfactory. It has the great advantage that any man with normally good eyesight can be easily trained to obtain accurate observations with it. Also, the adjustments which are required to keep the instrument accurate can be readily made at sea. A 1 metre base range-finder is in use in the British service for station keeping and navigational work.

A range-finder constructed on the sextant principle—the Waymouth-Cooke—has been used to a considerable extent on British destroyers. It is small and handy, but except on very short ranges it is far from accurate and has now been superseded by the short-base Barr and Stroud.

In the German Navy a Zeiss stereoscopic range-finder was used to a great extent, and it has also been adopted by some other countries. It has, however, the great disadvantage, that to use one of these instruments the observer must have stereoscopic vision—a rare gift and one which varies from day to day. This makes it inferior for general service at sea to the simpler Barr and Stroud instrument. (*See* Gunnery.) (S. H. W.)

RANGER, HENRY WARD (1858–1916), American painter (*see* 22.891), died in New York City Nov. 7 1916.

RANGOON (*see* 22.891), the capital of Burma and the third seaport of British India, had a population, very diverse in nationality and religion, of 341,962 in 1921, including about 125,000 Hindus, 62,000 Moslems, 25,000 Christians and 12,000 Chinese. The Burmese, who prefer the rural districts, were about 112,000 in number. The municipality, which is about 28 sq. m. in area, is lit with electric light and supplied with water from a large reservoir lake 17 m. distant, and has now a good drainage system. About 90% of the foreign trade of the province passes through the port, where the headquarters of the railway system and of all large commercial concerns are situated. Rangoon is the greatest rice port of the world, with a considerable Far Eastern trade, and the value of commerce in 1921, 1922 and 1923 was much larger than in any previous years. Native industries include wood and ivory carving, and gold and silver work. The Phayre museum, removed to make room for the general hospital, has been placed in the secretariat, pending the erection of new buildings. A teaching and residential university was opened in 1920.

RANJITSINJI, KUMAR SHRI (1872–), Maharaja of Navanagar, was born at Sarodar, in the province of Kathiawar, Sept. 10 1872. By race a Rajput, he was educated first at Rajkumar College, Rajkot and afterwards at Trinity College, Cam-

bridge, where he leaped into eminence as a cricketer, subsequently becoming familiar to the British public by the affectionate designation of "Ranji." He first played for Sussex in 1895 and in 1897–8 he was a member of the Stoddart all-England eleven which went to Australia. He headed the English batting averages in 1896 and again in 1900. On his cousin's death in 1907 he succeeded as chief of the state of Navanagar, in the Bombay Presidency of India, and quickly developed into an enlightened and sagacious ruler. During the early part of the World War, he provided troops for the Allies, and himself served at the front in France. He represented the Indian States on the League of Nations Assembly in 1920 and became vice-chancellor of the Indian Chamber of Princes. He wrote *The Jubilee Book of Cricket* (1897); *With Stoddart's Team in Australia* (1898); *Cricket Guide, and How to Play Cricket* (1906). *See* P. C. Standing, *Ranjitsinji, Prince of Cricket* (1903).

RAPALLO, TREATY OF (April 16 1922).—During the Conference of Genoa (*see* GENOA, CONFERENCE OF), at which it was designed to consider the economic relations of the participating Powers with Russia, the Russian delegates showed no great desire to resume relations with the Allied and Associated Powers, but to the consternation of the latter signed an agreement with Germany, after secret negotiations. The Treaty was initialled on April 16 1922 by M. Chicherin and M. Rathenau. Germany and Russia renounced reciprocally all claims to war indemnities of any sort, including payment for the maintenance of prisoners of war. Germany renounced any compensation for losses incurred by German subjects in consequence of Russian socialisation of private property "provided that the Soviet Govt. does not satisfy similar claims of other States." Diplomatic and consular relations were resumed, the principle of the most favoured nation was to be mutually applied, with a Russian reservation in favour of States formerly belonging to the Russian Empire. Economic relations were to be regulated "with mutual feelings of goodwill." The Treaty was made public immediately on signature (English translation is printed as a British White Paper, Cmd. 1637 of 1922), and it was emphatically denied that it contained any secret political or military clauses. On Nov. 5 1922 the Treaty was extended to the Ukraine, White Russia, the Transcaucasian republics and the Far Eastern republic.

RAŠIN, ALOIS (1867–1923), Czechoslovak statesman, was born at Nechanice. While at the university he took an active part in politics, and his abilities as an orator, journalist and organiser brought him into the forefront of the Czech progressive movement. His anti-Austrian activities brought him into conflict with the authorities; he was tried in connection with the "Omladina" affair in 1893 and condemned to two years imprisonment and the loss of his doctorate. After serving his sentence he gained a prominent position in the Czech Liberal ("Young Czech") party, which he represented both in the provincial diet of Bohemia and in the Austrian Reichsrath. During the anti-Czech persecution in the World War period, Dr. Rašin, together with Dr. Kramar, was arrested in 1915, charged with treason and condemned to death. The sentence, however, was not carried out, and after the accession of the Emperor Karl, Dr. Rašin, with other political prisoners, was amnestied. He then took part in the preparations for the revolutionary coup in 1918, which, as a member of the National Committee, he helped to bring about. In the first Czechoslovak Govt. he became Finance Minister and rendered inestimable services to his country by freeing the Czechoslovak currency from that of Austria and inaugurating a financial policy which led to the stabilisation of the Czechoslovak crown. He described his achievement in a book entitled *Financial Policy of Czechoslovakia During the First Year of its History* (1921, Eng. trans., 1923). In January 1923 he was attacked by a demented youth and died of his injuries six weeks afterwards, on Feb. 16 1923.

RASMUSSEN, KNUD JOHAN VICTOR (1879–), Danish explorer, was born at Jakobshavn, Greenland, June 7 1879. In 1902 he made the first of several expeditions to Greenland and the northern polar regions. Between 1905 and 1924 Rasmussen visited all the extant Eskimo tribes and ascertained that they were originally Red Indian tribes which had wandered east and west from the coast. Rasmussen, whose ancestors in the maternal line were Eskimos, gained a thorough knowledge of arctic peoples and customs and made them the subject of numerous tracts and publications, including *Nye Mennesker* (1905); *Myter og Sagn fra Gronland* (1921) and *Gronland Langs Polhavet* (1919). The last mentioned work has been translated into English by G. A. and R. Kennedy as *Greenland by the Polar Sea* (*1921*).

RASPUTIN, GREGORY EFIMOVITCH (1871–1916), Russian monk, was born in 1871 in the village of Pokrovskoe, near Tyumen, in the province of Tobolsk, Siberia. He was the son of a poor peasant whose disorderly behaviour resulted in his being given the name of Rasputin, meaning "debauchee." He received no education, and till the end of his life was unable to write properly. He spent the first part of his life till the age of 33 in his native village; he married in 1895 a well-to-do girl, Olga Chanigoff, and they had two daughters and a son. In 1904 Rasputin resolved to change his mode of living. He left his family and devoted himself to religious exercises, declaring to his people that he was inspired by God. His passionate nature, his great physical strength and the superstitious atmosphere in which he had been brought up, gave an unexpected direction to his religious exaltation. He adopted the views of the sect known under the name of "Khlysty," the leading idea of whose teaching was that salvation could be achieved only by repentance.

"Sin in order that you may obtain forgiveness"—was the practical rule which he drew from this doctrine. "A particle of the Supreme Being is incarnated in me"—he told his hearers. "Only through me you can hope to be saved; and the manner of your salvation is this: you must be united with me in soul and body. The virtue that goes out from me is the source of light, the destruction of sin" (E. J. Dillon, *The Eclipse of Russia*). This extravagant and dangerous teaching, which resulted in practice in the most wild orgies, not only created for Rasputin immense popularity and the reputation of a holy man among his fellow-peasants, but opened before him the doors of some of the most fashionable Russian houses and even those of the Imperial Palace. Looking for new experiences Rasputin left his native village, and made long pilgrimages to various holy places, and even went to Mount Athos and Jerusalem. He spent some time in different monasteries and applied himself to the study of holy books, but his lack of elementary education reduced the results of his labours almost to nothing. He only retained by heart some incomprehensible passages, and often used them in his prophecies. He had, however, a strong magnetic power, the influence of which was recognised by his bitterest opponents.

In 1907, during a stay in St. Petersburg (Leningrad), Rasputin was introduced to the Archimandrite Feofan, rector of the Theological Academy and confessor to the Empress, who took an interest in the story of his conversion. The Archimandrite, with the assistance of the Grand Duchesses Militza and Anastasia, presented Rasputin at Court, and he produced a deep impression on the Empress and Emperor. The mystic atmosphere which always prevailed at the Russian Court, and which was especially strengthened by the disasters of the Japanese War, the internal troubles in 1905 and the constant fear for the health of the Tsarevich, created a convenient background for the appearance of such a man. His disdain for all rules of good behaviour, his dark prophecies, and, above all, the eventual improvement in the health of the Grand Duke Alexis, which more than once seemed to result from his influence when medicine was ineffectual, created an exceptional position for him with the Empress. Disgusted with the Russian intellectual classes and the bureaucracy, she saw in Rasputin the representative of the mass of peasantry, the only sure support of orthodoxy and autocracy, specially sent by God to save the heir to the throne and preserve the dynasty.

Rasputin took advantage of this belief, and did his best to

persuade the Empress that his fate was closely tied with that of the imperial family. The example of the Court was followed by a large section of the upper class, and many doors were opened for the "Saviour," as the Empress used to call him. For some time Rasputin was satisfied by this side of his social success, and at first he did not interfere in politics. But his activity was felt in church questions. His friendship with the famous monk, Heliodor, and the Bishop of Saratov, Hermogen, which resulted in a complete rupture between them and in a series of scandals, had a painful echo in the country. The appointment of Varnava, an illiterate peasant and a friend of Rasputin, to be Bishop of Tobolsk in 1911, and the extraordinary servility with which the Holy Synod followed the wishes of the favourite, provoked a strong opposition among all classes of society. The most prominent upholders of orthodoxy demanded a complete reorganisation of the Russian church. and denounced the servile attitude of the Holy Synod. Guchkov, the Octobrist leader, in a famous speech delivered at the state Duma, made direct allusions to the nefarious influence exercised by Rasputin. But the influence of the "Saviour" was too strong to be checked by any expression of feeling in the country, and Rasputin triumphed over all his enemies.

An unsuccessful attempt to kill him, made by a certain Guseva in 1914, incited by the monk Heliodor, only strengthened his influence, which became especially powerful during the two last years of the imperial régime. No important nomination was made without his approval, and the most unexpected people rose to the highest offices as the result of his interference. Rasputin was too ignorant to have any opinion on political questions: he was in most cases an instrument of the reactionaries. Numberless stories of the debauchery practised at the Court, in which the name of Rasputin was coupled not only with some of the court ladies but even with that of the Empress herself, became a common topic of conversation in all classes of Russian society. At length a supreme effort to free the Empire and the dynasty from his influence was made by a small group of men of the highest social position, which included the Grand Duke Dimitri Pavlovich, Prince Yussupoff and M. Purichkevich. Rasputin was invited to a supper at the Yussupoff Palace on Dec. 15 1916, and shot dead, after an attempt at poisoning him with a strong dose of potassium cyanide mixed with wine had not produced the desired effect. His body was thrown under the ice of a canal. The death of Rasputin was a terrible shock to the Empress; she transferred his body to the park of Tsarskoe Selo, where a special chapel was erected, and came every night to pray on his grave. The Grand Duke Dimitri Pavlovich was sent to Persia to join a fighting column. Yussupoff was ordered to leave St. Petersburg (Leningrad) and interned in his estate. Purichkevich, protected by his immense popularity in the army and by his title of member of the Duma, returned to his work on the front. (P. Vi.)

See *Letters of the Tsaritsa to the Tsar 1914–6* (1923); and further letters published in *The Manchester Guardian*, Jan. 9 and Feb. 7 1924.

RATHENAU, WALTHER (1867–1922), German statesman and industrialist, was born in Berlin Sept. 29 1867, the son of Emil Rathenau, the founder of the Allgemeine Elektrizitäts-Gesellschaft. After studying philosophy, physics and chemistry at Berlin and Strasbourg he graduated in 1889, and spent a year studying machine structure and chemistry at Munich. He was then engaged as a civil engineer by the Aluminium Industrie A.-G. of Neuhausen, Switzerland.

In 1893 he became a director of the Electrochemische Werke G.m.b.H. at Bitterfeld for the utilisation of a process for making chlorine and alkalis by electrolysis. He also built large works at Rheinfelden, in Russian Poland, and in France, and elaborated processes for the production of ferrosilicate, chrome, soda and magnesia. In 1899 Rathenau became a director of the Allgemeine Electrizitäts-Gesellschaft, and built central stations at Manchester, Amsterdam, Buenos Aires and Baku. In 1902 he belonged to the board of directors of about 100 enterprises. During 1907 Rathenau accompanied Dernburg, the Secretary of State of the Imperial Colonial Office, to German East and West Africa, and also visited the British Colonies in Africa. His *Reflexionen* (1908) contain his two final reports on those visits. The year 1912 marked his first public appearance in politics. He published *Zŭr Kritik der Seit*, in which he subjected the existing social and economic order to severe criticism. His fundamental philosophic work, *Zŭr Mechanik des Geistes*, appeared in 1913.

Even at the beginning of the World War Rathenau realised the whole extent of the danger which the British blockade meant to Germany as regards raw material. In an astoundingly short time, with the acquiescence of the War Minister Von Falkenhayn, he established a huge organisation for the administration of the war raw materials then at Germany's disposal. This Board of the War Ministry, called the "Kriegsrohstoff-Abteilung," which he left in splendid working order to his successor on March 31 1915, alone made it possible for Germany to hold out with raw material till the end of the War.

After his father's death in the summer of 1915 Rathenau was made president of the Allgemeine Elektrizitäts-Gesellschaft, to which he devoted his best energy. During this time he published *Von Kommenden Dingen* (Eng. trans. *In Days to Come*), *Eine Streitschrift vom Glauben* and *Vom Aktienwesen*. In 1918 his collected works were published. After the War Rathenau endeavoured to found a middle-class Democratic Party which was to bridge the gulf between the middle classes and labour caused by the revolution, and in this way to restore to the country its unity. In 1919 he was called by the government to participate in the preliminary preparations in Berlin for the Conference of Versailles. From April 1920 to May 30 1921 Rathenau was a member of the so-called "Socialising Commission" convoked by the newly founded "Reichswirtschaftsrat" in order to discuss the question of nationalising the coalmines. In the summer of 1920 he submitted to the public his report on this question, in which he proposed to hand over the privately owned coal-mines to the state with a reasonable compensation and within a space of about 30 years.

He was appointed government expert at the Spa conference of July 1920, and in the spring of 1921 took part in the preliminaries to the London Conference. At the end of May 1921 he was asked by the Chancellor Wirth to join the government. The two leading men of the Cabinet thus formed, Wirth and Rathenau, were united by deep confidence and friendship. The combination of the Chancellor's original and impulsive nature, his courage and love of responsibility, was a happy blend with Rathenau's far-sighted and extraordinary capability.

Rathenau as well as the Chancellor realised that the chief task was how to bring about a better understanding abroad of Germany's real position, thereby annulling her complete isolation, just once more revealed at the London Conference (April-May 1921) and leading to a "reasonable solution" of the reparation problem. This policy of mutual understanding was to secure peace for Germany, Europe and the world, a peace absolutely necessary for the reconstruction of what had been destroyed. In a speech made at Stuttgart a fortnight before his death Rathenau characterised the task allotted to him as follows:—

> When in a space of 100 years the history of this epoch will be written, then the question will be carefully investigated: Where were the first threads of peace tied? How was it possible in a world poisoned by hatred and on a planet flaming with the passion of mutual revenge, in a world of destruction and dissension to knit the first threads? The answer will be: The German nation has united these threads by its patience, its energy, its positive will, its idealism, by its sense of sacrifice.

In this spirit Rathenau co-operated in the final conclusion of the Peace Treaty with the United States of America in Aug. 1921. As Minister of Reconstruction he concluded with Loucheur, the French Minister of the Régions Libérées, an agreement at Wiesbaden, securing to France the privileged supply of deliveries in kind as reparation payment, which contributed greatly to the relaxing of the tension between France and Germany. However, this fact did not, unfortunately, react on the Upper Silesian decision of the League of Nations. The

disruption of the Upper Silesian coal and iron district, quite contrary in German opinion to the Versailles Treaty and to the result of the plebiscite, provoked Rathenau to a demonstrative resignation from the Cabinet.

Rathenau did not withdraw his help from the Cabinet, however, and went, deputed by the same, in Nov. and Dec. 1921 to London, to enlist England's interest and understanding, and moreover to secure a British loan for the next reparation instalment due from Germany. This loan was refused, for the reason that "under prevailing conditions" decreed by the reparation commission for the German liabilities during the next year such a loan could not be granted by Britain. Whilst in England Rathenau came in touch with the then leaders of the British Government. Under his influence arose the famous Lloyd George "Project of Chequers," which for the first time gave a certain practical form to the idea of a "United States of Europe" by proposing the reconstruction of Russia through the united economic forces of the other chief nations of Europe, including Germany. The ideas underlying the later Pact of Locarno (1925) were also discussed.

In Paris, whither Rathenau went immediately after the London negotiations, he found less support. Nevertheless, the project discussed at Chequers led to the conference of Cannes (Jan. 1922), which gave Rathenau the opportunity, in an eloquent speech, to declare before the world the impossibility of the London reparation demands and to obtain an essential diminution for the reparation payment of 1922. It led also to the great economic conference of Genoa (April-June 1922) in which for the first time since the War Germany was admitted on equal terms with the other Powers.

In the meantime, at the wish of the Chancellor, Wirth, Rathenau had entered the Cabinet again, this time as Minister for Foreign Affairs. The negotiations in Genoa, opened under such great auspices, did not unfortunately produce the expected result of a united European work of reconstruction. The fundamental theme for the settlement of the question of reparation was not discussed owing to the opposition of the French Govt., led by Poincaré; Russia also would have nothing to do with the Chequers plan. But separate negotiations between British and French representatives took place with Russia to the exclusion of Germany. Rathenau, fearing that these secret negotiations would be carried out at the expense of Germany, accepted on April 16 1922 at Rapallo the Treaty of Peace and Friendship offered by the Russians, cancelling all reciprocal demands which had accrued from the War, thereby visibly proving that Germany was endeavouring on all sides to unite the threads which had been torn asunder by the catastrophe.

The climax of his endeavour to lead back the minds of the nations from their condition of blind hatred to the "way of reason" was shown by his great speech in Genoa on May 19 1922, which, after a concise summary of the hindrances to Europe's reconstruction and the necessary steps for the accomplishment of the same, ended with the soul-stirring cry of Petrarch: "Pace—Pace—Pace!" The question of the alleged war guilt of Germany was one that Rathenau had mostly at heart. He zealously furthered the publication of the pre-War documents and declared, on July 13 1922: "The way of truth is long; it is all the longer as the lack of European interest has caused the questions which to us are vital questions to be looked upon as solved and the verdict of history as pronounced. The verdict can only be pronounced by a universally acknowledged tribunal. Our search for the truth will not be satisfied till, in the name of history, a verdict has been passed by an authorised tribunal."

The effects of the inflation of the currency on the middle classes, who had made great sacrifices during the War and were now absolutely impoverished, caused him the greatest anxiety. Many relief measures for these classes were passed owing to his efforts. At the same time he fully realised that German industry, when no longer under the influence of the inflation, would have to encounter extraordinary dangers; but that the development of reparation payment in kind and the treaty with Russia would at least ensure some work for industry in the impending hard times of recovery. Nevertheless, he considered that all attempts in this province must of necessity be frustrated until the burden of reparation was kept within reasonable bounds.

Rathenau, however, was not permitted to see the fulfilment of his plans. On his usual morning drive from his house to the Foreign Office on June 24 1922 he fell a victim to the bullets and hand-grenades of misguided young Germans, who by this deed robbed their country, not only of a great philosopher and industrialist, but of one of their most fervent patriots and of the best Foreign Minister of that time. The intransigeance of Poincaré made Rathenau's politics appear too lenient to the fanaticised eyes of his youthful murderers. The anti-Semitism which is always wont to follow great upheavals contributed the rest. Numerous threats had preceded the murder; Rathenau knew too well to what dangers he was exposed during the whole of his public career as Minister, and in the proud consciousness of the integrity of his intentions he declined every attempt of the Chancellor and his friends to surround him with detectives.

The space available is insufficient to deal with Rathenau's philosophy as expressed in his writings. He was, in the philosophical sense, an idealist. Adopting the evolutionary theories of Leibnitz and Darwin, he saw the development of man's purpose in three stages—first, prehistoric man wholly guided by instinct, then historical man led by intellect and conscious purpose, and lastly the man of the future whose fulfilment will be in the kingdom of the soul. "The soul is no weapon," says Rathenau. It thus stands in contrast to the whole spiritual world of the instinct and purpose resulting from the struggle of life. In the social world, whilst believing in an aristocracy of the mind, he realised that democracy was necessary to consolidate the crumbling foundations of the society of his day. A capitalist by birth and training, without repudiating his creed he held that in countries like Germany, carrying the burden of a dense population, "Consumption, like all enormous activities, is not an individual but a communal affair"; "The equalisation of property and income is prescribed both by ethics and by economics"; "The extant sources of wealth are: monopolies in the widest sense, speculation and inheritance"; "The restriction of the right of inheritance, in conjunction with the equalisation of popular education at a higher level, will throw down the barriers which now separate the economic classes of society, and will put an end to the hereditary enslavement of the lower classes."

Rathenau's collected works (5 vol.) were published in 1925. The following were not included and appeared separately: *Die Neue Wirtschaft* (1918); *An Deutschlands Jugend* (1918); *Zeitliches* (1918); *Nach der Flut* (1919); *Der Kaiser* (1919); *Der Neue Staat* (1919) (Eng. trans. *The New Society*; *Krit. der dreifachen Revolution* (1919); *Die neue Gesellschaft* (1919); *Autonome Wirtschaft* (1919); *Was wird werden?* (1920); *Demokr. Entwicklung* (1920); *Albert Kollmann* (1921); *Reden* (1924); *Briefe* (1926). The *Rathenau Stiftung* (Berlin), founded after his death, collects all bibliographical material.

(F. St.)

RATIONING.—This is a term of military origin, indicating the apportionment to each member of a population or of an army of his due share of the available supplies. As usually understood, the process of "rationing" is associated with the distribution of commodities in a time of shortage. It aims at just and economical distribution and the prevention of improvident consumption. During the World War most countries were compelled to ration foodstuffs in the public interest.

Nature of the Operation.—A complete and effective system of rationing involved the control of commodities at every stage from the source of supply to the consumer. Rationing proved to be a twofold problem, positive in the securing and conserving of supplies, negative in the prevention of injustice, waste and fraud. The consumer saw only a small part of a complex and far-reaching organisation. The economic order of the operations involved is: (1) supply; (2) distribution to localities; (3) distribution to consumers or rationing. The experience of rationing schemes has led to the establishment of a fundamental rule, *i.e.*, "that supply must precede the ration"; in other words, sup-

plies must be assured before scientific distribution can be attempted.

During the World War two distinct rationing plans were evolved, by Germany and Great Britain respectively. Other countries adopted one or other of these schemes, with more or less modification.

I. THE CENTRAL EUROPEAN SYSTEMS

In Sept. 1914, the general commanding in Brandenburg assumed control of all cereals, and, before the end of the year, bread cards had appeared in many German cities. By the early days of 1915, all bread cereals in Germany were under official management. The method adopted to deal with supplies and distribution gives the keynote for all the Central European efforts at rationing. The control of bread was quickly followed by that of practically every article of daily consumption. The German scheme was based on the local control of consumption, and this reposed on a supply in the main nationally controlled. Distribution and control were largely conditioned by the existing machinery of local government, with its regular gradation from the Reich to the Commune. The registration system already in use rendered it easy for the local authorities to determine the incidence of demand, and the management of actual "rationing" fell naturally into their hands.

Control of Bread Cereals.—Taking the control of bread cereals as an example, the system may be thus described: The consumer was provided with a card, with dated and numbered sections, and the appropriate section was cancelled by the retailer or official distributor when the ration allotted by the local authority (Kommunalverband) was purchased. Card sections were only valid as dated and numbered. This was to prevent fraud and sudden fluctuations in demand. Bona-fide travellers used special cards. Supplies were allotted to Kommunalverbände on the basis of the amounts available and the number of "men" to be fed. Manual workers received slightly more than a "man's" ration, and women and children less. The Kommunalverband got its supplies either from local producers, or from the authorities of the Kreis. These again indented on the next highest authority, and, step by step, the requisitions went on till they reached the central authority of all. This was a company formed, partly of business representatives, partly of government nominees, and capitalised partly by subscription and partly by government funds. Beyond this central company, which controlled only the supplies of its own particular group of products, was the Imperial Food Bureau, with corresponding Ministries in most of the Federal states. All supplies of breadstuffs, except those allowed to the producers for their own sustenance, had to be held at the disposal of the central company, which, in the case of cereals, was the Reichsgetreidestelle.

The country's supplies were thus centralised, and the requirements of the various subordinate authorities were met in that degree which the national or local food policy made possible. Flour and all corn products were of necessity included in the scheme. This complicated machinery resulted in faulty distribution, especially as supplies became less plentiful.

The Central Empires had to rely for their food supplies almost exclusively on home production. They had, therefore, to face the problem of obtaining the articles to be distributed from the actual producers. A special ration was allowed to "self suppliers" (*Selbstversorger*), which, although small, was generally greater in amount than that allowed to other people. This was inevitably accompanied by evasion of regulations. If the self-supplier could conceal part of his output he could retain more than his official "ration," and this he usually succeeded in doing. As official rations dwindled, the practice of concealing output increased, and an extensive illicit trade (*Schleich-handel*) came into being. The activities of this trade completely upset the calculations of the German and Austrian food controllers, and by the middle of 1917 the rationing authorities themselves were obliged to have recourse to this efficient and wide spread organisation. The German plan for rationing food was beginning to break down. Till the end of the War the central European situation was one of increasing difficulty.

II. THE BRITISH SYSTEM

The British control of foodstuffs began to take shape in 1917. This system, as finally organised, depended principally on the fact that the bulk of supplies was seaborne. Nearly all articles. therefore, came naturally and easily under public control from the moment they entered the country. Since Britain met her problems after Germany had been compelled to deal with similar difficulties, she had the advantage of the German experience. The British authorities had first of all to find out the real incidence of demand. This was accomplished indirectly by the first measures adopted to deal temporarily with the effects of shortage in the supply of sugar, and the movement of population occasioned by the concentrated effort to produce munitions of war.

Sugar Supplies.—In Aug. 1914, a Royal Commission on Sugar Supplies was set up. By the end of 1916 sugar began to be in short supply. Each trader, wholesale or retail, was then given 50% of his 1915 supply, and left to share this among his customers as best he could. In June 1917, the Cabinet decided upon a rationing scheme, under which each householder was invited to register with a particular retailer, to whom supplies were issued at a given ration per head of registered customers. In order to work this first sugar rationing scheme, some 1,800 food control committees were appointed by local authorities. Their expenditure was met from national funds, and they were supervised by 15 divisional food commissioners. These commissioners were appointed by a special wartime Ministry of Food, at the head of which was the Food Controller.

Food Committees Established.—The 1,800 food committees were appointed in Aug. by the local authorities, and each set up its food office, appointed its executive officer and distributed to each household in its district a sugar card, showing the number of persons in the household and having a counterfoil for deposit with the retailer. Thus, the whole population was completely registered by households, in each district. In Oct. and the following months this scheme was revised, and household cards were exchanged for individual cards, which became the sole title to the sugar ration.

On Jan. 1 1918, the rationing of individuals began, and as meantime other food supplies (*e.g.*, tea, margarine, bacon, cheese) had begun to run short, and there was no hope of a national rationing scheme being made effective for some months, local food committees had, therefore, to arrange for the consumers under their charge as they best could. Several of them, that of Birmingham notably, began to use the powers of requisition granted to them by the Ministry of Food, and to distribute supplies to retailers, with whom consumers had to be registered. General provision for such schemes was made by an Order of the Food Controller, dated Dec. 22 1917. The same difficulty arose, however, as had been experienced in Germany many months before; different action by the authorities of adjacent districts led to confusion and discontent while some foods, such as margarine or frozen meat, were entirely unsuitable for local control. In London these difficulties at once became pressing.

Rationing in Force.—A rationing scheme, covering meat and fats, for London and the Home Counties, came into force on Feb. 25 1918. Each individual (about 10,000,000 were involved) received two cards, one with detachable coupons for meat, and one with numbered spaces, to be marked by the retailer, for butter and margarine. Each consumer was registered with one retailer, and each retailer was supplied with the appropriate quantity of rationed articles necessary for his registered customers. By a very efficient system of control of supplies at the ports and of the local producers through Government organisations, operating with powers of requisitioning supplies at fixed prices, and (in the case of home-grown produce) by the careful demarcation of areas of surplus and deficit, it proved possible to balance quantities available against requirements, and to insure with astonishing success that the ration cards were honoured on presentation. Just before the rationing scheme for London and the Home Counties was put into force, 500,000 people stood in food queues every Saturday in London. A month afterwards the queues had practically disappeared.

Since local authorities could not wholly insure or control supply, they could not effectively ration meat. A national scheme for meat rationing was therefore introduced on April 7. The success was as great as that of the London scheme. On July 14 1918, each member of the public received a single book, with coupons for meat and bacon, fats, sugar and lard. The supply of these articles was nationally controlled; their distribution was arranged through the normal channels of trade; and an equitable and unbroken distribution was thus assured. Jam was nationally rationed in Nov. 1918, and some

food committees rationed tea and cheese locally. It never became necessary to ration bread in Great Britain. Fodder stuffs were also controlled by the Ministry of Food, and a scheme for rationing them was coming into force when the War ended. After May 3 1919, coupons were abolished; and when sugar was decontrolled, in Nov. 1920, the period of rationing was over. In Ireland, the only rationing was a control over the distribution of sugar.

The British method of rationing was this: Each household had to send in an application form to the local Food Committee, and a ration book (with a validity, first of 16 weeks, and afterwards of six months) was then issued for each individual. The ration book contained differently coloured leaves for various foods. Each leaf consisted of a counterfoil to be signed, and given to the retailer with whom the holder of the book wished to register, and coupons (to be detached by the retailer at the time of actual purchase) for each week's supply. Spare leaves were inserted, for use if other foods (such as bread) had to be rationed at short notice. Special books were provided, entitling the holders to suitable rations for young children, growing lads, soldiers and sailors on leave, vegetarians, Jews and other particular classes. The essence of the scheme lay in the fact that each customer was tied to a particular retailer, and that thereby not only was fraud prevented, but the Food Ministry was able to have accurate information both as to the total demand and as to its distribution at any time. No retailer could obtain larger supplies than those to which he was entitled on the basis of the number of persons registered with him and the ration per head. In the case of some foods the ordinary machinery of the trade was maintained and the retailer got his permitted supplies by indenting on the wholesaler, who in turn had to send copies of the retailers' indents to a primary supplier.

Supervising and controlling the whole organisation was the Ministry of Food, which had to arrange for the importation and supply of foodstuffs in sufficient quantities to meet the rations. Special measures had to be taken in the case of meat and fats. The ordinary methods of distribution in the meat trade were transformed, farmers were tied to a particular market, each producing area had to deliver prescribed quotas of cattle, and a most elaborate control was set up at every stage of supply distribution. Butchers' meat was rationed by value, not by weight. The consumer received three coupons, each entitling him to 5d. worth of uncooked meat. The price of meat was elaborately controlled. All "establishments" of a public character, such as hotels, schools, teashops, asylums, etc., were classified, and specially treated, so that effectively their inmates or customers were on the same footing as other people.

III. CONCLUSION

The Two Systems Contrasted.—The two types of European rationing systems are thus contrasted. In Germany the essential idea was the administrative independence of the local authority, which, within its limits, was jealously guarded. The whole organisation of food supply had to turn upon that which lay within the competence of the local power, namely, the actual distribution of the ration. In Britain, and the countries which followed Britain, the primary thought was the assurance of supply, and its control. The ration was a consequence rather than an antecedent of the system. The difference is largely, but not wholly, to be explained by the economic effect on a nation at war of free access to the sea.

In none of the other Allied countries was food rationing as complete or as successful as in Great Britain. Both in France and Italy the system was conditioned mainly by the allocations of the inter-Allied programme committees (*see* CONTROL) and by the fact that the scheme was administered by local bureaucrats acting to a large extent independently, with the natural result of unco-ordinated control and public indifference. Among the neutral countries Holland and Sweden had the most efficient organisation, built up on German experience. Rationing in these countries was due chiefly to vicissitudes arising out of the Allied blockade, supplies being regulated by agreement with the belligerent powers.

United States.—In the United States sugar and wheat flour were subjected to regulation. Towards the end of 1917 the diversion of ships from the Cuban trade made it necessary to reduce the supplies to confectioners and sweet-makers; and from July 1 1918, shipments of sugar to retailers were made on the authority of certificates issued by the food administration on the basis of the number of their customers. The restrictions placed on the sale of wheat flour were at first voluntary, but compulsory regulations were issued in Jan. 1918. These were dictated solely by the necessity of maintaining export to the European Allies.

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RAVEL, MAURICE (1875–), French musical composer, was born at Ciboure, near St. Jean de Luz, Basses-Pyrénées, March 7 1875 and is the most distinctive voice in modern French music. More than that, he holds an assured place in that line of composers beginning with the *clavecinistes* of the 17th century, who had so powerful an influence on French instrumental music. Educated at the Paris Conservatoire, where his master in composition was Gabriel Fauré, Ravel won the second Prix de Rome for composition in 1901. But he was not awarded the "Grand Prix de Rome," and the judges were severely criticised for thus refusing to recognise his talent; the resignation of Dubois from the directorship of the Conservatoire was in fact attributed to this cause.[1] When Ravel's piano pieces began to be known, notably *Pavane pour une Infante Défunte* and *Jeux d'eau*, played in Paris by Ricardo Viñes in 1902, a comparison was made between him and Debussy, whose *Pelléas et Mélisande* (Opéra-Comique, 1902) was then arousing heated controversy. It was suggested that Ravel was under the influence of the older man, but calmer reflection[2] showed that his technical methods were not those of Debussy; and though their names were coupled as typical of an epoch, they nevertheless represent very different aspects of that epoch.

It is true that such diverse minds as Fauré, Chabrier, and Erik Satie[3] exercised an influence on Ravel during his formative years, but his personality showed itself from the first. This personality became more clearly defined in his subsequent works, which included the string quartet in F, the three *Schéhérazade* melodies for voice and orchestra or piano (both 1904); the *Histoires Naturelles* (1907); *Introduction and Allegro* (septet for harp, strings, flute and clarinet) and the *Rapsodie Espagnole* for orchestra (1907). For the piano he wrote *Miroirs* and *Sonatine* (1905); *Gaspard de la nuit* (3 pieces) (1909); *Ma Mère l'Oye* (suite of five pieces) (1908); and *Valses nobles et sentimentales* (1911). The last two of these are best known in England as orchestrated by the composer. The qualities of imagination and satirical humour, combined with a vivid, and at times grotesque, sense of the picturesque are all held in poise by a clearness of vision and a sense of values and effect which are Ravel's leading characteristics. However daring Ravel's harmony may appear, he is never experimental. He has an unerring sense of direction and knows where he is going, even if he sometimes seems to watch himself going there with a smile of amusement. The cynical wit of his one-act opera, *L'heure Espagnole* (Opéra-Comique, 1911) and the conscious pose of the ballet *Daphnis et Chloé* (choreography by Fokine and produced by Diagphilev, 1912), emphasise in different ways the detached attitude of Ravel towards his art. Each work is an accomplishment in which he takes delight, and he satisfies himself by mastering each *genre* in turn. As with many artists of his generation, Ravel's career was interrupted by the World War; but his subsequent works maintained, without materially adding to, his reputation. These included a sonata for violin and violoncello and a trio for piano and strings (1922); *La Valse* for orchestra (1920) and *Tzigane* (violin and orchestra). Studies of Ravel's work and aims have been made by Roland Manuel in *Maurice Ravel et son oeuvre* (1914) and *L'oeuvre de Maurice Ravel* (1921), and by André Coeurnoy in *La musique française moderne* (1922). (H. C. C.*)

RAVENSTEIN, ERNST GEORG (1834–1913), British geographer, of German origin, was born at Frankfurt-on-Main on Dec. 30 1834, and was educated there. In 1852 he went to England, where he served in the topographical department of the War Office from 1855 to 1872. His studies led mainly in the direction of the practice and history of cartography. He com-

[1] See Calvocoressi, *Musical Times*, p. 785 (Dec. 1913).
[2] See R. O. Morris, *Music and Letters*, vol. 2, No. 3 p. 274 (July 1921) *et seq.*
[3] See Prud'homme, *A Dictionary of Modern Music and Musicians*, J. M. Dent (1924).

piled many original maps and atlases, bringing a fine critical faculty to bear upon the data where these were not of the first order of scientific accuracy, as in his series of eastern equatorial Africa, scale 1:1,000,000 (1881–3), and of British East Africa, 1:500,000 (1889). One of his earliest writings was *The Russians on the Amur* (1861), but he was concerned mainly with the history of geography, as exemplified in his *Vasco da Gama's First Voyage* (1898) and *Martin Behaim, His Life and His Globe* (1908). He was an active member of the Royal Geographical Society and of the British Association, over the geographical section of which he presided in 1890. He died at Hofheim in the Taunus, Germany, March 16 1913.

RAWLINSON, HENRY SEYMOUR RAWLINSON, 1ST BARON (1864–1925), British soldier, was born Feb. 20 1864, son of Maj. Gen. Sir H. Rawlinson, Bart. He joined the army in 1884 and a year later became aide-de-camp to Sir F. Roberts in India on whose staff he served intermittently for some years. He took part in the Burma operations in 1886–7 and on the Nile in 1898; he had succeeded to the baronetcy in 1891. He served throughout the South African War (1899–1902). Some months after his return to England he became commandant of the staff college and from 1910 to May 1914 commanded the 3rd Division. Gen. Rawlinson was in charge of the forces sent to assist Antwerp in 1914, and took part in the first battles of Ypres and in the Neuve Chapelle and the Loos offensives. He commanded the IV. Army during the battle of the Somme (1916) achieving important successes. At the end of 1917 he was transferred temporarily to the command of the II. Army during Gen. Plumer's absence in Italy, and in Feb. and March 1918 he acted for some weeks as British representative on the Supreme War Council. Resuming his command of the IV. Army in April, his troops on Aug. 8, in conjunction with the French, attacked the enemy near Amiens and gained a signal victory, which heralded the general advance of the Allies. After the War he was raised to the peerage as Baron Rawlinson of Trent and received a grant of £30,000. In the latter part of 1919 he was sent to North Russia to conduct the withdrawal of the Allies from Archangel and Murman, and on his return he commanded at Aldershot for a year. At the end of 1920 he went to India as commander-in-chief. He died at Delhi March 28 1925 as the result of an operation for appendicitis.

RAW MATERIALS.—This term, borrowed from commerce, covers a variety of objects, classified with respect to their place in trade and industry, rather than with respect to their physical character. An object that may be classed with raw materials at one time may become a finished product at another, or vice versa. Camphor and indigo were formerly classed as raw materials in the chemical industry. Since the invention of the synthetic processes for their manufacture they have come to be classed as finished products. Coal tar, formerly a finished product of the distillation process, has now come to be the raw material for a great variety of chemical manufactures.

An International Pool.—As modern industry developed in many countries after the middle of the 19th century, notably in the United States and Germany, France, Belgium, Italy and Japan, the principal raw materials became, as it were, an international pool, distributed automatically among the consuming nations in proportions determined by what may be described in general terms as relative power of economic attraction; this power being based on a number of factors of fluctuating value, of which the chief are: (1) facilities for assembling materials in large masses; (2) facilities for distributing the manufactured product; (3) cheapness of fuel, or other sources of power, especially hydroelectric; (4) cheapness and above all efficiency of labour; (5) abundant liquid financial resources for carrying raw material stocks and finished products on their way to the consumer.

Old Versus New Countries.—The predominance of England as a market for raw materials in the first three-quarters of the 19th century rested upon a relative superiority in all these factors. Gradually other nations gained upon England in one factor or another; Germany in fuel and labour, especially the highly trained labour of the chemical industries; the United States in fuel, particular kinds of labour, financial power; Italy and Switzerland in hydroelectric power. In general, it may be said that the tendencies of the 50 years before the outbreak of the World War were in the direction of reducing the lead of the older industrial countries and sections in the power to attract raw materials. The disturbances of trade resulting from the War forced many countries to develop independent manufacturing facilities, such as the cotton industries of China and of certain South American countries, with the consequence that the claimants upon the international pool of raw materials have become more numerous and more nearly on an even footing. Under the *régime* of virtual freedom the trade in raw materials underwent an immense development. The demands of industry produced a great expansion in the production of raw materials, and this expansion, often outrunning demand, reacted upon industry and stimulated its development.

Science Gives New Resources.—In rare instances the progress of science and invention has freed industry from its dependence on the raw materials that figure in world trade. The development of aniline dyes cut severely into the trade in materials for the manufacture of vegetable dyes, and the rise in recent years of artificial silk, or rayon, has been regarded as a menace to the raw-silk industry. Scientific and industrial progress has steadily increased the number of raw materials in trade and the volume consumed. The enormous increase in the consumption of pig-iron, copper, lead, tin, zinc; the rise of rubber, petroleum and aluminium industries; the extension of the paper industry, are outstanding examples of the effect of technical progress on the demand for raw materials.

At the same time technical progress applied to the production of raw materials themselves has greatly extended the range of possible sources. Prior to the introduction of the flotation process in copper extraction, the minimum paying ore was about 3%; 1% is profitable now. Electric concentration has made available magnetic iron ores formerly regarded as too lean for working. The progress of plant-breeding is greatly extending the possibility of supplementing the limited natural production of long-staple cotton. The development of effective systems of plantation management has opened the whole tropical belt to the production of rubber, formerly confined to limited areas in the tropical forests. Moreover, chemical science progresses steadily toward a stage when an increasing number of raw materials may be produced synthetically.

Increased Consumption.—The growth of industry and wealth has further affected the demand for raw materials by raising the standard of consumption. To this influence must be ascribed not only such striking instances as increase in the demand for raw silk, and the finer grades of wool and cotton, but also the growth in the consumption of a long array of articles of common use. The increase in the use of soap, for example, together with advances in organic chemistry, have produced a demand for vast quantities of vegetable oils, ground nut, soya bean, cottonseed and palm oils. The increased purchasing power of the masses and the consequent demand for a more varied diet has produced a huge increase in the requirement of tin for preserving vegetables, fruits and meats. The steady increase in the consumption of aluminium wares is another example of the effect of a rising standard of mass consumption.

Distribution of Raw Materials.—Most of the important raw materials are distributed widely over the world. Hardly any considerable territory is entirely devoid of workable iron deposits, although the countries bordering on the Pacific are meagrely supplied as compared with those bordering on the Atlantic. Copper deposits are almost as widely distributed; the most extensive being found in the Americas. Zinc and lead are also widely distributed. Tin in workable deposits occurs far more rarely, and a few limited areas have virtually a monopoly of it. Wool, hides and skins are of universal production, but are more likely to yield a surplus for world trade where population is relatively sparse and great areas remain in pasture or forest. Wood pulp comes from regions of extensive woodlands and cheap water power. Rubber and the more important coarse fibres and some of the important vegetable oils are limited to the tropics.

Marketing.—It is rarely the case that rich sources of raw materials coincide with the industrial equipment and the consuming power requisite to their utilisation. They must, as a rule, seek distant markets, and therefore assume an important place in international trade. This trade is marked by serious fluctuations in both demand and supply. The production of raw materials of mineral origin is subject to shrinkage from the exhaustion of deposits and to expansion due to the discovery of new deposits. Raw materials of vegetable and animal origin are subject to serious fluctuations under seasonal influences. The demand for many of these products is peculiarly responsive to the alternations of prosperity and depression in the centres of industry and population. In prosperous times the consumption of rubber in the manufacture of motor tyres is very active. Copper is freely consumed in the replacement and extension of electric plants that would be left untouched in bad times.

Fluctuations of Price.—Because of the wide fluctuations in the demand and supply of raw materials, rapid price fluctuations are characteristic of the whole field. In the case of raw materials that are relatively imperishable, like the textile fibres, metals and other minerals, the fluctuations are somewhat evened out by the accumulation of stocks in plethoric times, to be gradually released to trade in times of scarcity. This involves a complicated organisation of finance for carrying the stocks and for distributing the risks of price fluctuations. The physical aspects of the problem involve grading and storage—technically complicated processes, but seldom occasioning serious issues of policy. The financial aspects are more difficult, involving as they do the question of speculation.

In general, it may be said that the carrying of raw material stocks is inherently speculative. Where the producer holds the raw material until he can dispose of it directly to the manufacturer, he carries the risk of price fluctuations himself. Where the manufacturer accumulates large stocks for future use, the risk rests on him. If speculative markets are well developed, much of the risk may be transferred from the producer of raw materials to a specially trained body of men, whose business it is to study all the possible sources of supply and form forecasts as to the future. Where such markets exist the manufacturer who makes a contract for the future delivery of goods, may safeguard himself against fluctuations in raw material prices through buying "futures;" a manufacturer who is producing for the general market may safeguard himself against a fall resulting from falling prices of material by "hedging," or selling futures for an equivalent volume of raw material.

From time to time the belief gains currency that the speculative markets are themselves responsible for price fluctuations in raw materials, and laws are passed for curbing their operations. While there are numerous instances of price manipulation through "corners," the weight of experience seems to indicate that speculative operations which do not conform with underlying conditions of demand and supply are doomed, as a rule, to disaster. It also indicates that price fluctuations are most disastrous in those materials for which there is no organised speculative market.

The Chief Markets.—The principal markets for dealing in raw materials are located at the financial centres that were originally most closely related to the points of assembly and primary distribution. London has long been the predominant market for an extensive list of raw materials. Alongside of the London market, independent markets are established wherever the business of handling materials becomes important. The various markets are closely interrelated. No very wide difference can long maintain itself in the prices on the London and the New York copper markets, for example. The initiative toward price changes may arise in either market; it will soon be reflected in the other. Chief influence, however, rests with the market which represents the greater aggregation of trained speculative abilities combined with financial power. For this reason a market might retain its dominant position long after the immediate cause of its establishment, the concentration in the vicinity of material stocks for consumption, has disappeared.

International Control.—The World War brought to the attention of the governments and the public the remarkable dependence of modern industrial countries upon the international movement of raw materials. For the tremendous consumption of war the ordinary supplies of many raw materials were inadequate. Accordingly every belligerent nation adopted measures for conserving, rationing, stimulating the production or importation of, or preventing the exportation of various raw materials. Raw materials occupied the centre of wartime economic policy (*see* CONTROL). After the close of hostilities there was a flood of projects for the rationing among nations of the available stocks of raw materials, and for the working out of a permanent policy of international controls. All these projects fell to the ground because of the inherent difficulties of the problem. The world's trade in raw materials returned for the most part to the system of automatic distribution under the principle of relative economic attractive power.

But the idea of controlling raw materials in the nationalistic interest did not entirely disappear. Various materials were in 1926 controlled by governments, or by private combinations under government auspices. Among them were plantation rubber, Egyptian long-staple cotton, iodine, nitrates, potash, mercury and sisal. Some 20 or 30 more materials might be controlled by one government, or by a combination of two governments. The object of control is in each case to maintain prices. While to a certain extent the maintenance of prices may be justified, any such policy of control lends itself readily to abuses, creating international friction and ill will. It is in effect a harking back to the early modern system of controlling raw materials in the supposed national interest.

While it is not to be denied that in certain cases the policy of national control of raw materials may exert a perceptible effect on prices and for a limited period of time work a certain amount of mischief, in the way of fixing exorbitant prices, there are many reasons for doubting its practicability in the long run. A nation or a combination of two or three nations may appear to control the chief sources of the supply of a raw material. But the high prices offer a tremendous stimulus to the development of new sources elsewhere. The Chilean nitrate monopoly, for example, is exposed to the remorseless progress of the technique of nitrogen fixation. The potash monopoly of the French and German producers is exposed to the progress of methods of recovering by-product potash. The plantation rubber of the East Indies is exposed to the progress of rubber-planting in tropical America and Africa. Moreover, modern science grows more and more fertile in the development of synthetic products, or substitutes that allow the replacement of a controlled material or reduce its use to a minimum. (*See* COAL; PETROLEUM; RUBBER, etc.)

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(B. M. B.)

RAYLEIGH, JOHN WILLIAM STRUTT, 3RD BARON (1842–1919), British physicist (*see* 22.933), died at Witham, Essex, June 30 1919. He was succeeded as 4th Baron by his eldest son, Robert John Strutt (b.1875), also distinguished as a physicist and the author of numerous scientific papers in the Royal Society's *Proceedings* and elsewhere.

RAYON: *see* ARTIFICIAL SILK.

RAYS.—Most people are aware that the sun is the great source of energy, though probably few realise the implication of this: that they all live and move and have their being in a physical sense entirely owing to the phenomenon of radiation. All things living, from man to the humble lichen, even the "life" of inanimate Nature—fire and flood, tempest and waterfall—derive their animation from the same far-distant source and owe their every movement to rays. These wonderful messengers carry into every nook and cranny of our teeming world supplies of energy, permits to continue to live, postponements from the oncoming of utter stagnation and death. Do we seek other

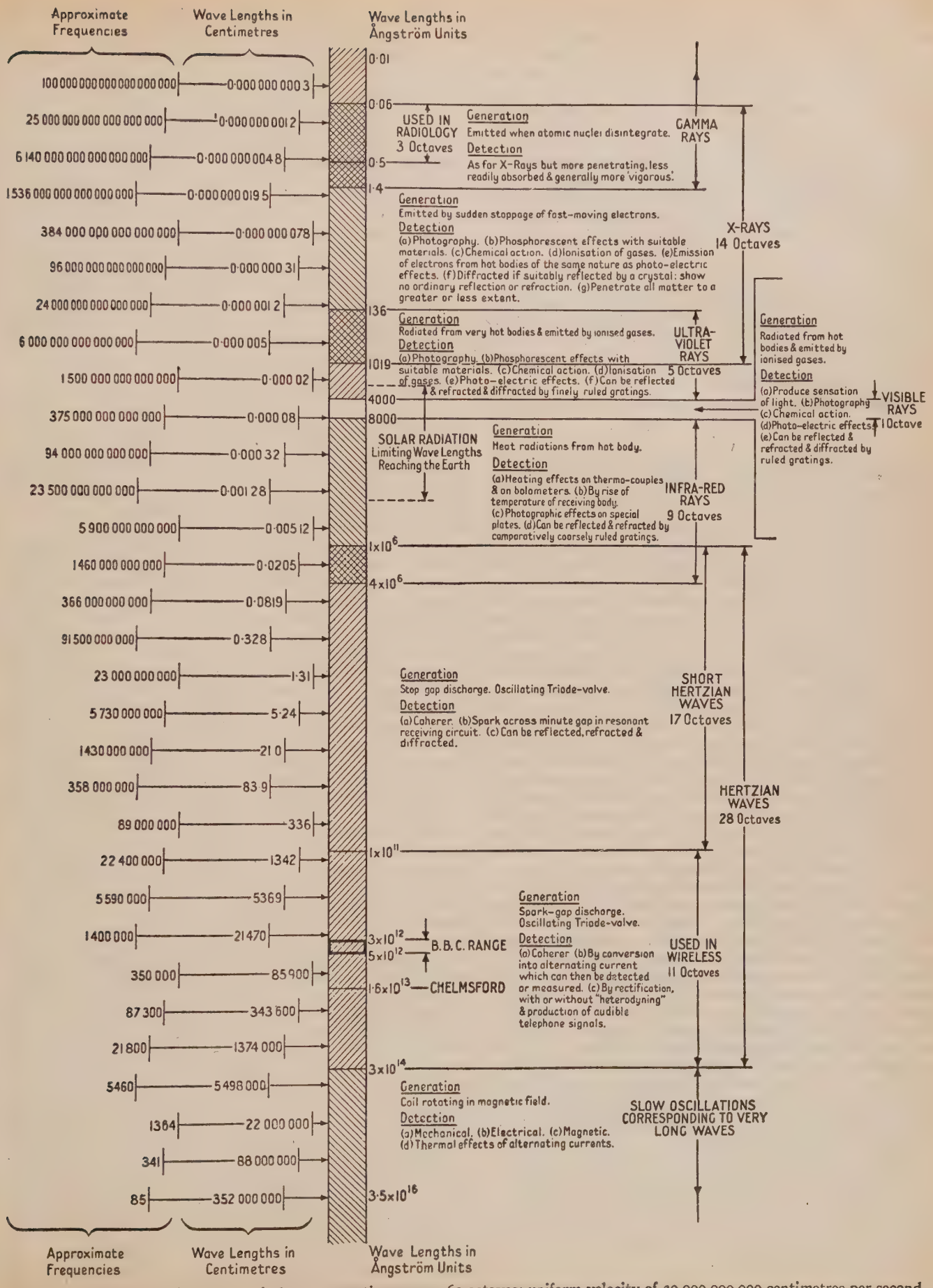
Approximate Frequencies
Wave Lengths in Centimetres
Wave Lengths in Ångström Units
100 000 000 000 000 000 000
0·000 000 000 3
25 000 000 000 000 000 000
0·000 000 001 2
6 140 000 000 000 000 000
0·000 000 004 8
1536 000 000 000 000 000
0·000 000 019 5
384 000 000 000 000 000
0·000 000 078
96 000 000 000 000 000
0·000 000 31
24 000 000 000 000 000
0·000 001 2
6 000 000 000 000 000
0·000 005
1 500 000 000 000 000
0·000 02
375 000 000 000 000
0·000 08
94 000 000 000 000
0·000 32
23 500 000 000 000
0·001 28
5 900 000 000 000
0·005 12
1460 000 000 000
0·0205
366 000 000 000
0·0819
91 500 000 000
0·328
23 000 000 000
1·31
5 730 000 000
5·24
1430 000 000
21 0
358 000 000
83·9
89 000 000
336
22 400 000
1342
5590 000
5369
1400 000
21470
350 000
85900
87 300
343 600
21 800
1374 000
5460
5498 000
1364
22 000 000
341
88 000 000
85
352 000 000
0·01
0·06
0·5
1·4
136
1019
4000
8000
1x10^6
4x10^6
1x10^11
3x10^12
5x10^12
1·6x10^13
3x10^14
3·5x10^16
USED IN RADIOLOGY 3 Octaves
Generation
Emitted when atomic nuclei disintegrate.
Detection
As for X-Rays but more penetrating, less readily absorbed & generally more vigorous.
GAMMA RAYS
Generation
Emitted by sudden stoppage of fast-moving electrons.
Detection
(a) Photography. (b) Phosphorescent effects with suitable materials. (c) Chemical action. (d) Ionisation of gases. (e) Emission of electrons from hot bodies of the same nature as photo-electric effects. (f) Diffracted if suitably reflected by a crystal: show no ordinary reflection or refraction. (g) Penetrate all matter to a greater or less extent.
X-RAYS 14 Octaves
Generation
Radiated from very hot bodies & emitted by ionised gases.
Detection
(a) Photography. (b) Phosphorescent effects with suitable materials. (c) Chemical action. (d) Ionisation of gases. (e) Photo-electric effects. (f) Can be reflected & refracted & diffracted by finely ruled gratings.
ULTRA-VIOLET RAYS 5 Octaves
Generation
Radiated from hot bodies & emitted by ionised gases.
Detection
(a) Produce sensation of light. (b) Photography (c) Chemical action. (d) Photo-electric effects (e) Can be reflected & refracted & diffracted by ruled gratings.
VISIBLE RAYS 1 Octave
SOLAR RADIATION Limiting Wave Lengths Reaching the Earth
Generation
Heat radiations from hot body.
Detection
(a) Heating effects on thermo-couples & on bolometers. (b) By rise of temperature of receiving body. (c) Photographic effects on special plates. (d) Can be reflected & refracted by comparatively coarsely ruled gratings.
INFRA-RED RAYS 9 Octaves
Generation
Stop gap discharge. Oscillating Triode-valve.
Detection
(a) Coherer. (b) Spark across minute gap in resonant receiving circuit. (c) Can be reflected, refracted & diffracted.
SHORT HERTZIAN WAVES 17 Octaves
HERTZIAN WAVES 28 Octaves
Generation
Spark-gap discharge. Oscillating Triode-valve.
Detection
(a) Coherer (b) By conversion into alternating current which can then be detected or measured. (c) By rectification, with or without "heterodyning" & production of audible telephone signals.
B.B.C. RANGE
CHELMSFORD
USED IN WIRELESS 11 Octaves
Generation
Coil rotating in magnetic field.
Detection
(a) Mechanical. (b) Electrical. (c) Magnetic. (d) Thermal effects of alternating currents.
SLOW OSCILLATIONS CORRESPONDING TO VERY LONG WAVES
Approximate Frequencies
Wave Lengths in Centimetres
Wave Lengths in Ångström Units

FIG. 1.—Diagram showing range of electromagnetic waves. 62 octaves; uniform velocity of 30,000,000,000 centimetres per second.
From *Phases of Modern Science*. By permission of the Royal Society.

supplies? We kindle the log fire as the nights draw in and there leaps into life again the sunshine of by-gone summers. We delve into the earth for coal and oil to augment the parsimony of the northern climate and stumble into a civilisation of steam and gas and electricity, such as the world has not before seen. But the glow of its furnaces is again that of the sunshine when the world was young, stored by the giant tree-ferns of the carboniferous era, ages before there was such a thing as man. In the last analysis the chariots of science are still harnessed to the same steeds as those that Boadicea flung against the Roman legions. But though unharnessed as yet and in the keeping of the future as regards their application, there are now known to theoretical science the higher powers that command and equip the chariots of the suns.

Radiation and Life.—In the whole economy of nature there seems to be one only door through which the prodigal outpourings of energy from the sun can find their way into the world of life. It is through chlorophyll, the green colouring matter of the leaves of all plants. The ordinary processes of destructive metabolism are the same as those of combustion and may be written after the manner of a chemical equation:—

Carbon compounds with Hydrogen + Oxygen = Carbon Dioxide + Water + Energy.

In the presence of chlorophyll illuminated by the sun's rays, this process is reversed and the energy of the light is stored up in the form of the carbohydrates—cellulose, starch, dextrin and sugar—produced in the tissues of the plant out of the carbon dioxide and moisture of the air. A forest in sunshine is storing energy at the rate of some 5,000 H.P. per sq. m., recoverable when the timber is burnt. But this is but a minute fraction compared with that which eludes the vigilance of life. The solar radiation between latitudes 45° N. and S. of the equator corresponds on the average to 1 H.P. per 4 sq. ft., or 7,000,000 H.P. per sq. m., so that a very tiny fraction of it would suffice to do all the mechanical work of the world thousands of times over. Actually, in practice, experimental solar radiation engines have been constructed developing 1 H.P. per 100 sq. ft. of heating surface.

Rays, Old and New.—The subject of rays divides itself naturally into the old and the new. The older known rays are all of the one type, being electromagnetic rays travelling through empty space radially outward from their source at the uniform speed of light, 185,000 m. (or 3×10^{10} cm.) per second. Some of the more recently discovered rays are of the same type as light, with either very much longer waves and lower frequencies—the Hertzian waves—or very much shorter waves and higher frequencies—Röntgen or X-rays, the γ-rays of radium and the most recent of all, which may be termed Millikan rays. Others of the newer rays—the α- and β-rays of radioactive substances and the cathode rays and positive rays of the vacuum tube, are not waves at all but radiant particles carrying an electric charge. When the radiated particle is a negative electron, as is the case for the cathode and β-rays, it generates rays of the first or wave type on impact with matter, much as a stone thrown into water generates waves in the water. The relation, however, as is so often the case with electrical phenomena, is reciprocal, and electromagnetic waves will liberate electrons from (*i.e.*, "ionise") the atoms of matter in their path, and these liberated electrons may, under suitable conditions, act as cathode rays. The α-rays consist of the flight of atoms of helium, carrying two positive charges, and the only justification for calling them α-rays as well as α particles, both terms being in use, is that they are propagated radially from their source. The positive rays, similarly, are positively charged atoms, and like cathode rays generated inside vacuum tubes, they follow the lines of electric force in the tube. So for these there is not even this justification for calling them rays. The most consistent definition of the term "ray" would perhaps be any carrier of physical energy across empty space, but this would include a meteor and exclude a sound wave.

Electromagnetic Radiation.—The whole gamut of electromagnetic radiation is well set forth in the accompanying chart, prepared by the British Empire Exhibition Committee of the Royal Society and reproduced here by their courtesy. The wave-length in centimetres, multiplied by the frequency, which is defined as the number of waves per sec., obviously gives the distance travelled in one sec., or velocity of the rays. As this is uniform for all electromagnetic waves, it follows that the wave-length is inversely proportional to the frequency, and if one is known the other is also. The wave-length, or distance measured from crest to crest of the wave, is usually expressed in terms of the Ångstrom unit (Å) which is 1/100,000,000 of a centimetre (10^{-8} cm.). The known rays range from an estimated wave-length of 4/10,000 of an Ångstrom unit and a frequency of 10^{22} to wave-lengths of many miles and frequencies of the order of 10,000. By analogy with sound, the frequency may be well expressed in octaves. It is doubled in one octave, quadrupled in two, multiplied by eight in three and so on. In the chart each octave is shown of the same length from the left-hand end of excessively high frequency and very long wave-length. The numerical details are set forth in the chart so that we may concentrate on the more important characteristics and uses of this vast range of radiation.

Light.—All that the 18th century handed on to the 19th was the visible region of the solar spectrum from violet to red, which is about one octave out of 62 shown in the chart, which does not include the new Millikan rays at the extreme top. It would be difficult to find in science another example of a set of phenomena apparently so diverse being comprehended under essentially the same cause, the only difference being the frequency or "pitch" of the vibrations.

Immediately on either side of the visible spectrum are the invisible ultra-violet and infra-red rays. The former, called also the photographic or actinic rays, are chiefly responsible for the chemical, physiological and therapeutic actions of light, as in photography, the photochemical synthesis of carbohydrates by vegetation already dealt with, sunburn and the pigmentation of the negroid races, and the modern methods of health culture and treatment of ailments by sun-baths, arc light and mercury vapour lamps. The shorter wave-lengths ionise the air and make it a conductor of the electric current, and on this account they play a large part in meteorological phenomena such as the electrification of the atmosphere, the condensation into rain, thunderstorms and, indirectly, of the aurora. Though invisible, they produce powerful visible fluorescent effects in a variety of crystalline substances, notably the platinocyanides.

Absorption of Ultra-violet Light in the Atmosphere.—In passing from the red end of the spectrum into the ultra-violet, a gradual and continuous change comes over the general penetrating power of the rays, which is reversed when we get beyond the ultra-violet into the region of X-rays. The redness of sunrise and sunset, when the rays tangentially striking the earth have to pass the maximum thickness of air in their path, shows that the red rays are less absorbed than those of shorter wave-length. On ascending a mountain and leaving the atmosphere more and more beneath our feet, the light becomes richer and richer in ultra-violet rays. Above 18,000 ft., the greater part of the atmosphere has been left behind, but long before this the well-known burning action of the sun on the skin makes itself felt. It needs something of a coarser texture than a gas like air—the suspension of liquid and solid particles which constitutes smoke, fog and cloud—to stop the visible rays. But in a fog, if the sun shows at all it is usually red. A much smaller pollution of the atmosphere by smoke than is necessary to stop the visible rays suffices completely to absorb the health-giving ultra-violet, so that it becomes of vital importance to the national health, especially in northern latitudes, to deal with the smoke problem which is one of the penalties attaching to the new coal-and-oil civilisation. Sometimes, however, when there is great uniformity of size in the particles causing the fog or smoke, curious selective absorption effects occur. The writer once saw for several days together in the Rockies, during forest fires of exceptional extent even for that region and which were causing an enormous amount of smoke, a pure violet sun.

Absorption of γ-Rays.—The transparency and opacity of matter to radiations of the range dealt with in optics are highly specific properties of the substances themselves, though outside of this range in both directions these specific differences disappear. We think it natural that most gases are colourless and transparent, whilst most solids are opaque, and the power of the X-rays and γ-rays to pass through opaque solids seems extraordinary. The γ-rays of radium can still be detected after passing through 20 cm. (8 in.) of solid lead or liquid mercury, yet if the sun were made of pure radium not a detectable trace of the radiation would survive absorption at a height of 18,000 ft. above sea-level, for the absorption of the air would there be due to the equivalent of half the total atmosphere, *i.e.*, 38 cm. of mercury, and this would reduce the γ-rays of radium to one million-millionth (10^{-12}) of their original value. In this region of very short wave-length the differences of transparency, so marked for substances with light, have totally disappeared and all substances absorb a homogeneous radiation of very short wave-length to the first approximation simply according to the weight of the matter in the path of the beam. In this respect ordinary light, which reaches us so abundantly from the sun through a weight of air corresponding with 76 cm. of mercury, is far more penetrating than the γ-rays.

The Region Between Light and X-rays.—As we proceed from the red to the far ultra-violet, air becomes less and less transparent until we reach a point at a wave-length of 1,700 Å., when air and other gases are ionised by the light rays just as they are by X-rays and radium rays, and air becomes so opaque to the rays that further progress in their investigation can only be pursued in a vacuum. Ordinary glass is opaque to waves shorter than 3,500 and longer than 30,000 Å., whereas quartz will transmit between 1,800 and 70,000 and fluorite between 1,000 and 95,000 Ångstrom units. For the investigation of the Schumann and Lyman rays, which lie between 1,700 and 500 Å., not only is a vacuum essential but also specially sensitised plates containing hardly any gelatin which is strongly opaque. The necessity for totally excluding the air beyond this range makes it exceedingly difficult to excite the spectrum, because the electric discharge will not ordinarily pass through a perfect vacuum. Under these circumstances, Millikan in 1920 succeeded in reaching 200 Å. in the spectrum of nickel by the use of very powerful short sparks, which produced also X-rays. So that the gap between light and the X-rays may be regarded as bridged (*see* SPECTROSCOPY). We are here approaching the maximum opacity of gases where the wave-length is diminishing to molecular magnitude and the frequency increasing to that of the natural periods of vibration of the electrons in the individual molecules and atoms.

The X-rays are generated by the collision of high-speed cathode rays with platinum, tungsten or other heavy metal targets in a vacuum, in the well-known X-ray tube. For these X-rays the penetrating power, not only for gases and transparent substances, but for all substances increases rapidly as the wave-length decreases, right up to the shortest wave-lengths known.

The Reaction Between the Electrical and Optical Projections of Matter.—For any substance to be transparent it must be an insulator. The absorption of the waves is due to their communicating their energy to the electrons in matter and if these are free from, or only loosely associated with, the atoms the substance will conduct electricity. A gold-leaf which is so excessively thin that it will transmit green light becomes quite transparent by annealing and then loses its power to conduct an electric current. Air is rendered a conductor by Schumann rays and so is opaque to them. Ebonite, a splendid electrical insulator, is practically transparent to all rays of longer wave-length than the visible, and acts as an almost perfect filter of the dark heat or infra-red rays from light. It is indeed just transparent to the extreme red, as may be tried by looking at the sun through a very thin ebonite sheet, when it will be distinctly seen as a deep red ball. The writer noticed this in testing the light-tightness of a photographic shutter, of all things in the world, the leaves of which were made of this material, and so ran to earth the cause of a succession of mysterious failures with his camera when isochromatic plates were employed! In modern thought the chemical and physical activity of light coming into evidence in photography and fluorescence are traced primarily to the ionising action of the rays and to the electrons temporarily "jerked out" of the atoms and molecules of matter by the passage among them of waves of light in tune with their natural periods.

Dark-heat Rays.—In the infra-red region, rock salt is by far the most transparent optical material, and the spectrum can readily be explored by photography up to 10,000 Å., using plates sensitised with dicyanin. Beyond this they must be investigated by their thermal effects, usually by some adaptation of the thermopile which converts the heat into electric energy. The very shortest Hertzian waves which can be electrically generated have a wave-length of about 2 mm. (20,000,000 Å.) but heat waves as long as 0·3 mm. have been detected in the radiation from the Welsbach gas-mantle, so that the gap here also is practically bridged. Quartz refracts these very long waves far more strongly than the others, and by the simple plan (termed "focal isolation") of passing the rays through a quartz lens furnished with a central circular disk of black paper, the long waves may be brought to a focus under conditions that leave the others divergent, the device acting as a perfect filter for this extreme heat radiation. Wood, to whom, with Rubens, this is due, made the further very interesting observation that a "dew" of mercury globules of diameter from 0·01 to 0·03 mm., condensed on a quartz surface from the vapour, though opaque to light and ordinary heat waves, will still transmit the longest waves of all.

Wave-length and Molecular Magnitude.—This is a good example of how the behaviour of matter to radiation is dominated largely by the condition whether or not it is "in tune" with the rays. We get the most interesting results when the order of fineness of the material structure corresponds with the wave-length. The ruby glass of the photographer owes its beautiful pure red tint to the merest trace of metallic gold, the particles of which are of such a size as to resonate with red light but to damp out and destroy other frequencies. In microscopy this consideration is again of the utmost importance, for the resolving power of lenses is properly expressed in terms of the wave-length of the light employed. To get higher resolving power than is at present possible—as an example, to reveal the still sub-microscopic world wherein it is suspected reside the bacterial agents responsible for many diseases that baffle the physician—the only possible line of further improvement of the existing methods is by working entirely by photography in the far ultra-violet region, with objectives compounded for use with these short wave-lengths. The limit of resolvability with visible light has been already reached.

Some Applications.—By photographing the lunar surface through screens capable of transmitting only yellow, violet and ultra-violet light respectively a sort of lunar survey by colour has been attempted. It revealed a remarkable deposit round one of the craters, Aristarchus, which in all probability is due to sulphur. Screens transmitting ultra-violet light with hardly any of the visible rays produce the most revealing effects on the human countenance, distinguishing instantly false teeth from real and skin from cosmetics by their different fluorescent power. Under radiations of short wave-lengths including the X-rays and γ-rays, many natural gems, such as the diamond, shine brilliantly by fluorescence, whilst imitations remain dark, and this simple test serves to distinguish the false from the true.

The Laws of Radiation.—The most important laws concerning radiation are those connecting the quantity and quality of radiation with the temperature of the radiator. They are strictly true only for perfect radiators or "black bodies," but are applicable under certain conditions to all bodies: for example, when they are heated in a closed furnace and their radiation examined through a small hole in the wall. Stefan's law states that the total quantity of energy radiated freely to outer space by a body is proportional to the fourth power of the absolute temperature. Wien's displacement law states that as the temperature increases, the region of maximum radiation shifts along the spectrum from

longer to shorter wave-length, the maximum energy is radiated at a wave-length which is inversely proportional to the absolute temperature, and the quantity of energy radiated at this maximum is proportional to the fifth power of the absolute temperature.

The latter law states in exact form the familiar fact that a body when treated first glows red, and that as its temperature is increased the colour changes through yellow ultimately to white. Below red heat, the maximum of energy emission occurs in the infra-red region, and the hotter the body the further is the maximum displaced towards the violet. In this way the surface temperatures of the sun and stars have been estimated. The red stars, like Betelgeuse, are comparatively cool with a temperature of about 3,000° C., which is about that of the carbon arc, the highest attainable on the earth, whilst blue-white stars like Sirius have temperatures at least four and perhaps 10 times as great. The surface temperature of the sun is estimated at about 6,000° C., and the maximum of energy emission at this temperature occurs at the yellow-green. It is probably by no means mere coincidence that this is also the most vivid colour, in the sense that light energy of this colour is perceived by the eye in smaller amount than that of any other. Probably the eye has adapted itself through the ages to make the most of that which there is most of in the sunlight. If so, and in the course of time the sun cools, people, if any were still alive, would see red most vividly. Our violet would have faded out and become ultra-violet, and our infra-red heat rays would have become visible as light.

The Structure of Matter.—To understand the mode in which electromagnetic radiation originates it is necessary to be acquainted with the modern theories of the nature of matter. Matter is regarded as intrinsically positively charged, *i.e.*, it carries a positive charge of electricity as an essential quality. In the neutral atom, this charge is exactly neutralised by a corresponding number of separate electrons or atoms of negative electricity. The atom is regarded as a miniature solar system with a positive material nucleus as the sun and the individual electrons as planets. The number of units of positive electricity on the nucleus and the number of revolving electrons both differ by unity in passing from one element of the periodic table to the next. This number is called the Atomic number, or Moseley number, after the brilliant young Oxford physicist who fell at Gallipoli shortly after his researches on the characteristic X-rays of the elements, from which this conclusion was drawn. The Atomic or Moseley number is one for hydrogen, two for helium, three for lithium and so on through the periodic table of the elements up to uranium, the last and 92nd, for which it is 92.

But these numbers really represent the net positive charge of the nucleus, the difference between its gross positive charge and a smaller number of nuclear electrons, for all atomic nuclei except hydrogen contain some electrons. The hydrogen nucleus is regarded as the pure positive sub-constituent of all matter, and is called sometimes the "proton." When for two atoms the nett charge is the same, but the gross charges (positive *minus* negative) different, we get elements identical in chemical character but of different atomic weight, called isotopes (*q.v.*). So far as wave radiation is concerned, we deal with the electrons external to the nucleus, but the β-rays of radioactive substances are electrons ejected from the nucleus of the atom. The external electrons are regarded as arranged in sets of " shells " at different " levels " or distances from the nucleus, whilst the odd ones over are the outermost of all and are relatively far removed from the central nucleus. They are called the valency electrons, as it is they alone that confer on the atom its chemical affinities or valencies. The others constitute with the nucleus a more self-satisfied economy, which, however, entirely controls the configuration of the outer electrons and therefore the chemical character of the atom. The most complex elements, like uranium with 88 " shell " electrons and four valency electrons, are regarded as having many shells, called as we go outward the K, L, M . . . shells, whilst the lightest element with a complete shell, helium, has only the K shell.

The Origin of Radiation.—Electromagnetic radiation arises whenever an electron alters its previous mode of coexistence with matter sufficiently abruptly. Beyond the range of frequency even of the longest Hertzian waves, with wave-lengths of many miles and frequencies of the order of 10,000, we come to the frequencies of the ordinary alternating electric current of commerce, given by a dynamo, and ranging from 15 to 100 or so a second. In the conductors carrying such a current the electrons are surging back and forth at these low frequencies, but the motion is too leisurely to excite any external radiation. Besides, the wave-length for a frequency of 15 would be $1\frac{1}{2}$ times the earth's diameter.

Hertzian Waves.—In the spark that occurs when a condenser or Leyden jar is discharged, or in the lightning flash, alternating currents of precisely the same kind, but with the frequency of the order of a million are set up. The frequency is completely controlled by the resistance, self-induction and capacity of the oscillating circuit. The electrons surging backward and forward through the circuit set up waves of their own period, which carry outward through space some of the energy of the electric current as Hertzian waves. In general the smaller the dimensions of the oscillating circuit, the higher the frequency and the shorter the wave-length. As we pass along the gamut, beginning with this artificially excited surging, through the aerial and antennae of a transmitting station, to the infra-red rays, we pass to the natural motions of the electrons in the molecules of matter at their own proper periods, which are excited by heat.

Spectrum Lines.—At first there is probably no very close connection between the vibrating electrons and the individual atoms and molecules. As in the transmission of the ordinary electric current, the electrons concerned in producing radiant heat are probably those associated loosely with aggregates of matter rather than with single atoms and molecules. But the higher frequencies result from the constituent electrons of the individual atoms of matter moving with their natural periods around the nucleus in definite orbits, each orbit giving a sharp line in the spectrum (*q.v.*) of the element. The break between ultra-violet light and the X-rays occurs at the valency electrons. Optical spectra result from the outermost electrons, and X-ray spectra from one or other of the inner completed shells.

The actual emission of radiation is depicted as due to the " falling in " of an electron towards the nucleus, after some previous disturbance has ejected it. In the series spectra in which the lines of the series are mathematically related, which line of the series is emitted depends upon which of many possible orbits the falling electron ends up at. There are for each electron a large number of possible " non-radiating " orbits in any one of which it may revolve indefinitely without radiating energy, if undisturbed, but if it falls from an outer to an inner orbit, the atomic system as a whole loses energy, which is emitted as radiation. The frequency is a function of the amount of energy so lost (*see* QUANTUM THEORY).

Different Types of Spectra.—Should the initial disturbance which precedes the emission of radiation eject the electron altogether from the sphere of influence of the parent atom the latter is ionised; that is, it becomes a positive ion, and the electron, if it has sufficient velocity, may come into evidence as the cathode-ray. Without going too far into the details, we may broadly regard the emission of radiation as accompanying in general the reunion of electron and positive ion. Not only one, but two, three or even four of the valency electrons may be ejected from an atom and the positive ion may be singly, doubly, trebly or quadruply charged. This gives the explanation of the fact that certain elements give different spectra according to the mode of excitation, whether by heat as in the flame or electric arc, or by electrical agencies as in the electric spark. It has been ascertained that the arc spectrum signalises the union of the electron with the singly charged, or as the chemist would say, monovalent, positive ion, to yield the neutral atom, whereas the spark spectra signify that a multiply charged or polyvalent ion has united with an electron to form a positive ion with one charge less than before.

These phenomena are the spectroscopic equivalent of the changes with which the chemist is familiar in the reactions of

salts, bases and acids, as distinct from those of organic compounds and other non-electrolytes, or non-ionised substances. Ferrous iron, Fe^{++}, resembles magnesium, Mg^{++}, in its chemistry, whereas ferric iron, Fe^{+++}, resembles aluminium, Al^{+++}, the element next to magnesium in the periodic table. So the spark spectrum of a metal, whilst totally different from the spark spectrum of the same metal, often bears a very close resemblance in its series relationships to the arc spectrum of the metal next preceding it in the periodic table. The spark spectrum of magnesium, due to the change $Mg^{++} \rightarrow Mg^{+}$, is analogous to the arc spectrum of sodium, due to the change $Na^{+} \rightarrow Na$. Sodium, magnesium, aluminium and silicon are successive elements in the periodic table. So we find aluminium giving, in addition to the arc spectrum, two spark spectra due to the changes $Al^{+++} \rightarrow Al^{++}$ and $Al^{++} \rightarrow Al^{+}$, the first of which is analogous to the arc spectrum of sodium and the spark spectrum of magnesium, and the second to the arc spectrum of magnesium. Similarly, silicon, in addition to its arc spectrum, possesses three spark spectra (1) $Si^{++++} \rightarrow Si^{+++}$, analogous to the arc spectrum of sodium, the spark spectrum of magnesium, and the second spark spectrum of aluminium, (2) $Si^{+++} \rightarrow Si^{++}$, analogous to the arc spectrum of magnesium and the first spark spectrum of aluminium, and (3) $Si^{++} \rightarrow Si^{+}$ analogous to the arc spectrum of aluminium.

Stellar Spectra.—In some of the hotter stars the sparks or, as they are sometimes called, the enhanced lines, are found unaccompanied by the arc lines of the element. This is never the case for artificially generated spectra. Norman Lockyer ascribed their origin to veritable transmutations of the elements into simpler "proto-elements" due to the intensely high temperatures. We now know that they are of electrical rather than thermal origin, and are due to precisely the same changes as we are familiar with in the chemistry of elements capable of acting with more than one valency.

X-ray Spectra.—In the X-ray spectra the inner shells of electrons are concerned, and although these correspond with changes of a deeper character than chemical—the material counterpart of which remains unknown—yet even these are not transmutational. These spectra are characterised by relatively great simplicity. A beam of X-rays is diffracted by a crystal. The regular spacing of the atoms in the crystal is of the same order of magnitude as the wave-length of the X-rays and several thousand times finer than the finest diffraction gratings ruled by the dividing engine, which are used to produce optical spectra. The production of X-rays is, like that of Hertzian waves, an artificial rather than a natural process. The electron ejected from the cathode of a vacuum tube under high electric potentials acquires great speed and becomes the cathode-ray (the radiant matter of Sir W. Crookes). If speedy enough, it can penetrate into the deeper electronic orbits and ionise the atoms in its path. If it disturbs the deepest level of all, an X-ray of the K series is generated. These are of the highest frequency and shortest wave-length, and consist for each element of a pair of doublets, one strong and one weak, which alter their frequency with the utmost regularity in passing from element to element in the periodic table (Moseley's law). So that the wave-length may be calculated for any element even if the element is not known, and in this way several new elements, notably hafnium, have recently been discovered. What has happened is that we are now so near the nucleus that its + charge, altering integrally from element to element, alone controls the periodicity of the K electrons. The outer L, M, N levels neutralise one another's effects, much for the same reason as that there is no effect of an external charge inside a hollow closed conductor. The L, M, N series of X-ray spectra are not so simple as the K series, but they are still simplicity itself compared with optical spectra. They are excited by electrons of far less velocity than the K series and require for their generation only moderate voltages.

But it is impossible to generate artificially the K series of the heaviest elements, *i.e.*, to impress on the electron sufficient energy to carry it beyond the L level. Fortunately, here nature comes to our aid. The penetrating γ-rays of the radioactive substances are the K series of the heaviest elements.

As we pass outward from the K to the N series, the X-rays become of increasing wave-length and decreasing frequency and penetrating power, until progress can only be further made by working in a complete vacuum as for the shortest ultra-violet rays owing to the absorption of the air.

The Rays of Radioactive Substances.—In the other direction, when we pass the K level and enter the "holy of holies" of the atom—the atomic nucleus—we come to the region of radioactive phenomena. From the artificial Hertz waves to natural heat and light rays we passed on to the artificial X-rays, but now we are back again to a natural process—withal a recently discovered one—confined to the last and most complex elements of the periodic table. So far it has proved itself one which our utmost electrical potentials are quite unable to imitate or affect in the slightest degree. Radioactivity is essentially a nuclear explosion, in which either a β or an α particle is violently expelled, the former at speeds ranging nearly up to that of light and the latter at speeds between 1/14th and 1/20th of light. As the β particle rushes outwards from the nucleus it may play havoc even with the K economy, which in the most complex elements is too deep to be disturbed by any available artificial agency. The most penetrating γ-rays are emitted as these K electrons resume their orbits, but there are also other and less penetrating types of γ-rays emitted, corresponding with the L and possibly other orbits.

Medical Uses.—On account of their unique penetrating power and powerful "burning" therapeutic action, the X-rays and γ-rays are employed—quite apart from the well-known application of the former to surgical diagnosis—as medical agents especially in the treatment of deep-seated cancers. It appears that young and developing cells especially are most sensitive to and easily destroyed by these agents and this explains their use in this field and also their alleged action in producing sterility both in the male and female. In America, especially, the technique of radium therapy has been ingeniously developed as an accessory in the surgical treatment of cancer. The radium emanation, which is the first gaseous product of the disintegration of radium—the γ-rays being emitted in the fourth change—is sealed up in capillary glass—or more recently gold—tubes, capable of being inserted by a surgical needle into the growing periphery of the cancer, after the excision of the main growth. The tubes, hardly thicker than a hair, are left in place. The radium emanation decays in the course of a few days, whilst the original radium from which it was derived generates a fresh crop for use again. This treatment has its legitimate niche in therapeutics, but it has been grossly exploited to augment the market price of radium.

The most penetrating X-rays it is possible to produce by the most powerful appliances are only one-twentieth as penetrating as the most penetrating γ-rays, being quite undetachable after passage through 1 cm. (3/8ths of an inch) of lead and for all practical purposes completely absorbed by 4 millimetres. They belong to the L series of tungsten, platinum or iridium, according to the metal used for the anticathode of the X-ray bulb. On the other hand, in regard to intensity or quantity of energy, the γ-rays cannot be compared with the X-rays. The output of power from an ordinary X-ray tube is vastly greater than from any quantity of radium normally obtainable. As in so many other cases, the problem in the use of these agents in medicine is to adjust their strength to the correct quantity to inflict the greatest damage on diseased tissue with the least to the healthy tissue.

The α-rays.—The α-rays of radioactive substances, our knowledge of which is mainly due to the long and brilliant series of researches upon them by Sir Ernest Rutherford, can only be mentioned incidentally as they are sufficiently important to deserve separate treatment. Though possessing by far the greater part of the total energy radiated by the radioactive substances they are of relatively slight penetration, being stopped by a few centimetres of air. Indeed it is a new and most significant phenomenon to find *atoms of matter capable of passing through matter at all.* But, like the other rays, they are stopped by matter irrespective of its chemical or optical nature, and mainly according to the weight in the path of the beam. They are exceptional in that

they have a very definite range, depending only on their velocity, which causes them to continue in unchanged numbers during absorption and suddenly to stop all together. This is well seen in the microscopic halos, called pleochroic halos, sometimes encountered in clear mica. The α-rays have the power of darkening mica, and these halos surround infinitesimal specks of radioactive materials in the mica. Under the microscope they are seen to be perfectly spherical, of diameter 0·03 mm. in the case of the uranium halos and 0.04 mm. for those due to thorium, and they often possess a clear structure consisting of a number of concentric rings, the diameters of which correspond to the ranges of the various α-rays involved. The mica has, through the ages, integrated and recorded in minute detail the properties of the α-rays from quantities of material too infinitesimal to be detected even by the most delicate direct radioactive tests.

Similarly, the α-rays possess a definite though minute range of penetration in glass, very similar to that in mica, and capillary glass tubes can be drawn so excessively thin in the wall as to allow the α particles to go through. Such tubes are completely impervious to ordinary gases, but if filled with radium emanation which emits α-rays *helium is produced outside the tube in quantity sufficient to be detected by the spectroscope.* This constituted the final step in the long chain of proof that the α-rays are radiant helium nuclei, *i.e.*, helium atoms shorn of their 2 K electrons, and each carrying therefore two positive charges.

The Exploration of the Atom by α-Rays.—The central nucleus of the atom was originally put into evidence by a careful examination of the trajectories of the α particles during their passage through matter. Like errant suns invading other solar systems, it is only rarely that they make a full head-on collision with the centre of the atomic solar system invaded. They scatter the electrons in their way almost as though they were not there, but a minute proportion of the impinging α particles are turned abruptly out of their paths and may even be returned the way they came. These are the ones which have passed sufficiently near to the central nucleus of the atom collided with, to be sensibly deflected from their headlong path. In some cases it has been established that the nucleus struck by the α particle suffers actual disruption, a hydrogen nucleus being detached from it and going off as a separate "H-particle," having similar properties to the original particle. This constitutes a secondary transmutation consequent on the natural one of the radioactive substance itself.

Artificial Transmutation.—To drive the positively charged helium nucleus up against the very highly positive charged nucleus of a heavy atom demands great energy, whereas a negatively charged β particle or cathode ray, provided it has sufficient energy to overcome the repulsion of the cloud of electrons surrounding the nucleus of an atom, will, once it has got through them, tend to rush into the nucleus. If it stayed there, the atom struck would itself be transmuted into an atom of the element preceding it in the periodic table; for example, lead into thallium, thallium into mercury or mercury into gold. In the radioactive change in which a β particle is expelled from the nucleus we have the exact converse. The atom from which the β particle is ejected constitutes an atom of the element *succeeding* the original in the periodic table. Its atomic number has been increased by one by the loss of a negative charge, and therefore the element moves up one place in the periodic system. In the α-ray change, in which the atomic nucleus loses two positive charges, the element moves down two places. For example, from uranium we get an isotope of thorium, and from thorium an isotope of radium.

Altogether apart from theory, Miethe of Charlottenburg has recently claimed to have effected an infinitesimal transmutation of mercury into gold, by its use in the mercury vapour lamp and in the turbine interrupters employed with X-ray coils. Since then (1926) Smits and Karrsen of Amsterdam, using a lamp with molten lead instead of mercury, have obtained the clearest spectroscopic evidence of the production of mercury, and to a lesser extent thallium, in the process. These results, if established by further experiments, constitute the first clear achievement of an artificial transmutation process. They are quite in keeping with modern ideas of atomic structure, always on the assumption that the actual proportion of element so transmuted is excessively minute. It is only the infinitesimal proportion of the impinging rays accurately aligned upon the minute central nucleus that can be effective. In Rutherford's experiments with the α particle, it was estimated that only 10 in a million million of the collisions in the most favourable cases effected the disruption of the nucleus.

Millikan Rays.—It has been known since 1903 that the atmosphere was traversed by very penetrating rays similar to those given by radium but extremely feeble in intensity, and it was natural to attribute these to the small amount of radium, (*q.v.*) billionths of the whole, known to be present in rocks and other materials of the earth's crust. No doubt part of the effect is due to this cause. But in 1912–4 Gockel and other German physicists, investigating this penetrating radiation in the atmosphere from balloons, made the remarkable discovery that it increased on ascending, slowly at first but rapidly above 10,000 feet. Millikan, in the United States, sent up recording instruments in balloons to the height of 10 m. and, though he confirmed the increase, found that it was much too small to be explained by *ordinary* γ-rays reaching the earth from outer space. He then sunk his instruments in the deep lakes fed with pure glacier water found at high altitudes in the Rockies and (1925) completely established the existence of an entirely new radiation reaching the earth from the outside, capable of penetrating 68 ft. of water, or over 6 ft. of lead, before being completely absorbed. The whole thickness of the atmosphere, though it would much enfeeble a radiation of this penetrating power, would not completely stop it. The intensity of this new cosmical radiation is not affected by day or night, so that it does not come from the sun, and most of the ordinary γ-like radiation of the atmosphere appears to be a secondary result of this new radiation being scattered and transformed in passing through the air. The new rays are about as much more penetrating than the most penetrating radium γ-rays as the latter are with reference to the most penetrating X-rays, and their wave-length is estimated at 0·0004 Ångstrom unit. By their discovery some $4\frac{1}{2}$ octaves are added to the extreme top of those shown in the chart.

The Origin of Radiant Energy.—Their existence gives weight to some very far-reaching cosmogonical speculations to account for the primary source of cosmical energy which have recently been put forward by Jeans. The quantity of energy that the sun and stars appear to be perennially pouring out is so great that no known process, not even radioactivity, can account for it. It must, however, be remembered that there is no actual proof that radiation is really propagated uniformly in all directions. Of recent years there has been a tendency to believe that this may be an illusion due to our being completely surrounded by matter, the air above and the earth beneath. An alternative view that has been gaining ground during the present century is that radiation can only travel along lines or tubes joining separated portions of matter. If this, just possible, point of view should prevail there would then be no great difficulty in accounting for cosmical energy. If the sun only radiated to the earth and other worlds surrounding it, the emission of energy would be only a tiny fraction of what it must be if it is radiating to an equal extent in all directions of space.

However that may be, Jeans has supposed that the primary source of cosmical energy is a veritable annihilation of matter. The doctrine of relativity points to an equivalence between energy and matter, and blends the twin laws of conservation into one. Matter is conserved when energy is, and energy is conserved when matter is, but the real relation is that the sum of matter and energy is conserved, though matter may be transformed into energy and energy into matter at a definite exchange ratio. According to this theory, the annihilation of matter would result in the appearance of energy equal to that possessed by twice the mass annihilated moving with the speed of light. Thus from a very minute amount of matter an almost incredible amount of energy would be generated.

In all the processes we have considered, proton and electron maintain their separate identities, though powerfully attracting one another, by actions identical in type with those which keep

apart satellites from planets and planets from suns in cosmical systems. Whereas if proton and electron fell into one another so that their opposite charges neutralised each other, there would in all probability be nothing but the energy of the system left, and this, from analogy with the known cases of electromagnetic radiation, would be radiated outward, at a very high frequency corresponding with the colossal quantity of energy involved. The estimated wave-length and frequency of the Millikan rays is just about of the order to be expected from the actual falling in of an electron into a proton, and for the total annihilation of the mass by transformation into radiant energy. This gives this otherwise extremely speculative and bold theory greater importance. Such a process would satisfy the demands of the cosmogonist for energy over almost infinite periods of time. It may be taking place in some stages of the evolution of stars. That it cannot be a complete explanation in itself seems to be indicated by the fact that our sun at least does not appear to be emitting these new radiations. So science is advancing into ever wider horizons and the 20th century bids fair to hand over to its successor realms as vastly greater than it received as were the realms the 19th handed on to us.

See also ASTRONOMY; ATOM; ATOMIC WEIGHTS; CANCER RESEARCH; CHEMISTRY; CRYSTALLOGRAPHY; GASES, ELECTRICAL PROPERTIES OF; HEAT; ISOTOPES; MATTER; MICROSCOPY; PHOTOGRAPHY; PHYSICS; PUBLIC HEALTH; QUANTUM THEORY; RADIOACTIVITY; RADIO-THERAPY; RADIUM; SMOKE PREVENTION; SOLAR ENERGY; SPECTROSCOPY; SPECTRUM; TRANSMUTATION OF ELEMENTS.

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REA, SAMUEL (1855–) American railway official, was born at Hollidaysburg, Pa., Sept 21 1855. In 1871 he worked for the Pennsylvania Railway as chain and rod man. From 1875 to 1877 he was assistant engineer on construction of the Monongahela river bridge at Pittsburgh. He was next appointed assistant construction engineer for the Pittsburgh and Lake Erie, returning to the Pennsylvania lines in 1879. In 1889 he joined the Baltimore and Ohio, being chief engineer for construction of the belt-line tunnel under Baltimore. In 1892 he was appointed an assistant to the president of the Pennsylvania railway, rising through the various grades to first vice-president in 1911. In 1913 he was elected president. He was in charge of the construction of the Pennsylvania station in New York City (completed in 1911), the connecting tunnel under the Hudson river, the New York connecting railway, and Hell Gate bridge over the East river (opened in 1917). In 1917 he became a member of the special commission on national defence of the Railroads War Board. He was director of the department of railroads, electric railways, highways and waterways of the committee of public safety of Pennsylvania. In 1918, when the railways were taken over by the Government as a War measure, he was replaced as operating head of his road, but remained in charge of its corporate affairs. He retired from the presidency of the railway Sept. 1925. He was the author of *The Railways Terminating in London* (1888).

READING, RUFUS DANIEL ISAACS, 1ST MARQUESS OF (1860–), British statesman, was born in London Oct. 10 1860, the second son of Joseph Isaacs, merchant of the city of London. He was educated at University College School, London, and abroad. This education was truncated by his adventurous spirit, which caused him to run away to sea at the age of 14 and to serve for two years before the mast in a sailing ship; and it was as ship's boy scrubbing the deck that he first saw India where he afterwards ruled as Viceroy. He entered subsequently the commercial world on the Stock Exchange, but here also his adventurous spirit resulted in complete failure. Undaunted by these early disasters he proceeded to read for the Bar, was called in 1887 and became a bencher of the Middle Temple in 1904. In 1887 he married Miss Alice Cohen. His legal career was one of unbroken and immediate success, through indefatigable capacity for work, great personal popularity and a method of advocacy which relied on quickness and subtlety of intellect and enormous tenacity of memory. Perhaps the most sensational of his cases was the prosecution of Whittaker Wright for fraud, which was followed by the defendant's suicide, after a conviction obtained despite the published and declared opinion of the law officers of the Crown that no prosecution had any chance of success. He rose by a succession of triumphs to the position of the most distinguished advocate and verdict getter of his generation.

He entered Parliament as a Liberal Imperialist, winning a seat for his party at Reading in a bye election in 1904, a seat which he retained in numerous successive elections until he was transferred to the House of Lords. In political oratory, although an effective speaker in the country, he failed, as so many great lawyers have failed, to impress the House of Commons; being far more inclined to address his opponents as a jury with a view to their conversion than to stimulate enthusiasm for the policy of his own party. From the beginning, however, his extraordinary power of sane judgment was recognised, even before his appointment as attorney general in 1910; and the high regard entertained for him by the leaders of the Liberal party was openly recognised, in defiance of all precedents, by the giving to him of a seat in the Cabinet in June 1912, while he held that office.

His career of unbroken success was clouded for a time by a fierce and bitter attack upon him for having purchased from his brother some shares in the American Marconi Company at a time when the British Marconi Company was making a contract with the British Government; and as he had sold a few of these shares to the Chancellor of the Exchequer, Mr. Lloyd George, he had to bear the brunt of an onslaught concerning a transaction in which he had been merely careless, stimulated in the main by anti-Semitic prejudice and by partisan efforts to destroy the reputation of Mr. Lloyd George. After nearly a year, however, of heated deliberations by a committee of the House of Commons and violent attack and abuse, his honour was decisively vindicated by the verdict of the committee which was endorsed by Parliament, and a few months later (Oct. 20 1913) he was raised to the position of Lord Chief Justice of England, and a short time afterwards was created Baron Reading of Erleigh. As attorney general he only once personally undertook prosecution for murder (in the Seddon poisoning case) and although he obtained a verdict with his usual ability in this historic criminal trial, he consistently refused to undertake such work again.

He distinguished himself mainly in his high judicial office by humanity in the conduct of criminal cases, and by the deliberate establishment of the principle that the court of criminal appeal should act as a real court of revision, upsetting verdicts or reducing sentences even of the individual High Court judges. The most historical of the trials over which he presided occurred during the World War. This was his trial of Sir Roger Casement for treason in connection with the Irish Rebellion, in which he exhibited, with the granting of every kind of opportunity to the advocates of the prisoner in a political trial, an historical example of the dignity and impartiality of British Justice in face of an outburst of national feeling.

After the outbreak of the War in Aug. 1914 the Government utilised his soundness of judgment and knowledge of finance in matters altogether apart from the high court of justice. He assisted the bankers in the drafting and the administration of those measures which saved England from financial and in consequence economic ruin. The most sensational of these was the granting of the British guarantee to the great accepting houses, to bills amounting to many hundred millions of pounds, without which neither food nor munitions could have been moved from their foreign places of origin to this country. This bold and daring measure not only saved Britain from starvation riots and the great firms of the city of London from bankruptcy, it also resulted in the end in the Government losing nothing by the transaction.

In the next two years, Lord Reading was occupied in the inner councils of the Government, especially on all questions connected with finance, and in endeavours to reconcile the growing friction between various parties in the Cabinet and between the Cabinet and the great newspapers outside. In 1915 he was President of the Anglo-French Loan Commission to the United States, where he won universal popularity and succeeded in accomplishing the most difficult of all tasks, the flotation of a great War Loan in America, which was at that time less sympathetic to the Allies than at any other time during the War. On June 26 1916 he was created Viscount Reading of Erleigh. His efforts at conciliation and sympathetic action failed, however, to prevent the breaking up of the Coalition Government of 1916. But the newly-formed administration under Mr. Lloyd George was not so foolish as to leave unutilised his extraordinary capacity for sound judgment, placating opposition and manipulating the minds of men towards decisions vital to the welfare of his country.

In 1917 he was appointed high commissioner and special envoy to the United States, perhaps the most important position for winning success in the World War, and in Dec. of that year was created an earl. In 1918 he was appointed high commissioner and Special Ambassador at Washington. It would be difficult to overestimate the services rendered on so critical an occasion by that capacity of judgment which distinguished his whole public career, combined with serenity of temper, impersonal devotion to the public welfare, and a charm which created innumerable friendships and persuaded men to modify their preconceived notions and to endeavour to fall in with his desires. It was obvious that these qualities were exactly those demanded on the War's conclusion, in the troubled and unhealthy state of India, which had been created partly by prolonged development of resentment against the absolute dictatorship of British rule, and partly by the reverberations of the War. In a condition which was highly disturbed, the appointment of the Earl of Reading to the office of viceroy and governor general of India was acclaimed by men of all parties as an appointment of the man most qualified of all living statesmen to reduce the chaos and discontent to some method of loyalty, order and peace.

Lord Reading's term as viceroy and governor general of India marked an epoch in the history of that Imperial Continent. He was faced immediately by four almost insoluble problems. First the Diarchy system of the Montagu-Chelmsford Govt. of India Act devised as a step in advance towards complete self-government, was definitely rejected by the leaders of the United Hindu and Mahommedan educated population, who in the movement known as Swaraj had resolved to make it unworkable. The second was the influence of Mahatma Gandhi, one of the most remarkable men of all time, who had inflamed millions of Indians to a boycott of the West by the East and a kind of gigantic movement of passive resistance, in which both English products and English Govt. were to be alike rejected. The third was that the national temper of India had been aroused by prohibitions and indignities put upon Indians in other parts of the Empire. The fourth, the ghastly story of the Punjab rebellion and the slaughter at Amritsar in 1919, with the support of General Dyer's action there by the governing classes in England had excited a feeling of such fierce resentment throughout the length and breadth of the peninsula as might well have caused a general uprising. Formerly, as the new viceroy said to a friend, the disaffection was confined to the articulate classes. Amritsar spread it among the villagers and peasants. One may add to this, the general impoverishment created by the vast war expenditure and by the enormous fluctuations in currency reflected in India from similar changes in the world of international affairs.

Lord Reading set himself, with patience, flexibility and loyalty to India which he had been called upon to represent, to endeavour to alleviate these sources of discontent. In dealing with the revolt against the diarchy, he found himself compelled to imprison the two Mahommedan leaders, the brothers Ali. And although he was able before the end to establish some kind of self-government in most of the local provinces and even something like friendly co-operation in the Central Legislative Council the Constitution broke down in the Central Provinces and had to be suspended in Bengal, with a return to complete autocratic government. In the case of the boycott of the West and of Western Govt., the viceroy after several attempts at reconciliation with Gandhi—attempts that were condemned by some Anglo-Indian opinion—found himself compelled to authorise his prosecution for inciting to mass civil disobedience which resulted in a sentence of six years' imprisonment, although the Mahatma was released on the grounds of ill health after two years.

In the matter of the treatment of Indian immigrants in other parts of the Empire, Lord Reading showed himself as determined in assertion of the rights of India as could any elected native prime minister; challenging both the home government and the government of the Dominions in the rights of Indians as in the ancient days of the rights of "citizens of Rome." In the case of Amritsar and the memories of the rebellion he could only exhibit his sympathy with the Indian population and work for the healing influences of time. His difficulties were further increased by a problem altogether outside India, the struggle between Turkey and the Christian populations which was interpreted as an attempt to annihilate the Mahommedan religion. His messages on this subject to the Secretary for India, published without authorisation by Mr. Montagu, produced the dismissal of the latter; but probably assisted the Viceroy in his exhibition of sympathy with the people whom he represented.

In the struggle for financial stability he was compelled to exercise the power of certification by the viceroy against the Assembly of the much-hated salt tax. But he saw, and acquiesced in, India, like many other of the Dominions, converting itself from a free trade into a protectionist country, a change produced partly by a passionate nationalism which rejected the excise cotton duties, and partly by the need for compensating revenue by a big import duty on iron and steel. The happy result of a stabilised budget was the raising of a new loan for national development of railways and canals, the voluntary acceptance by the Indian representatives in the Legislative Council of the prohibition of the export of opium in conformity with the desire of the League of Nations, the substantial reduction of the military expenditure, combined with the establishment, if on the smallest scale, of an Indian navy, designed as a step forward in the realisation of the Indian demand to be treated as one of the great Dominions and not as a subject race. That he could exercise sternness when required as well as sympathy was shown by his action towards the Maharajah of Indore, who was compelled to abdicate as an alternative to trial by his peers for the murder of an Indian merchant who had protected a dancing girl who had escaped from his harem.

While it would be idle to assert that Lord Reading's rule had solved all the difficulties of the almost insoluble problem of India's future, no one can deny that that rule will stand in history as the great advance in conciliation, largely created by the personal popularity of himself and his wife and by his ability to convince the leaders of Indian educated opinion that his sole desire was to promote the welfare and fulfil the legitimate aspirations of a proud, self-conscious, if bewildered people. On relinquishing his office on Thursday March 26 1926, he addressed both houses of the legislature at Delhi in a speech which was received with an ovation. "The differences which have occurred" he then asserted, "have arisen from honest divergencies of opinion. There has been no difference in purpose; we have striven to attain the same end—the prosperity and happiness of India." He emphasised the whole object of his actions, not merely economic prosperity, but advance to new status and dignity, to enable India steadily to build up her own responsible institutions within the commonwealth of nations forming the empire. He could assert with truth that since the years of his accession to office there has been a great change in the atmosphere: "Peace reigns on our borders; internal disturbances have been set at rest; law and order have been vindicated and

established; the financial situation has been stabilised, with beneficent reactions on the nation-building activities of the reformed constitution. Conditions have been created which give a fair prospect to the development of India's resources, and the anxieties of the Indian moslem population have been allayed." This is no bombastic summary of a wholehearted intelligent and devoted work with a predominant sense of responsibility towards the people whom Lord Reading was called upon to rule, and it is probable that the modest catalogue of achievements, for which he was prepared to give all the credit to others, will come to be the verdict of time and credited to his own great labours. Upon his return to England in April, it was announced that Lord Reading had been raised to the rank of Marquess. (*See* INDIA.) (C. F. G. M.)

READING, England (*see* 22.939), had a population of 92,278 in 1921. Since 1911 parts of Theale, Tilehurst and Caversham have been included in the borough, which has now an area of 9,105 acres. A new parish, that of St. Luke's, was created on the Redlands estate in 1912, and a church, St. Andrew's, built at Caversham in 1911. Among new buildings are the Shire Hall, in Forbury, and the post-office. A new bridge over the Thames to Caversham was opened in 1923, and the old one close by closed for rebuilding in 1925. It will have two arches of unequal span, the centre pier resting on an island in the river, where the remains of an ancient bridge and a 14th century chapel have been found.

READING, Penn.., U.S.A. (*see* 22.940), annexed several tracts between 1910 and 1920, increasing its area from 3,975 to 6,090 acres. The population increased 12·2%, to 107,784; and to 112,707 in 1925 according to the census bureau estimate. Reading kept its place as the third industrial city of the State, and as an important distributing centre for anthracite shipments and agricultural produce. Trolley and bus lines were developed in every direction, and daily motor-truck service was established to New York, Philadelphia and other points. Schuylkill Canal, after nearly a century of service, was abandoned.

Reading is the centre of Pennsylvania's first super-power system, which furnishes electric current from Harrisburg to New Jersey. The value of factory products within the city limits was $51,135,000 in 1909; $141,561,000 in 1919; $134,501,690 in 1923, when there were 395 establishments, several of them the largest of their kind in the world. Among the leading manufactures (1925) were hosiery, silk underwear, narrow fabrics, wrought-iron pipe, goggles, hats, children's shoes, candy, builders' hardware and machinery. By 1925 the public school system had been enlarged and diversified; extensive improvements had been made in the sewage systems; the water supply had been doubled and improved by municipal control of the watersheds, and a bond issue had been approved by the voters (1920) for the construction of additional impounding reservoirs. The construction of a new city hall and a new court house were authorised in 1925.

READING, UNIVERSITY OF.—On March 17 1926 a charter of incorporation was conferred on the university. Accommodation for 400 students is provided in the halls of residence, to which a sanatorium is attached. The faculties are letters, science, agriculture and horticulture in association with the National Institute for Research in Dairying and the British Dairy Institute. The progress of this institution since 1902, when it became the University College of Reading, has been uninterrupted in every respect. It has a capital endowment of £250,000 and in 1924 received £20,000 for endowing the library. In 1924 an exchange of professors was arranged with Bristol University and members of the professional staff attended the World's Dairy Congress at Washington and Philadelphia.

REALITY: *see* LOGIC.

RECALL.—The recall is a method whereby public officials may be removed from office by popular vote prior to the normal end of their term.

In European States.—An early instance is afforded by the *Abberufung*, an institution of considerable antiquity, which still survives in the constitutional texts of several Swiss cantons, although there is no record of its use during the present generation. The *Abberufung* provided that upon petition signed by a certain percentage of voters a popular vote should be taken upon the continuance in office of the legislature as a whole. If a majority of the voters showed themselves hostile to the sitting House it was dissolved and elections were held for a new legislature. Curiously enough, although the *Abberufung* is moribund in Switzerland, an institution closely similar to it has been written into the new constitutions, dating from 1919 and 1920, of the greater states of the German Reich—Prussia, Bavaria, Württemberg and Baden. Also the new constitution of Estonia (1920) provides that the legislature shall be dissolved in case it is defeated by the people on an initiative or referendum vote.

In the United States.—It is in the United States, however, that the recall has found the widest favour recently. Unlike the initiative and referendum (*q.v.*) this development was inaugurated in ignorance of Swiss models. Also unlike the latter the recall, as invented anew in America, is designed for attack upon a single official, although some of the laws on the subject permit it to be directed against a number of officials at the same time. Introduced first in the municipal charter of Los Angeles (1903), this feature has been copied widely by city governments operating under the commission or commission-manager plans, of which there are now some 400 in all parts of the United States. By constitutional amendment in 1908, Oregon made the recall applicable to elective state officials as well as to elective officials in counties, cities and other local government units. Between 1908 and 1920, 10 other States adopted the state-wide recall, among them California, Colorado, Kansas and Louisiana. With the single exception of Michigan all the recall States lie west of the Mississippi.

Constitutional and charter provisions on the subject usually exempt officials from recall during the earlier part of their terms —as a rule for the first six months of a term of two years or longer. To be effective petitions for recall must be signed by a certain percentage of the voters of the district or State, such requirements ranging from 10 to 55%, the most common being 25%. Within from 20 to 90 days following the filing of an adequate petition a special election is held, at which, in most cases, the elector is asked to vote, first, on the question of the recall of the official under fire; and, second, on the choice of a possible successor from among the candidates presenting themselves for that purpose.

The greatest controversy over the recall in the United States turned upon its use against judges. Opponents held that such use would destroy the independence of the courts. On the other hand it was asserted that judicial officials, like all others, might become too subservient to political machines or to corporate influence, and that occasional reminders of their dependence upon the people would be a serviceable corrective. That the opposition was effective in part appears from the fact that of the 11 States having the state-wide recall, four (Idaho, Michigan, Washington and Louisiana) expressly exempt judicial officials. In connection with the recall of judges may be mentioned the proposal for the recall of judicial decisions, which attracted a large share of attention during the presidential campaign of 1912, being advocated in the Roosevelt Progressive platform of that year. It was destined to be stillborn, however. One State only, Colorado, attempted to adopt the recall of judicial decisions (1913), but no employment was made of the device, and in 1921 the state Supreme Court of the United States declared it unconstitutional.

Unlike the initiative and referendum which have been employed actively and generally, the recall has been used in sporadic cases only, chiefly against local officials such as mayors, police magistrates and county judges. No higher state judicial officials have been removed by it, and no state-wide officials of other kinds with the single exception of the North Dakota case of 1920, when a governor and two other administrative officers were removed. The recall is no longer regarded as a dangerously radical innovation; indeed it is considered rather ineffective as a cautionary measure against "the never-ending audacity of elected persons." One positive beneficial result may be ascribed to the recall. It has reduced appreciably popular antipathy against centralising the powers and lengthening the terms of elective officials, without which necessary reforms in this direction, particularly the movement for commission and commission-manager government for cities, could not have made such great progress. (R. C. B.)

J. D. Barnett, in *The Operation of the Initiative, Referendum and Recall in Oregon* contains an excellent detailed study of the operation of the recall in that state. (*See* also INITIATIVE; REFERENDUM.)

RECIFE (*see* 22:953), is sometimes known by the name of the State, Pernambuco. The population in 1925 was 356,000, an increase of 126,000 in 15 years. Federal, State and municipal Govts. by co-operation with the Rockefeller Foundation (1919), the erection of modern hospitals, a new water system (1917) and the extension of sanitation have improved health conditions. The death-rate has been reduced to about 34 per 1,000. Yellow fever and smallpox have been practically eradicated. Paving of old and narrow streets has advanced and in the newer parts of Recife wide modern avenues are extending. Among new public buildings are fine municipal and State offices, a law college, a commercial museum, schools and theatres. New business buildings and private homes add to the city's attractiveness. Electric light and street car services have extended further into the suburbs. Good roads are multiplying and the use of motor cars is growing. Textile (one silk) mills, shoe, oil, soap and lock factories, better electric light equipment, modern homes for workmen, are a few of the industrial and civic advances. Port construction, now well advanced, has already cost $20,000,000; additional construction is in progress, including a new light system (1925) and the deepening of the inner harbour.

Recife exports sugar, cotton, lumber, tobacco and fruits. It ranks fourth in Brazilian exports of foods and raw materials and third as regards imports of foreign goods. The total commerce handled in a recent year amounted to 363,000 tons. More than 1,000 m. of railways radiate to interior regions, providing outlet through Recife. (W. A. R).

RECLAMATION: *see* COAST PROTECTION.

RED CROSS (*see* 1.801), the national and international organisation for the care of the sick and wounded in war, the assistance of prisoners-of-war, and other humanitarian purposes.

I. THE INTERNATIONAL MOVEMENT AND THE NATIONAL SOCIETIES

The international Red Cross Committee, founded in 1863 by Henri Dunant and a group of prominent citizens of Geneva, promoted two diplomatic conferences which drew up the Geneva Convention of Aug. 22 1864 (revised July 6 1906) and supplied the international legal basis to the work of the Red Cross. The International Committee was constituted to supervise the observance of the Geneva Convention, to found and develop Red Cross societies throughout the world, to act as an intermediary between governments, peoples and groups of various nationalities for mutual assistance and relief for victims of war, sickness, etc. The various societies meet at intervals in international conferences. The 9th conference, held at Washington in 1912, dealt chiefly with relief for prisoners of war. The Red Cross emblem (red cross on a white background) displays the arms of Switzerland reversed, and was adopted in honour of that country.

The work of the Red Cross during the wars which have occurred since its foundation has been steadily extended. The War of 1914 necessitated a very great development, especially as regards collaboration with the various military medical services; care of the wounded, formation of hospitals and detachments of nurses; relief for prisoners-of-war and their families; building of hospitals; supplies; hospital transport; canteens; relief for war victims in the various countries; relief of civilians in distress and of refugees, etc.

National Organisations During the War.—The belligerent countries naturally made great efforts on behalf of their own nationals. The British and American services are dealt with separately at the end of this article. Perhaps the most remarkable of the other efforts was that of Germany, where the Red Cross mobilised a total auxiliary medical service of 250,770 persons, and organised 85 hospital trains and floating ambulances, 3,470 hospitals and convalescent homes, 500 portable Döcker barracks, 508 homes for the troops, 490 supply stations and 421 hospital posts for men on leave. The Italian Red Cross treated close on 700,000 wounded and collected funds amounting to 51,000,000 lire. Nearly 18,000,000 parcels were sent to Italian prisoners-of-war. Of the neutrals, the Danish Red Cross organised a large service for the transmission of letters and parcels to prisoners of war in Austria, Germany and Russia, and for distributing literature to internment camps. The Prisoners Bureau at Copenhagen had branches at Berlin, Moscow, Vienna, Paris, etc. The Danish Red Cross played an important part in the prisoners of war conference between Russia, Rumania and the Central Powers at Copenhagen in 1917. The Dutch Red Cross gave much assistance to Belgian refugees, and assisted interned prisoners and the exchange of invalids and health personnel. The Swedish accomplished much relief work, especially regarding Germany and Russia. The Swiss organised the repatriation through Switzerland of severely wounded prisoners (80,377 men) and the internment in Switzerland of sick prisoners.

International Committee During the War.—In 1914, the International Red Cross Committee set up at Geneva the International Prisoners-of-War Agency, with departments of prisoners-of-war and missing men of the Entente countries (12 sections, dealing with 30 countries); prisoners-of-war and missing of the Central Powers (4 sections); and interned and deported civilians, hospital staff, hostages and refugees. Between 1914–8, more than 20,000 people came in person to Geneva to obtain information. The daily post varied between 2,000 and 15,000 letters. The total number of index cards was over 5 million.

There was a special department for naval prisoners-of-war, or men missing at sea. Further, the International Agency made enquiries about men missing on the field, dealt with the transmission of relief to and the repatriation of families in the invaded areas, with the repatriation of deported workers from reprisal camps, and of members of the ambulance corps. The International Red Cross Committee sent numerous delegates to inspect prisoners-of-war and civilian internment camps in Europe, Asia and Northern Africa. Printed reports on these visits were issued regularly. Further, the International Committee made the necessary protests against violations of the Geneva convention. Thus, on Sept. 21 1914, it reminded belligerents of their duty strictly to observe the 1906 convention concerning the care of sick and wounded without distinction of nationality. It also drew attention to the neutrality of the ambulance staff, to the desirability for suspending hostilities for the identification and burial of corpses, to the question of the bombardment of hospitals and the illegal treatment of sanitary or Red Cross staff; the question of reprisals; the protection to be afforded to hospital ships. As a result of steps taken by the International Committee, the Swiss Govt. proposed the negotiations between belligerent countries for the repatriation of invalid prisoners-of-war. In Feb. 1915, the International Committee took steps also to secure the internment in neutral countries of sick prisoners.

International Committee after the War.—Among the activities of the Red Cross Societies in repairing the effects of the War may be mentioned: repatriation (with assistance of the League of Nations) of 300,000 Russian prisoners stranded in Germany, and 150,000 German and Austro-Hungarian prisoners detained in Russia and Siberia; delegations for distribution of emergency relief and protection of hospitals and charitable institutions and of aliens during the civil wars in Russia (1918), Hungary (1919), Upper Silesia (1921); visits to political prisoners in the Ruhr (1923), Ireland (1923), Poland (1924), Montenegro (1925); relief to starving populations in Poland, Austria, Hungary (1919–22), Anatolia (1922), Germany (1923–4), Albania (1925), Syria (1925); the maintenance of a central office in Vienna to fight epidemics, co-ordinating with work in Poland, Galicia, the Ukraine, Rumania and Austria; work in the Ukraine against spotted typhus (1919–20); anti-malarial work and general medical study in Georgia (1923); relief for the 1,500,000 Russian refugees in Europe (1920), assisting the League of Nations when it took over this question in 1921; relief and hospital work among Greek refugees from Asia Minor (1922)—commission for the exchange of prisoners-of-war between Greece and Turkey; and evacuation of Russian refugees in Manchuria, in collaboration with the International Labour Office (1925).

Activities after the War.—Special work was undertaken by national societies, including the work of French, Belgian, British and American Societies, in re-establishing sanitary conditions in

the devastated regions of France and Belgium; similar work in the Baltic States, Poland, the Ukraine, Asia Minor; first aid and medical treatment to distressed populations in Austria, Hungary, Germany, Russia, Asia Minor and China (during the famine); work against epidemics; co-ordinated measures against exanthematic and recurrent typhus in the Ukraine; against malaria (Italian Red Cross); a tropical institute for prevention of malaria (Georgia); summer hospitals (China); campaign against epidemics among the natives (Siam, Dutch East Indies, Congo). Many societies organised relief for the sufferers from special disasters, notably: cyclones and fires (America); cyclones, fires, burst dams (Holland); floods (China); earthquakes and cyclones (Central and South America); eruptions, earthquakes, fires (Italy); earthquakes, especially that of Tōkyō, Sept. 1923 (Japan). Still another branch of activity was the evacuation of the wounded in case of accidents, disasters, civil war, revolutions in various countries (Portugal, Germany, Russia, China, Central and South America).

The system of training nurses and hospital helpers was reorganised and directed mainly towards intensifying health propaganda and performing emergency relief work. In Germany, nurses were especially trained for campaigns against epidemics and tuberculosis; in France for work with occupying troops in Rhineland, Upper Silesia, Morocco, Tongking, Syria; in the French devastated areas, against tuberculosis and for protection of children; in England as visiting nurses in slum areas. National societies also established special hospitals, sanatoria, preventive institutes, orphanages and dispensaries; they conducted propaganda for the increase of Red Cross membership, especially among young persons; they organised social hygiene courses and lectures to encourage campaigns against tuberculosis, cancer, venereal disease and further hygiene in general. Many homes for children and colonies for sick children have been established to combat tuberculosis. Lessons in hygiene have been organised in schools; the Italian Red Cross alone has given assistance to over 50,000 children.

League of Red Cross Societies.—In 1919, on the proposal of Mr. H. P. Davison, President of the American Red Cross, the American, British, French, Italian and Japanese Red Cross societies founded the League of Red Cross Societies, to encourage in all countries the development of a duly authorised national Red Cross organisation, the object of which is to improve health conditions, to prevent disease, to contribute to the general well-being by placing new scientific discoveries at the disposal of everyone, and to act as an intermediary for the co-ordination of various relief works in the event of disasters, national or international.

The League is managed by a general council and a board of governors, and since 1922 its headquarters have been at Paris. It includes departments dealing with international relief, propaganda, publications on hygiene, tuberculosis, venereal disease, the protection of children, visiting nurses, the Junior Red Cross, etc. The League has adopted as a symbol the Red Cross in a star with five points, symbolical of the five Red Cross societies which founded it.

International Conferences.—International Red Cross conferences were again convened from 1921 onwards. The 10th Conference (Geneva, March 30 to April 7 1921), surveyed the activity of the various national Red Cross societies during the War, and drew up a programme for the future. It also adopted resolutions concerning the limitation of war, the preparation of a diplomatic convention concerning prisoners-of-war, civil war, and the international organisation of the Red Cross; and prepared a draft revision of the Geneva Convention.

The Eleventh Conference (Geneva, Aug. 28 to Sept. 1 1923) considered the situation of civilians in the power of the enemy, and drew up a scheme of international relief for populations stricken by disasters. This report was drawn up by Senator Ciraolo, President of the Italian Red Cross, and after having been submitted to the Council and Assembly of the League of Nations in 1925, is now being considered by a special committee of enquiry.

The 12th Conference (Geneva, Oct. 7 to 10 1925) which was attended by 170 delegates representing 39 governments, 44 Red Cross societies and 20 other institutions, drew up the present programme for the work of the Red Cross societies, confirming, on the basis of past experience, the work of the national societies in time of war, and laying down general principles for the development of Red Cross work in new fields.

The resolutions adopted at this Conference were concerned with chemical warfare, the relations between military medical services and the Red Cross societies, measures for diminishing the number of missing in war time, the situation of non-combatants on enemy territory, the immunity of hospital air-planes, relief for members of foreign legions, the work of the Red Cross in the event of the application of Article 16 of the Covenant of the League of Nations, relief for refugees, relief for Red Cross volunteers in the event of accidents or disasters, the creation of an identity card for members of Red Cross societies travelling abroad, the standardisation of sanitary material and the international organisation of the Red Cross. Further, an International Institute to consider the question of sanitary material was proposed, which should collect the various types of material in use in the various countries and organise competitions with a view to perfecting and standardising, as far as possible, such equipment as stretchers and other means of transporting the wounded.

New Red Cross Societies.—In 1912 the number of national Red Cross societies was 38. Between 1914 and 1925 the International Red Cross Committee officially recognised the following new societies: Luxembourg (1914); Poland, Czechoslovakia (1919); Finland, Siam (1920); Soviet Russia (1921); Costa Rica, Colombia, Paraguay, Estonia, Danzig (1922); Bolivia, Latvia, Ecuador, Albania, Guatemala, Lithuania (1923); Egypt, Panama, Persia (1924); Iceland, San Salvador (1925).

Various previously existing Red Cross societies have either ceased to function or have been replaced by others. The societies of Württemberg, Prussia, Hesse, Saxony, Baden and Bavaria have amalgamated into a single German Red Cross; in Montenegro, the society has ceased to exist; the Congo has become a part of the Belgian Red Cross; and the Russian Red Cross has been replaced by a new society.

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II. THE BRITISH AND AMERICAN RED CROSS

British.—All existing British Red Cross societies were amalgamated in 1905 into the British Red Cross Society, with the aim of preparing in time of peace for rendering first aid to the sick and wounded in war. The War Office undertook to receive all offers of such help only through the B.R.C.S. When the Territorial Force was formed in 1908, the War Office invited the Society to form Voluntary Aid Detachments for work with the Territorial troops. Both the B.R.C.S. and the Order of St. John set about organising these V.A.D.s for first aid work and assistance of the regular medical units during military operations. In fact, under the stress of the War, the Red Cross undertook much work which belonged strictly to the Army Medical Service. On the outbreak of war the B.R.C.S. and the Order of St. John appealed for funds.

A joint war committee of the two organisations was formed, all subscriptions were pooled, and this committee carried out almost all war work undertaken in Britain. Scotland acted separately, and the Dominions, notably Canada, Australia, South Africa and Egypt, sent their own detachments to the theatres of war. *The Times* fund for the British Red Cross realised over £16,500,000

in the course of the War, the four annual Empire "Our Day" collections producing over £8,500,000, of which more than five-eighths came from overseas. There were, besides, gifts of stores and gifts to local hospitals. The latter, which were in connection with military centres and controlled by a trained nursing staff and local medical men, assisted by V.A.D. nurses, were formed out of private houses, schools, etc., and usually received minor or convalescent cases. They were supported by local subscription with, when necessary, assistance from Red Cross Headquarters and a Government capitation fee per patient. Over 3,200 auxiliary home hospitals were opened during the War; large sums were also spent on equipping and maintaining hospitals abroad, special hospitals at home and convalescent homes. The stores department covered a great variety of items and involved extensive business arrangements with all the machinery of a large commercial organisation.

The Central Prisoners of War Committee administered a sum of over £4,000,000 and regularly despatched parcels to the prisoners' camps. Enquiries for wounded and missing were undertaken in 1915; 384,000 reports were obtained. Care was taken for interned prisoners in Holland and Switzerland. Particular attention was paid to the after-treatment of wounded or disabled men; both accommodation for convalescents and institutional treatment for patients suffering from neurasthenia, epilepsy, tuberculosis, paralysis and the effects of wounds. The first Red Cross detachment went to France Aug. 1914, the last to Vladivostok, Oct. 1918. The V.A.D. detachments before the armistice numbered 4,083 with a personnel of 125,993. The total staff of the joint Committee alone numbered 9,234. Although the general direction was in the hands of men, the outstanding feature—which every patient will remember till his death—was the self-sacrificing work of the women.

American.—The American Red Cross, founded in 1881 under the name of the "American Association of the Red Cross," was incorporated and nationalised in 1905 as the National Red Cross; the President of the United States became its president, and the War Department its auditor. Early in the World War the Red Cross offered through the State Department the aid of its trained personnel and contributors of hospital supplies to every belligerent country. This offer was accepted by almost all belligerents. A public appeal was made for funds, and soon large quantities of hospital supplies and about 200 nurses were sent to England, Belgium, France, Germany, Austria, Serbia and Russia. Seventy-one physicians and surgeons were also sent, and a special sanitary commission went to Siberia to fight the typhus plague there. The value of relief supplies sent to Europe by the Red Cross before the United States entered the War was over $1,500,000, of which about $350,000 worth went to Germany and Austria.

In May 1917 after America's entry into the War, President Wilson appointed a special Red Cross War Council under Mr. H. P. Davison, to direct the activities of the organisation during the War. A popular campaign for a special war fund realised $100,000,000 in a week. The service was reorganised and quickly expanded from 500,000 members in 500 chapters to over 16,000,000 members. A further week's drive in May 1918 realised $170,000,000, and the grand total 1917–8 exceeded $400,000,000.

The American Red Cross recruited, organised and equipped hospitals and ambulance units, assisted in the care of the sick and wounded in emergencies, and provided nurses for the army and navy. It supplied comforts, clothing, medical supplies, surgical dressings; ran canteens, assisted the families of soldiers and sailors, photographed graves, etc. It supported 50 base hospital units, 40 overseas ambulance companies, over 23,000 trained nurses, a Women's Volunteer Motor Corps of 14,000 members, 92 convalescent homes in the training and embarkation camps, 130 canteens, 24 military hospitals and 12 convalescent hospitals in France, 33 canteens in Italy, 28 military hospitals and 82 canteens in Belgium. The "Civilian Relief Abroad" to the European populations was on a vast scale. $1,000,000 a month were spent on relief to French and Belgian refugees in France, including help to over 150 national and local French organisations. Over 30,000 tuberculosis patients were helped and a large children's welfare movement run. Substantial assistance was given in Russia; also in Belgium, Italy, Rumania, Serbia and Greece. The relief expenses included $28,978,000 in America, $57,207,000 in France, $63,841,000 elsewhere overseas. A total of 101,000 tons of relief supplies were sent overseas; 3,780 French and over 1,500 Italian hospitals assisted. The value of the relief articles produced by volunteer workers during the War was estimated at nearly $100,000,000. (G. Ad.)

REDESDALE, ALGERNON BERTRAM FREEMAN-MITFORD, 1st Baron (1837–1916), British politician and writer (*see* 22.968), died at Batsford Park, Glos., Aug. 17 1916. He was succeeded as second baron by his second son, David Bertram Ogilvy Freeman-Mitford (b. 1877).

RED INDIANS: *see* INDIANS, NORTH AMERICAN.

REDMOND, JOHN EDWARD (1851–1918), Irish political leader (*see* 22.968), obtained for the first time a position of real power in Parliament after the general election in Jan. 1910. Though he had amalgamated the two Irish Nationalist parties under his own lead in 1900, he had never hitherto been able, owing to the large Unionist majority of 1900 and the Liberal majority of 1906, to hold that balance of power in the House of Commons which had proved such a formidable weapon in the hands first of O'Connell and then of Parnell. But the great reduction of the Liberal forces in Jan. 1910 made it impossible that Mr. Asquith's Government should long continue unless it found favour with Mr. Redmond.

The first use which he made of this new authority was to insist that Mr. Lloyd George's famous budget of 1909, on which the dissolution had turned, but which was not in itself greatly to the taste of the Irish party, should be postponed till after the constitutional resolutions directed against the House of Lords—his one object being to remove the veto of the Upper House, which was the main barrier against Home Rule. This order of procedure was also demanded by the Labour party and by the Radicals; and the Government complied. But Redmond did not trust them completely, and pressed for an assurance that the Royal prerogative would be at the Prime Minister's disposal to overbear any rejection by the Lords of the veto resolutions. He was impatient at the constitutional conference called in the summer at the beginning of King George's reign to endeavour to discover a solution by consent, and went to America to secure sympathy and funds. The conference having broken down, he conducted a strenuous campaign on behalf of the ministerial programme for the second general election of the year, in spite of a harassing movement on his flank by a small party of independent Nationalists under Mr. O'Brien and Mr. Healy, who accused him of having sold the Irish vote to the Government.

When the result of the polling had confirmed Mr. Redmond in his tenure of the balance of parliamentary power, he forwarded the progress of the Parliament Bill in 1911 by the steady vote of his party rather than by speech. In the autumn he was regularly consulted on the details of the forthcoming Home Rule Bill, and when the bill was introduced, in April 1912, he welcomed it as an adequate measure, and procured an enthusiastic acceptance of it from a nationalist convention in Ireland. His speeches during its passage through Parliament were, on the whole, moderate; he disclaimed separation but denounced any attempt to take Ulster out of the bill as a mutilation of Ireland. In token of the union of feeling between Nationalists and Liberals, he attended the meeting of the National Liberal Federation at Nottingham in Nov. 1912, and spoke for the first time on the same platform as Mr. Asquith. When the determined attitude of Ulster began to suggest to the Liberals the advisability of compromise, Redmond was very loth to agree, denouncing the Unionists and Ulster as engaged in "a gigantic game of bluff and blackmail." He insisted that Mr. Asquith's county option scheme was the extreme limit of concession. He was being pressed in Ireland by the rising power of Sinn Feiners and other extremists who had raised, in reply to Ulster, a great body of 100,000 Nationalist volunteers, over whom Mr. Redmond only obtained control in June 1914 after a sharp struggle.

Nevertheless he took part, at the end of July, in spite of Nationalist criticism, in the abortive Buckingham Palace Conference.

Then came the World War, and in the debate succeeding Sir E. Grey's famous declaration on Bank Holiday, Aug. 3, Redmond created a profound sensation by a speech in which he declared that the events of recent years had completely altered the Nationalist feeling towards Great Britain. The Government, he said, might withdraw its troops from Ireland, whose coasts would be defended by her own sons, Nationalist volunteers joining with Ulster volunteers in the task. This generous attitude was met by the decision of the Government to pass the Home Rule Bill into law, suspending its operation till after the War. Redmond took an active part in promoting recruiting in Ireland, and stood on the platform in Dublin Mansion House on Sept. 25 by the side of the Prime Minister and the Lord Lieutenant. Unfortunately, owing partly to the anti-recruiting agitation promoted by Sinn Fein, and partly to red tape at the War Office, his efforts were only moderately successful. But he refused Mr. Asquith's offer to join the first Coalition Government, and he successfully opposed all attempts to apply conscription to Ireland. It was a stunning blow to him when the smouldering dissatisfaction of Southern Ireland broke out into a blaze in the Dublin rebellion of Easter 1916. He expressed in the House of Commons his detestation of the crime, and lent his assistance to the attempt which was made by the Government in the summer through Mr. Lloyd George to arrange an agreed settlement of the Irish question.

But the effort failed, and Mr. Duke, K.C., a Unionist, was appointed Chief Secretary; and Redmond treated the whole transaction as a fresh outrage on Ireland, moving on Oct. 18 a resolution (which was, of course, rejected) charging ministers with maintaining a system of government in that country inconsistent with the principles for which the Allies were fighting in Europe. Next year he threatened a return of his party to the old obstructionist opposition; but when in May 1917 Mr. Lloyd George, as Prime Minister, suggested an Irish convention to produce a scheme of self-government, Redmond agreed; and in the convention he played a prominent and conciliatory part, making in particular a favourable impression on the Southern Unionists. During its sittings, however, his health failed. He died of heart failure in London on March 6 1918.

John Redmond's younger brother, WILLIAM HOEY KEARNEY REDMOND (1861–1917), intended, as a young man, to adopt the army as his profession, and in 1881 he was a lieutenant in the Co. Wexford militia battalion of the Royal Irish Regiment. But he resigned his commission to take part in the Land League movement and was imprisoned as a "suspect" in Kilmainham. He was returned for Wexford borough in 1883, and sat in Parliament, though for different constituencies, from that time till his death. He was of an ardent and ebullient temper, which resulted in his spending three months in Wexford gaol in 1888 for inciting, at an eviction, to resistance to the sheriff, and in many agitated scenes at different times in the House of Commons, where, however, he was personally very popular. Like his brother, in the Nationalist split he adhered to Parnell, and, also like his brother, on the outbreak of the World War he instantly recognised the duty of Ireland to fling herself into it on the side of the Allies. Though 53 years old, he joined at once the Irish Division, receiving a commission in the Royal Irish Regiment. He was promoted major for services at the front and mentioned in dispatches. In his intervals of service he made two thrilling speeches in the House of Commons, advocating conciliation, and a new start, between England and Ireland. He died of wounds in France on June 7 1917. (G. E. B.)

REDWOOD, SIR BOVERTON (1846–1919), British chemist, was born April 26 1846, and educated at University College School, London. He was trained as a pharmacist, but early specialised in the study of petroleum, becoming in 1869 secretary of the Petroleum Association and subsequently studying oil conditions at first hand in many parts of the world (1883–6). He served on several important Government commissions both before and during the World War. Founder of the Society of Petroleum Technologists, he became its first president 1913–4 and he was also a member of many other societies in pure and applied science. He was knighted in 1905, was made a baronet in 1911 and died in London on June 4 1919. Sir Boverton wrote some standard books on his subject, including *Petroleum*, 3 vol. (1913); and many articles and pamphlets.

REFERENDUM (*see* 23.1).—Switzerland during the period 1910–25 continued freely and frequently to use the referendum, which had been made general and compulsory by its constitution of the year 1848. By means of referenda (*a*) proportional representation was rejected in 1910 and 1912, but accepted in 1918; (*b*) measures were carried in favour of sickness and accident insurance (1912), a war tax on fortunes over a certain sum (1915), a special levy to clear off the war debt (1919), restriction of the liquor traffic (1920), entry into the League of Nations (1920) and an eight-hour day for Government employees (1920), and (*c*) proposals were rejected which advocated female suffrage (1920), a capital levy (1922), extended state control over the liquor traffic (1923) and modification of the eight-hour day in certain emergencies (1924). In some cantons, among which Zurich was pre-eminent, the employment of the referendum for the settlement of such questions as the route of tramways, the construction of bridges, or the site of public buildings, was so regular as to constitute the virtual establishment of a direct democracy. (See N. Ornstein-Brodsky, *Das Referendum in der Praxis. 25 Jahre Gemeindeabstimmung in Zürich.* Vienna, 1920.)

The United States.—The legislative referendum was formally adopted by Arkansas and Colorado in 1910, by Arizona, California and New Mexico in 1911, by Nebraska, Idaho, Ohio and Washington in 1912, by Michigan in 1913, by Mississippi and North Dakota in 1914, by Maryland in 1915, and by Massachusetts in 1918. Its chief adherents still lie west of the Mississippi River, only five eastern states having adopted it, *i.e.*, Maine, Massachusetts, Maryland, Ohio and Michigan,—and 26 states have made no provision for direct legislation. In those states which have incorporated its principle in their legislative machinery, its use has not been commensurate with the claims which its advocates made for it.

On the other hand the constitutional referendum, which contemplates only proposed amendments to the state constitutions, is in force in every state with the exception of New Hampshire and Delaware, and this is the form in which the referendum has been usually resorted to in recent years. The constitutional problems most persistently laid before the electors for decision were female suffrage and prohibition. As a result of referenda, the suffrage was given to women in some states, *e.g.*, Washington in 1910 and California in 1911, but refused in others, *e.g.*, Oklahoma in 1910 and South Dakota in 1911. The subject of prohibition was thrashed out over almost the entire United States by means of referenda, until the matter was removed from the cognizance of the state legislatures and electorates by the eighteenth (prohibition) amendment to the federal constitution. Apart from the wider state spheres of action, the referendum has been adopted in local government matters, particularly in the matter of money bylaws which in certain circumstances have to be submitted to the taxpayers for their approval, and also in connection with the adoption or otherwise of the commission and city manager systems of municipal government.

British Empire.—Great Britain has not adopted the referendum, but since the abolition of the Lords' veto in 1911 its adoption has been urged by a number of influential men. On March 2 1911 Lord Balfour of Burleigh introduced a Referendum Bill, but, after an interesting debate, the measure was rejected.

In Australia the referendum, which had been employed only once before 1910, was used on several important occasions during the subsequent 15 years. In 1910 itself a referendum authorised the transference of the debts of the various states to the Commonwealth Government. In 1916, and again in 1917, the vital question of extension to service abroad of the compulsory enlistment (which was already in use for home defence) was referred to the Commonwealth electorate and on each occasion rejected—in 1916 by 1,146,000 to 1,085,000 and in 1917 by

1,181,000 to 1,015,000. In 1911, 1913 and 1919 amendments to the Commonwealth constitution of a Socialistic tendency were all rejected. Similarly in the separate States of the Commonwealth, *e.g.*, Victoria 1920 and Queensland 1923, proposals in favour of prohibition were defeated by large majorities. There can be no doubt that in Australia the referendum has proved to be an obstacle to innovation.

New Zealand used the machinery of the referendum in 1911, 1914, 1919 and 1922 in order to discover the will of her people respecting this same vexed question of prohibition. On each occasion, although by dwindling majorities, prohibition was rejected.

Canada.—The referendum in the legislative sense has, when resorted to, been as a rule the result of special laws, and particularly on the question of prohibition. The suppression of the liquor traffic was thus carried out in Alberta, 1915, Manitoba, British Columbia and Saskatchewan in 1916, and Ontario in 1919. In 1920, however, British Columbia by means of a referendum, reversed its decision and adopted a system of government liquor control,—an example subsequently followed by Manitoba, Saskatchewan and Alberta. Under United States influence the referendum has been widely introduced into local government matters, more particularly as regards the submission of bylaws about money to the people, and in this restricted sense has operated successfully, though upon occasions it has proved difficult to induce any large number of voters to exercise the franchise.

European Countries.—Three constitutions framed since the War incorporated the referendum as part of the machinery of government. The German constitution of 1919 empowers the President to order a referendum when he sees fit, and provides it also as a means of escape from a conflict between *Reichstag* and *Reichsrat*. It was used on June 20 1926, to decide the question as to whether or not property of the Hohenzollerns or other former ruling houses should be confiscated. Over 15,000,000 votes were cast for confiscation, but, as less than half the total votes was polled, the proposal failed. (*See* GERMANY.)

The Estonian constitution of 1920 uses it as a means of resolving a deadlock between the two houses of legislature. The rejection of a measure passed by the representative assembly involves the dissolution of the assembly and a general election within 75 days.

The Irish Free State constitution, 1922, requires a referendum to be taken on any measure passed by the Dail, if a demand is made by either one-fifth of the Senate or one-twentieth of the electorate. (F. J. C. H.)

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REFORMATORY SCHOOLS (*see* 23.22). *Great Britain.*—Reformatory and industrial schools (*see* also CHILDREN'S COURTS; PROBATION) in Great Britain are institutions for the reception of neglected children and young offenders under the provisions of the Children Act 1908, as amended in 1921. They are conducted by voluntary bodies of managers, or in a few cases by local authorities, and are under the general supervision in England and Wales of the Home Secretary and in Scotland of the Secretary for Scotland. Their net cost is shared equally between local authorities and the state. The position of the schools was fully reviewed by a departmental committee which reported in 1913.[1] As a result of their recommendations, a number of important changes were made in the organisation and management of the schools, and in the character of the education and training given in them.

[1] *Report of the Departmental Committee on Reformatory and Industrial Schools*, Cd. 6838 (1913).

One of the most striking features in the history of the schools has been the fluctuation, during and after the War, in the annual number of committals to them. The number had maintained a fairly steady level in the years preceding the War; but it was symptomatic of the disruptive effect of the War on family life that between 1913 and 1916 the annual committals of boys to reformatory schools increased by nearly 70% and of boys to industrial schools by over 15%. The number of committals fell sharply in 1919 to a point far below the pre-War level, and has continued to decrease, though the experience of 1924 and the two preceding years suggest that a period of stability may have again set in. As a result of the decrease it became necessary to close a considerable number of schools. During later years the so-called "short term schools" for truants have been merged with the ordinary industrial schools (*q.v.*), and the day industrial school has largely disappeared.

The general trend of progress in the remaining schools has carried them far towards the realisation of the high ideals by which the enlightened founders of the movement were inspired. While the law preserves a distinction between the two classes of schools, the reformatory being a training institution exclusively for young delinquents and the industrial school having the primary purpose of a home for children who by reason of the criminal, immoral or neglectful habits of their parents are in danger of falling into delinquency, the problems with which the two classes of schools have to deal are in the main similar, particularly since under the Children Act 1908 young offenders under 12 years of age may not be sent to reformatories, but are eligible for industrial schools, which may also receive first offenders up to 14 years of age. The distinction, therefore, is tending in practice to disappear.

In the reformatory school of to-day nothing remains of the old idea of retributive punishment, so long perpetuated in the prison-like uniform, the cropped head and the routine of monotonous labour. In an increasing degree, the methods of repression have given way to a régime of freedom and encouragement combined with a wise discipline. Corporal punishment becomes less and less necessary; absconders are comparatively infrequent. In many industrial schools boys and girls are able to attend the ordinary elementary or secondary schools in the district. In both classes of schools special encouragement has been given to early release on license, and to the development of an effective system of after-care. Every pupil is released on license as soon as his progress and the general circumstances justify it, and he then remains under supervision—actively exercised and including power to recall him, if necessary, to the school—until the age of 19 if the school is a reformatory or 18 if it is an industrial school. In all schools boys and girls are given, by a system of rewards and privileges, by the grant of home leave and not least by participation in organised games and healthy recreations, every incentive to develop for themselves those qualities of self-respect and self-reliance which will best equip them for an after-life of good citizenship.

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United States.—The reformatory system of the United States, as distinguished from the penitentiary or prison system, may be considered under two heads: (*a*) reform schools and industrial schools for youths under 16 or 18 committed for violations of the criminal law or for the want of proper guardianship, and (*b*) reformatories for older adolescents between the ages of 16 or 18 and 30 convicted of criminal acts; the former is an outgrowth of the Houses of Refuge, which developed in the early part of the 19th century, under private and charitable organisations.

Beginning with the last quarter of the 19th century, a number of states established Industrial Schools or State Homes for the correction and training of their delinquent youths. The reformatory for older adolescents had its birth in the United States in 1869, when the New York State Legislature enacted legislation and appropriated funds to build the New York State Reformatory at Elmira. This legislation was brought about largely through the efforts and influence of Dr. E. C. Wines, Dr. Theodore Dwight, and Mr. Z. R. Brockway, who became the first superintendent and was responsible for the development of the Elmira Reformatory system of academic and trade training, which is still regarded as the best of its kind in the United States. Almost every state in the American union has at least one reformatory. In practically all cases the system of discipline, training and release established at Elmira has been more or less followed. The indeterminate sentence is an integral part of

the American reformatory system; the principles of this system of release were embodied in the first legislation establishing the procedure for operating the reformatory in 1877.

The U.S. Govt. opened its first Federal reformatory for adolescent male offenders in March 1926, at Chillicothe, Ohio. Prior to this time, male offenders of all types over 16 years of age were received at the Federal penitentiaries. In 1926 there was under construction in West Virginia a Federal Reformatory for adolescent females; this will be in operation before the close of the year. The Federal Govt. follows the practice of boarding many of its offenders in state reformatories and county workhouses.

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(C. DE).

REFRIGERATION (*see* 23.30).—By this term is meant the artificial control of the humidity and temperature of the air, or of the temperature of commodities when these temperatures are below that of the atmosphere.

In accordance with the second law of thermodynamics (*see* 26.808) these ends are accomplished by the use of a reversed engine, for, in the refrigerating cycle, heat is absorbed at the lower temperature and rejected at the upper temperature, a process which is the reverse of that performed by the ordinary heat engine. But similar to the conditions in the steam-engine cycle, a working medium, in this case a refrigerant is used to carry out the cycle of operations. This refrigerant is a volatile liquid such as ammonia, carbon dioxide, sulphur dioxide, butane or propane, but ammonia is used more extensively than any of the others.

In the refrigerating cycle, the refrigerant is made to pass into the evaporating coils so as to enable heat to be absorbed from the commodity to be cooled. During the absorption of this heat, the refrigerant is evaporated. As it is essential, for reasons of convenience and economy, to return the refrigerant back to the liquid state, the medium must be compressed to such a degree as will enable the liquefaction to occur under atmospheric temperature. The result is a closed cycle using the same medium continuously, and the cycle includes a heat-absorbing system at the lower temperature (usually called the refrigerator); a heat-rejecting system at the upper temperature (frequently called the source); a reversed motor, usually a compressor; and a pressure-reducing device, which is preferably an expansion cylinder, but is always a throttling valve when liquids are handled. The theoretical cycle can be brought out clearly by means of an illustrative example:—

The Problem.—A reversed Carnot engine is used for refrigeration. The temperature of the refrigerator is −10° F. and that of the hot body is 80° Fahrenheit. Find the horsepower required to drive the motor if 10,000 B.T.U. are to be taken from the cold body per minute. The efficiency of the cycle is

$$E = \frac{T_1 - T_2}{T_1} = \frac{540 - 450}{540} = 0{\cdot}1667$$

Therefore $0{\cdot}1667 = \frac{Q_1 - 10{,}000}{Q_1}$ or $Q_1 = 12{,}000$ B.T.U., from which the work done, AW = 2,000 B.T.U. per minute

$= 2{,}000 \div 42{\cdot}44 = 47{\cdot}1$ horsepower

Unit of Refrigeration.—The unit of refrigeration is defined differently in different countries. The British rating is the production of refrigeration at the rate of 1 calorie per sec., or 342,860 B.T.U. per 24 hours. The American rating is slightly less and is given as the cooling rate of 200 B.T.U. per min. or 288,000 B.T.U. per 24 hours. A machine having such a capacity for cooling is said to have a rating of 1 ton of refrigeration.

Refrigerants.—According to the second law of thermodynamics all refrigerants (working media) have the same efficiency, although this is not achieved in practice, and a large number of volatile liquids, as well as air and steam, have been tried with varying success. At the present time ammonia, carbon dioxide and sulphur dioxide are used in the order named, and air and water are practically abandoned. Ammonia is preferred because of its large value of the latent heat of vaporisation and its nominal pressure (of less than 200 lb. per sq. in. as a rule). Carbon dioxide is preferred on account of its "safety" factor, as the gas cannot explode, will put out fires, and is practically innocuous. Hence carbonic refrigeration is popular in the United States for theatre cooling and marine work. For the latter application the decrease in compressor size, as compared with ammonia machine requirements, the decrease in weight and the fact that a copper condenser can be used with carbon dioxide without corrosion, are all advantages. Sulphur dioxide has no friends in America, except in the case of the 1/20-, 1/10- and the 1/6-ton household machines, whereas in Germany, and to a lesser extent in Great Britain, the sulphur dioxide compressors are used in large sizes.

Brine or Direct Expansion.—Refrigeration can be accomplished by two separate methods; by the direct use of the refrigerant in the cooling coils—direct expansion—and by the use of a non-freezing solution, previously cooled by the refrigerant;—the brine system. In cold-storage refrigeration, and in the packing-houses, either system will be found in about the same proportion. When brine is used it is almost always calcium chloride, especially for temperatures below 15° Fahrenheit. Brine can use ordinary (full weight) piping and the usual fittings for 150-lb. pressure, but direct expansion requires for ammonia special fittings of air-furnace, cast-iron or drop forgings.

Brine has a cheaper pipe system in first cost, but both supply and return pipes have to be insulated. A brine circulating pump is required, and brine requires a lower suction pressure on the refrigerating machine than does direct expansion. With the brine system a storage capacity is possible, a factor not possessed by direct expansion, and therefore the refrigerating machine does not have to run continuously. It is considered safer to use brine, as the ammonia cannot, under these conditions, cause damage should an accident occur to the piping. In special cases brine is preferred, as for example, in the case of the chilling of castings, and in brine spray systems in the packing houses.

Types of Compressors.—In marine work the compressor is nearly always a vertical one. In Great Britain very few horizontal compressors now are being installed, whereas the horizontal, double-acting ammonia and carbon dioxide compressors are common in the United States. In Great Britain the preferred type of compressor is that with the enclosed crank case, and with 2, 3 and even 4, vertical cylinders, designed either for single or double acting. In America the preference appears to be for the twin vertical single-acting enclosed crank case compressor up to 75 tons capacity, and for the use of 3 cylinders in the larger sizes, but the double acting, vertical compressor is never used. The horizontal, slow and medium speed double-acting machines are used in sizes of 75 tons capacity and upwards.

Valves.—The valves used in refrigerating compressors have been modified recently, due to the general desire to increase the rotative speed. The old type of poppet valve is not now used to any extent, although the modified type of poppet valve of light weight is used as a "balanced" suction valve in the piston, and, when necessary, a number of light-weight poppet valves are used for the discharge. The favourite type of valve is the ring plate valve made of special steel, hardened and ground, or of the thin steel ribbon valve. These valves are placed in cages and are identical for suction and discharge except for the direction of the opening of the valve. The smaller of the enclosed type compressors, both for ammonia and carbon dioxide, have rotative speeds up to 600 revolutions per minute.

Type of Drive.—While the steam engine was formerly the only prime mover, in 1926 the Diesel engine or the electric motor, was used almost exclusively for refrigerating machines. The electric motor used is the direct-current type in special cases, but usually the squirrel cage, or the wound rotor type of induction motor. Since 1915 there has been a great demand for the synchronous motor, even for such small capacities as 15 tons. When the synchronous motor is used, clearance pockets are frequently installed in the compressor head in order to vary the capacity without shutting down the machine. This can be done without much loss of operating efficiency.

Cold Storage and the Packing-house.—By keeping fruits, vegetables, eggs, fish, poultry, and meats in cold storage, the natural processes of decay can be retarded and eatables can be carried over from the period of heavy production to the season when the fresh commodity would be scarce or unavailable. Cold storage means the maintenance of a fixed temperature and humidity, at the conditions best suited for the goods being stored. In the packing-house the animal heat must be removed from the

carcasses quickly. If put in storage the meat must be kept at a temperature near 32° F., but if shipped to any distance it must be frozen. The average time between slaughtering and consumption is slightly more than two months. By means of refrigeration it is possible to organise large control slaughter houses, under government inspection and the best sanitary conditions, with shipment to all points by means of refrigerator cars. The modern packing-house means wholesome food to an extent impossible with the local butcher.

The object of cold storage being economic, there is no object in holding except to preserve the surplus supply until the demand permits its use. Although foods may be kept in good condition much longer than the intervals named below, U.S. Govt. reports give the average length of storage for various articles as:—

Eggs . .	5·91 months	Beef . .	2·28 months
Dressed poultry	2·42 months	Mutton . .	4·45 months
Butter . .	4·43 months	Pork . .	0·88 months

Fruits, particularly the apple, can be kept in cold storage satisfactorily, and the same is true of vegetables like lettuce, celery, potatoes, etc. Berries and some soft fruits have been kept in a frozen condition for from 6 to 10 months, and were then reported to be equal to fresh fruit for most purposes.

Eggs, Fruit, Poultry, Fish, etc.—Commodities of the best quality only should be put in cold storage, except in the case of eggs frozen in bulk. Apples should be held at 31° F. with an average relative humidity of 85%. Fresh air circulation does not show any advantage, but a lively circulation of air to each individual apple is required in order to reduce scald. The amount of carbon dioxide in the air should be less than 12%. The egg should be kept at a temperature of from 29° to 32° F. with a relative humidity of 85%. Ventilation must be provided by careful storing with strips ½-in., or thicker, between the boxes and 2-in. strips on the floor. Poultry should be carried at 2° F. or lower, and should be stowed with at least 1-in. dunnage. Poultry should be dry-picked and dry-packed in clean, well-made boxes, 12 birds to the box, and each one separately wrapped, and the box lined with a good paper.

Fish are washed free of dirt and the larger ones are gutted. Pans containing about 40 lb. are placed in sharp freezers at from −5° to −15° Fahrenheit. As soon as the fish are reduced in temperature they are glazed by being made to pass through a trough of water at 32° F., or they are placed in a grilled platform and are lowered into the water. After glazing, the fish are held at from 0° to 10° Fahrenheit.

The Manufacture of Ice.—The use of manufactured ice is becoming more and more a necessity, although in the United States the small household refrigerating machine has been taking to a great extent the place of ice in the cities. The average amount of ice consumption *per capita* in the larger cities of the United States is estimated at 1,000 lb. per year and this amount is increasing steadily. The use of natural ice diminished during the years 1910–26 very rapidly in the city retail trade because of its uncertainty from year to year, its irregular size and indifferent appearance, and the idea that it is unsanitary. The bulkiness of artificial ice practically requires its use near the point of its manufacture, although railroad freight and auto-truck shipments expand the range of its use somewhat. The total production in the United States in 1919 was 28,000,000 tons of 2,000 lb. each as compared with 21,000,000 tons in 1914. As an estimate has been made that only ⅛ of the families in the United States at present use ice at all, there appears to be an opportunity for an appreciable increase.

In ice-making, mechanical refrigeration is used to the extent of about 1·6 tons of refrigeration per ton of ice (daily capacity). The present preferred system uses deep well or city water, not distilled as formerly, and air agitation during freezing. Commercial freezing is accomplished by immersing galvanised iron cans holding 300 and 400 lb. of water in a brine bath held at a temperature of from 14° to 20° Fahrenheit. Air agitation at from 3 to 12 lb. per sq. in. pressure is resorted to in order that the ice block shall be transparent, a condition required by the retail trade.

The brine is kept cold by means of ammonia piping between the cans in the brine, or by the use of the shell and tube brine cooler submerged in the brine in the ice tank. The 300 and 400 lb. cans require from 40 to 45 hours for freezing, and are removed to the dumping platform by means of a travelling crane which handles as a rule from 6 to 24 cans at a time. When electrically driven machinery is used, a ton of ice can be produced with the expenditure of from 35 to 55 kw. hour, depending on the time of the year, the condenser pressure and other details in the plant. When crushed ice is desired, the manufactured ice does not have to be transparent, and the air agitation in the cans can be omitted.

Cooling of Milk and Manufacture of Ice Cream.—When milk is transported some distance, especially for urban distribution, the time between production and consumption is over 24 hours; even frequently 48 hours. This means that it is imperative to cool the milk quickly and to keep it at a temperature of 50° F. or lower. Pasteurised milk is becoming more general in use, and refrigeration must be resorted to in all cases where a liberal supply of cold water is not available at slight cost and where the use of ice and salt is not economical. Mechanical refrigeration is often resorted to because of its easy control of temperature and its cleanliness. The amount of refrigeration required in cooling milk varies with the rate of cooling, as the desire frequently is to hasten the process in order to deliver promptly. Roughly, one gallon per min. will require 1½ tons of refrigeration, assuming that the milk is cooled 30°, say from 70° to 40° Fahrenheit.

The ice cream industry is increasing rapidly in the United States and Great Britain. In 1924 the number of wholesale plants engaged in the manufacture of ice cream was estimated at 4,000. The estimate of the U.S. Dept. of Agriculture for 1920 indicated a total production in that country of 260,000,000 gal., and the rate of factory-produced cream in the cities of from 4 to 5 gal. per year *per capita*.

In the manufacture of ice cream it is usual to allow one ton of refrigeration per 60 gal. of cream, including freezing, hardening, storage, etc. Calcium chloride brine has been used almost exclusively, at about 0° F. in the freezer, but direct expansion is now being used somewhat. The cream is cooled to about 25° in the freezer, and is then placed in containers for storage in the sharp freezer held at from 0° to −10° Fahrenheit. Ice cream is usually held in storage for a day or two to improve the flavour.

Cooling of Buildings.—Public buildings in the larger cities of the United States, like Chicago, New York, St. Louis, etc., use refrigeration to make the air more comfortable during the hot summer. The method is to utilise the ventilating systems already installed and provide the same amount of air per person, but the air must be cooled from 8° to 15° F. below the temperature of the outside air. Too great an amount of air cooling has been found unwise, and the relative humidity should be between 65 and 75%. For this purpose spray nozzles are employed, using water at about 45° to 50° F., and usually direct expansion coils at the entrance to the spray chamber. These coils act as air and water coolers, and no fear of the refrigerant is entertained because of the negligible danger of a panic, or of the after effects to people should even relatively large amounts of carbon dioxide gas enter the auditorium.

In theatre ventilation and cooling the amount of recirculated air effects the tonnage, but where 50% of the air is permitted to be returned to the washer to be cleaned and cooled, and the other 50% is fresh air, the load is from 2½ to 3 tons of refrigeration per 1,000 cu. ft. of air per min. passing through the spray chamber, in localities having summer conditions comparable with Chicago. Roughly, the amount required to cool and condition the fresh air is twice that required to cool the recirculated air. In the latter case the load on the machine is that required to neutralise the effects of heat leakage, the heating effects of the people and the illumination and to condense the moisture exhaled by the audience. (H. J. M.)

REFUGEES AND THE EXCHANGE OF POPULATIONS.—In the early history of European civilisation wars and conquests were often followed or accompanied by considerable movements of population. Sometimes the two went necessarily together, because the motive for war was the desire for richer lands on which the conquerors wished to live; sometimes the movement of population resulted from the ferocity of the invaders who drove whole populations away from the countries which they had inhabited.

Refugee Movements

Temporary.—For a long period this feature of warfare disappeared, but with the World War of 1914 it once more recurred. The events of 1914–8 caused greater movements of population from one place to another than there had been for centuries before. In some cases, it is true, these movements,

though large, were only temporary. For example, although the Belgian refugees who fled from the German invaders in 1914 were very numerous, and although practically all of them remained away from their homes until the end of 1918, they did not attempt to create a new life or to establish new homes outside their native land; their migration was only temporary, like that of the refugees who fled from the invaded provinces of France and Italy.

Permanent.—But in other cases, great masses of refugees who left their homes when the tide of war swept over them had little prospect of ever returning or of recreating their previous life there. This has been the situation of a considerable proportion of the inhabitants of the Balkan Peninsula. In that unhappy region of the world, where the population of large areas is mixed in race, great masses of people were obliged, either by fear of the invading armies or by the hostility of their immediate neighbours, to fly from the places where for centuries they and their forefathers had lived, and once they had left their homes the Governments of the countries which they had abandoned made it plain that they would not allow them to return, or that if they did return they would not allow them the means of decent life. Faced, therefore, with prolonged, if not permanent exile, the refugees were forced to try to build up a new life in the country to which they had fled. This happened in one case as the result, not of international, but of civil, war. The struggle of 1917 to 1919 between the White and Red armies in Russia led to the emigration of great numbers of Russians who were subsequently scattered to every part of the world. In yet other cases the movement of population took place, not as the direct result of military action during a war, but in consequence of the terms of the treaties made when the war ended. But whether they came under about the terms of these so-called " Exchange of Population " treaties, or whether they were due to the compulsory or spontaneous flight of terror-stricken minorities while hostilities were still going on, these movements of population were due directly to the War. They all presented a number of common features, while collectively they created a great economic and political problem for the exhausted Governments of Europe. Before indicating what has been done to deal with this problem it is necessary to say a few words about its extent.

Movements—Various Countries

Excluding such temporary movements as those of the Belgians, the emigrations of war refugees of different nationalities were roughly as follows:—

1. *Russians.*—Between 1917 and 1920 more than 1,000,000 political refugees from Russia were thrown upon the charity of Europe. Some of these refugees were prisoners taken by the Germans and Austrians during the War, who refused to return to Russia. A great number were members of the defeated armies of Koltchak, Wrangel, Denikin and others. Many were women and children who fled from the terrors of the Bolshevist revolution. When they had time to settle down their distribution was roughly estimated as follows: Germany, 300,000; Poland, 400,000; France, 400,000; Serbia, 50,000; Bulgaria, 30,000; Czechoslovakia, 20,000; Rumania, Greece, at least 50,000; Finland, 50,000. In addition a large number—at least 100,000—fled eastwards into China.

2. *Greeks.*—As the result of warlike operations there fled into Greece between 1915 and 1922 1,250,000 Greek refugees from Asia Minor and Eastern Thrace and 50,000 from Bulgaria. In addition there came under treaties for the exchange of population from Bulgaria a further 50,000; from Asia Minor approximately 100,000.

3. *Armenians.*—From the year 1915 onwards there were expelled from their dwellings in Asia Minor more than 2,000,000 Armenians. Great numbers of them were either massacred or perished in their wanderings in the mountains; some few succeeded in making journeys on foot as far as Mesopotamia; others sought protection in the Russian Empire. In 1921 the independent Armenian Republic of Erivan, with an Armenian population of 800,000, adopted the Soviet régime and became part of the Federated Union of Socialist Soviet Republics. To its original population, 300,000 to 400,000 additional refugees from Turkish Armenia were shortly added, and in spite of their great suffering, they were absorbed with remarkable rapidity into the economic system of the country. It is further estimated that more than 300,000 other Armenians are scattered more or less in destitution over Europe, Russia and the Near East. In 1921 100,000 fled to Syria and have now become Syrian subjects in the territory under French mandate; more than 60,000 fled in the following year to Greece; 20,000 to 30,000 more fled to the Republic of Erivan.

4. *Bulgars.*—From 1918 onwards a large number of minorities of Bulgarian or quasi-Bulgarian race and language fled before the Turkish, Greek and Serbian Armies from their homes in the Dobrudja, in Macedonia and in Eastern and Western Thrace. It is calculated by the Bulgarian Govt. that their total number amounts to almost half a million. In addition, about 75,000 Bulgars have voluntarily emigrated to Bulgaria from Greece under the terms of the Greco-Bulgarian Exchange of Population Treaty.

5. *Turks.*—Approximately 50,000 Turks fled from Eastern Thrace and Smyrna when these territories were occupied by Greek forces in 1919, but returned to their homes in 1922. In addition, approximately 350,000 to 400,000 Turks were moved from Greece (most of them from Macedonia, Crete and Western Thrace) to Asia Minor under the terms of the Exchange of Population Treaty made at Lausanne in 1922.

Effects of Refugee Movements

Broadly speaking, the general features of these movements of population may be summarised as follows:—

First, the great emigration of Russian political refugees has been an almost unmixed evil both for Europe and for the refugees themselves. Their great suffering has not been compensated by any considerable political or economic gain. This is not equally true, however, of the movement of population in the Balkans and in the Near East. These movements have at least done a great deal towards the effective unmixing of the populations in these areas. The mixture of populations has led to so much political trouble in modern times that this unmixing process must be regarded as a very considerable advantage.

Further, in certain countries the influx of refugees, while at first it appeared to be a disaster, is in the long run proving to be a source of strength. This is particularly true of Greece, where, thanks to arrangements which will be mentioned shortly, the refugees were absorbed very quickly into the economic system of the country, where they have immensely increased the agricultural production and have imported industries hitherto unknown. There is no doubt that they have thus much improved the political position of Greece by giving it a homogeneous and vigorous new population and by increasing the economic wealth of the nation as a whole. It appears probable that the same result will in due course happen in Bulgaria, though there the process has been much slower, as the refugees showed less inclination to accept their exile as definitive and to settle down in new homes, than those who went from Asia Minor to Greece.

Another result of general importance which has followed the movement of population caused by the War is that Asia Minor has been left almost exclusively to the Turks. Hitherto inhabited by a very mixed population, including elements which continued the traditions of the ancient civilisation of Byzantium, there are now few of these elements left.

These changes, whether they be good or evil, have only come about at the cost of terrible suffering to all the individuals concerned. This is true even of those who have been moved under treaties of exchange, though of course their sufferings have been much less than those who fled before invaders. It is the personal aspects of refugee movements which generally dominate the minds of people when they consider refugee questions; and no doubt these personal aspects are of supreme importance, not only on account of the claim of the refugees to the humanitarian sympathy of every civilised man and woman, but also because it is the personal problems of individual refugees, which when they are taken collectively, make up the economic problems which their movements cause. And the economic problems brought upon the Governments of Europe by refugee movements since the War have been of great importance. In many countries they have seriously over-flooded the labour market, and in a number of centres the arrival of vast masses of strangers, wholly destitute and unable to find employment, threw a great burden on the financial resources of the States to which they came, whose Governments, unwilling to see them die of starvation, were literally obliged to furnish them with doles from their national funds. This part of the problem is, however, much affected by the so-called Treaties for the Exchange of Population, on which, therefore, it is necessary to say a word.

Treaties of Exchange.—Under these treaties, the most important of which are the Greco-Turkish and the Greco-Bulgarian, impartial committees, consisting of one representative from each government and two or three impartial experts appointed by the League of Nations, supervise or actually carry out the transportation of the persons moved from one country to the other, value their property, keep an exact record of it and establish their claim for this value against the government of the country to which they go. These treaties of exchange have worked with varying success. So far as the Greco-Turkish Treaty is concerned, its principal and most necessary effect was to make room in Greece, by the removal of 350,000 Turks, for a great part of the incoming flood of refugees, who found in the evacuated Turkish properties fields and houses ready for their use. Without this treaty of exchange, the absorption of the Greek refugees into productive employment in their motherland could never have been done. On the other hand, the fate of the Turks transported under the treaty from Greece into Turkey appears to have been less happy. Official information cannot be had, but persistent rumours allege that although there were also in Turkey many empty properties for the incoming Turks, the arrangements have been so defective as to inflict grave losses on them.

Of the Greco-Bulgarian treaty of exchange, it is enough to say that while the working of its machinery has been slow, it has already laid the foundation for an unmixing of the population in Greek Macedonia and in parts of Bulgaria, which in the long run, though at the cost of great personal suffering, is likely to lead to satisfactory results.

Work of the League of Nations

The other personal and economic problems which have been raised by the Refugee movements above described have been dealt with partly by individual governments and partly by the League of Nations. To take the Russians first, many governments throughout Europe accorded them particular privileges and gave them much State help—in particular Serbia and Bulgaria deserve mention. The League of Nations also played a considerable part through the action of the Delegations which it established in Constantinople and in Bulgaria, Greece, Serbia, Germany, Poland, France and other countries, in breaking up the most disastrous congestions of refugees in places where no employment could be found, for example, in Constantinople and Greece; in securing for the refugees in many countries legal protection, freedom of movement in search of employment and a new form of so-called "League of Nations Passport" under which they were enabled to travel from one country to another; and even in securing for a small number who desired it, repatriation to their native land. Under the auspices and with the help of these League offices, large movements of Russian refugees were carried out to France, to the United States, to Canada and to other countries where employment could be found.

For the Greek refugees the League has done still more. Through its machinery a loan of £12,000,000 for their settlement in agricultural and other employment was obtained, and under the international control of a League Commission this settlement has been carried out with remarkable success. On June 12 1926 the council of the League of Nations announced their intention of providing a loan of £2,250,000 to the Bulgarian Government to assist the settlement of the Bulgar refugees. The conditions for administration and security were similar to those laid down in the case of the Greek refugee loan.

For the Armenians the same passport privileges and legal protection were obtained through the machinery of the League as had previously been obtained for the Russians. Their dispersal from places where they were concentrated in too great numbers, for example, from Greece, was also assisted by the agents of the League.

The effect of this League of Nations action is likely to be cumulative, and considerable as are its short period results in mitigating the sufferings of the refugees and in helping to solve the economic problems caused to the governments concerned, its long period results are likely to be more important still. By the various kinds of action which it has undertaken, the League has helped to remove centres of disaffection and discontent; it has helped to build up the prosperity of different portions of the world; and it has helped to raise, by the distribution and settlement of industrious and highly educated refugees, the standards of civilisation in various portions of the globe. It is, therefore, possible to say that, as the result of the generosity of a number of governments and of their enlightened co-operation through the machinery of the League, the ultimate results of the Refugee movements will be better than even the most optimistic could have ventured to expect.

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REGINA, Canada (*see* 23.39), the capital of the province of Saskatchewan, increased its population from 2,244 in 1901 to 34,432 in 1921. The city has a large distributing trade and is the central market for an agricultural region. It is on the Canadian Pacific and Canadian National railways, and has 12 radiating lines. There are many mills, banks, wholesale houses and factories, including a large oil refinery. An annual exhibition is held in a big exhibition park. Extensive buildings for the provincial government have been erected in a park of 160 ac. on the south bank of the Wascana Lake. Regina is the western headquarters of the Royal Canadian Mounted Police.

REHAN, ADA (1860–1916), American actress (*see* 23.48), died in New York City Jan. 8 1916.

REID, SIR GEORGE (1841–1913), British painter (*see* 23.50), died at Oakhill, Somerset, Feb. 9 1913.

REID, SIR GEORGE HOUSTON (1845–1918), Australian politician, was born Feb. 25 1845 at Johnstone, Renfrewshire, and emigrated in 1852 to Australia. He practised as a barrister in Sydney and was elected to the N.S.W. Parliament in 1880. In 1883–4 he was minister of public instruction and from 1891–4 was leader of the Free Trade party. In 1894 he became premier and retained office until 1899. Reid played a conspicuous part in the Federation movement and was a member of the first Commonwealth Parliament of 1901, leading the Free Trade Opposition to Sir Edmund Barton. In 1904 he became Prime Minister, but he stood for a programme which was unacceptable to a predominantly Protectionist country, and after his fall in the following year he never again held office. He led the opposition from 1905–8 and in the latter year retired from Australian politics. Created K.C.M.G. in 1909, in the same year he was appointed high commissioner in London; and on the expiration of his term sat in the House of Commons as Conservative member for St. George's, Hanover Square, London, till his death Sept. 12 1918.

REID, WHITELAW (1837–1912), American journalist and diplomatist (*see* 23.52), died in London Dec. 15 1912. His last public address was delivered before the students of the University College of Wales, Aberystwyth, on Thomas Jefferson. In 1912 appeared *The Scot in America and the Ulster Scot*, and posthumously, in 1913, *American and English Studies*. See Royal Cortissoz, *The Life of Whitelaw Reid* (1921).

REIMS, France (*see* 23.53), with a population of 76,645 in 1921, as compared with 102,800 in 1906, suffered severely during the World War. The German advance of Sept. 1914 brought the enemy within eight miles of the town, which was heavily bombarded and the population sheltered in the huge subterranean wine-cellars, where dormitories were made, schools were held and a daily paper was published. In Easter week, 1917, more than 25,000 shells fell on the town and the civilian population who remained—some 17,000 persons—were evacuated. Reims was one of the objectives of the Germans in 1918, but, though they got within two miles of it, the town held out until freed by the Allied offensive in October. Reims was then in ruins; it is said that less than a hundred houses remained undamaged. The Place Royale, the Rue de Vesle, the hotel de ville, the churches of St. Rémy and St. Jacques and the archbishop's palace, were burnt out or in ruins. The cathedral had been heavily shelled, under the pretext that the towers were used as

observation posts (which was denied by the archbishop) and was gravely damaged, especially on the southwest side.

Reims in 1926 was still a long way from complete recovery, and new buildings were everywhere interspersed with ruins and open spaces. The cathedral was in process of careful restoration; as many as possible of the statues will be reassembled, and the nave roof will be strengthened with concrete. Considerable progress has been made here and on the façade, Mr. J. D. Rockefeller having given 5,000,000 fr. towards the work, but it was reckoned in 1922 that complete restoration would take some 30 years, and much of the detailed work is irreparably lost. Part of the north aisle is in use as a temporary church. The statue of St. Joan of Arc, which stood in front of the cathedral, was removed during the War for safety, and replaced in 1921; many of the art treasures, tapestries, etc., were also saved. Light railways, starting from the Gare des Promenades, have been built to various spots on the battlefields. Strong efforts have been made to rehabilitate the wool spinning industry.

REINACH, JOSEPH (1856–1921), French author and politician (*see* 23.55), died in Paris April 18 1921.

RE-INFORCED CONCRETE: *see* FERRO-CONCRETE ENGINEERING.

REINHARDT, MAX (1873–), German stage and theatrical manager, was born at Baden near Vienna, Sept. 9 1873. He studied under Emil Bürde and began his theatrical career in a theatre in Salzburg. In 1894 he went to Berlin, where he was one of the founders of the Kleines Theater (1902). In 1903 he became manager of the Neues Theater and from 1905–20 was director of the Deutsches Theater, Berlin, which was connected with the Kammerspiele. He was also in 1919–20 director of the Grosses Schauspielhaus in the same city. At the Deutsches Theater, with the help of a company of excellent actors, including Wegener and Bassermann, he put into practice his ideas of a new art of the theatre. He aimed at ensemble effects and the unification of rhythm of speech, gesture, scene and background, tone, colour, costume and movement. Reinhardt achieved fame in England as the producer of *Sumûrun* (1911), of *The Miracle* at Olympia, London (1911–2), and of *Oedipus Rex* (1912). In addition to his interests in Berlin, Reinhardt also owned theatres in Vienna and Salzburg.

RÉJANE, GABRIELLE (1857–1920), French actress (*see* 23.58), died in Paris June 14 1920. During the World War she visited England and acted in patriotic plays in London. She was made chevalier of the Legion of Honour for her War services.

REJUVENATION.—Post-mortem examinations of many hundreds of cases where great age has been attained reveal invariably the same histological changes, diminution and atrophy of the functional cells, augmentation and hypertrophy of the tissue cells and of the fibrous tissues. Physiological equilibrium is lost, energy disappears, and the cellular activity is no longer adequate for the maintenance of life.

In *Vivre*, published in 1920, (an hypothesis was put forward which is in accordance with the views expressed by Metchnikov, by which "conjunctive tissue forms a support of scaffold work for the functional cells of all organs in which are found epithelial cells, which are cells specialised to the work of the respective organs. The conjunctive tissue provides the organs with the plasma they need as nourishment, which it in turn gets from the capillary system by osmosis. Their work is purely passive, they are less fragile, and retain at all stages their power of regeneration, while the highly specialised functional cells wear out more quickly and lose their power of recuperation. There comes a time when the conjunctive cells which are still energetically reproductive come into contact with functional cells which have lost their power and are doomed to atrophy. The conjunctive cells are naturally incapable of discharging specialised functions, so that the organism becomes progressively weaker till the functional cells fail to assure vital equilibrium, and in this contest after valuable collaboration the epithelial cells are worsted by elements which are less perfected, and are unable to secure the due functioning of the several organs of the body, so that old age and death ensue. Not only do the functional cells diminish while the conjunctive cells increase, but they also undergo a regressive evolution."

In all multicellular animals the process of regeneration, growth and rejuvenation is constant as is shown typically by the hair and nails. It is now possible to cultivate tissues in suitable media (*see* TISSUE CULTURE) and to keep them alive long after the death of the parent organism. This proves that death is not the inevitable end of cellular vitality, but is in every case the result of unfavourable conditions to which the cells are subjected at a given moment. Obviously, scrupulous attention to personal hygiene can do much to secure favourable conditions for the activity of the organs, but it cannot struggle with success against the regressive evolution of the cells which is brought about by old age (*see* DEATH).

The endocrine glands produce substances (hormones), which they pour into the circulatory system and thereby influence the metabolic processes, the growth and morphology of the cells. One of these glands should have as its special function the secretion of a substance which gives tone and stimulus to cellular vitality during a certain period of life and ceases to do this on the approach of old age. This cannot be the special function of either the thyroid, parathyroid, pituitary or suprarenal glands, since they continue to act during old age. The only gland which constitutes an exception to this rule is the genital gland. It plays a double rôle. It secretes spermatozoa externally, and it secretes internally hormones which it passes into the blood stream, actively at puberty and during maturity, but less and less thereafter, so that the diminution and disappearance of its activity correspond with old age.

Examination of male vertebrate animals after removal of the genital glands shows distinctly the nature of the influence of the internal secretion of these glands on the whole organism as affecting, not only the secondary male sexual characters, but also the growth and development of the body as a whole, the brain and skin cells, the bones and tissues. The physical and intellectual qualities of animals and of man are as intimately conditioned by the hormone secreted by the testicles as are the secondary sexual characters.

Characteristics of Eunuchs.—Personal observation of a number of eunuchs in Egypt shows that their cranial capacity is below normal, their intelligence is less than the average and sluggish, the memory is weak. They are prone to subterfuge, always a mark, as Dr. Dartigues has shown, of mental weakness. As to eunuchs who have played a conspicuous part in history, in diplomacy, and in war, they were men reduced to that state not in infancy but after attaining maturity, so that the hormone secretion would have operated on their mental development.[1]

The skeleton is affected by the removal of the testicles and their hormonic activity. The long bones, such as the tibia and femur, ossify much more slowly, and eunuchs are taller than the average of their race. The cranium is reduced in size. The face is narrower and all the bones more fragile. The shoulder blades are slender and the pelvis enlarged. The cartilages of the larynx do not ossify, and retain their infantile structure. The Adam's apple does not project as is usual. Clearly the removal of the testicles before the completion of bodily growth modifies the whole bony structure, and proves the preponderating influence of the testicular hormone on the architecture of the skeleton.

The effect of these hormones on the metabolism of the body, the chemical transformation of substances assimilated by the organism, is also general, since, as Marignan has shown, the glycogen content of "entires" is greater than that of animals which have been castrated. Reduction of muscular development is accompanied by an increase of adipose tissue, which is spread over the whole body but is specially marked in the mammary region, the abdomen and the buttocks. The skin is affected by castration; eunuchs have a pale tint, and their hair goes at an early age.

There can thus be no doubt as to the nature of the relation between the general reduction of the forces of the organism and the disappearance of the internal secretion of the testicles. No organ can keep its vital energy and yield a full return if the cells are not stimulated and vivified by the testicular hormone. It acts more or less directly on other endocrine glands, since castration is followed by hypertrophy of the anterior lobe of the pituitary gland and by regression of the thyroid body and epiphysis. If the genital glands remained active in old age, were

[1] *Rejuvenation by Grafting*, Serge Voronoff.

they not the only glands which cease to secrete hormones, old age would certainly be delayed.

Eunuchs in Cairo who had been castrated at an early age and had therefore never been exposed to the activity of the testicular hormones, were never known to have been more than 60 at death. All had the appearance of old men, with desiccated skins, haggard eyes, bent, and looking like centenarians. They die between 50 and 60, prematurely old, long before the term normally reached by their fellows.

It is obvious that the deprivation of the internal secretion of the testicles accelerates the advance of old age and shortens life. The only remedy is to graft a young testicle, whether that of a young human being or of an ape, by which the tone-giving substance is provided, so as to increase the vitality of all the cells which are weakened but are not yet atrophied and therefore still able to renew themselves, and thus effectively to rejuvenate the whole organism. So long as an organism, however old, continues to exist, its cells continue to be renewed and rejuvenated. Unfortunately, in old age this process of rejuvenation is slowed down, a certain number of the functional cells regress and are replaced by conjunctive tissue. Not every cell is atrophied. Were this to happen life would stop. The cells which escape this are renewed more slowly, but continue to be renewed to the extreme limit of their vitality.

With a rich addition of the testicular hormone, the cells acquire new energy, grow more rapidly, proliferate more intensely and rejuvenate the whole system. At the end of several years the beneficent action of the grafted gland is exhausted because the grafts in turn are subject to positive regression. The organism is again deprived of the stimulating hormones and the symptoms of old age reappear. In most cases testicular grafting is adequate, but in some cases thyroid grafts have to be added, as stated in *Vivre*. See S. Voronoff, *Rejuvenation by Grafting* (*1925*).

(S. V.)

RELATIVITY.—The progress of physical science during the first quarter of the present century was specially remarkable for the general acceptance by the scientific world of the principle of relativity, as expounded by Prof. Albert Einstein, professor of physics in the Kaiser Wilhelm Institut, Berlin. Its meaning and its history as part of present-day physical theory are the object of this discussion.

Introduction.—The primary aim of the investigator in pure science is the discovery of natural laws. As a secondary and hardly less important aim, he tries to invent a mechanism which shall account for the laws already known. The secondary aim is forced upon him partly by the constitution of the human mind; our intellects, unsatisfied with a mere accumualtion of facts, impel us ever to search for the causes underlying the facts: *Vere scire est per causas scire.* But to the working scientist the discovery of a mechanism has an additional and more practical value. When he has found a mechanism which will account for certain laws, he can proceed to examine the complete set of laws which the mechanism demands. If his mechanism corresponds with sufficient closeness to reality he may in this way be led to the discovery of new natural laws. On the other hand, the new laws deduced from the supposed mechanism may be false. If the falsity of the new laws is not at once revealed science may for a time be led into wrong paths. When more accurate experimenting or observation discloses that the laws are not true a recasting of ideas becomes necessary, and the branch of science concerned may experience a time of revolution followed by a period of rapid growth.

An obvious illustration of these general statements is provided by the history of astronomy. The laws of the motions of the planets, as observed from the earth, were tolerably well known to the Greeks. They had also evolved an explanatory mechanism starting from the metaphysical premise that the paths of the planets must necessarily be circles. The earth was the centre of the universe and round this revolved spheres to which the planets were attached. To explain the retrograde motion of the outer planets, these were supposed attached to secondary spheres revolving about points on the primary spheres which in turn revolved about the earth. This mechanism of cycles and epicycles as an explanation of planetary motion held the field for eighteen centuries. Finally the observations of Tycho Brahe provided a test which revealed the falsity of the whole structure. The position of Mars was found to differ from that required by the mechanism of epicycles by an amount as great as eight minutes of arc. " Out of these eight minutes," said Kepler, " we will construct a new theory that will explain the motions of all the planets."

The history of the succeeding century of astronomy need not be recapitulated here (*see* 2.811). The earth yielded its place as the centre of the universe, and the structure of cycles and epicycles crumbled away. The laws of planetary motion were determined with a precision which for the time appeared to be final. The mechanism underlying these laws was supposed to be a " force " of gravitation. This force was supposed to act between every pair of particles in the universe, its intensity varying directly as the product of the masses of the particles and inversely as the square of the distance separating them—the famous law of Newton.

In science, history repeats itself. Recent years have provided a further instance of the general processes we have been considering. Under the Newtonian mechanism every planet would describe a perfect ellipse about the sun as focus, and these elliptic orbits would repeat themselves indefinitely except in so far as they were disturbed by the gravitational forces arising from the other planets. But, after allowing for these disturbing influences, Leverrier found that the orbit of the planet Mercury was rotating in its own plane at the rate of 43 seconds a century. Various attempts have been made to reconcile this observed motion with the Newtonian mechanism. The gravitational forces arising from the known planets were demonstrably unable to produce the motion in question, but it was possible that Mercury's orbit was being disturbed by matter so far unknown to us.

Investigations were made as to the disturbance to be expected from various hypothetical gravitating masses—a planet or a ring of planets between Mercury and the sun, a ring of planets outside the orbit of Mercury, a belt of matter extended in a flattened disc in a plane through the sun's centre, an oblateness greater than that suggested by the shape of the sun's surface, in the arrangement of the internal layers of the sun's mass. In every case the mass required to produce the observed disturbance in the motion of Mercury would have also produced disturbances not observed in the motions of the other planets. The solution of the problem came only with the theory of relativity. Just as Tycho's eight minutes of arc, in the hands of Kepler and Newton, revolutionised mediaeval conceptions of the mechanism of the universe, so Leverrier's 43 seconds of arc, in the hands of Einstein, has revolutionised our 19th-century conceptions, not only of purely astronomical mechanism, but also of the nature of time and space and of the fundamental ideas of science. The history of this revolution is in effect the history of the theory of relativity. It falls naturally into two chapters, the first narrating the building of an earlier physical theory of relativity, and the second dealing with the extension of that theory to gravitation.

The Physical Theory of Relativity.—The earliest successful attempt to formulate the laws governing the general motion of matter is found in Newton's laws. The first law states that:—

Every body perseveres in its state of rest or of uniform motion in a right line unless it is compelled to change that state by forces impressed thereon.

In this law no distinction is made between rest and uniform motion in a straight line, and the same is true of the remaining laws. Hence follows the remarkable property to which Newton draws explicit attention in his fifth corollary to the laws of motion:—

The motions of bodies included in a given space are the same among themselves, whether that space is at rest, or moves uniformly forwards in a right line without any circular motion.

As a concrete application of this principle, Newton instances " the experiment of a ship, where all motions happen after the

same manner whether the ship is at rest or is carried uniformly forward in a right line." Just as a passenger on a ship in a still sea could not determine, from the behaviour of bodies inside the ship, whether the ship was at rest or moving uniformly forward, so we cannot determine from the behaviour of bodies on our earth whether the earth is at rest or not. We believe the earth to be moving round the sun with a speed of about 30 km. a second, so that there can be no question of the earth being permanently at rest, but we are unable to determine whether it is at rest at any specified point of its orbit, or, in the probable event of its not being at rest, what its absolute velocity may be. There is no more reason for thinking the sun, than the earth, to be at rest. Newton wrote as follows:—

It is possible that in the remote regions of the fixed stars, or perhaps far beyond them, there may be some body absolutely at rest, but impossible to know, from the positions of bodies to one another in our regions, whether any of these do keep the same position to that remote body. It follows that absolute rest cannot be determined from the position of bodies in our regions.

The above quotations are all from the first book of the *Principia Mathematica*. Previous to them all Newton writes: "I have no regard in this place to a medium, if any such there is, that freely pervades the interstices between the parts of bodies." The two centuries which elapsed after the publication of the *Principia* witnessed a steady growth of the belief in the reality of such an all-pervading medium. It was called the aether, and by the end of these two centuries (1887) it was almost universally believed that light and all electromagnetic phenomena were evidence of actions taking place in this aether. Light from the most distant stars was supposed to be transmitted to us in the form of wave motions in the aether, and we could see the stars only because the sea of aether between us and these stars was unbroken. It had been proved that if this sea of aether existed it must be at rest, for the alternative hypothesis that the aether was dragged about by ponderable bodies in their motions had been shown to be incompatible with the observed phenomenon of astronomical aberration and other facts of nature (*see* 1.292). On this view it was no longer necessary to go to Newton's "remote regions of the fixed stars, or perhaps far beyond them," to find absolute rest. A standard of absolute rest was provided by the aether which filled our laboratories and pervaded all bodies. Owing to our motion it would appear to be rushing past us, although without encountering any hindrance—"like the wind through a grove of trees," to borrow the simile of Thomas Young. The determination of the absolute velocity of the earth was reduced to the problem of measuring the velocity of an aether current flowing past us and through us.

In this same year (1887) the first experimental determination of this velocity was attempted by the Chicago physicist A. A. Michelson. The velocity of light was known to be, in round numbers, 300,000 km. a second, a velocity which was believed to represent the rate of progress of wave motion through the aether. If the earth were moving through the aether with a velocity of 1,000 km. a second, the velocity of light relative to a terrestrial observer ought to be only 299,000 km. a second when the light was sent in exactly the direction of the earth's motion through the aether, but would be 301,000 km. a second if the light was sent in the opposite direction. In more general terms, if the earth were moving through the aether, the velocity of light, as measured by a terrestrial observer, would depend on the direction of the light, and the extent of this dependence would give a measure of the earth's velocity. The velocity of light along a single straight course does not permit of direct experimental determination, but the same property of dependence on direction ought to be true, although to a less extent, of the average to-and-fro velocity of a beam of light sent along any path and then reflected back along the same path.

It was through this property that Michelson attempted to measure the earth's velocity through the aether.

The apparatus was simple in principle. A circular table ABCD (*cf.* fig. 1) was arranged so as to be capable of slow rotation about its centre O. Light sent along CO was divided up at O into two beams which were made to travel along perpendicular radii OA, OB. The arms OA, OB were made as equal as possible and mirrors were placed at A and B to reflect the beams of light back to O. An extremely sensitive optical method made it possible to detect even a very slight difference in the times of the total paths of the two beams from O back to O. There would in any case be a difference owing to the necessarily imperfect equalisation of the lengths of the arms OA, OB, but if the earth is moving through the aether in some direction OP, and if the table is made to rotate slowly about O, then this difference ought itself to vary on account of the earth's motion through the aether. Michelson, and afterwards Michelson and Morley in collaboration, attempted to estimate the amount of this variation. No variation whatsoever could be detected, although their final apparatus was so sensitive that the variation produced by a velocity through the aether of even 1 km. a second ought to have shown itself quite clearly.

Thus to the question "What is our velocity through the aether?" Nature appeared to give the answer "None." It was never suggested that this answer should be accepted as final; it would have brought us back to a geocentric universe. Clearly either the question had been wrongly framed or the answer wrongly interpreted. It was pointed out in 1893 by Fitzgerald, and again independently, in 1895, by Lorentz, that the *null* result of the Michelson-Morley experiment could be explained if it could be supposed that motion through the aether altered the linear dimensions of bodies.

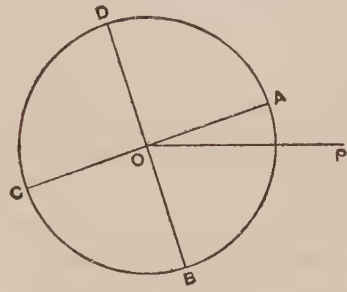

FIG. 1.

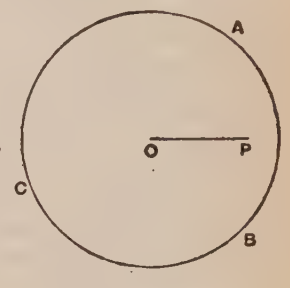

FIG. 2.

To be explicit, it was found that the experiment would invariably and of necessity give a *null* result if it was supposed that every body moving through the aether with a velocity u was contracted in the direction of its motion in the ratio $\sqrt{1-\frac{u^2}{c^2}}$, c being the velocity of light. The supposition that such a contraction occurred was not only permissible—it was almost demanded by electrical theory. For Lorentz had already shown that if matter were a purely electrical structure, the constituent parts would of necessity readjust their relative positions when set in motion through the aether and the final position of equilibrium would be one showing precisely the contraction just mentioned.

On this view, there was no *prima-facie* necessity to abandon the attempt to measure the earth's velocity through the aether. The answer to the problem had merely been pushed one stage farther back, and it now became necessary only to measure the shrinkage of matter produced by motion. It was obvious from the first that no direct material measurement could disclose the amount of this shrinkage, since any measuring rod would shrink in exactly the same ratio as the length to be measured; but optical and electrical methods appeared to be available. Experiments to this end were devised and performed by Rayleigh, Brace, Trouton and Noble, Trouton and Rankine and others. In every case a *null* result was obtained. It appeared then that if the earth moved through the aether this motion was concealed by a universal shrinkage of matter, and this shrinkage was in turn concealed by some other agency or agencies.

At this time the word "conspiracy" found its way into the technical language of science. There was supposed to be a conspiracy on the part of the various agencies of nature to prevent man from measuring his velocity of motion in space. If this motion produced a direct effect x on any phenomenon, the other agencies of nature seemed to be in league to produce a countervailing effect $-x$. A long train of experiments had not revealed, as was intended, our velocity through the aether; they had merely created a conviction that it was beyond the power of man to measure this velocity. The conspiracy, if such there was, appeared to have been perfectly organised.

A perfectly organised conspiracy of this kind differs only in name from a law of nature. To the inventor who tries to devise a perpetual-motion machine it may well appear that the forces of nature have joined in a conspiracy to prevent his machine from working, but wider knowledge shows that he is in conflict not with a conspiracy, but with a law of nature—the conservation of energy. In 1905 Einstein, crystallizing an idea which must have been vaguely present in many minds, propounded the hypothesis that the apparent conspiracy might be in effect a law of nature. He suggested, tentatively, that there might be a true law to the effect that "it is of necessity impossible to determine absolute motion by any experiment whatever." This hypothetical law may again be put in the equivalent form: "The phenomena of nature will be the same to two observers who move with any uniform velocity whatever relative to one another." This may be called the hypothesis of relativity.

The hypothesis in itself was not of a sensational character. Indeed, from the quotations which have already been given from Newton's works, it appears probable that Newton himself would have accepted the hypothesis without hesitation: he might even have regarded it as superfluous. The true significance of the hypothesis can only be understood by a reference to the scientific history of the two centuries which had elapsed since Newton. The Newtonian view that absolute rest was to be found only "in the remote regions of the fixed stars, or perhaps far beyond them," had given place to a belief that absolute rest was to be found all around us in an aether which permeated all bodies. What was striking about the hypothesis was its implication—either that we could not measure the velocity relative to ourselves of a medium which surrounded us on all sides, or else that no such medium existed.

The hypothesis demanded detailed and exhaustive examination. It was for the mathematician to test whether the hypothesis was in opposition to known and established laws of physics, and to this task Einstein, Lorentz and others set themselves. If a single firmly established law proved to be in opposition to the hypothesis, then of course the hypothesis would require to be abandoned. It was unlikely that such an event would occur among the well-established laws, for if it did, the phenomena governed by that law would enable direct measurement to be made of the earth's velocity through the aether, a measurement which had so far eluded all attempts of experimenters. It was among the more obscure and less well-established laws, if anywhere, that discrepancies were to be looked for.

It is impossible here to give a complete account of the many tests to which the relativity hypothesis has been subjected. The result of all can be summed up in one concise and quite general statement:—Wherever the hypothesis of relativity has appeared to be in conflict with known or suspected natural laws further experiment, where possible, has without a single exception shown the laws to be erroneous, and has moreover shown the alternative laws suggested by the hypothesis of relativity to be accurate. It is only in somewhat exceptional cases that the hypothesis of relativity of itself suffices to determine fully the form of a natural law; these cases constitute the most striking triumphs of the theory. As instances may be mentioned the determination of the law connecting the mass of an electron with its velocity; of the law expressing the velocity of light through a transparent medium in motion (Fizeau's water-tube experiment); and of the formulae for the magnetic forces on moving dielectric media (experiments of Eichenwald and H. A. Wilson).[1]

Before passing on from the general statement which has been made, particular mention must be made of one special case. A natural law which, at an early stage, was seen to be in conflict with the hypothesis of relativity was Newton's famous law of gravitation—namely, that every particle of matter attracts every other particle with a force proportional to the product of the two masses, and to the inverse square of their distance apart. Either, then, Newton's great law had to be abandoned, or else the hypothesis of relativity had to be discarded, in which case it would immediately become possible, in theory at least, to determine the earth's velocity through space by gravitational means. It is the choice between these two alternatives that has led to the most surprising developments of the theory of relativity; and to these we shall return later.

Space and Time.—The hypothesis of relativity, as has already been explained, postulates that the phenomena of nature will be the same to any two observers who move relative to one another with any uniform velocity whatever. The hypothesis has been so amply tested as regards all optical and electromagnetic phenomena that no doubt is felt, or can rationally be felt, as to its truth with respect to these phenomena. The hypothesis can be examined and developed in two opposite directions. We may, on the one hand, proceed from the general hypothesis to the detailed laws implied in it; this has already been done, with completely satisfactory results as regards confirmation of the hypothesis. Or we may regard the hypothesis of relativity as being itself a detailed law, and attempt to generalise upward to something still wider. It is this possibility which must for the moment claim our attention.

In 1905 Einstein examined in full the consequences of the hypothesis that one simple optical phenomenon—namely, the transmission of a ray of light in free space—was, in accordance with the hypothesis of relativity, independent of the velocity of the observer. If an aether existed, and provided a fixed framework of reference, then light set free at any instant would obviously travel with a velocity which would appear to an observer at rest in this aether to be the same in all directions, and the wave front at any instant would be a sphere having the observer as centre. On the hypothesis of relativity the phenomenon of light transmission must remain unaffected by the motion of the observer so that the light must appear, to a moving observer also, to travel with a uniform velocity in all directions, and thus to the moving observer also the wave front must appear to be a sphere of which he will be the centre. It is, however, quite obvious that the same spherical wave front cannot appear, to each of two observers who have moved some distance apart, to be centred round himself, unless the use either of the common conceptions of science or of the ordinary words of language is greatly changed. In fig. 2 it is not possible, in ordinary language, that both O and P should at the same instant be at the centre of the sphere A B C. The change to which Einstein was forced is one which has an intimate bearing upon our fundamental conceptions of the nature of space and time; this change it will be necessary to explain in some detail.

Suppose that two observatories, say Greenwich and Paris, wish to synchronise their clocks, with a view to, let us say, an exact determination of their longitude difference. Paris will send out a wireless signal at exact midnight as shown by the Paris clock, and Greenwich will note the time shown by the Greenwich clock at the instant of receipt of the signal. Greenwich will not, however, adjust their clock so as to show exact midnight when the signal is received; a correction of about ·001 second must be made to allow for the time occupied by the signal in traversing the distance from Paris to Greenwich. To turn to mathematical symbols, if t_0 is the time at which a signal is sent out from one station, the time of receipt at a second station is taken to be $t_0+\frac{x}{c}$, where x is their distance apart, and c is the velocity of light. This represents the ordinary practice of astronomers, but it is clear that if the earth is travelling through a fixed aether with a velocity u in the direction of the line joining the two observatories, the velocity of transmission of the signal relative to the two observatories will not be c but $c+u$, and the time of receipt at the second station will be $t_0+\frac{x}{c+u}$. Thus it appears that it is impossible to synchronise two clocks unless we know the value of u, and that the ordinary practice of astronomers will not, as they expect, synchronise their clocks,

[1] For references to the original papers dealing with these and other tests of the hypothesis of relativity *see* Cunningham, *The Principle of Relativity*, or J. H. Jeans, *Mathematical Theory of Electricity and Magnetism* (4th or 5th ed.).

but set them at an interval apart equal to

$$x\left(\frac{1}{c}-\frac{1}{c+u}\right)$$

which may, to an approximation, be put equal to $\frac{ux}{c^2}$.

According to the hypothesis of relativity, it is impossible ever to determine the value of u, and so it is impossible ever truly to synchronise two clocks. Moreover, according to this hypothesis, the phenomena of nature go on just the same whatever the value of u, so that the want of synchrony cannot in any way show itself—in fact, if it did, it would immediately become possible to measure the effect and so arrange for true synchrony.

As the earth moves in its orbit, the value of u changes, so that its value in the spring, for instance, will be different from its value in the autumn. One pair of astronomers may attempt to synchronise a pair of clocks in the spring, but their synchronisation will appear faulty to a second pair who repeat the determination in the autumn. There will, so to speak, be one synchrony for the spring and another for the autumn, and neither pair of astronomers will be able to claim that their results are more accurate than those of their colleagues. More generally we may say that different conceptions of synchrony will correspond to different velocities of translation.

These elementary considerations bring us to the heart of the problem which we illustrated diagrammatically in fig. 2. The observer at O in the diagram will have one conception of simultaneity, while the second observer who moves from O to P will, on account of his different velocity, have a different conception of simultaneity. The instants at which the wave front of the light signal from O reaches the points A, B, C in the diagram will be deemed to be simultaneous by the observer who remains at O, but the observer who moves from O to P will quite unconsciously have different ideas as to simultaneity. At instants which he regards as simultaneous the wave front will have some form other than that of the sphere ABC surrounding O. If the hypothesis of relativity is to be true in its application to the transmission of light signals, this wave front must be a sphere having P as its centre. Einstein examined mathematically the conditions that this should be possible. A precise statement of his conclusions can only be given in mathematical language.

The observer who is supposed to remain at O in fig. 2 may be supposed to make exact observations and to record these observations in mathematical terms. To fix the positions of points in space he will map out a "frame of reference" consisting of three orthogonal axes, and use Cartesian co-ordinates x, y, z, to specify the projections along these axes of the radius from the origin to any given point. He will also use a time co-ordinate t which may be supposed to specify the time which has lapsed since a given instant, as measured by a clock in his possession. Any observations he may make on the transmission of light signals can be recorded in the form of equations between the four co-ordinates x, y, z, t. For instance, the circumstance that light travels from the origin with the same velocity c in all directions will be expressed by the equation (of the wave front):—

$$x^2+y^2+z^2-c^2t^2=0 \qquad (1)$$

The second observer who moves from O to P will also construct a frame of reference, and we can simplify the problem by supposing that his axes are parallel to those already selected by the first observer. His co-ordinates, to distinguish them from those used by the first observer, may be denoted by the accented letters x', y', z', t'. If his observations also are to show light always to travel with the same velocity c in all directions, the equation of the wave front, as observed by him, must be:—

$$x'^2+y'^2+z'^2-c^2t'=0 \qquad (2)$$

A 19th-century mathematician would have insisted that x, y, z, t must be connected with x', y', z', t' by the simple relations:—

$$\left.\begin{aligned} x' &= x-ut \\ y' &= y \\ z' &= z \\ t' &= t \end{aligned}\right\} \qquad (A)$$

but it is obvious that if these relations hold, then equation (1) cannot transform into equation (2). Einstein finds that equation (1) will transform into equation (2) provided the co-ordinates x, y, z, t of the first observer are connected with the co-ordinates x', y', z', t' of the second observer by the equations:—

$$\left.\begin{aligned} x' &= \beta\,(x-ut) \\ y' &= y \\ z' &= z \\ t' &= \beta\left(t-\frac{ux}{c^2}\right) \end{aligned}\right\} \qquad (B)$$

where β stands for $\left(1-\frac{u^2}{c^2}\right)^{-\frac{1}{2}}$

To form some idea of the physical meaning of these equations, it will be advantageous to consider the simple case in which the first observer is at rest in the aether while the second moves through the aether with velocity u. The points of difference between equations (B) and (A) then admit of simple explanation. The factor β in the first of equations (B) is simply, according to the suggestion of Fitzgerald and Lorentz already mentioned, the factor according to which all lengths parallel to the axis of x must be adjusted on account of motion through the aether with velocity u. The moving observer must correct his lengths by this factor, and he must correct his times by the same factor in order that the velocity of propagation of light along the axis of x may still have the same velocity c; this explains the presence of the multiplier β in the last of equations (B). The one remaining difference between the two sets of equations, namely, the replacement of t in (A) by $t-\frac{ux}{c^2}$ in (B), represents exactly the want of synchrony which, as we have already seen, is to be expected in the observations of two observers whose velocity differs by a velocity u.

Although the equations admit of simple illustration by considering the case in which one observer is at rest in a supposed aether, it will be understood that the equations are more general than the illustration. They are in no way concerned with the possibility of an observer being at rest in an aether, or indeed the existence of an aether at all. Their general interpretation is this: If one observer O, having any motion whatever, finds, as a matter of observation, that light for him travels uniformly in all directions with a constant velocity c, then a second observer P, moving relative to O with a constant velocity u along the axis of x, will find, as a matter of observation, that light, for him also, travels uniformly in all directions with the same constant velocity c, provided he uses, for his observations, co-ordinates which are connected with the co-ordinates of O by equations (B).

This is the meaning that was attached to the equations by Einstein in 1905, but the equations had been familiar to mathematicians before this date. They had in fact been discovered by Lorentz in 1895 as expressing the condition that all electromagnetic phenomena, including of course the propagation of light, should be the same for an observer moving through the aether with velocity u as for an observer at rest in the aether. For this reason the transformation of co-ordinates specified by these equations is universally spoken of as a "Lorentz transformation." What Einstein introduced in 1905 was not a new system of equations but a new interpretation of old equations. The two observers who used the co-ordinates x, y, z, t and x', y', z', t' had been regarded by Lorentz as being one at rest in an aether and one in motion with a velocity u; for Einstein they were observers moving with any velocities whatever subject to their relative velocity being u. Lorentz had regarded t as the true time and t' as an artificial time. If the observer could be persuaded to measure time in this artificial way, setting his clocks wrong to begin with and then making them gain or lose permanently, the effect of his supposed artificiality would just counterbalance the effects of his motion through the aether. With Einstein came the conception that both times, t and t', had precisely equal rights to be regarded as true time. The measure

t' is precisely that which would be adopted naturally by any set of observers, or race of men, who disregarded their steady motion through space; their adoption of it would be above criticism if, as Einstein suggested, their motion through space had no influence on material phenomena, and it represents, as we have seen, the usual practice of astronomers in comparing time at different places. From this point of view neither measure of time is more accurate or more logical than the other. There are as many ways of measuring time as there are observers, and all are right.

The investigator who is trying to discover laws of nature will, in general, require to measure either directly or indirectly both time and space. If, to take a simple case, he is studying the motion of a single particle, he will measure out the position of the particle at definite instants as determined by his clock. He may specify the position of the particle at any instant by three measurements in space—for instance, he may say that two seconds after his particle started it was 6 ft. to the E. of the point from which it started, 9 ft. to the N. and 12 ft. vertically upward. The mathematician would express this by taking axes x, y, z to the E., to the N. and vertically upwards, and saying that at time $t=2$ the particle had co-ordinates $x=6$, $y=9$, $z=12$. Or he might, putting his time co-ordinate t on the same footing as the space co-ordinates x, y, z, simply say that $x=6$, $y=9$, $z=12$, $t=2$ represented one position of the particle. A complete set of readings of this type, each consisting of values of four co-ordinates, would give the complete history of the motion of the particle.

Such sets of simultaneous measurements form the common material of investigations in both pure and applied science. For instance, the engineer may measure the extension of a sample of steel corresponding to different loads; the electrician may measure the amount of light given by an electric filament corresponding to different amounts of current passed through it. In each of these cases there are only two quantities to be measured simultaneously, and an investigator can conveniently represent the result of the whole series of his measurements in graphical form; a single reading is represented by a point whose distances from two fixed perpendicular lines represent the quantities measured, and the curve obtained by joining these single points will give all the information contained in the whole set of readings.

We have seen that, in studying the motion of a particle in space, four sets of quantities must be measured, so that the results obtained cannot be plotted graphically on a piece of paper. Their proper representation demands a four-dimensional space, in which x, y, z and t are taken as co-ordinates. The practical importance of such graphical representation is *nil*, since it is impossible to construct a four-dimensional graph, but its theoretical importance to the theory of relativity is immense. For if the hypothesis of relativity is true, then the four-dimensional graphs of any natural event constructed by all observers, no matter what their relative motions, will be identical. The influence of their motion will be shown only in that the axes of x, y, z and t will be different for different observers, and the relations between these sets of axes will be those given by the foregoing equations (B).

The importance of this conception can hardly be overestimated, and it may be well to consider it further with the help of an illustrative example. Imagine a number of aeroplanes flying over England, and, in order to eliminate one of the three directions in space—the vertical—let us limit them to fly always at the same height, say 1,000 ft. above sea-level. Imagine a number of similar plates of glass prepared, each marked faintly with an outline map of England and with lines of latitude and longitude. Suppose that at 12 h. 0 m. G.M.T. a plate is taken and the position of each aeroplane marked by a thick black dot. At 12 h. 1 m. let a second plate be taken and similarly marked, and let this be done every minute for an hour. The 60 plates so marked will constitute a record of the motion of each aeroplane within this hour. If, now, we place the plates in order, one above the other, on a horizontal table, the mass of glass so formed will present a graphical representation, in three dimensions, of the motions of all the aeroplanes. In this graph the two horizontal co-ordinates represent motions in any two rectangular directions over England, say E. and N., while the third co-ordinate—the vertical—represents time. The individual black dots which represent the positions of any one aeroplane will form a dotted curve, and this curve gives a graphical representation of the motion of the particular aeroplane. Our rectangle of glass contains the history, for one hour, of all the aeroplanes in graphical form.

To represent the motion of particles in the whole world of space a four-dimensional graph is required. The four-dimensional space in which it is constructed may, following the usual terminology, be spoken of as a four-dimensional continuum. The history of any particle in the universe—just as that of any aeroplane flying over England—will be represented by a continuous line in the continuum, and this is called the "world line" of the particle. If the hypothesis of relativity is true the same continuum and the same world lines will represent the history of the particles of the universe equally well for all observers, the influence of their motions being shown only through their choosing different axes in the continuum for their axes of space and time. Thus the continuum must be thought of as something real and objective, but the choice of axes is subjective and will vary with the observer, the relation between different choices being expressed mathematically by our equations (B), the equations of the Lorentz transformation. An inspection of these equations shows that the sets of axes chosen by different observers have different orientations in the continuum, so that what one observer describes as a pure space interval will appear to another to be a mixture of time and space.

The instant of time and point in space at which any event occurs can be fixed by a single point in the continuum, so that the interval between two events will be represented by a finite line. The events and the interval between them are absolute, but the interval will be split up into time and space in different ways by different observers. The interval between any two events, such as the great fire of London and the outburst on the star Nova Persei, may be measured by one set of observers as so many years and so many millions of miles, but another set of observers may divide the interval quite differently. For instance a terrestrial astronomer may reckon that the outburst on Nova Persei occurred a century before the great fire of London, but an astronomer on the Nova may reckon with equal accuracy that the great fire occurred a century before the outburst on the Nova. A third astronomer may insist that the events were simultaneous. All will be equally right, although none will be right in an absolute sense. At this stage we may notice one respect in which our pile of glass plates failed to represent the true continuum. The mass of glass was stratified into different plates which represent different times for one particular observer. To obtain a section which would represent what an observer in motion relative to this first observer could regard as simultaneous positions of the aeroplanes, we should have to cut the mass of glass on the slant. The continuum is more closely represented by our plates of glass if they are annealed into a solid mass from which all trace of the original stratification is made to disappear. All observers, no matter what their motion, are then equally free to cut a section to represent their individual ideas of simultaneity.

Thus space and time fade into subjective conceptions, just as subjective as right hand or left hand, front and behind, are in ordinary life. The continuum alone is objective and may be thought of as containing an objective record of the motion of every particle of the universe. The curve in which this record is embodied is spoken of as the world line of the particle in question. To use the words of Minkowski: "Space in itself and time in itself sink to mere shadows, and only a kind of union of the two retains an independent existence."

Gravitation and Relativity.—Since all the phenomena of light and of electromagnetism are believed, on almost incontrovertible evidence, to be in accordance with the hypothesis of relativity,

it is necessarily impossible to determine absolute velocity by optical or gravitational means. On the other hand, as we have already mentioned, the Newtonian law of gravitation is readily seen to be inconsistent with the hypothesis of relativity. Three alternatives are open:—

(i.) The Newtonian law may be true, in which case it must be possible to determine absolute velocity by gravitational means.

(ii.) The Newtonian law may be untrue in its original form, but may become true when amended so as to conform to the relativity hypothesis.

(iii.) Neither of the foregoing possibilities may be true.

Alternative (i.) was explored by Sir Oliver Lodge, who, assuming the exact truth of the Newtonian law of gravitation, deduced that the observed motion of the perihelion of Mercury could be accounted for if the sun were moving through space with a velocity of about 70 km. a second in a certain direction. This investigation had to be abandoned when it was shown by Eddington that a similar discussion of the motions of the other planets would lead to vastly different values for the sun's velocity. Alternative (ii.) was explored by Einstein and others, but was found to lead to a motion of the perihelion of Mercury equal only to one-sixth part of that actually observed.

Alternative (iii.) remained with its innumerable possibilities. Einstein commenced his attack on the problem by eliminating all possibilities which did not conform to two general principles. The first of these was the principle of relativity. Inasmuch as all physical phenomena except gravitation were believed to conform to this principle, it was natural to try, as a working hypothesis, the effect of assuming gravitation also to conform. The second principle was the so-called principle of equivalence, and this demands a word of explanation.

To our children we explain that an apple falls to the ground because a force of gravitation inherent in the earth's mass impels the apple towards the centre of the earth. Most schoolboys know that this is not quite the whole story; the path of the apple is more accurately determined by supposing the apple to be acted on simultaneously by two forces—a gravitational force of attraction towards the earth's centre and the centrifugal force arising from the earth's rotation. It is only because the earth's rotation is comparatively slow that the conception of an attraction towards the earth's centre gives a tolerably plausible account of the fall of the apple. If the earth rotated at 17 times its present rate objects would not fall, even approximately, towards the earth's centre; they would fall always parallel to the earth's axis, and the inhabitants of the northern hemisphere might explain this as arising from a force of repulsion inherent in the pole star. If the earth rotated many times faster even than this, bodies would fall always perpendicularly away from the earth's axis, and this might be interpreted as arising from a gravitational repulsion residing in the earth's axis.

These illustrations will show that it is easy to confuse acceleration arising from the earth's rotation with gravitational attraction. We may go further and say that it is impossible to distinguish between the effects of gravitational attraction and the effects of acceleration of any kind whatever. Every aeroplanist knows this to his sorrow; it is inherently impossible to devise any instrument which shall show the direction of the vertical in an aeroplane, since an acceleration of the aeroplane produces on any instrument whatever, effects which are indistinguishable from those of gravity. From such considerations Einstein was led to his principle of equivalence, which may be enunciated as follows:—

A gravitational field of force at any point of space is in every way equivalent to an artificial field of force resulting from acceleration so that no experiment can possibly distinguish between them.

Guided by these two principles—relativity and equivalence—Einstein was led to the view that all gravitational "fields of force" must be illusions. The apparent "force" arises solely from acceleration and there is no other kind of gravitational force at all. In this statement, as in the statement of the principle of equivalence above, the word acceleration is used in its widest sense. Acceleration results not only from change in the amount of a velocity, but from a change in its direction also. For instance a motor-cyclist riding in a circle at a uniform speed of 60 miles an hour will be the subject of an acceleration towards the centre of the circle. He knows that the apparent force so produced is just as real in its effects as gravitation, and to save himself from falling as a result of its influence he must incline the direction of his machine to the vertical.

It is clear that the acceleration or curvature of path which figures as gravitation cannot be an acceleration or curvature in ordinary three-dimensional space. Before the apple starts to fall from the tree there is neither acceleration nor curvature, and yet the apple is undoubtedly acted on by gravitation. Moreover, this three-dimensional space is, as we have seen, different for different observers—it is a subjective and not an objective conception, and the gravitation resulting from such a curvature could not conform to the relativity condition. Einstein was accordingly led to suppose that gravitation arose from curvature in the four-dimensional space, or continuum, in which time formed the fourth dimension. This continuum, as has been seen, is objective and if the path of the particle can also be made objective, the resulting gravitation will conform to the relativity principle. The path of the particle in the continuum is, however, simply its "world line," which we have already had under discussion. This world line is determined by natural laws, and if these are to be objective the specification of the world line must also be objective. There is, however, only one specification of world lines in the continuum which is objective in the sense that the same specification will give the same world lines to observers moving with different velocities. It is that every world line must be so drawn as to represent the shortest path between any two points on it. Mathematically, lines which satisfy this condition are known as *geodesics*. Thus Einstein was led to suppose that world lines must be geodesics in the four-dimensional continuum.

Consider for a moment a page of this volume as presenting a two-dimensional analogy of the continuum. The shortest distance between any two points is of course the straight line joining them, so that the geodesics are simply straight lines. These possess no curvature of path, and if they formed a true analogy to the geodesics in the continuum there could clearly be no explanation of gravitation of the type we have been contemplating. There is, however, another type of two-dimensional surface. It is represented by the surface of a solid body such as a sphere—say the earth. On the earth's surface the geodesics are the great circles; every mariner or aeronaut who desires to sail the shortest course between two points sails along a great circle. To take a definite instance, the shortest course from Panama to Ceylon is not along the parallel of lat. (about 9° N.) which joins them—the aeronaut wishing to fly the shortest course between the two countries will fly N.E. from Panama, he will pass over England and finally reach Ceylon from the northwest. The reader may rapidly verify this by stretching a thread tightly over the surface of an ordinary geographical globe. Let him now trace out the course on an ordinary Mercator chart, and it will be found to appear very curved indeed—the course of the aeronaut will look surprisingly like that of a comet describing an orbit under the attraction of a sun situated somewhere near the middle of the Sahara.

The reader who performs these simple experiments will understand how Einstein was led to suppose that gravitation could be explained by a curvature inherent in the continuum. The world lines of particles are geodesics but the space itself, so to speak, provides the curvature. The curvature of path is thrust upon the particle by the nature of the continuum, but we, who until recently have been unaware even of the existence of the continuum, have been tempted to ascribe it to the action of a special agency which we have invented *ad hoc* and called "gravitation." According to Einstein's view of the nature of gravitation, it is no more accurate to say that the earth attracts the moon than to say that the pockets of an uneven billiard table repel the balls.

Perhaps this train of thought may seem artificial. If so, the reason is that we have not been able to explore the other possibilities which have branched off our main line of thought. In point of fact, Einstein found himself practically limited to the conclusion we have stated. Not only so, but the actual type and degree of curvature in the continuum prove to be uniquely fixed in terms of the masses of the gravitating bodies. Thus Einstein, knowing the mass of the sun, found himself in a position to predict absolutely what the motion of the perihelion of Mercury ought to be. It was found to be 42·9″ a century, a figure which agreed with observation to well within the limits of error of the observations. The motions of the other planets as predicted by the theory of relativity, have also been found to agree with those observed to within the errors of observation. This latter test is not a very stringent one, since the departures from the motion predicted by the Newtonian law are too small to admit of very precise measurement.

The Effect of Gravitation on Light.—Einstein's theory requires that the world line of a ray of light also shall be a geodesic in the continuum. In a gravitational field the curvature of the continuum will impose a twist on the path of a ray of light. Einstein found in particular that a ray of light which comes from a distant star and passes near the edge of the sun on its journey ought to be bent, in its passage past the sun, by an angle which should be 1·745″ if the ray just grazes the sun, and would be less, in proportion to the inverse distance from the centre of the sun, for other rays.

The observatories of Greenwich and Cambridge dispatched expeditions to test this prediction at the eclipse of 1919. It was found that the stars which appeared near to the sun at the instant of eclipse showed an appreciable displacement, as compared with their normal positions, of the type required by Einstein's theory. Exact measurement confirmed that the displacement varied approximately as the inverse distance from the sun, and that the displacement at the limb was sensibly equal to Einstein's predicted value of 1·745″. The Cambridge observers, hampered by cloudy weather, obtained for this quantity the value 1·61″=0·30″. The Greenwich observers obtained a value of 1·98″=0·12″, but Prof. H. N. Russell subsequently pointed out that their photographs indicate a horizontal and vertical scale difference of the order of one part in 12,000, almost certainly due to a distortion of the coelostat mirror under the sun's rays, and if the measures are corrected for this the result is brought much closer to the theoretical prediction. Three years later an expedition, sent out by Lick Observatory to observe the 1922 eclipse, was favoured by good weather and obtained for the displacement at the sun's limb, a value of 1·72″ with a probable error of 0·11″. None of the expeditions had of course measured the deflections of stars actually at the sun's limb; most of the stars were several diameters away from the limb, the observed deflections being corrected so as to bring them to the limb. The deflections of stars at all distances were found to agree well with the predictions of Einstein's theory.

The theory makes one further prediction which admits of experimental test. The atoms of any element, say calcium, may be supposed to be formed according to a definite specification, the terms of which depend neither on the velocity of a particular observer nor on his position relative to the gravitational fields of the universe. It can be deduced that the light received from a calcium atom situated in the intense gravitational field near the sun's surface ought to be of slower period, and therefore of redder colour, than the similar light emitted by terrestrial atoms. To be more precise, the Fraunhofer lines in the solar spectrum ought to show a displacement to the red; this displacement ought to be homologous, and should be of amount 0·008 Å units at the cyanogen band λ 3883 at which observations have been chiefly made. Attempts to test this prediction have led to strangely discordant results. All observers have found some effect of the kind predicted, but its amount has generally been substantially less than the predicted amount, varying from almost *nil* (St. John, 1917) to nearly the full amount to be expected (Evershed, 1918 and 1923, Grebe and Bachem, 1919).

The reason is that the predicted shift of 0·008 Å is in any case hardly greater than the normal errors of observation and is apt to be masked by larger shifts of uncertain amount arising from other causes. Larger shifts would be expected in stars which were of larger mass than the sun or of smaller radii. Many known stars have masses far larger than the sun, but they also have larger radii, and so ought to show only about the same spectral shift as the sun. On the other hand the class of stars known as " white dwarfs " have masses about equal to that of the sun, but far smaller radii. For instance calculation shows that the companion to Sirius, a star whose radius is only about a thirty-fifth of that of our sun, ought to show a shift of as much as 0·30 Å and when the matter was put to the test at Mount Wilson Observatory, W. S. Adams found an actual shift of 0·32 Å. It is hardly possible any longer to doubt that the spectral shift predicted by Einstein really exists.

Further Developments.—It will have been seen that the restricted physical theory of relativity introduced a revolution into the foundations of scientific thought by destroying the objectivity of time and space. The gravitational theory has effected a hardly less important revolution by destroying our belief in the reality of gravitation as a " force." The physicist has, however, to deal with other " forces " besides those of gravitation, and the question inevitably arises as to whether these too must be regarded as illusions, arising only from our faulty interpretation of the special metrical properties of the continuum. Prof. H. Weyl has pointed out that the continuum imagined by Einstein and found to be adequate to explain gravitational phenomena, is not, in respect of its metrical properties, the most general type of continuum imaginable. A further generalisation is possible, and the new curvatures introduced must of necessity introduce new apparent forces other than gravitational. Weyl's investigation shows that these new forces would have exactly the properties of the electric and magnetic forces with which we are familiar. Indeed, the predicted forces coincide so completely with known electromagnetic forces that no experimental test of Weyl's theory is possible. Had there been the slightest divergence between the forces predicted by Weyl and those predicted by ordinary electromagnetic theory, experiment could have been asked to decide between the two, but no such divergence exists. It may, however, be said that Weyl's theory makes it highly probable that all forces reduce to nothing more than our subjective interpretations of special properties of the continuum in which we live.

Finally a thought may be given to the position, under the new conceptions introduced by the theory of relativity, of the electromagnetic aether. At one stage in the history of science there was a tendency to fill space with aethers, to the extent almost of one aether for every set of phenomena requiring explanation. That stage passed, and by the end of the 19th century only one aether received serious consideration, the so-called electromagnetic aether of Faraday and Maxwell. This aether gave a plausible mechanical explanation of electrostatic phenomena, although it was more than doubtful whether it could account for the electromagnetic phenomena from which it took its name, and it was comparatively certain that it could not account for gravitation. It gave, however, a satisfactory explanation of the propagation of waves of light—they were simply waves in the aether and travelled with an absolute velocity c determined once and for all by the structure of the aether. On this view it was quite certain that an observer moving through the aether with a velocity u would measure the velocity of light travelling in the same direction as himself as $c=u$. Relativity teaches that this velocity is always precisely c, and this in itself disposes of the aether of Faraday and Maxwell. Whether any new aether will be devised to replace it remains to be seen, but none appears to be necessary. Any aether which can be imagined would appear to depend upon an objective separation of time and space. Relativity does not deny that such an objective separation may, in the last resort, really exist, but it shows that no material phenomena are concerned with such a separation. By a very slight turn of thought, the primary postulate of relativity may be

expressed in the form that the material world goes on as though no aether existed.

To the relativist the essential background to the picture of the universe is not the varying agitation of a sea of aether in a three-dimensional space but a tangle of world lines in a four-dimensional space. Moreover, it is only the intersection of the world lines that are important. An intersection at a point in the continuum represents an event, while the part of a world line which is free from intersections represents the mere uneventful existence of a particle or a pulse of light. And so, since our whole knowledge of the universe is made up of events, it comes about that the tangle of world lines may be distorted and bent to any degree we please; so long as the order of the intersections is not altered, it will still represent the same universe. And so the last function of the aether, that of providing a scale of absolute measurements in space, becomes a superfluity. To the physicist who urges that space measurements without an underlying aether become meaningless, the relativist can reply that time-measurements without an underlying "time-aether" are equally meaningless. A "time-aether" has never been regarded as a necessity, and the relativist feels that the "space-aether" has no greater claim to retention.

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RELATIVITY: PHILOSOPHICAL CONSEQUENCES.—Of the consequences in philosophy which may be supposed to follow from the theory of relativity (*q.v.*), some are fairly certain, while others are open to question. There has been a tendency, not uncommon in the case of a new scientific theory, for every philosopher to interpret the work of Einstein in accordance with his own metaphysical system, and to suggest that the outcome is a great accession of strength to the views which the philosopher in question previously held. This cannot be true in all cases; and it may be hoped that it is true in none. It would be disappointing if so fundamental a change as Einstein has introduced involved no philosophical novelty. (*See* SPACE-TIME.)

Space-Time.—For philosophy, the most important novelty was present already in the special theory of relativity; that is, the substitution of space-time for space and time. In Newtonian dynamics, two events were separated by two kinds of interval, one being distance in space, the other lapse of time. As soon as it was realised that all motion is relative (which happened long before Einstein), distance in space became ambiguous except in the case of *simultaneous* events, but it was still thought that there was no ambiguity about simultaneity in different places. The special theory of relativity showed, by experimental arguments which were new, and by logical arguments which could have been discovered any time after it became known that light travels with a finite velocity, that simultaneity is only definite when it applies to events in the same place, and becomes more and more ambiguous as the events are more widely removed from each other in space.

This statement is not quite correct, since it still uses the notion of "space." The correct statement is this: Events have a four-dimensional order, by means of which we can say that an event A is nearer to an event B than to an event C; this is a purely ordinal matter, not involving anything quantitative. But, in addition, there is between neighbouring events a quantitative relation called "interval," which fulfils the functions both of distance in space and of lapse of time in the traditional dynamics, but fulfils them with a difference. If a body can move so as to be present at both events, the interval is time-like. If a ray of light can move so as to be present at both events, the interval is zero. If neither can happen, the interval is space-like. When we speak of a body being present "at" an event, we mean that the event occurs in the same place in space-time as one of the events which make up the history of the body; and when we say that two events occur at the same place in space-time, we mean that there is no event between them in the four-dimensional space-time order. All the events which happen to a man at a given moment (in his own time) are, in this sense, in one place; for example, if we hear a noise and see a colour simultaneously, our two perceptions are both in one place in space-time.

When one body can be present at two events which are not in one place in space-time, the time-order of the two events is not ambiguous, though the magnitude of the time-interval will be different in different systems of measurement. But whenever the interval between two events is space-like, their time-order will be different in different equally legitimate systems of measurement; in this case, therefore, the time-order does not represent a physical fact. It follows that, when two bodies are in relative motion, like the sun and a planet, there is no such physical fact as "the distance between the bodies at a given time"; this alone shows that Newton's law of gravitation is logically faulty. Fortunately, Einstein has not only pointed out the defect, but remedied it. His arguments against Newton, however, would have remained valid even if his own law of gravitation had not proved right.

Time not a Single Cosmic Order.—The fact that time is private to each body, not a single cosmic order, involves changes in the notions of substance and cause, and suggests the substitution of a series of events for a substance with changing states. The controversy about the aether thus becomes rather unreal. Undoubtedly, when light-waves travel, events occur, and it used to be thought that these events must be "in" something; the something in which they were was called the aether. But there seems no reason except a logical prejudice to suppose that the events are "in" anything. Matter, also, may be reduced to a law according to which events succeed each other and spread out from centres; but here we enter upon more speculative considerations.

Physical Laws.—Prof. Eddington has emphasised an aspect of relativity theory which is of great philosophical importance, but difficult to make clear without somewhat abstruse mathematics. The aspect in question is the reduction of what used to be regarded as physical laws to the status of truisms or definitions. Prof. Eddington, in a profoundly interesting essay on "The Domain of Physical Science,"[1] states the matter as follows:—

> In the present stage of science the laws of physics appear to be divisible into three classes—the identical, the statistical and the transcendental. The "identical laws" include the great field-laws which are commonly quoted as typical instances of natural law—the law of gravitation, the law of conservation of mass and energy, the laws of electric and magnetic force and the conservation of electric charge. These are seen to be identities, when we refer to the cycle so as to understand the constitution of the entities obeying them; and unless we have misunderstood this constitution, violation of these laws is inconceivable. They do not in any way limit the actual basal structure of the world, and are not laws of governance (*op. cit.*, pp. 214–5).

It is these identical laws that form the subject-matter of relativity theory; the other laws of physics, the statistical and transcendental, lie outside its scope. Thus the net result of relativity theory is to show that the traditional laws of physics, rightly understood, tell us almost nothing about the course of nature, being rather of the nature of logical truisms.

This surprising result is an outcome of increased mathematical skill. As the same author[2] says elsewhere:—

> In one sense deductive theory is the enemy of experimental physics. The latter is always striving to settle by crucial tests the nature of the fundamental things; the former strives to minimise the successes obtained by showing how wide a nature of things is compatible with all experimental results.

The suggestion is that, in almost any conceivable world, *something* will be conserved; mathematics gives us the means of constructing a variety of mathematical expressions having this property of conservation. It is natural to suppose that it is useful

[1] In *Science, Religion and Reality*, ed. by Joseph Needham (1925).
[2] A. S. Eddington, *Mathematical Theory of Relativity*, p. 238 (Cambridge, 1924).

to have senses which notice these conserved entities; hence mass, energy, and so on *seem* to have a basis in our experience, but are in fact merely certain quantities which are conserved and which we are adapted for noticing. If this view is correct, physics tells us much less about the real world than was formerly supposed.

Force and Gravitation.—An important aspect of relativity is the elimination of "force." This is not new in idea; indeed, it was already accepted in rational dynamics. But there remained the outstanding difficulty of gravitation, which Einstein has overcome. The sun is, so to speak, at the summit of a hill, and the planets are on the slopes. They move as they do because of the slope where they are, not because of some mysterious influence emanating from the summit. Bodies move as they do because that is the easiest possible movement in the region of space-time in which they find themselves, not because "forces" operate upon them. The apparent need of forces to account for observed motions arises from mistaken insistence upon Euclidean geometry; when once we have overcome this prejudice, we find that observed motions, instead of showing the presence of forces, show the nature of the geometry applicable to the region concerned. Bodies thus become far more independent of each other than they were in Newtonian physics: there is an increase of individualism and a diminution of central government, if one may be permitted such metaphorical language. This may, in time, considerably modify the ordinary educated man's picture of the universe, possibly with far-reaching results.

Realism in Relativity.—It is a mistake to suppose that relativity adopts an idealistic picture of the world—using "idealism" in the technical sense, in which it implies that there can be nothing which is not experience. The "observer" who is often mentioned in expositions of relativity need not be a mind, but may be a photographic plate or any kind of recording instrument. The fundamental assumption of relativity is realistic, namely, that those respects in which all observers agree when they record a given phenomenon may be regarded as objective, and not as contributed by the observers. This assumption is made by common sense. The apparent sizes and shapes of objects differ according to the point of view, but common sense discounts these differences. Relativity theory merely extends this process. By taking into account not only human observers, who all share the motion of the earth, but also possible "observers" in very rapid motion relatively to the earth, it is found that much more depends upon the point of view of the observer than was formerly thought. But there is found to be a residue which is not so dependent; this is the part which can be expressed by the method of "tensors." The importance of this method can hardly be exaggerated; it is, however, quite impossible to explain it in non-mathematical terms.

Relativity Physics.—Relativity physics is, of course, concerned only with the quantitative aspects of the world. The picture which it suggests is somewhat as follows:—In the four-dimensional space-time frame there are events everywhere, usually many events in a single place in space-time. The abstract mathematical relations of these events proceed according to the laws of physics, but the intrinsic nature of the events is wholly and inevitably unknown except when they occur in a region where there is the sort of structure we call a brain. Then they become the familiar sights and sounds and so on of our daily life. We know what it is like to see a star, but we do not know the nature of the events which constitute the ray of light that travels from the star to our eye. And the space-time frame itself is known only in its abstract mathematical properties; there is no reason to suppose it similar in intrinsic character to the spatial and temporal relations of our perceptions as known in experience. There does not seem any possible way of overcoming this ignorance, since the very nature of physical reasoning allows only the most abstract inferences, and only the most abstract properties of our perceptions can be regarded as having objective validity. Whether any other science than physics can tell us more, does not fall within the scope of the present article.

Meanwhile, it is a curious fact that this meagre kind of knowledge is sufficient for the *practical* uses of physics. From a practical point of view, the physical world only matters in so far as it affects us, and the intrinsic nature of what goes on in our absence is irrelevant, provided we can predict the effects upon ourselves. This we can do, just as a person can use a telephone without understanding electricity. Only the most abstract knowledge is required for practical manipulation of matter. But there is a grave danger when this habit of manipulation based upon mathematical laws is carried over into our dealings with human beings, since they, unlike the telephone wire, are capable of happiness and misery, desire and aversion. It would therefore be unfortunate if the habits of mind which are appropriate and right in dealing with material mechanisms were allowed to dominate the administrator's attempts at social constructiveness.

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RELIEF WORK.—Upon the outbreak of the World War in 1914 relief problems far surpassed the capabilities of private charity, involving broad questions of governmental finance, control of production, purchase and transport of huge quantities of supplies from one part of the world to another, intervention of diplomatic agencies, control of shipping and railways, and finally, after the War, general economic rehabilitation and broadly conceived treatment of fundamental social ills. For the first time in history, virtual world control of production and distribution of food was attained (*see* RED CROSS).

CIVILIAN RELIEF IN BELGIUM AND FRANCE

During the occupation of Belgium inhabitants found themselves in desperate straits from the interruption of agriculture and the confiscation of stocks by the occupying forces. Belgium's essential food imports were cut off, and hordes of refugees fled before the advancing German armies. A Belgian committee was formed and appealed for aid. Herbert Hoover, an American engineer, recognised the urgency of the situation, and with the backing of the U.S. Govt. persuaded the Allied Govts. to open the blockade and to secure proper guarantees from Germany against interference and requisitioning of local food products that would otherwise have to be imported. The Commission for Relief in Belgium (C.R.B.) established by Herbert Hoover as a neutral organisation in the midst of war, possessing recognised diplomatic rights and obligations, flying its own flag and issuing its own passports, held an unprecedented status.

The commission faced not only large problems of transportation, blockade and distribution, but the marshalling of hundreds of millions of dollars to supply food to the 9,000,000 inhabitants of Belgium and northern France. Food had to be secured in disorganised markets, supplies had to pass across mine-strewn North Sea waters through the naval blockade, be transhipped to barges and towed through 133 m. of obstructed waterways, passing across the German military line. The first relief cargo of 2,300 tons of food reached Brussels on Nov. 1 1914. It led a procession of relief vessels, 2,313 in number, carrying in the neighbourhood of 100,000 tons each month for nearly five years.

The harvest of 1914, at the time of the invasion, was uncontrolled; but in addition to many other diplomatic guarantees exacted from both Germany and the Allies, the commission formed a committee of Germans, Belgians and Americans which took over subsequent harvests of breadstuffs, insuring equitable distribution to the civil population. The world's charity was mobilised through nearly 2,000 committees located in the United States, Great Britain, Canada, Australia, New Zealand, India, South Africa, Holland, Italy, Spain, Argentina and elsewhere. Within Belgium and northern France were set up nearly 10,000 communal committees dealing with food supplies. Purchasing and shipping agencies were organised in the principal world markets and ports. Offices for governmental liaison were maintained at Brussels, London, Paris and Washington. Upon America's entry into the War the C.R.B. remained unchanged, except for the necessary withdrawal of American directors from within the German lines. The Spanish-Dutch committee for the protection of the relief in Belgium and northern France was formed,

and took over diplomatic and other functions within the lines. The national committees, one Belgian and one French, for diplomatic reasons necessarily under control of the C.R.B., administered distribution. These were the Belgian Comité National de Secours et d'Alimentation and the Comité d'Alimentation du Nord de la France under the leadership of Emile Francqui.

During the whole period of relief the commission acquired goods well over $1,300,000,000 in value, including interchange of native products. More than 55,000 volunteers gave their services. Over 5,000,000 tons of supplies were imported. Foods were acquired by purchase abroad with gift money, from gifts in kind, by purchase from commercial exchange out of Belgium, and by purchase with governmental subsidies. The Belgian Govt. granted monthly fixed subsidies to the commission from loans advanced by the United States, Great Britain and France. The actual financial resources of the commission amounted to $894,797,150, the expenditure of the benevolent side of the relief organisation was $615,237,147 of this total. Of the total funds available to the commission, 47% came from the United States ($421,153,287); 23% from French Treasury loans ($204,862,854); 14% from British Empire sources ($125,686,364); and 16% from other sources. The total administrative expenditure of the C.R.B. was kept down to less than one-half of one per cent. The average prices maintained for staple foods in the occupied territory during the entire period of the War were from 15 to 20% less than prices in the Allied countries at the same periods. With the signature of the Armistice the programme increased to revive the weakened population, and the Belgian and French Govts. in May 1919, took the responsibility of feeding their people.

Relief in Central Europe

When peace came in Nov. 1918 the Allied and associated Govts. were confronted with the necessity of extending relief not only to liberated territories in central Europe but also to their enemies. From the Baltic to the Adriatic and Black Seas hundreds of millions of people needed food to save them from an even greater catastrophe that would follow if they were allowed to starve before agricultural production could be brought back and before industries and transportation could be restarted. Herbert Hoover was appointed director-general of Allied Relief, acting under the Supreme Economic Council. Because America found itself in a better food position than any of the nations of Europe, the United States was destined to play the principal part, supplemented by a substantial programme of Great Britain. Mr. Hoover formed the American Relief Administration (A.R.A.) to carry out the work, placing financial, purchasing and shipping problems in charge of the U.S. Grain Corporation. To assure the success of the complicated arrangements for the mass feeding of millions of people the director-general assumed temporary control of railways in central and southern Europe, re-established or controlled 10,000 m. of telegraph and telephone lines, arranged barge shipments on European rivers, initiated food exchanges between the newly established states, re-allocated army supplies suitable for civilian needs, established a temporary monetary exchange system, furthered the import of raw material, controlled coal production and in general helped struggling governments to re-establish normal economic life.

Food from America had to be transported overseas and distributed in 21 countries or states, including Allied, neutral, ex-enemy and the smaller new states. American deliveries to Allied or neutral countries were financed on credit by the U.S. Treasury. With the exception of Austria, deliveries to ex-enemy countries were paid for in cash. Deliveries to the new states were either outright gifts or long-term loans without considering ability to repay. In addition to U.S. credits and other resources, the U.S. Congress appropriated $100,000,000 as a revolving fund for the operations. Ex-enemy countries were excluded from benefits from this fund. Allied and neutral countries supplied by the United States were Italy, Denmark and Holland; ex-enemy countries supplied against cash payments were Germany, Austria, Hungary, Bulgaria and Turkey. The so-called liberated territories supplied were Finland, Estonia, northwest Russia, Latvia, Lithuania, Poland, Belgium, northern France, Czechoslovakia, Rumania, Yugoslavia, south Russia and Armenia.

Great Britain's part in these measures was large. Notwithstanding its difficult financial position, the British Govt. was able to appropriate £12,500,000 and to set up other substantial grants. Great Britain agreed to fill the gaps between what the United States could provide and what was required for barest necessities in war-torn regions. British assistance was given to Poland, Serbia, Czechoslovakia, Rumania, Estonia and Austria. The British relief was administered by Sir William Goode.

During the Armistice year relief deliveries to Europe reached about 4,760,000 tons of food valued at over $1,147,600,000. More than two-thirds of the programme, or $870,000,000 worth, came from the United States. About $120,000,000, or 10%, came from the United Kingdom; from France and Italy about 2% each; about 4% was financed jointly by the United States, France and Italy; and about 5% came from other countries. Of the U.S. deliveries in 1919 about 20% were sold for cash, 77% on credit and 2·2% ($19,300,000) as charity. Of the British deliveries 65% were sold for cash, 32% on credit and 3% ($3,500,000) as charity. Operations were supervised largely by army and navy officers, whose services were lent by their governments. Inland transportation was paid for by the governments aided. Local ministries and native volunteer committees attended to distribution.

These prompt relief measures undoubtedly saved Europe from an even greater social cataclysm than her people had already suffered. Weakened by war, without food or employment, eastern Europe provided a breeding ground for anarchy and social revolution of the brand that had already laid Russia in economic ruin. Russian emissaries of world proletarian revolution actively spread through the small new states whose governments were inexperienced, tossed in political turmoil and in fervid Chauvinistic conflict with surrounding neighbours. The relief operation laid down "a wall of food" against militant Russian Bolshevism, in fortifying the people for resumption of the production without which they could not live. They helped to bring order out of chaos to the end that factories could start and transportation be resumed.

Privately Organised Relief.—With the signing of peace, all these Allied and American organisations passed out of existence. Certain stocks given by the American Govt. for charitable purposes were turned over to a new private organisation formed by Herbert Hoover, also known as the American Relief Administration. Large numbers were still faced by extreme shortage. Children were the greatest sufferers. The new privately organised A.R.A. carried on mass child feeding in Finland, Estonia, Latvia, Lithuania, Danzig, Poland, northern France, Czechoslovakia, Austria, Hungary, Rumania, Yugoslavia and Armenia. American Quakers co-operated with the A.R.A. in feeding over 1,000,000 children in Germany. With gradual reductions, as were permitted by economic recovery, the work was carried on until 1923.

During the whole of that period about 8,000,000 different children benefited from these charitable relief importations. Free cooked meals were distributed to as many as 4,000,000 children daily at one time, to whom a total of over 1,500 million meals were served. Warm clothing to the value of over $8,000,000 was distributed to more than 2,000,000 children. Each of the countries aided assumed the burden of transportation and storage within their country and assisted in distribution. These governments also donated some foods and financed some of the foreign importations. Over 100,000 men and women co-operated in this preservation of the coming generation from war's ravages. Their ready response demonstrated the effectiveness of a foreign aid specifically organised to help the people of these new states to help themselves, rather than to dispense a charity which merely maintained an individual or group without offering aid and incentive to self-help. National welfare bodies thus founded and built up by the A.R.A. were perpetuated in many countries. The total amount expended for these post-War charitable operations reached nearly $100,000,000.

Prisoners of War.—Dr. Fridtjof Nansen prevailed upon the newly formed League of Nations to help in repatriation of prisoners of war, bringing more than 427,000 war prisoners out of Russia and Siberia back to their homes in a dozen countries. Prominent in post-War relief works were the Save the Children funds of Great Britain and many other countries which, through Dr. Nansen, brought help to eastern European countries; the American Jewish Joint Distribution Committee in Poland, Czechoslovakia, Austria and other places; several Irish relief committees; the American and British Societies of Friends (Quakers). The French war orphans committee brought aid to children in devastated France. The Rockefeller Foundation gave over $22,500,000 for the relief work of the Commission for Relief in Belgium and other charitable purposes.

Russian Famine.—When these post-War relief operations were closing down, famine in Russia brought 25,000,000 people in the Volga valley face to face with starvation. Herbert Hoover revived the American Relief Administration, secured grants from the U.S. Govt., induced the Soviet Russian Govt. to purchase seed grains, and rushed food, grain and medical supplies to the stricken country. Because of dilapidated ports, broken-down railways, the general inertia of the broken *morale* of the Russian people, and the dissolution of the productive organism, complicated by suspicions of the so-called proletarian Soviet Govt. against emissaries from "capitalistic" America, the task of bringing immediate and effective relief to the people in an area of 770,000 sq. m. was immense. It was necessary to initiate and supervise every step of operations of transport and distribution amid greatest economic disruption and appalling scenes of misery.

The administration of this relief was accomplished by less than 200 persons supervising a distributing organisation of nearly 150,000 Russian workers. More than 10,000,000 people were fed; medical and sanitary supplies valued at $7,600,000 were distributed to 16,500 hospitals and other institutions to combat the spread of typhus, cholera, and other epidemics following in the wake of famine; over 8,000,000 vaccinations or inoculations against smallpox, typhoid and para-typhoid were given to people in epidemic regions; 200,000 tons of seed grain were distributed; and other relief measures brought the total value of American relief to the Russian famine to about $60,000,000. The work was made possible by the contribution of $24,000,000 in cash and medical supplies by the U.S. Govt., of $3,600,000 worth of medical supplies by the American Red Cross, about $4,000,000 by the American joint distribution committee, and of $12,000,000 worth of seed grain purchased and transported by the A.R.A. against gold payment by the Soviet Government. Many other American groups co-operated with Mr. Hoover in furnishing means to an extent of nearly $3,000,000. These were the Society of Friends, Mennonite relief, European student relief, Federal Council of Churches of Christ in America, Knights of Columbus, National Catholic welfare council, National Lutheran Council, Volga relief society, Y.M.C.A. and Y.W.C.A. The Russian operations of the American Relief Administration started in Sept. 1921, and were brought to a close in July 1923. Although the sums thrown into Russian famine relief by British agencies and the Nansen relief committee were small in comparison with the American relief, the accomplishment was effective. As High Commissioner for the League of Nations, Dr. Nansen also co-operated with the A.R.A. in care of Russian refugees in the Balkans, arranging for the transport of some 15,000 of these refugees to other localities where they could be supported. (*See* ROCKEFELLER FOUNDATION.)

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REMIZOV, ALEXIS (1877–), Russian novelist, was born June 24 1877 in Moscow and brought up amid factory surroundings and in the strict observance of Orthodox Church rites, with frequent pilgrimages to monasteries. He thus gained an intimate knowledge of national habits, monastic life and old religious legends. He studied natural science and economics at Moscow University, took part in revolutionary activities, and was imprisoned and spent years of exile in Wologda. He subsequently went to live in Paris. The influences of his varying surroundings contributed to the formation of his unique fantastic personality uniting the whimsical mischievousness of some fairy-tale sprite with a deep spirit of pity. His literary life dates from 1902; from that time until 1920 he published 36 volumes of fiction: novels, tales, short stories and fairy-tales, miracle plays, etc.

The most remarkable of Remizov's novels are *The Pond* (1905), a powerful and gloomy picture of vulgarity, vice and crime among the Moscow bourgeoisie and the monasteries. *The Clock* (1908, Eng. trans. 1924), *The Fifth Pestilence*, novels of provincial life; *The Sisters of the Cross* (1910), a novel of St. Petersburg life; also *The Cockerel* and stories relating to the revolution of 1905, and several miracle and folk plays. A great realist, Remizov has perhaps exercised more influence than anyone else of his generation upon contemporary Russian fiction.

RENEVIER, EUGÈNE (1831–1906), Swiss geologist (*see* 23.98), died at Lausanne May 4 1906.

RENNER, KARL (1870–), Austrian politician, was born on Dec. 14 1870, the son of a peasant, at Dolní-Dunajovice, Moravia. He studied law at the university of Vienna, and early attached himself to the Social Democratic party. He became an official in the library of the Reichsrat, and under the pseudonyms of "Synopticus" and "Rudolf Springer" showed a fertile literary activity, especially in connection with the problems of the Austrian state, whose existence he justified on geographical, economic and political grounds. On the nationality question he upheld the so-called "personal autonomy," on the basis of which the super-national state should develop, and thereby influenced the programme and tactics of the Social Democratic party in dealing with it. As a theorist he was reckoned as one of the leaders of Neo-Marxism. He had been a deputy since 1907, and, as leader of the Social Democrat party, he repeatedly attacked the Government. He deeply influenced the movement which preceded the fall of the monarchy. After the collapse he became head of the Government, and after the elections had given the Social Democrats and Christian Socialists an overwhelming majority, he formed a coalition ministry, as the leader of which he became the first chancellor of the Austrian republic.

Renner was largely responsible for the decrees of the national assembly which called for the dethronement of the dynasty of Habsburg-Lorraine and the banishment of all members of this house if they did not submit entirely to the laws of the republic, and he was in charge of the negotiations which led to the ex-Emperor Charles leaving Austria in March 1919. He was responsible for thwarting the separatist endeavours of the different provinces and the demands which the Communists, supported by their partisans in foreign countries, made with the object of overthrowing the Government. On May 12 1919, he went to Paris as head of the Austrian Delegation to receive the conditions of peace from the victors. On his return consultations were held whether to accept or to refuse the conditions of peace. Otto Bauer, who at that time was secretary for foreign affairs, refused to take responsibility for certain provisions of the treaty, and resigned. Renner now took over the conduct of foreign affairs and signed the Treaty of St. Germaine-en-Laye of Sept. 10 1919. It was accepted by the National Assembly in Oct. 1919, and came into force in July 1920. In Dec. 1919 Renner went to Paris to depict Austria's miserable situation to his former enemies and to beg for help. His efforts were not without success. A special Austrian section of the Reparations Commission was appointed to study the measures necessary for a lasting cure for the ills of the body politic and gradually brought help. It is true that the Republic grew more and more dependent on the Powers signatory to the treaty of St. Germain, in consequence of the interference of the various inter-allied commissions which had to supervise the disarming of Austria by land, sea and air.

Meanwhile, the first coalition ministry had been succeeded in Oct. 1919 by a second, in which Renner was again chancellor and secretary for foreign affairs. His endeavours were now directed towards establishing better relations with the succession States. The journeys which he undertook to this end to Rome

and Prague were not unsuccessful and paved the way to further negotiations. On the other hand, the relations between the Austrian Government and Hungary, which since the régime of the revolution had been succeeded by a reaction, were very strained. Renner, who, as a Social Democrat, had been inimical to the reactionary Hungarian Government and feared that an accession of strength to it would bring danger to the Austrian Republic, refused the Hungarian Government the assistance which it asked in its struggle with the leaders of the Soviet party, who had fled to Vienna. This brought him into conflict with the Christian Socialists and their representatives in the Cabinet. The coalition broke up in June; but Renner remained in charge of foreign affairs in the so-called "proportional cabinet," only resigning in Oct. 1920. He continued to take part in the parliamentary debates and the enterprises of the Social Democrat party. But his influence rapidly declined.

His principal works are *Grundlagen und Entwicklungsziele der Österreichisch-ungarischen Monarchie* (1906); *Oesterreichs Erneuerung* (1919); *Die Wirtschaft als Gesamtprozess und die Sozialisierung* (1924). (A. F. Pr.)

RENOIR, AUGUSTE (1841–1919), French painter (*see* 23.101), died at Cagnes, France, Dec. 3 1919.

REPARATIONS AND THE DAWES PLAN.—The Treaty of Versailles in June 1919 did not directly settle or deal with the question of reparations in its financial aspects. It placed on Germany the moral responsibility for all damage done to the population of the Allied countries (*see* Versailles, Treaty of). It set up a Reparation Commission to translate the Treaty into actual figures by assessing the damage, to lay down the method and times of payment, and to come to its determination by May 1921.

I. FROM THE TREATY TO THE LONDON CONFERENCE

San Remo to Spa.—In April and May 1920 the Allies (Great Britain, Belgium, France, Italy and Japan) met in conferences at San Remo and Hythe, and discussed in a preliminary way the methods of computing the liability of the enemy countries and also of sharing the proceeds. The Supreme Council had their own experts making computations, the Reparation Commission in the meantime continuing their investigation of the damages and mode of collection. (At this stage there was a tentative agreement for France to pay her debt as and when she received payment from Germany.) In June 1920 at Boulogne, statements of actual amounts emerged. A minimum annuity of 3,000 million gold marks for 35 years, with a maximum aggregate of 269,000 million, was proposed; the actual amount to be settled by economic conditions. The costs of military occupation were to be a first charge on the "deliveries in kind," of which coal was the chief, and customs and natural resources were to be employed as guarantees. At the important Spa Conference—July 1920 (following a meeting of experts at Brussels) and with Germany and Portugal represented, they discussed proposals for Germany to pay 42 annuities aggregating 240,000 million gold marks; coal deliveries were fixed at two million tons monthly forthwith. There was an actual agreement, which has survived, as to the division of the proceeds as follows:—

	%		%
France	52	Belgium	8
British Empire	22	Japan and Portugal	1·50
Italy	10	Others (Greece, Rumania, etc.)	6·50

A priority for 2,000 million gold marks was given to Belgium. At this conference the Germans expressed their views on the importance of territorial integrity, and the necessity for first securing an "export surplus" before making any payment in cash or kind.

The Paris Decisions.—In Dec. 1920 financial experts met in Brussels and made recommendations to the Supreme Council, and on Jan. 29 1921 the Allies reached the "Paris decisions." The fixed annuities were to be:—

(*a*) 2 annuities of 2 milliard gold marks.
(*b*) 3 annuities of 3 milliard gold marks.
(*c*) 3 annuities of 4 milliard gold marks.
(*d*) 3 annuities of 5 milliard gold marks reached by May 1932.
(*e*) 31 annuities of 6 milliard gold marks reached by May 1963.

These 42 annuities were to be paid from 1921 equal to 12% of the value of Germany's exports. Supervision of Customs and occupation of the Ruhr in event of failure were discussed. In Feb. 1921 the various Allies had submitted their "claim" to the Reparation Commission. For damages alone the claims totalled about 100 milliard gold marks (1 milliard gold marks = 50 million sterling) but including other claims the total was about 225 milliard gold marks, or, say, 11,600 million sterling. In March 1921 at the first London Conference, Germany proposed 1,500 million pounds in cash over 30 years, with credit for 1,000 millions already paid. In April through the United States a vastly increased offer was made with stipulations about the return of surrendered territory.

II. FROM THE LONDON CONFERENCE TO THE DAWES COMMITTEE

The London Ultimatum.—On April 27 1921, the Reparation Commission announced their "assessment" as 132 milliard gold marks (6,600 million sterling, or 58% of the claim). The decision did not refer to Germany's "capacity to pay" at all—it was a computation of legal liability, on the terms of the treaty. The Allies decided that this was to be paid in annuities of £100,000,000, plus 26% of German exports. Three series of bonds were to be issued, two in 1921, (*a*) 600 million pounds, (*b*) 1,900 million, and the balance as series (*c*) 4,100 million at such time as the Reparation Commission might determine. These bonds were to bear 5% interest, and 1% amortisation.

Upon this report the London Conference issued an ultimatum (May 5 1921), giving effect to those decisions and also deciding that deliveries of coal and materials, etc., were to continue, Germany being given credit for the appropriate values. A Committee of Guarantees was to be set up to report upon the German fiscal revenues and to supervise the actual machinery for delivering funds, etc. Occupation of the Ruhr Valley and penalties in regard to customs and other revenues were proposed in case Germany failed to accept the terms.

The first payment of one milliard gold marks due by Sept. 1 1921 was actually paid over, partly out of foreign balances which had accumulated prior to May, partly by sales of paper marks on the Exchange, and partly by temporary advances from an international group of banks. Deliveries in kind after May covered the Nov. instalment. The export tax, a quarter of a milliard, was paid for the first quarter.

In Oct. certain details were agreed between the French and German ministers at Wiesbaden in regard to deliveries in kind for France, in place of the 26% export tax, and the practical details of these agreements were subsequently accepted by the other Governments concerned.

Difficulties began to arise almost immediately in regard to the payment of the annuities. In Aug. 1921, Mr. J. M. Keynes first published his famous prediction that the instalments of Jan. and Feb. 1922 might be covered out of further "deliveries," temporary advances and foreign assets of German industrialists. But the payment of April 1922 would present more difficulty. "Sometime between Feb. and Aug. 1922 Germany will succumb to an inevitable default. This is the maximum extent of our breathing space." In Dec. 1921 the German Government notified the Reparation Commission that their attempt to raise a foreign loan having been abortive, they could not raise in addition to deliveries in kind more than 200 million gold marks on account of the payments for Jan. and Feb. 1922. There were conferences of the Allied Prime Ministers at London in Dec. 1921 and Cannes in Jan. 1922, as a result of which the Commission granted a moratorium to Germany from the amounts due under the schedule of payments, accepting payments of 31 million gold marks every 10 days. It was laid down that Germany was to present plans for balancing the budget, stabilising the

currency and preventing exports of capital. Shortly after, Germany made an offer of 720 million gold marks per annum in addition to 1,450 million by deliveries in kind, agreeing to balance the budget, increase the coal and sales tax and check inflation by a compulsory loan. Germany asked for a reduction of the Treaty payments to an amount within her capacity.

At the Paris Conference in March (March 11 1922) the Reparation Commission were asked to consider the possibility of an external loan, but an international committee of bankers, which met at the end of May, concluded that such a loan was impossible so long as Germany's external liabilities remained at the figure arranged. Meanwhile in March 1922 the Reparation Commission agreed to a payment of 720 million gold marks inclusive, as the cash payment, suspending the schedule of payments in the meantime, and laying down that Germany should impose her new taxation at once or be exposed to the "sanctions" of the London Agreement.

In Aug. 1922, after Germany had asked for 2½ years' moratorium, the third London Conference and the Reparation Commission suspended cash payments, and agreed to accept the balance of instalments for 1922 in six months' bills at 4½%. It was laid down that further default would bring about the seizure of productive guarantees. In Nov. the German Govt. replied requesting a definite moratorium and the revision of the total payments. They asked for time to carry out the plans for stabilisation recommended by the currency experts.

The British Proposals of Jan. 1923.—In Jan. 1923 there was a Conference in Paris of the Prime Ministers, when a somewhat complicated proposal was put forward by Britain for an issue of 50 milliards of "A" bonds maturing in 1954, with interest deferred entirely for the first four years, and 1% for the next four down to the end of 1930. There was to be an issue of "B" bonds, to be definitive unless Germany proved to a tribunal before April 1933 her inability to meet the payment, and deliveries in kind were to be continued for determined amounts, with any excess to be set off against the bond interest. This plan was linked up with the question of Inter-Allied Debts and their cancellation. Germany was to agree to the currency stabilisation plan recommended by the foreign experts a few weeks previously. She was to balance her budget within two years and accept a foreign finance supervision which should supersede the Reparation Commission in all executive functions. There were also conditions as to Germany's forfeiture of customs and the allocation of loans, issued in the allied markets, to the redemption of the bonds.

At the same time the French Prime Minister put forward a proposal to adhere to the capital sums determined in May 1921, with a moratorium of two years, giving Germany the power to repay under discount. The customs were to be retained as productive pledges, and the Reparation Commission were to take control of German finance. France agreed that if any of her debts to the Allies were remitted, she would be prepared to consider the question of reducing Germany's total indebtedness.

The Ruhr Occupation.—During the comparative deadlock that followed, France began to carry out her proposals for the occupation of the Ruhr. In the immediate ensuing period considerable doubt existed as to the effect of the occupation upon reparations, but by May and June the Germans had become thoroughly alarmed, and their proposals for the evacuation of the Ruhr Valley and the restoration of Germany's economic freedom, were contained in special German notes the net effect of which was that the capital debt should be fixed at 30 milliard gold marks, of which 20 milliards would be covered by an international loan in July 1927, 5 milliards two years later, and 5 milliards by July 1931, the proceeds to be given over to the Reparation Commission. As guarantees for the service of these loans they were to mortgage the railways for 10 milliards, yielding 500 million gold marks per year; 500 million from the general mortgage on the industries and natural resources of Germany and, thirdly, the pledge of their consumption taxes, *i.e.*, luxury, tobacco, beer, wine and sugar, to an amount probably exceeding 200 million gold marks.

Germany suggested an international conference to determine their capacity to make further payments. The effect of inflation and the general disintegration of German finance, became very marked, and Germany's whole constitutional fabric was in grave danger. (*See* GERMANY: ECONOMIC HISTORY.)

Appointment of the Dawes Committee.—Towards the end of the year active steps were being taken to set up an international committee of experts to consider Germany's position, and to make proposals for stabilising the currency and balancing the budget. The credit for this proposal has been variously assigned to Mr. Hughes of the United States, to Sir John (afterwards Lord) Bradbury on the Reparation Commission, and to the International Chamber of Commerce Conference at Rome. The representatives of this Committee were in form chosen by the Reparation Committee and appointed by them. But their selection was made a matter of Government interest in each country, there being two representatives from France, Belgium, Italy, Great Britain and the United States respectively. The chairmanship was put into the hands of the United States in the person of General Dawes, and this Commission became afterwards known as the "Dawes Committee," and its Report as the "Dawes Report." The personnel of the Committee was as follows: United States—General Charles G. Dawes, Owen D. Young; Great Britain—Sir Robert Kindersley, G.B.E., Sir Josiah Stamp, K.B.E.; France—J. Parmentier, Professor Alex; Italy—Dr. Alberto Pirelli, Professor Flora; Belgium—E. Franqui, Baron Houtart. (There was a second committee under the chairmanship of the Rt. Hon., Reginald McKenna, set up "to consider the means of estimating the amount of German exported capital and of bringing it back to Germany.")

III. THE DAWES REPORT

The Dawes Committee began its meetings in Paris on Jan. 14 1924 and reported on April 9 1924. Although neither the evacuation of the Ruhr nor the question of reparations was mentioned in the terms of reference they really were in the forefront of the task. In the first place, so long as the occupation of the Ruhr continued and Germany was not a complete fiscal unit, she had not entire control of her receipts and expenditure, and there could be no guarantee of a balanced budget. In the second place, the reparation liabilities under the Treaty figured amongst the budgetary expenses, and if in excess of budgetary possibilities, made it impossible to guarantee that steps taken for the stability of the currency would be permanent and effective. The question of Reparations, therefore, figured prominently in the Report.

General Principles.—The Report adopted a business attitude and considered political factors only in so far as they affect the practicability of the plan. It sought the recovery of debt, not the imposition of penalties, regarding the payment of that debt by Germany as her necessary contribution to repairing the damage of the War. The committee recommended it as in the interest of all parties to carry out this plan in good faith, these assurances being paramount having regard to the temper ruling at that time, and the suspension of motives. They avoided the political guarantees which had been so prominent hitherto and proposed only economic ones. They were emphatic that for success in stabilising currency and balancing budgets, Germany needed the resources of German territory as defined by the Treaty of Versailles, and free economic activity therein. On the vexed question of military "sanctions" and occupation which were strictly beyond their terms of reference, they confined themselves to stating "within the unified territory, the plan requires that, when it is in effective operation:—

1. If any military organisation exists, it must not impede the free exercise of economic activities;
2. There shall be no foreign economic control or interference other than that proposed by the plan."

The report treated stabilisation of currency and the balancing of budgets as interdependent, though provisionally separable for examination, and insisted that currency stability could only be maintained if the budget were normally balanced; while the

budget could only be balanced if a stable and reliable currency existed. Both were needed to enable Germany to meet her internal requirements and treaty payments. They laid stress upon Germany's economic future as indicated by her productive power, plant capacity, increasing population, technical skill, material resources and eminence in industrial science.

Organisation of the Reichsbank.—In their proposal for the stabilising of the currency they suggested that a new bank be set up or the Reichsbank reorganised. The main characteristics of the bank were given:—

1. To issue notes on a basis stable in relation to gold, with an exclusive privilege;
2. To serve as a bankers' bank, establishing the official rate of discount;
3. To act as the Government banker, but free of Government control;
4. Advances to Government to be strictly limited;
5. To hold on deposit reparation payments;
6. The capital of the bank will be 400 million gold marks;
7. It will be directed by a German president and managing board, who can be assisted by a German consultative committee;
8. The due observance of its statutes will be further safeguarded by a General Board, of which half of the members, including a commissioner, will be foreign.

They were emphatic that even granted full economic and fiscal sovereignty, balancing the budget would necessitate a period of relief from reparation payments, though the pressure of political interests was too great to allow of a complete suspension of deliveries in kind.

Although the budget might be balanced without the total *capital* debt of Germany being fixed, they maintained it could not be continuously balanced if there were any uncertainty as to the maximum *annual* charge that would fall upon it for some years, on a basis clearly prescribed in advance. The report deferred to the principle that the German people ought to bear a burden commensurate with that in the Allied countries, and they claimed to apply the principle "to the full limit of practicability."

The Transfer Committee.—A transfer committee of an international constitution was set up to control the "delivery" programme, to receive the payments in marks in Germany, and to be responsible for the extent to which, and the way in which, these sums were transferred abroad in foreign currencies. Thus the mistake of forcing Germany beyond the economic point in the purchase of foreign currencies, which had been made in the past, was guarded against for the future. No attempt was made, as it was outside the terms of reference, to assess the *length* of time during which these payments should be made, or the total amount of the Reparation debt, but it was clear that the amount to be paid in the standard year, viz.: 2½ milliards would not do more than pay the interest on a portion of the liability imputed under the Treaty. It was provided, however, that the payments in the standard year should be increased with the increasing prosperity of Germany, the measure to be determined by an "Index of Prosperity" based upon comparative statistics of imports, exports, public revenues, population, consumption of sugar, etc. In this way it was at least possible that the sums ultimately payable annually would be greatly in excess of the 2½ milliards in the standard year. In the event of the economic circumstances of Germany's foreign trade being such that the transfer committee could not succeed in transferring the whole sum to the Allies, it was provided that there should be an accumulation in Germany up to a limit of 5 milliards, at which point, if necessary, the payment should be reduced.

The report set out the varying economic principles underlying reparations which up to that time, had not been generally recognised by the public, or acted upon by politicians. It was laid down, for example:

> There has been a tendency in the past to confuse two distinct though related questions, *i.e.*, first the amount of revenue which Germany can raise available for reparation account, and, second, the amount which can be transferred to foreign countries. The funds raised and transferred to the Allies on reparation account cannot, in the long run, exceed the sums which the balance of payments makes it possible to transfer without currency and budget instability ensuing. But it is quite obvious that the amount of budget surplus which can be raised by taxation is not limited by the entirely distinct question of the condition of external transfer. We propose to distinguish sharply between the two problems, and first deal with the problem of the maximum budget of surplus and afterwards with the problem of payment to the Allies. In the past, the varying conclusions formed as to Germany's "capacity" have often depended upon which of these two methods has been chosen.

Schedule of Payments.—The provisions made for payment under the treaty were as follows:—

Budget; Moratorium Period:	Million gold marks
First Year: from foreign loan and part interest (200 millions) on railway bonds;	
Total of	1,000
Second Year: from interest on railway bonds (including 130 millions balance from first year) and interest on industrial debentures and budget contribution, including sale of railway shares;	
Total of	1,220
Transition Period:	
Third Year: from interest on railway bonds and industrial debentures, from transport tax and from budget;	
Total of	1,200
Subject to contingent addition or reduction not exceeding 250 gold marks.	
Fourth Year: from interest on railway bonds and industrial debentures, from transport tax and from budget;	
Total of	1,750
Subject to contingent addition or reduction not exceeding 250 million gold marks.	
Standard Year:	
Fifth Year: from interest on railway bonds and industrial debentures, from transport tax and from budget;	
Total of	2,500

The first year was to begin to run from the date when the plan should have been accepted and made effective. These payments were to be absolutely inclusive of all the various expenses for military purposes that were being thrown upon Germany. They were also to include the value of deliveries in kind.

Securities for Payment.—The "securities" proposed were of three kinds: Taxes, railways and industrial debentures. As regards railways, the whole system was to be made over to a company and be no longer directly under the Reich. Railway bonds were to be set up. Eleven milliards of first mortgage railway bonds against a capital cost of 26 milliards to be created for reparations; these bonds to bear 5% interest and 1% sinking fund per annum; in view of reorganisation, interest to be accepted as follows:—

1924–5 330 million gold marks.
1925–6 465 million gold marks.
1926–7 550 million gold marks.
1927–8 and thereafter: 660 million gold marks.

Behind the bonds there were to be created:—

2 milliards of preference shares to be reserved for sale to the public and
13 milliards of common stock.

Three-fourths of the proceeds of the preference shares was to be applied, as required, to the payment of debt and for capital expenditure of the railways. The remaining 500 millions of preference shares and all the common shares were to go to the German Government. They assigned the Transport Tax to the extent of the first 290 million gold marks for reparations. Industrial debentures were recommended: Five milliards of industrial debentures were to be provided for reparation; these bonds to bear 5% interest and 1% sinking fund, *i.e.*, 300 million gold marks per annum. Pending economic restoration, interest and sinking fund were to be accepted as follows:—

First Year	Nothing
Second Year	125 million gold marks
Third Year	250 million gold marks.
Thereafter	300 million gold marks.

As further guarantee, they proposed to pledge certain revenues as collateral security, *i.e.*, the taxes on alcohol, tobacco, beer and sugar, and the customs, but only up to definite limits. An arrangement for control, simple in the ordinary course, but becoming drastic if circumstances demanded, was recommended.

The new organisation therefore required a trustee for railway and industrial bonds, three commissioners of (1) railways, (2) the bank, (3) controlled revenues, and they recommended an agent for reparation payments to co-ordinate the activities of the above and to preside over the transfer committee. The feature of the plan on which its whole inception depended was the raising of a foreign loan of 800 million gold marks, which had to serve the double purpose of a gold reserve and also financing the internal payment for the Treaty in 1924–5. The report claimed to take the question of "what Germany can pay" out of the field of speculation and put it in the field of practical demonstration.

IV. ADOPTION OF THE REPORT

The reception of the report was immediately favourable, and it was finally adopted by the Governments concerned in the London Agreement on Aug. 30 1924. Steps were immediately taken to put it into operation. So far as all formal acts and the setting-up of the machinery for the future working of the Plan are concerned, it may be said that everything has gone satisfactorily. The Reparation Commission have officially stated: "Germany is faithfully fulfilling her reparation obligations as far as they are at present fixed." The actual test of the working of the full apparatus will come later, since the reparation payments to be made by Germany in its early stages are comparatively negligible. That a new spirit has been secured is beyond question. The first report of the Agent-General, Mr. S. Parker Gilbert, says:

It is too early to draw conclusions regarding the ultimate effects of the Plan. Broadly, it is an endeavour to stimulate confidence among peoples and to apply principles of reason and justice to a difficult, vital problem. The success of the Plan will be measured not alone in terms of payments effected. It will be determined also by the extent to which it helps to replace distrust and discord with confidence and conciliation. Its early operation has fulfilled expectations.

The pivot of the whole Plan for the first year was the German External Loan of 40 millions sterling or 800 million gold marks. In the words of the report, this was necessary to assure currency stability and financing essential deliveries in kind during the preliminary period of economic rehabilitation.

It enabled the Allies to receive something on account of reparations without, at the same time, any burden being placed upon the German budget. Negotiations were completed on Oct. 10 1924, and on Oct. 13, the Reparation Commission constituted the service of the loan as a first charge on all the payments provided for under the Plan, and also on the collateral security of the controlled revenues, and any other assets or revenues of Germany to which the powers of the Commission extended under the treaty. The transfer committee at its first meeting recognised the priority of the loan, and gave it an absolute right of remittance irrespective of the effects upon the exchange. This loan provided 800 million gold marks out of the total of 1,000 million gold marks, which constituted the first year's annuity, and the balance of 200 million gold marks came from the German Railway Company as interest on the bonds. Apart from this 200 millions, there was no drain whatever on the current resources of Germany for the first year.

Receipts	Million Gold Marks	Payments	Million Gold Marks
Cash withdrawn from proceeds of German External Loan, 1924	800·0	Payment to various Allied countries	789·0
Interest on railway bonds	200·0	Expenses of: Reparation Commission 5·6	
Exchange differences and Interest received	0·5	Rhineland High Com. 9·4	
		Military Com. of Control 7·7	
		Naval Com. of Control 0·07	22·8
		European Commission of the Danube	0·2
		Service of German External Loan	77·5
		On account of administration cost of office for reparation payments, and discount on railway payments in advance	3·9
		Cash in hand, Aug. 31 1925	107·0
Total	1,000·5		1,000·5

First Year's Working of the Plan.—The first complete year of the Dawes scheme is shown in the preceding table of receipts and payments.

The distribution of the 893·5 million gold marks includes 48·6 million gold marks for miscellaneous deliveries to the smaller claimants, leaving 740·4 millions for the four chief interests distributed as follows:—

	(Million Gold Marks)				
	To Great Britain	To France	To Italy	To Belgium	Total 4 countries
Arising on account of Reparation Recovery Acts	155·2	25·1	..	..	180·3
Cost of Armies, requisitions, etc.	30·2	144·2	..	20·7	195·1
Delivery of dyestuffs, etc., and receipts in kind	4·5	227·3	60·4	72·8	365·0
Total	189·9	396·6	60·4	93·5	740·4

Thus 49% has been transferred as deliveries in kind, 26½% for occupation expenses, and 24½% has been forthcoming from the Reparation Recovery Acts.

France has received 50%; Great Britain (including the Dominions), 24%; Belgium, 12%; Italy, 7½%, and other Allies, 6½%. Under the Agreement of Jan. 1925 the United States are to get 2¼%, to be contributed proportionately by the other participants.

The transfer committee have had time to examine their problem before having to take any executive action on its chief difficulties. They have not been called upon to decide delicate questions of exchange priority or pressure. Their first year has been taken up in making arrangements for deliveries in kind and Reparation Recovery Acts. The latter in particular presented difficult questions which have been described by the Agent General in his report. By forcing the German exporter to look to the German Govt. or Agent General for the deductions made by the British Govt., in respect of a total which had no relation to the Dawes Plan or to the sums transferable by the transfer committee, the British Govt. could virtually ride round the powers of the committee, "confronting them with an accomplished fact."

In the report of the negotiations between the British Treasury and the Agent General, it was arranged for the German exporters as a whole to deliver to the Reichsbank monthly 30% of the sterling proceeds of their exports to Great Britain. Deposits are made at the Bank of England for credit to the Agent General's account. The transfer committee regains control and the system adjusts itself automatically to the British Govt.'s share in the available annuity.

Towards the end of 1925 Germany passed from a stage of comparatively easy conditions into an industrial crisis which may retard the full development of her fiscal resources towards the position demanded by the third year of the Plan.

V. THE INDUSTRIAL ASPECTS OF REPARATIONS

It has been increasingly realised by the industrialists of the Allied nations that, just as the payment of reparations by Germany involved the necessity for her to maintain an export surplus, so the recipient countries may derive all they need of the goods involved by imports from Germany at the expense of the competing industries in the Allied countries, and that even if the surplus of German goods should go to neutral markets they may serve only to displace similar goods hitherto exported from the Allied countries. Hence the anomalous situation has arisen that reparation payments, speaking generally, have been ardently desired by the creditor governments, but speaking

particularly, have been feared and resisted by the business men in the same countries.

The Committee on Economic Restoration of the International Chamber of Commerce in Nov. 1924 set up a sub-Committee (Sir Josiah Stamp, Dr. Alberto Pirelli and Count André De Chalendar) to study the question of international transfers of reparation payment. One report signed by all three, and a supplementary one by the English member, were presented in May 1925, and adopted at the conference in Brussels in June 1925. The chief items and recommendations were:—

The solution of the "balance of trade" problem in relation to the liabilities under the Dawes Plan, is to be found in the following order:—

1. By a considerable expansion of German exports to general world markets in the ordinary course and under those conditions normal to Germany without any special overhead organisation or effort. This carries with itself the possibility of cash payments to the Allied Govts., which is, of course, the ideal form for the latter of receiving reparation payments.

2. By arrangements between each allied creditor country and Germany with a view of developing, in the widest possible manner compatible with national interests and the obligations of the transfer committee, deliveries in kind or services. This, though possibly in the long run not a major part of the total, is important. Serbia may want locomotives which she does not produce. Italy may want coal which she may not possess, France or Great Britain may want dyestuffs or potash. These are merely examples of a wide range of goods which Germany can probably deliver without difficulty.

3. By the operation of certain international co-ordination in enterprise and public works, by research and study and practical action, of which we have in this report, given an illustration called "Assisted Schemes."

4. Where the three foregoing still leave a gap between the accumulation of reparation marks and their effective transmutation into external values, it may be possible to gain time and to defer the greater difficulties of forcing the Plan by two methods (*a*) The sale of railway, industrial and eventually other German bonds on the international markets and (*b*) by making permanent investments in Germany which will belong to non-Allied or neutral holders. The method (*a*) above may play a very important part, either as redemption of capital debt or for the balance of the annuities. It must not be forgotten, however, that the extensive use of the plan throws a burden upon the future export surplus in addition to the fixed annuities. The system under (*b*) finds certain limitations under the Dawes plan and in practice, but it may be *e.g.*, that an Argentine resident or a Brazilian will become the owner of property in Germany, or of shares in German companies, by means of the export of food or raw materials to Allied individuals. These sales, as also these loans, are not an immediate method of externalising German wealth, but they, so to speak, stave off the day of difficulty and gain time. The difficulty of exporting £1,000 outright is transmuted into the smaller difficulty of transferring £50 or £60 interest thereon annually in perpetuity, a difficulty capable of retransmutation into capital at some distant date after the export surplus is no longer monopolised by reparation payments, by Germans buying in the investments held by foreigners in their own country.

While theoretically the "demand" of individuals in the Allied countries will be so increased by relief in taxation that it could, *in amount*, absorb a new supply of German goods, the demand will not fully coincide *in kind* with the goods which are offered. There may be, in consequence of this maladjustment, important reactions in price which will make the burden greater for Germany to discharge, make full transfers difficult, and induce unduly severe competition in certain markets. Moreover, vested industrial interests in both capital and labour in the Allied countries may be adversely affected, and for various reasons, if the whole question is left to uncontrolled economic forces political difficulties will arise.

We have certain suggestions to make for co-ordinated and systematic international action which, while it may not affect a large sum in relation to the whole reparation annuity, may be of great importance in assisting a settlement of this *residual problem*. We conceive that there is everything to be gained by systematic study and the existence of a "safety valve" in the event of normal channels being inadequate for the purpose, to relieve the concentrated competition, and also to prevent the consequences of accumulation of reparation payments in Germany. Our proposal would tend to prevent existing channels of German trade being flooded by excessive supplies and by a prepared plan irrigate, without disaster and with ultimate profit to the world, a wider area than could otherwise be open.

The International Chamber have decided to prosecute the idea of assisted schemes, and are setting up an organisation to elaborate them.

As soon as the Dawes Scheme has had time to operate, it will be seen whether "transfers" on the basis suggested are practicable or not. In any case, it is anticipated that the question of the total amount on the duration of the reparation scheme will again come forward for consideration, and the difficult diplomatic questions relating to so-called "modifications of the Treaty" will have to be settled.

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REPERTORY THEATRE: *see* DRAMA.

REPIN, ILJA JEFIMOVICH (1844–1918), Russian painter (*see* 23.105), died at Knokkala, on the Finnish frontier, July 17 1918.

REPINGTON, CHARLES A. COURT (1858–1925), British military critic, was born Jan. 29 1858 and commissioned in the Rifle Brigade in 1878. After serving with distinction in the Afghan War, the Sudan and South Africa, he was appointed military attaché at Brussels and the Hague in 1900, being then a lieutenant-colonel. Two years later his military career ended abruptly through domestic causes, and he took up journalism, becoming military correspondent of *The Times* in 1914. His resignation was a loss to the Army, for his abilities had marked him out for high command, but in his new sphere he was able to render notable services to the cause of national security, and was also several times employed on delicate missions abroad. In 1911 he was appointed editor of the official *Army Review*, but as he retained his post on *The Times* the appointment aroused parliamentary criticism and was terminated in 1912. In 1915, after staying with the British commander-in-chief in France, he came home to call attention to the shell shortage. In Jan. 1918 a divergence of views caused him to leave *The Times* for *The Morning Post*, and after the War he became military correspondent of *The Daily Telegraph*, a post which he held till his death at Hove, Sussex on May 25 1925. His works include *Vestigia* (1919); *The First World War, 1914–8; Personal Experiences* (1920); *After the War; A Diary* (1922); *Policy and Arms* (1924).

REPUBLICAN PARTY (*see* 23.177).—From 1897 to 1911 the Republican party was in control of the Federal Govt. of the United States. It had settled the "battle of the standards"—gold *v.* silver—by placing the country on a gold basis, and had conducted the Spanish-American War to a successful conclusion, though with some scandals in the War Department. In dealing with the resulting question of over-seas imperialism and colonial administration and still more in handling the problem of the tariff, conservation, railways, monopolies and trusts, it had alienated part of its following, particularly in the agrarian northwest. Since 1911 the history of the party falls into two periods. During the first of these it lost control first of the House of Representatives (1911), then two years later of the Senate and the presidency, remaining wholly a party of opposition to the dominant Democratic administration until 1919. The second period witnessed the restoration of the Republican party to power, first in the Senate and House (1919) and two years later in the presidency. Since 1921 the Republicans have controlled without interruption all branches of the Federal Government.

The period of exclusion from power was preceded by a party split caused by the bolt of Roosevelt and the formation in 1912 of the Progressive party (*q.v.*). By 1916 the Republicans were again united, superficially at least. The Democratic administration under President Wilson, however, had dealt with domestic problems boldly and on the whole successfully. On the questions raised by the World War both parties were non-committal. Former Supreme Court Justice Hughes, the Republican nominee, lost some support, particularly on the Pacific coast, by tactical errors and was defeated by a narrow margin, his vote in the electoral college being 254 to 277 for Wilson.

During the participation of the United States in the World War the activities of the Republican minority as an opposition

party were, of course, largely subordinated to the common purpose of winning the War. Nevertheless intense antagonisms were developing. When in Oct. 1918, President Wilson appealed to the country for the return of Democratic majorities to the Senate and House, his action was bitterly denounced by Republican leaders as inconsistent, as revealing dictatorial inclinations and as reflecting unworthily upon the motives of the party. In the ensuing congressional elections the Republicans gained control of the House by 46 votes and of the Senate by a plurality of one.

With the Senate once more in their hands the Republicans, not without the aid of certain Progressives and dissenting Democrats, succeeded in defeating the policies of President Wilson, who favoured ratification of the Treaty of Versailles and the adhesion of the United States to the League of Nations. As a result the latter question became the paramount issue in the campaign of 1920. Undoubtedly many Republicans favoured the league with reservations, while many others were bitter-enders. By an adroitly drawn platform plank the adherence of nearly all these divergent elements was secured. It was now the turn of the Democratic party to suffer from the accumulated errors and mischances of a long lease of power. War taxes and burdens, industrial dislocations, high prices and the national feelings of foreign-born voters contributed to swell the Republican tidal wave. In the Nov. election Harding and Coolidge, the Republican nominees, received the enormous popular plurality of seven million votes and carried the electoral college by 304 to 127 votes over the Democratic candidates James M. Cox and Franklin D. Roosevelt.

President Harding's administration made a separate peace with Germany and conducted a successful Conference for the Limitation of Armaments, in Washington. It was marred, however, by grave administrative misconduct, as a result of which three of his Cabinet appointees were forced later to resign. Upon his death in 1923, Vice-President Coolidge succeeded. Both Harding and Coolidge represented the more conservative wing of the Republican party and hence were attacked by leaders of the agrarian element. Under LaFollette the latter element broke away again in 1924, organising a second Progressive party movement 12 years after the first. In their platform for 1924 the Democrats severely criticised Republican "dishonesty, discrimination, extravagance and inefficiency"; and proposed a referendum on the League of Nations. They suffered, however, from internal dissensions between Klan and anti-Klan factions and from bitter rivalries for leadership, which had caused a long-drawn-out contest for the nomination at their New York convention.

The Republican party nominated Calvin Coolidge at its Cleveland convention and adopted a platform favouring the adherence of the United States to the Permanent Court of International Justice, but reaffirming the stand taken in 1920 against the League of Nations. It pledged further reductions in taxation, reasserted belief in protective tariffs and declared for settlements with all debtor countries similar to the debt agreement made with Great Britain. The election of Nov. 1924 gave the Republican candidates, Coolidge and Dawes, 382 votes in the electoral college; the Democratic candidates, Davis and Bryan, 136; and the Progressive candidates, LaFollette and Wheeler, 13. The Republican popular vote exceeded the combined vote of the two other parties by more than two millions in a total poll of nearly thirty millions.

RESEARCH, INDUSTRIAL.—The phrase was hardly known at the beginning of the 20th century, and now it is widely used as a panacea for the troubles of a world struggling to renewed life and strength. Mr. Stanley Baldwin, speaking in the House of Commons in June 1925, said that one of the essential steps in the endeavour to find a way out of our present difficulties is "to link up science with our industries" and of this chain industrial research forms many links. It aims at applying to industry the truths wrested from nature by workers in science. For research in the world of medicine see MEDICAL RESEARCH.

In 1893 Sir Wm. Anderson wrote "The days are past when an engineer can acquit himself respectably by the aid of mother wit alone or of those constructive instincts which in the past led our predecessors to such brilliant results." Each year makes the truth of his words more manifest; industrial research is one important stone in the foundation of our modern civilisation.

But appreciation of this truth has been slow of growth, at any rate in England. In Germany during the later years of the 19th century the Reichsanstalt and the Materials Prüfungs Amt were founded, and their work, along with investigations at technical institutes, had no small effect on German industry. The beginning of the 20th century saw the establishment of the National Physical Laboratory in Great Britain, followed almost immediately by that of the Bureau of Standards at Washington, while in Paris there was the Laboratoire Central d'Électricité and much renewed activity at the Laboratoire d'Essais in the Conservatoire des Arts et Métiers.

The seed had been sown, but it took time to germinate; for years the harvest was scanty and men attached but little value to the crop; it needed, as we shall see, the shock given by the World War before the truth of Sir Wm. Anderson's words was fully grasped. Scientific research has for its object the explanation of some natural phenomenon, or the discovery of some natural law. "How does it go–" was a question continually in the mouth of the future Kelvin when a boy, and to discover, for the mere pleasure arising from the discovery, how something works is sufficient reason for the natural philosopher. To apply this knowledge to manufacture or industry is a further step, and when the discovery is sought or the investigation made with such an object in view the research becomes industrial. Industrial research does not necessarily differ from so-called pure research in its methods; it is the object with which the investigation is made that constitutes the difference; and of course much work is necessary—a great part of which may fairly be called industrial research—before the laboratory discovery, or the brilliant intuition of the inventor, verified by striking experiments, can be translated into the practice of the farm or the factory.

Mendel's Work.—It was the desire for knowledge, research pure and simple, that led the Abbé Mendel in his monastery at Brünn to unravel some of the laws of heredity by crossing various kinds of peas. When, at an agricultural institute, the laws that he discovered and the methods he employed are utilised to improve the breed of cattle or to produce new and more valuable forms of wheat, the research has become industrial.

The Structure of Matter.—At present physicists in many countries are investigating the properties of matter by X-ray analysis, determining the forms of lattice in which the atoms which constitute the substance are arranged and endeavouring to draw conclusions applicable to all matter; this is a great work of pure research. The metallurgist employed in some works or in an industrial research laboratory seeks to use the results of the physicist and the methods which have been devised as a tool to enable him to learn, for example, why steel is hardened by quenching, what is the cause of the deleterious effect of phosphorus on copper, or why cast metal which is brittle can be made soft and ductile by heat treatment and mechanical work. This is industrial research. Such a worker must carry his investigations further in order that they may be of use to industry. In his works laboratory some method devised for making and treating a new and valuable alloy works perfectly or some instrument designed to register the course of a factory process appears foolproof and without a fault; in the factory the alloy cannot be worked or the instrument fails under the first real test; it is his business to find out why; to make the advances of science—advances due in part to his own researches—available for industrial purposes, to transform his work into the dividends that repay the shareholders and are necessary if the enterprise is to succeed.

Here a distinction should be drawn between the research laboratory of a works and the works laboratory; where both exist there may well be close co-operation and possibly joint control, but the spheres are distinct. In any modern factory a works laboratory of some sort is essential, to check the purity of

the materials employed and to ensure that the product is up to standard; an engineering works will have its chemical laboratory for this and similar purposes, its testing laboratory where the strength and character of its manufactures are sampled before they are put upon the market; but such work is not research; though it often may indicate where research is necessary, and lead up to original investigations of high value to the firm.

The works manager knows that for success the temperature at some point in a complicated process must be kept within narrow limits, whereas during other operations large variations of temperature have little effect. Samples which fail come to the works laboratory for examination, and inquiry shows that the temperature limits at this critical stage have been exceeded. Such an occurrence naturally leads a competent chemist to inquire what is the nature of the action which takes place at this critical temperature; how does the product produced, when the temperature limits are over-stepped, differ from the proper article? This inquiry may lead to a long and intricate investigation with results of the utmost importance to the firm. It may be found, for example, that a slight change in the composition of the material will render the close limits unnecessary and will reduce greatly the care and attention required for the manufacture. The problem has become one for industrial research, not merely for routine testing, and the consequences of that research have proved to be simplification of manufacture and cheapening of the product.

British Problems.—In Great Britain nearly 50,000,000 people must be supplied with food, mostly brought from beyond the seas, and this food must be paid for with the products of industry at home, by the goods manufactured in great part from materials purchased from abroad but dependent on the coal and iron of English mines and by the knowledge and skill of English manufacturers. It is of the utmost importance that the high quality of those goods should be maintained, the methods of their manufacture improved and the costs of production reduced. In the words of a recent report: " Scientific and industrial research is an essential factor in the national effort on which the continued maintenance of our present population unquestionably depends." And these words, though used here for England, apply to the other nations of the world as well.

Progress and Present Position

And now, leaving the discussion of the meaning of industrial research and its importance to any national community, we come to the consideration of the means taken to promote it and of its present position and work in various lands.

State Organisation.—These means are various; the state in a number of instances has organised research laboratories devoted mainly to industrial problems; large private firms have recognised its value and have established similar laboratories under their own control, while attempts have been made by the formation of research associations to combine the efforts of a number of firms concerned in the same industry. The universities, too, and technical colleges have aided the endeavour by organising more fully the teaching of science and giving facilities for the training of research workers.

German Developments.—It needed a catastrophe to produce the results which have been attained. The Reichsanstalt in Berlin was a direct outcome of the War of 1872. Established in two divisions, the one devoted to pure science, the other to its applications, its founders realised the close interdependence of the two, and while the first division dealt to a large extent in questions bearing on the fundamental units and standards of measurement whether in heat, electricity, light or any other branch of physics, the second division was concerned mostly in the application of the principles which resulted from these investigations to the advancement of German industry and manufacture.

At the same time technical colleges were established in a number of centres; of these, perhaps the colleges at Charlottenburg and Darmstadt were the most important, and from their professors and students came a stream of scientific facts and discoveries, many of great value to industry, which were eagerly seized upon and assimilated by men at the head of great industrial concerns who had realised that science was the foundation of their success and that without its help the place in the sun of which they dream could never be attained.

In their own factories these men were no less active and far-seeing. Charlottenburg and the Materials Prüfungs Amt at Grosse Lichterfelde which developed from it taught the engineer and the metallurgist the value of research. Its professors devised delicate instruments for use in investigating the properties of materials; the Martens Extensometer is an example. Sorby, of Sheffield, in 1864 was the first to investigate the structure of metals and alloys by the aid of the microscope, but his work was not pursued until, at a later date, Osmond in France and Martens in Germany took up the study independently and showed its importance to the industrialist.

In electrical science, also, the work of the Reichsanstalt had a marked effect and the great electrical firms—the Allgemeine Electricitäts Gesellschaft, Siemens and Halske and others—established research laboratories to develop for their own purposes and private benefit the results of scientific investigations.

Nor should the great chemical firms be forgotten. Perkins, in England, was the founder of the modern dye industry, but it was in Germany that this teaching first bore practical results. The Badische Anilin Fabric and other similar works were founded and huge sums were spent in developing new methods and inventing new dyes. Artificial indigo took the place of the natural product, with the inevitable result to the Indian industry. Germany had learned the lesson, and industrial research promised, unless other countries woke up, to give her the leading position among the manufacturing nations of the world.

The National Physical Laboratory.—In England, until towards the end of the 19th century, the danger was hardly appreciated. At meetings of the British Assn. and elsewhere, Lodge and others had pointed out the value of the Reichsanstalt to Germany, the need that England should have a similar institution. In 1900 the National Physical Laboratory began in a small way—the expenditure during the first year was £5,479—in the old buildings of the Kew Observatory at Richmond. In 1901 the work was transferred to Bushy House, Teddington, with a staff of eight scientific assistants and six attendants in addition to the director. The scientific character of its work was secured by placing the ultimate control in the hands of the Royal Society, while a close connection with industry was maintained by having representatives of the great engineering societies on its governing body. The laboratory, at the time the only public institution in the country devoted to the application of science to industry—to industrial research—grew slowly and prospered for the next 12 or 14 years, and when the World War came, it was in a position to be of material service to the country.

British Engineering Standards Committee.—About the same time, the British Engineering Standards Committee was founded, chiefly at the instance of Sir John Wolfe Barry, who had realised the loss caused by the infinite number of standards used by engineers and the advantages to be gained by a system based on accurate measurement and a careful investigation of the properties of the materials which they employed. In this work the National Physical Laboratory co-operated very fully. Meanwhile at an earlier date industrial research of importance had gone on in a few laboratories attached to firms in Sheffield and elsewhere. The work of Sorby on the micrographic structure of metals has already been referred to and at a later date Roberts Austen of the Mint utilized this method of inquiry in his investigation of a broken rail which had led to a serious accident at Abbots Ripton on the Great Northern Railway. Manganese steel was produced from the laboratory of Sir Robert Hadfield in 1882 as an outcome of a scientific inquiry into the properties of alloys; many results of high value have since come from the same source.

Developments in France.—In France, work of value was being done in various places; the Laboratoire d'Essais and the Laboratoire Central d'Électricité both contributed. The metallurgical work of Osmond and Le Chatellier was of marked importance,

while the discovery of the special properties of Invar—an alloy of nickel steel—by Gulleaume has proved of value in many iddustries.

International Standards.—One of the marked consequences of industrial research has been the realisation of the importance of international standards of measurement, and as a result international co-operation between the standardising laboratories in various countries and other bodies concerned with standards has become necessary. From this need arose the Bureau International des Poids et Mesures at Sèvres and various international associations such as the International Electrotechnical Assn. or the Assn. for Testing Material. In 1908 the British Govt. summoned an International Congress in London at which the system of electrical units, now universal throughout the world, was adopted.

In America the Bureau of Standards was founded early in the 20th century and many striking results have followed from the investigations of its staff. America has ever been foremost in promoting international standardisation and most generous in affording opportunities for co-operation in research. There, too, the development of research laboratories in connection with the great manufacturing firms has reached an extent unknown elsewhere.

War Problems.—In 1914 came the earthquake, and from the ruins which it left has sprung a wider appreciation of the importance of scientific investigations in every phase of national life. This is not the place to give any account of the influence of science on war; experience showed it to be vital and the phrase that Science won the War, interpreted to mean that without science the War would have been lost, only expresses the truth.

In the Allied countries on both sides of the Atlantic, men and women were at work solving problems of vital importance. Facilities for research were open to them, funds undreamed of in peace time were at their disposal, and the results of their endeavours contributed to a more general acceptance of the view that in peace time industry would benefit in the same way from scientific inquiries wisely guided and pursued. And so, in Great Britain as elsewhere, a movement started to organise in some more definite way the connection between science and industry. The establishment of the Dept. of Scientific and Industrial Research was the outcome of this movement. This was announced by Lord Crewe, Lord President of the Council, at the end of 1916 in reply to a deputation from the Joint Board of Scientific Societies headed by Sir Joseph J. Thomson. An advisory council of scientific men was established and the sum of £1,000,000 was placed at the disposal of the department to be used in the application of science to industry.

The financial responsibility for the National Physical Laboratory, with a staff which before the end of the War had grown to 600, was transferred to the department; boards were set up for fuel research, food investigation, building research and various other subjects, while a number of co-ordinating bodies were established to deal with researches of importance to Government departments, specially those bearing on industry. These researches are carried on either in special laboratories or at one or other of the national laboratories; the Geological Survey and Museum became one of the activities of the new department, which thus undertook the task of guiding and supervising the various official agencies for making the advances of science of service to national progress.

Co-operative Research.—But the department has done more than this. In Germany and America many of the great industrial firms have their own research laboratories; reference has already been made to some of the results on German industry. But research laboratories are costly; in many industries in England the firms concerned are small, a private research laboratory is too expensive to be contemplated, besides a number would produce wasteful overlapping. Hence the attempt was made to introduce a system of co-operative research. In an effort to lead manufacturers to rely more on scientific results, research associations have been set up. Each of these consists of a body of men engaged in the same industry who associate themselves for the purposes of research bearing on their industry. Each association has its own director of research, or similar official, under whose guidance the work planned by its council is carried on either in their private laboratory or by arrangement at the National Physical Laboratory or in the laboratories of some university or technical college.

The work is financed in part by the associated firms, in part from the million fund, usually on a pound to pound basis guaranteed under certain conditions for five years and with a limit of £5,000 a year to its amount. In 1926 there were 21 such associations in existence and the balance in the million fund is £518,200; a substantial part of this is required to complete the payments already promised. In a number of cases the first five years for which the grant was made have elapsed and the department, with a view to determining its future course, has arranged for a report from some independent body on the work and progress in each case. In a recent report to the committee of the Privy Council responsible for the work of the department, the advisory council writes:—

> The reports supply much encouraging evidence of the soundness and utility of the scheme for co-operative research and of the advances which have been made under the scheme in the application of scientific research to the technical problems of industry.

It is clear, however, from their general tenor that five years is insufficiently long even under the most favourable conditions to set a research association on its feet and make it independent of government assistance. To devise a programme, collect an efficient staff and obtain results all take time. Besides there is much educational work to be done; half-hearted supporters need to be converted by results before they will contribute freely; trade rivalries tend to prevent complete co-operation; trade has been bad and returns barely sufficient to keep old ventures going; there has been little to spare towards an expenditure of whose value the manufacturer is only half convinced. And so the department has now under consideration the steps that can be taken to maintain the work for some years to come and, in the case of some important associations, has already settled the terms of future grants.[1]

The Training of Workers.—But there are other ways in which official support is being given to industrial research, and among these the schemes for training research workers is most important. Under this scheme young graduates are assisted to carry out researches under the guidance of some competent professor, while, in a number of cases, funds have been granted to prominent workers to enable them to pursue inquiries of importance. The department also aids the work of the Aeronautical Research Committee which—at first as the advisory committee for aeronautics—has contributed in no small degree to the science of aviation. The royal commission for the exhibition of 1851 administers for the advancement of education and research funds arising from the balance left when the exhibition closed. For many years past its scholarships and studentships have been of great value to students of science. The commission has inaugurated a number of Industrial bursaries given on the recommendations of the universities and technical schools to men trained in science who were prepared to enter, as apprentices or students, engineering or other works. In this way, a stream of trained workers in science is provided for industry.

Private Research Laboratories.—Before concluding, reference should be made again to the research laboratories of prominent firms; in England, the laboratory of the General Electric Co. at Wembley occupies a leading place; but it is to Germany and America that we turn for striking examples of what a works research laboratory can do. Such laboratories are essential to mass production; in this the results no longer depend mainly on the skill and intelligence of the workman, but on his performance of one of a carefully devised series of operations worked out as the result of researches in the laboratory and investigations of highly trained engineers and physicists. Thus, to quote from a book in which the laboratory of the General Electric Co. at Schenectady, N. Y., is described, we read:—

[1] Particulars will be found in the reports of the department for 1923–4 and 1924–5 published by H. M. Stationery Office, London.

This laboratory is not concerned primarily with the solution of works problems or with investigations on the manufacturing problems of the company; it has deliberately sought entirely new discoveries, new applications of material and new developments in the art of electricity. From it have come the metallised carbon and the drawn wire tungsten filament lamp, the nitrogen-filled high-efficiency lamp, the magnelite arc lamp and the Coolidge tube.

The development of each of these has involved investigations of great importance to science, while among the workers at the problem, which of all others is now arousing the interest of the physicist, Dr. Langmuir, of the G.E.C. laboratory, is a leading figure. Much the same might be written of other works research laboratories in America; it is sufficient to mention the Pittsburgh laboratories of the Westinghouse Co., the laboratories of the Western Electric Co. at New York, or of the Kodak Co. from which has come the work on light filters and other investigations which have been of the utmost value to the photographer.

(R. T. G.)

United States.—With the cumulative benefits of the preceding century upon which to draw, natural resources unexcelled in variety and extent, and the demands of the World War as a stimulus, it was to be expected that the period 1910–26 would see in America the deepest interest in and most amazing results from industrial research. In whatever direction one turns these results are apparent, although progress has not been uniform in all industries.

A Summary of Work Done

Naturally, most attention has been given to the fields of immediate importance. Studies in the cracking of oil have doubled the available supply of gasolene and promise methods for completely converting crude oil into motor fuel with a little by-product coke. Motor fuels with anti-knock properties have been developed, and a way devised for winning the bromine required for one of them from the sea. The service life of tires has been greatly increased, thanks to research on accelerators for vulcanisation, on rubber compounding and on tire fabrics.

Progress has been made in the preparation and use of industrial gases—hydrocyanic acid as a fumigant, argon for incandescent lamps, carbon dioxide for "dry ice," and acetylene, hydrogen and oxygen for metal cutting and welding. Refrigeration for household units by compression or absorption is a recent research product. Chromium as a metal for plating, the perfection of alloys, the anticorrosion studies and research on the fatigue of metals are all important. Not only has radio developed from work on vacuum tubes, but the possibilities in other directions using such tubes as power control valves are being studied. Unique products in nitrocellulose lacquers, improvements in artificial leather and in rayon, all indicate activity in cellulose chemistry. Paper pulp has been made from cotton linters available in quantity since the World War. Insecticides and fungicides have been made from war gases, and progress has been made in the use of excess chlorine. America has developed a source of potash, established a fixed nitrogen industry and devised furnace methods for the manufacture of phosphoric acid, all as results of industrial research. Attention has been given to power generation, a kilowatt now being obtainable for each pound of coal burned. Low temperature carbonisation is an active research subject. Research in electrical insulation, on alloys for telegraphic and telephonic communication, and for power transmission has been successful. Synthetic resin is a distinct research product.

Such food staples as bread, meat and milk are now the subject of intensive research. The hydrogenation of oils has been perfected and commercial sources of new sugars seem assured. Crystalline dextrose is already used by the ton. Furfural, an aldehyde used as a solvent and substitute for formaldehyde, results from research upon waste agricultural products. Cutting tools of chromium, cobalt and tungsten which hold the cutting edge even when white hot afford a further example.

Perhaps industrial research has been most active in the synthetic organic chemical field, where America in the period 1910–26 has accomplished phenomenal results. The list of dyes, medicinals, perfume bases, flavours, photographic chemicals, etc., of coal-tar origin is now sufficiently extensive for American needs. Research has also turned successfully to natural gas and petroleum as sources of new and important compounds. A new group of solvents is now available. Resistance glass for commercial installation and developments in glass-blowing and control by machine deserve mention.

However, the significant things in industrial research in America are not the list of accomplishments, which could be indefinitely extended, but rather the attitude of industry toward research, both pure and applied. It is encouraging to find a growing realisation that in science there lies future security, that the great waste problems cannot be solved without it, and that only through research can the true conservation of natural resources be practised. Research facilities have been made available for the small manufacturer who wants only the occasional advice of the consultant, as well as for the great organisation appropriating millions for research and employing 1,500 scientists. There are now more than 500 industrial research laboratories in the United States with annual budgets aggregating more than $35,000,000. In addition many firms support fellowships and join in co-operative work. There is a growing number of research professorships, fellowships and studentships, an increase in co-operation between industry, university and government laboratories, and more than 40 trade associations support research as one of their major activities. There has come about a general acceptance of the fact that fundamental research must be encouraged and supported if industrial progress is to continue. Industrial research in America therefore not only points to its accomplishments in the period 1910–26, but is so ordering its affairs and gathering strength as to indicate even greater things in the immediate future. (H. E. H.)

RESIN: *see* COAL TAR PRODUCTS; SYNTHETIC RESIN.

RESPIRATORY SYSTEM, DISEASES OF THE (*see* 23.195).—Some notable advances in the technique of diagnosis and in the means of treatment, both medical and surgical, of diseases of the respiratory system have been evolved in the present century. Many of them are still in the process of development, but the results so far obtained have been encouraging.

Means of Diagnosis.—Direct methods of investigation, so long familiar in regard to the mouth, pharynx and larynx, have been extended to the trachea and bronchi, by means of the bronchoscope. The trachea, the main bronchi and their principal subdivisions can now be directly illuminated and observed. The importance of this in regard to the presence of inhaled foreign bodies is obvious, but it has also proved helpful in connection with obscure pathological conditions of these tubes. A notable application of the same principle of direct illumination has been made by Jacobaeus of Stockholm to the pleura and lungs. To enable this to be done, an artificial pneumothorax (*q.v.*) is first established, whereby the lung retracts from the chest wall except where it is prevented from so doing by adhesions. At a suitable time after this, a small tube is inserted through an intercostal space under local anaesthesia, and a special instrument with electric light and a system of lenses is fitted into it. By this means a clear view of the state of the pleura and of the surface of the lung may be obtained. Small adhesions, preventing the complete collapse of the lung, in the application of the artificial pneumothorax treatment to various conditions, may be successfully divided. The method promises also to be helpful in the diagnosis of certain tumours of the lung and pleura.

Improvements in the technique of X-ray methods have greatly increased their value in diagnosis. Their use is now almost a routine matter in cases of obscure intra-thoracic disease. In the distinction between fluid in the pleura and solid conditions of the lung, in the diagnosis of the extent of the disease in tuberculosis of the lungs and to some degree in the assessment of its type, in the early recognition of tumours of the bronchi, lungs, pleura or mediastinal glands, X-ray investigation is invaluable, and sometimes indispensable.

A recent extension of their use in regard to the diagnosis of bronchiectasis or dilatation of the bronchial tubes is already

proving of great value. A measured quantity of lipiodol, a liquid substance opaque to the X-rays, is injected down the trachea, through the crico-thyroid membrane or directly in between two of the cartilaginous rings of the trachea, under good local anaesthesia, the patient usually being placed in such a way that the lipiodol goes chiefly into the main bronchus of the side it is desired to investigate. The lipiodol rapidly diffuses into the bronchi of that lung, and in an X-ray film taken shortly afterwards the bronchial tree and its abnormal dilatations, if present, are seen with extraordinary clearness and accuracy. Applications of an old method, the study of so-called "vital capacity" that is, the amount of air it is possible to exhale by a maximum expiration after a maximum inspiration, promise to give valuable information in diagnosis. The further developments of bacteriological and other laboratory methods in the period under consideration have been helpful but not dramatic in their results.

Diseases of the Air Passages.—An important function of the nose is to secure that the air reaches the lungs, warmed, moistened and filtered from micro-organisms. In this connection the importance of adequate treatment, either medical or surgical, of conditions causing nasal or pharyngeal obstruction and therefore leading to mouth breathing, has become more generally recognised. For the same reasons, the treatment of septic conditions in the nose and nasal sinuses is more commonly carried out. The value of scientifically devised breathing exercises is also more widely accepted. Such measures lessen the risks of catarrhal infections, and in young people prevent deformities of the chest with their attendant disadvantages. The use of the bronchoscope has proved to be of great value in the extraction of inhaled foreign bodies. In America, Chevalier Jackson of Pittsburgh has pioneered this method with brilliant results. By its means the majority of inhaled foreign bodies can be removed, and the serious and often fatal results so common formerly are obviated.

The use of vaccines (*see* VACCINE THERAPY) in the prevention of the "common cold" and the more serious forms of catarrh of the air passages has given encouraging results. It is usual to employ a "stock" vaccine, containing a mixture of catarrh-producing organisms. An autogenous vaccine, *i.e.*, one made from the patient's own infective organisms, is, however, sometimes employed. At present, however, these protective vaccines have not proved as generally effective as the use of antityphoid and antiparatyphoid vaccines in the prevention of the enteric fever group of diseases. With increasing knowledge of the catarrh-producing organisms, a somewhat large and diverse group, and of the conditions favouring their activity, greater success may be obtained.

Bronchitis.—The use of vaccines in treatment has proved somewhat disappointing, except in the form due to the pneumobacillus of Friedländer, though in chronic cases they are helpful.

Gassing.—The employment of irritant and poisonous gases in the World War largely increased our knowledge of their effects, and in some measure led to advances in means for the prevention of such effects and for the treatment of the resultant conditions occurring in civil life from accidental or occupational causes. Some of these, such as chlorine and phosgene, lead to oedema of the lungs; others, such as mustard gas, to acute bronchopneumonia; and others, such as carbon monoxide, to changes in the blood. Tuberculosis as a sequel of gassing has proved to be relatively infrequent, but severe chronic bronchitis and emphysema are common.

Asthma.—The idiosyncrasies of asthmatics are well known, and their susceptibility to the emanations of certain animals was long ago recognised by Hyde Salter. This peculiarity has found a rational explanation in recent work on anaphylaxis, or hypersusceptibility (*see* MEDICINE). Some, if not all, cases of asthma seem to fall into a group of toxic idiopathies—*i.e.*, disease conditions due to hypersusceptibility to certain foreign protein substances. These may be derived from animals, such as the horse, dog, cat, etc.; or from articles used as foods; or again they may be toxic agents produced by bacteria.

This aspect of the disease has been closely studied by Chandler Walker in America and by Fleming and Coke in this country. It was hoped that by testing the sensitiveness of the skin of asthmatic patients to large numbers of such substances, collectively called antigens, by means of scratches to which they are applied in solution, it would be possible to discover the particular agents to which the patient was susceptible, with a view either to avoiding contact with them if possible, or to desensitisation by inoculation with minute but increasing doses of the particular substances concerned. Some good results are on record, but on the whole this method has been disappointing. Probably hypersensitiveness is not the only factor in asthma, and there may be, in addition, an inherited or acquired instability of the centre in the brain controlling the inervation of the bronchi.

The non-specific method of treatment of hypersusceptibility called protein shock therapy (*see* THERAPEUTICS) has been extensively tried in this disease, with some benefit in certain cases, but on the whole also with disappointing results. Of medicinal agents, apart from the iodides and the antispasmodic group of drugs such as belladonna, stramonium, grindelia and lobelia, small injections of adrenalin or of pituitrin, alone or together, have proved most useful.

Bronchiectasis.—Bronchiectasis, or dilatation of the bronchial tubes, was for a long period almost the despair of treatment. The offensive character of the sputum, and the serious general effects of the septic and putrefactive processes which occur in connection with the retained bronchial secretion, renders this condition unusually distressing to the patient and to his friends. The course of these cases had been progressively downhill, and the result almost invariably fatal, often after years of suffering and incapacity. The application of surgical methods in suitable cases, if employed sufficiently early, seems to promise hope of real amelioration, or even of actual cure. In a small proportion of the cases, where pleural adhesion has not occurred, artificial pneumothorax may be sufficient; but, in the majority phrenicotomy or a more or less extensive thoracoplasty may be necessary. By these means the sputum may be lessened or entirely lost, and its offensive character ended.

DISEASES OF THE LUNGS

Pneumonia.—There are certain advances to record in regard to this disease. The study of the causal organism, the pneumococcus, by Duchez, Gillespie and Cole in America, served to explain in some degree the failure of serum treatment in this disease in the past. They have shown that there are at least four types of pneumococcus, each with different serum reactions, called respectively types I., II., III. and IV. Attempts have naturally been made to prepare specific anti-sera for each of these, but so far only that for type I. has proved to be of real value in treatment, though a serum has been used in type II. Unfortunately, no effective antiserum has been obtained for type III., which is responsible for the most serious and fatal form of pneumonia. Pneumococcal vaccines have been used in the treatment of acute pneumonia, but though sometimes successful they have not achieved any widespread recognition. If they are to be of real value they must be employed early in the course of the disease. It has been recommended to use a stock vaccine as soon as the disease is recognised, and then if possible to prepare and use an autogenous one. Vaccines seem to be more helpful in cases of delayed resolution.

Abscess and Gangrene of the Lung.—Although some cases are successfully treated by medical measures, notably in the case of gangrene by injections of arsphenamine, the greatest success has been achieved from improved surgical methods.

Tumours of the Lung, Mediastinum and Pleura.—The application of artificial pneumothorax promises to render some of these more easy to recognise and to deal with surgically.

Pulmonary Mycoses and Spirochaetosis.—Improved laboratory methods have enlarged our knowledge of conditions due to some organisms such as moulds and spirochaetes, which occasionally cause pulmonary infections.

Pulmonary tuberculosis.—(*see* TUBERCULOSIS).

Diseases of the Pleura

Pleurisy with Effusion.—New methods of tapping the pleura have been introduced, including the replacement of the fluid by sterile air or oxygen by means of an apparatus like that for inducing pneumothorax. This may be particularly helpful in regard to chronic or recurrent effusions, more especially such as occur in association with malignant disease.

Empyema.—The treatment of collections of pus in the pleura has changed considerably. The method employed varies with the cause of the empyema. In cases due to the pneumococcus, early drainage by means of removal of a small piece of rib is now the rule. In those due to streptococcal invasion repeated aspiration is adopted, until the process is localised, or until the fluid withdrawn is actually pus instead of thin turbid fluid, after which drainage by removal of a piece of rib is employed. In both cases many surgeons now employ special appliances for drainage, whereby a negative pressure is maintained in the pleural space to promote re-expansion of the lung. In empyema associated with tuberculosis, aspiration with gas replacement is the rule.

Surgery of the Pleura and Lungs.—War experience gave a valuable impetus to the surgical treatment of respiratory conditions. The treatment of empyema has already been referred to. Haemothorax or blood effused into the pleural space is now treated like any other effusion, and aspirated or gas-replaced if necessary. If infected it is treated like empyema (*q.v.*). Artificial pneumothorax is proving of great value as a preliminary to other operative procedures, apart from its uses as a means of treatment of pulmonary tuberculosis. The operation of exairesis or avulsion of the distal part of the phrenic nerve as a means of treatment of chronic basic lung conditions, including pulmonary tuberculosis, is on its trial and bids fair to be useful. More extensive operative procedures are ligature of branches of the pulmonary artery, and lobectomy or removal of diseased portions of the lung.

Operations designed to promote collapse of the lung when this is impracticable by artificial pneumothorax are pneumolysis and thoracoplasty. In pneumolysis attempts are made to collapse the lung, by the insertion outside the pleura of fat tissue or some extraneous substance such as paraffin. In thoracoplasty, sufficient portions of as many ribs as may be necessary are removed to allow the chest wall to fall in and thereby collapse the lung. The outlook in regard to the surgery of the lung and pleura is distinctly encouraging.

See Sir R. D. Powell and Sir P. H. S. Hartley, *Diseases of the Lungs and Pleura* (1921); F. W. Price (ed.), *Textbook of the Practice of Medicine* (1922). (R. A. Y.)

RESTAURANT: *see* FOOD SERVICE.

RESZKE, JEAN DE (1850–1925), operatic singer (*see* 23.201), died at Nice April 3 1925.

REUNION, CHURCH.—The movements for the Reunion of the Churches, especially among English-speaking Christians, are due mainly to two causes. In the first place, the reasons for division, which seemed once to be based on spiritual principles about which no compromise was possible, have grown fainter than they were. Few men cling to them so tenaciously as they did, *e.g.*, in the 17th century. Secondly, there is a widespread feeling of the ineffectiveness of the churches in face of the tasks and problems of civilisation since the outbreak of the World War in 1914. To a large extent this is attributed to the divisions and consequent lack of unity of witness and aim among the churches themselves. This dissatisfaction has given new emphasis to the conviction that it is the purpose of Christ that there should be only one visible body, and consequently our "unhappy divisions" are entirely contrary to His will.

These movements for reunion are concerned with the divisions outside the Roman Catholic Church, which takes no part in them. On principle it cannot do so, as it has its own terms, surrender and not adjustment, from which there can be no departure. The one possible exception to this statement is to be found in what are known as the Conversations at Malines. At the invitation of Cardinal Mercier a small body of English theologians has met a similar body of Roman Catholic scholars for the purpose of exploring their grounds of difference. Begun quite unofficially, at a later stage these conversations have been held with the cognisance of the Archbishop of Canterbury; but at present, beyond an atmosphere of friendship and respect, very different from the controversial temper of the past, there are no positive results to report.

I. THE CHURCH OF ENGLAND

Movements for reunion may be dealt with conveniently under three heads:—

1. The conferences and discussions based either upon the Lambeth Appeal or the proposed World Conference on Faith and Order. These are concerned with such questions as (*a*) the relations between the Church of England or the American Episcopal Church and the Oriental Churches, (*b*) the relations between the Church of England and non-Episcopal churches and possible terms of corporate union.
2. Within these larger groupings there have been movements for union owing to the urgency of practical needs or a growing sense of real identity of spiritual aim and purpose, *e.g.*, among the various sections of the Methodist Church, between the Church of Scotland and the United Free Church, among the Congregationalists, Methodists and Presbyterians of Canada, and between the Church of England and the South India United Church.
3. Some reference must be made to religious movements which, though not directly concerned with the problem of reunion, cut across ordinary ecclesiastical divisions and create an experience of unity in faith and action in groups of men who formerly were not accustomed to act together. They are important factors on the practical side, for they illustrate the wide area of agreement which exists already and by the spirit which they create make it natural to discuss even acute points of difference as friends and not as partisans.

The Church of England and the Orthodox Eastern Church.—Negotiations between the Church of England and the Eastern Orthodox Church for mutual recognition and fellowship have a fairly long history, but the pace has been quickened largely owing to events which have followed the World War. In Jan. 1920, an Encyclical Letter was issued from the Patriarchate of Constantinople "unto all the Churches of Christ wheresoever they be." It is an earnest plea for closer contact and better mutual understanding:—

> We consider it as most important that love between the Churches should be revived and strengthened, so that they may no longer look upon each other as strangers and enemies, but as relatives and friends in Christ.

As a means to this end it is suggested that there should be a uniform calendar for Christian feasts, intercourse between theological schools, exchange of students, impartial and more historical examination of doctrinal differences, etc. Following this, a "proposed concordat" was drawn up by the American Episcopal Church. After setting forth points of agreement in faith and order, it concludes:—

> In accordance with the preceding agreements, we do solemnly declare our acceptance of the sacramental acts each of the other, and that they are true and valid. And, holding fast the truth once delivered to the Saints, we pronounce that intercommunion is desirable and authorised for all our members wherever and whenever it is deemed convenient and practicable by the proper local and ecclesiastical authorities.

To this the locum tenens of the Oecumenical Patriarchate sent a sympathetic reply. The next step was the presence of a delegation of the Patriarchate at the Lambeth Conference in July 1920. Their subsequent report to the Holy Synod is marked by a good deal of reserve. The latitude of the Church of England is a source of difficulty.

> While with us the true member of the Church, who continues in organic union with the whole, must accept the whole of our teaching, share economically in the Holy Sacraments and believe in lawfully settled ecclesiastical principles, in the English Church men differing from each other in faith, not in things indifferent and non-essential, constitute one undivided whole.

They also point out that the Lambeth Appeal puts forward "measures in relation to the non-episcopal Churches which also, in spite of goodwill, manifestly conflict with venerated principles and systems." Subsequently the Eastern Churches committee appointed by the Archbishop of Canterbury issued a statement

of terms of intercommunion. In Feb. 1923, the Archbishop announced that the Holy Synod at Constantinople, after careful consideration, had decided in favour of the validity of Anglican ordinations. He pointed out, however, that this decision must be endorsed by all Patriarchates or by a General Council before it could become an oecumenical act.

The Church of England and the Free Churches.—The movement for closer relations between the Church of England and the Free Churches has been roused into activity by the Lambeth Appeal to all Christian people in 1920. This brought to a focus various efforts for a better understanding which have been going on behind the scenes, notably in the conferences held at Mansfield College, Oxford, in 1919 and 1920. The American proposal for a world conference on Faith and Order was made at the general convention of the American Episcopal Church in 1910, prior to the Lambeth Appeal. Various commissions have been appointed, the adhesion of numerous churches in Europe and America has been secured, and a great deal of preliminary work has been done. In 1920, a meeting of a widely representative character was held in Geneva and it is hoped that the world conference itself will meet in 1927; but no forecast can be given of the probable result in view of the conflicting claims and traditions which have to be harmonised. The Lambeth Appeal, though addressed to all Christian people, has had its most important effect in the field of English ecclesiastical life. It has forced the great nonconformist bodies to reconsider their relations to the Church of England and the grounds of their separation, and to do so in an atmosphere of friendliness and goodwill. The terms on which the appeal believes that union is possible are as follows:—

We believe that the visible unity of the church will be found to involve the whole-hearted acceptance of—

The Holy Scriptures, as the record of God's revelation of Himself to man, and as being the rule and ultimate standard of faith; and the Creed, commonly called Nicene, as the sufficient statement of the Christian faith, and either it or the Apostle's Creed as the baptismal confession of belief;

The divinely instituted sacraments of Baptism and the Holy Communion, as expressing for all the corporate life of the whole fellowship in and with Christ;

A ministry acknowledged by every part of the Church as possessing not only the inward call of the Spirit, but also the commission of Christ and the authority of the whole body.

It is claimed that the Episcopate is the one means of providing such a ministry. " But we greatly desire," it is added, " that the office of a Bishop should be everywhere exercised in a representative and constitutional manner, and more truly express all that ought to be involved for the life of the Christian family in the title of Father-in-God." These proposals have been the subject of prolonged discussion between representatives of the Church of England on the one hand and a joint committee of the Federal Council of the Evangelical Free Churches and the National Free Church Council on the other, but so far no agreement has been found possible on two matters of essential importance, viz., the use of the Creed and the necessity of episcopal ordination.

On the first point, the Free Church position is expressed in the resolutions adopted by the annual assembly of the Federal Council in Sept. 1922:—

We regard the place given to the two ancient Catholic creeds as . . . subordinate to the inspired Word and living Spirit; and these creeds are received not as a complete expression of the faith, but as preserving " essential elements " in it " in the form handed down through many centuries," and with reasonable liberty as to their interpretation and their use. We hold as not only consistent with this, but as implied in it, alike the fullest freedom in the intellectual investigation of Truth and the most single-hearted discipleship to the Mind of Christ.

In regard to episcopal ordination the difficulty turns upon the question of the validity of the Free Church ministry. There is on the one hand a natural refusal to accept anything which implies that the Free Church minister must be re-ordained before he can administer valid sacraments in a united Church, and on the other there is disinclination on the part of the Church of England to advance beyond the admission that many Free Church ministries have been " manifestly blessed and owned by the Holy Spirit as effective means of grace," and consequently must be regarded as " real ministries of Christ's Word and Sacraments in the Universal Church," though they may be in varying degrees " irregular or defective."

General Results.—The difficulties indicated above are still unsolved, in spite of many discussions and explanatory statements marked by a very conciliatory spirit. In a memorandum signed by the Archbishops of Canterbury and York and the Moderator of the Federal Council in June 1925, it is stated that the joint conference believes that there should be a suspension of its activities in order that the documents already submitted may be studied with care. At its annual meeting in Sept. the Federal Council concurred, and at the same time recorded its conviction that the conferences which have taken place " have done much to bring representative members of the Churches concerned into closer fellowship and to a better understanding of each other's position; and, further, that they have prepared the way to further progress towards unity in the future."

II. METHODIST AND PRESBYTERIAN REUNION

Methodist Reunion.—The movement for reunion among the three branches of the Methodist Churches in England has reached a stage when it seems likely that it will soon be an accomplished fact. A scheme has been drawn up, and in 1924 the Wesleyan Conference, the Primitive Methodist Conference and the United Methodist Conference passed a practically identical resolution in the following terms:—

The conference is of opinion that, provided the Methodist people desire the organic union of the three Methodist Churches concerned, the scheme now submitted (which is the result of prolonged deliberation and exhaustive inquiry) affords a basis of union which would ensure harmonious working without the sacrifice of any principle vital to Methodism. The conference therefore commends the scheme to the prayerful consideration of the Methodist people

In 1925 the Wesleyan conference took the further necessary step of declaring in favour of the union of the three Methodist Churches, provided that substantial agreement can be secured as to the measures to be adopted for effecting union. If this agreement is secured, application for an Enabling Act must be made to Parliament.

The Churches of Scotland.—The first step towards union between the Church of Scotland and the United Free Church of Scotland was taken in 1908, when the General Assembly of the Church of Scotland resolved " to request the other Presbyterian Churches to confer with them on the present ecclesiastical situation." Conferences followed, and in 1914 a constitution was drafted under which the Church would be both national and free. No further progress was possible till 1919, owing to the War. In 1920, the articles of the constitution were approved and in July 1921, an Enabling Bill was passed by Parliament. Certain questions connected with the property and endowments of the Church of Scotland remained to be dealt with by a departmental committee appointed in 1922 and presided over by Lord Haldane. It reported in 1923, and its recommendations are embodied in The Church of Scotland (Property and Endowments) Bill of 1924.

Reunion in Canada and Australia. In Jan. 1924, the Presbyterian, Methodist and Congregational Churches in Canada accepted a scheme of union under the name " The United Church of Canada." In spite of an elaborate statement of doctrine, which has evidently been drawn up so as to exclude any possibility of modernist heresy, the dissentient churches have been few in number. There is a movement among the same bodies in Australia for union on very similar lines with the title " The United Church of Australia."

III. REUNION IN THE MISSION FIELD AND ELSEWHERE

The need for union on the mission field is illustrated by the negotiations between the Episcopal Synod of India and Ceylon and the South India United Church. The latter is a union of Christian congregations connected with the London Missionary Society and the American Board of Commissioners for Foreign Missions (both Congregational), the Church of Scotland, the United Free Church of Scotland, the Dutch Reformed Church in America and the Basel Mission. A joint com-

mittee was constituted in 1920 and several reports have been issued. As in England, the difficulty of agreement turned chiefly on the insistence upon episcopal ordination for all ministers of the United Church. It is suggested that the fact of episcopacy should be recognised without insistence upon any doctrine of its meaning, and that a joint service should be held to commission all ministers who desired full status in the United Church on reciprocally equal terms. The South India United Church also insists that it cannot allow itself to be cut off from these non-episcopal churches with which it is now in full communion.

It treasures its present catholicity too highly to take any step that would diminish or destroy the fellowship which it now enjoys with Evangelical Christendom.—(Resolution, Aug. 1923.)

A brief reference must be made to some of the movements of co-operation among different bodies of Christians, which have grown in strength and number since the end of the World War. Though these movements do not deal directly with the problem of reunion, the same motives lie behind them, viz.: a sense of the weakness of the Christian witness in the world due to division and a desire to co-operate in large fields of Christian enterprise which are recognised as common ground. (*a*) The World Alliance for promoting International Friendship through the Churches, founded at Constance on Aug. 2 1914.

Its object is set forth in the following resolutions:—

1. That, inasmuch as the work of conciliation and the promotion of amity is essentially a Christian task, it is expedient that the Churches in all lands should use their influence with the peoples, parliaments and governments of the world to bring about good and friendly relations between the nations, so that, along the path of peaceful civilisation, they may reach that universal goodwill which Christianity has taught mankind to aspire after. 2. That inasmuch as all sections of the Church of Christ are equally concerned in the maintenance of peace and the promotion of good feeling among all the races of the world, it is advisable for them to act in concert in their efforts to carry the foregoing resolution into effect.

The Alliance consists of 28 national councils and is representative of the organised Christianity of the world with the exception of the Roman Catholic Church. The international committee meets once every three years. Its meetings in Copenhagen (1922) and Stockholm (1925) did much to focus Christian thought upon the question of peace. The expense of the international work of the Alliance is borne by the American Peace Union.

International Missionary Council.—The functions of this body are defined in the following resolutions adopted in 1921:—

1. To stimulate thinking and investigation on missionary questions, to enlist in the solution of these questions the best knowledge and experience to be found in all countries and to make the results available for all missionary societies and missions.
2. To help to co-ordinate the activities of the national missionary organisations of the different countries and of the societies they represent, and to bring about united action where necessary in missionary matters.
3. Through common consultation to help to unite Christian public opinion in support of freedom of conscience and religion and of missionary liberty.
4. To help to unite the Christian forces of the world in seeking justice in international and inter-racial relations.

The Council is responsible for the publication of the *International Review of Missions.*

Universal Christian Conference.—The universal Christian conference on Life and Work held its first meeting at Stockholm in Aug. 1925. Six hundred and ten delegates were present, representing 31 communions and 37 nations. As a result, a message to all followers of Christ has been issued, setting forth the findings of the conference in the sphere of economics, of social morality and of international and inter-racial relationships. A continuation committee has been appointed:—

To follow up what has been begun, to consider how effect can be given to the suggestions which have been made, to examine the practicability of calling another such conference at a future date and in particular to take steps for the further study of difficult problems, and that further education of ourselves and of our Churches, on which all wise action and judgment must be based.

The conferences at Mürren, under the leadership of Sir Henry Lunn, must also be mentioned in this connection. Though not representative in any official way yet, by bringing together leading members of English denominations in an atmosphere of friendship and sympathy, they have been a factor of some importance in preparing the way for some form of corporate reunion.

Bibliography.—*Towards Reunion*, being contributions to mutual understanding by Church of England and Free Church Writers (1919); George Eayrs, *British Methodism* (1920); various writers, *The Problem of Christian Unity and Fellowship* (1921); G. K. A. Bell, ed., *Documents on Christian Unity, 1920–4* (1924); G. K. A. Bell and W. L. Robertson, eds., *The Church of England and the Free Churches* (1925). *See* also *Handbook of the World Alliance.*

(W. H. Dr.)

IV. REUNION IN THE UNITED STATES

The first pronounced voices for reunion in the United States were those of Thomas Campbell and his son Alexander of the Seceder Presbyterian Church, whose labours at the beginning of the 19th century, gave formation to the communion known as Disciples of Christ. The irenic attitude of the father was overshadowed by the aggressive attitude of the son, who became the leader of the movement; but the constant controversies and acrimonious debates of the Disciples, along with their rapid growth, especially in the Middle West, drove them somewhat into isolation and, therefore, into a denominational attitude which, in the midst of other interests, quite obscured their message for reunion. From the middle of the 19th century to nearly its close Philip Schaff, of the Reformed Church, was, perhaps, the foremost voice for reunion in the United States. He was one of the founders of the American branch of the Evangelical Alliance.

Recent interests in reunion in the United States centre around the year 1910. In the summer of that year several Protestant Episcopalians organised the Christian Unity Foundation of New York for the promotion of Christian unity throughout the world by research and conference. They invited representatives of several communions to be their guests for conference and published pamphlets announcing the results of these conferences. It was the first attempt on the part of one communion to set forth under their own authorship and at their own expense a friendly interpretation of another communion without some adverse criticism.

On Oct. 19 of that same year at the General Convention of the Protestant Episcopal Church, meeting in Cincinnati, a commission, consisting of seven bishops, seven presbyters and seven laymen, was appointed to take under advisement the promotion of a world conference on the Faith and Order of the Church to be participated in by representatives of all Christian bodies throughout the world. On the same day the Disciples of Christ, meeting in their General convention in Topeka, organised the Association for the Promotion of Christian Unity, emphasising intercessory, prayer, friendly conferences and the distribution of Christian unity literature by writers from all communions. At the same time the Congregationalists, meeting in their National Council in Boston, appointed a commission on Christian unity, dealing with all churches, but especially with the Protestant Episcopal Church.

The Episcopal movement, under the leadership of Robert H. Gardiner, soon brought into co-operation representatives from most of the Christian communions; and their first preliminary conference, held at Geneva, Switzerland, in 1920, marked the opening of a new chapter in theological reconciliation. Of the larger churches only the Roman Catholic Church declined the invitation, but the Pope expressed sympathetic interest. For ten days representatives from Eastern Orthodox, Anglican and Protestant churches sat together in friendly conferences over theological questions that have divided Christendom for centuries. The next conference is to be held in 1927 at Lausanne. Many smaller conferences in this cause have been held in the United States and other countries.

The Disciple movement continued its policy as announced by its Association for the Promotion of Christian Unity. In 1925 the

secretary of that organisation became also a member of the secretariat of the World Conference on Faith and Order, and in 1926 the chief publication of the association—*The Christian Union Quarterly*—became a separate corporation, independent of any communion, having been from the start functioning interdenominationally, with an inter denominational editorial council composed of representatives from various communions in all parts of the world. The Congregational movement functioned in a general agitation for Christian reunion, particularly under the leadership of Newman Smyth, who advocated a concordat with the Protestant Episcopal Church; this, however, failed of ratification by either communion.

At the instance of the Presbyterian General Assembly in 1918 the American Council on Organic Union of the Evangelical Churches of America was organised and bore testimony to the necessity of reunion by a representative gathering in Philadelphia, in which 16 Protestant communions took part.

The Federal Council of the Churches of Christ in America was organised in 1908 in Philadelphia for the co-operation of the various Protestant communions in service rather than in an attempt to unite upon definitions of theology and polity. It has grown into large usefulness. Aside from its general service through the Protestant denominations, more than 50 municipalities and several states have formed church federations. Its headquarters are located in New York City. While Protestant federation is not reunion, the Federal Council has functioned remarkably toward a larger and better understanding among Protestants and thereby has contributed to reunion.

Bibliography.—N. Smyth and W. Walker, ed., *Approaches Toward Church Unity* (1919); Macfarland, *Christian Unity at Work; Christian Century* (Chicago), *Historical Documents Advocating Christian Union;* P. Ainslie, *Message of the Disciples for the Union of the Church* (1913); Willett, *Our Plea for Union and the Present Crisis;* N. Smyth, *Passing Protestantism and Coming Catholicism* (1908); Ashworth, *Union of Christian Forces in America;* Manning, *The Call to Unity;* Ainslie, *If Not a United Church-What?;* Lynch, *The Christian Unity Movement in America;* Leighton Parks, *The Crisis of the Churches* (1923); Brown, *The Church in America;* Cowden, *Saint Paul on Christian Unity.* (P. Al.)

REVEL or Tallinn (*see* 23.211), the capital of Estonia, had a population in 1922 of 120,179, 84·8% Estonians, 8% German and 3% Russian. All the streets have been renamed in Estonian, and the statue of Peter the Great removed from Peetri Place, but Russian is spoken everywhere. Revel is a fine old city, but is passing through difficult times; the country is surrounded by rivals, so that there is little trade. Estonia is little developed industrially, and most of the factories are in Revel. There has been considerable over-production, owing to expectations of trade with Russia, which have not been realised. An International Industrial Fair is held yearly in June. Revel is the chief port of Estonia; the harbour is closed for some weeks in the early part of the year by ice, but a channel is kept open by an ice-breaker. A polytechnic and technical school have been opened. There were raids on groups of communists in 1924, and 149 were tried and sentenced. An armed rising in Dec. led to serious street fighting, but was quickly suppressed. Soon afterwards the railway station was burnt down by communists.

REVILLE, ALBERT (1826–1906), French Protestant theologian (*see* 23.224), died in Paris Oct. 25 1906.

REVOLVER: *see* pistol.

REVUE: *see* variety theatre.

REYER, ERNEST (1823–1909), French musical composer (*see* 23.225), died at Lavandou-sur-Hyères Jan. 15 1909.

REYMONT, LADISLAS STANISLAS (1867–1925), Polish novelist, was born at Kobiele Wielkie in the county of Piotrkow May 7 1867. He spent his youth in various transient occupations and his first novels were written when he was superintendent of a small railway sector. *The Comédienne* (1896, Eng. tr. 1921), *Ferments*, 2 vol. (1897) and *Lily* (1899) were objective novels describing the every day life of a troupe of provincial actors. In 1899 appeared *The Promised Land* (2 vol.), modelled on Zola and based on life in the Polish industrial town of Łódź. Reymont's best-known work, *The Peasants*, appeared in four volumes 1904–9 (Eng. tr. 1925–6). In it he revealed unusual insight into the life of the Polish peasant; the construction of the novel is based on the four seasons' labours of a peasant and brings to light his primitive instincts, inward dignity and almost religious attachment to the land. The merits of Reymont's peasant epic were recognised by the award of the Nobel Prize for literature in 1924. While *The Peasants* was being prepared, a number of novels and short stories appeared, the most important of which are *Before Dawn* (1902), *Komurasati* (1903), *From a Diary* (1903) and *The Storm* (1907). As a historical novelist, Reymont, the naturalist and observer of the direct processes of life, was not so successful: the trilogy *1794*, (*The Last Diet*, 1913, *Nil Desperandum*, 1916 and *The Insurrection*, 1918), though not lacking in literary merit, revealed a lack of historical exactness. *The Revolt*, Reymont's last work, an allegorical novel describing a revolt of domestic animals against man appeared in 1924. He died Dec. 5 1925. (*See* Polish Literature.)

See I. Matuszewski, *Twórczość i Twórcy* (Warsaw, 1904); Z. Debicki, *W. S. Reymont* (Warsaw, 1925); J. Lorentowicz, *Ladislas Reymont, prix Nobel 1924* (1925).

RHINE (*see* 23.240).—The Treaty of Versailles (1920), while deciding that the Act of Mannheim (*see* 23.241) should, under certain conditions, continue to regulate navigation on the Rhine, put the vessels of all nations on the same footing as vessels belonging to the Rhine navigation. The composition of the Central Commission was modified by the admission of Switzerland, Belgium, Great Britain and Italy. Belgium, though a non-riparian State, is in an exceptional position, since Antwerp handles a large amount of Rhine traffic. The terms of the Treaty of Versailles in respect of the Rhine were completed by a protocol of adhesion on the part of the Netherlands, dated Jan. 21 1921, accompanied by an additional protocol dated March 29 1923. The Barcelona Convention (*see* Inland Water Transport) applies to the Rhine, and its provisions take precedence over those of the Mannheim Convention, should the two texts disagree.

Regulation Work.—Under Articles 358 and 359 of the Treaty the Central Commission for Rhine Navigation has had to deal with works of regulation on the Rhine between Strasbourg and Basle. A scheme was laid before the Commission by the French Govt. for the creation of the Grand Canal d'Alsace between Huningue and Strasbourg, intended to be used both for navigation and for hydraulic power. Under Article 358 the Central Commission must see that the execution of this scheme does not interfere with navigability or reduce facilities for navigation. The French scheme planned the construction of a weir across the bed of the Rhine and of a canal on the left bank running more or less parallel to the Rhine, being about 114 km. long, and comprising eight locks and eight power stations. At low watermark all the water of the Rhine, with the exception of 50 cu. metres, would be taken by the canal; at the average water level the canal would take about 800 cu. metres per second. The weir was to have nine bays, the three central ones having an opening 30 metres wide, closed by movable sluice-gates; furthermore, fish ladders were to be built on both banks. The canal would have a bottom width of 86 metres and an average depth of 6·50 metres. The power available for the whole of the various stations would at average water level be equivalent to 769,000 horse-power.

The Swiss Govt. submitted a scheme for regulation works on the Basle-Strasbourg stretch. The Commission considered the two schemes simultaneously, and approved under certain conditions both schemes. The final decision was taken in April 1925. In the meantime the schemes had been modified. After the approval in May 1922, by the Commission of the digging of the first stretch, the French Govt. had submitted in 1924 a new detailed scheme for the seven other reaches. The Swiss Govt., after the Commission (also in May 1922) had approved the principle of regulation work, proceeded, with the assistance of the Baden Hydraulic Service, to investigate a scheme for works of regulation between Strasbourg and Istein.

Approval of the works of regulation was subject to an undertaking on the part of Germany and Switzerland to prevent navigation being in any way impeded (by the carrying out of the works of regulation) and to provide compensation for any damage that the part of the Rhine below Strasbourg might suffer from the carrying out of works above that town.

As far as the canal was concerned, the Commission laid down the following conditions:—Each reach must have two connected locks 25 metres wide, and at least 185 and 100 metres long, respectively. Furthermore, a place where boats can lie while waiting to enter the lock (garage) 1,000 metres long and 75 metres wide upstream, and

another similar mooring place of the same width and at least 500 metres long downstream from the locks must be provided. Provision must be made for the working of the locks by day and night even on Sundays and holidays. Each reach must also have two places at which craft can turn about. So far as the working of the power stations and locks is concerned, they must not interfere with the regular flow of the Rhine. The Central Commission further took note of an undertaking given by France similar to that demanded from Germany and Switzerland in respect of works of regulation. Lastly, it is laid down that navigation on the canal should be subject to the same international régime as navigation on the Rhine, in particular no toll or tax can be levied for the use of the waterway and the locks.

The question of the customs régime on the canal was left open. It was maintained from certain quarters that since the canal was not to involve any reduction of facilities for navigation, no customs formalities could be imposed during the journey on craft plying along the canal, since at the present time no such formalities existed on the Rhine where it formed the frontier between France and Germany.

Traffic Tariffs.—In virtue of Article 354 of the Treaty of Versailles the Central Commission for Rhine Navigation was in 1926 still engaged in revising the Convention of Mannheim of 1868. Among the questions which the Commission had still to discuss the following may be quoted: In several countries the railways introduced a tariff system which is seriously injuring shipping on the Rhine. The German railways reintroduced preferential tariffs for traffic to their seaports. This measure resulted in diverting traffic from its natural course to the ports of Hamburg and Bremen. On the other hand, the preferential tariffs, which existed before the World War for the Rhine ports, but which were abolished after the War at the same time as the tariffs for seaports, were not reintroduced; principally because since the transfer of the railways of the federated States to the Reich, the Baden and Palatinate railways have lost their direct interest in developing traffic involving transhipment at a Rhine port. Moreover, as long ago as 1920 Germany introduced a new graduated tariff with reduced rates for long distances and relatively high rates for short distances. These two measures in conjunction considerably diminished the hinterland for Rhine navigation, both as regards inward and outward traffic. The French and Belgian railways also introduced very low rates for traffic in certain directions and over certain lines; much of the traffic to and from the Saar Territory and Alsace-Lorraine was thus diverted.

Mr. Hines, in his report on Rhine navigation, expressed the opinion that both from the national and from the international point of view it is in the general interest that all traffic which can normally be carried on the Rhine with economic advantage should follow that route, and that the destruction of this river traffic by purely artificial reductions in railway rates would conflict with the fundamental interests of all the riparian States.

The Policy of France.—Another important question is that of the special supertax (*surtaxe d'entrepôt*) imposed by France on goods imported from overseas by any route other than a French seaport. The general policy of additional taxes adopted by the French Govt., and which now also applies to Alsace-Lorraine had the effect of diverting traffic from the Rhine. A single exception was made for the port of Antwerp as regards imports to Alsace-Lorraine. Consequently much of the traffic which formerly passed through Rotterdam now goes through Antwerp. It has been argued on the Dutch side that the fact that goods imported into Alsace through Havre, for example, pay reduced customs duties while the same privileges are not granted to goods imported by the Rhine through Rotterdam, is not in accordance with the provisions of Article 14 of the Convention of Mannheim, which lays down that any facilities which may be granted by the High Contracting Parties in respect of the import, export and transit of goods by other land routes or waterways shall also be granted in respect of their import, export and transit on the Rhine.

A careful examination of this problem gives rise to the question whether the establishment of a discrimination between certain Rhine ports, and between the Rhine and other traffic routes to the advantage of the latter, is in accordance with the principle that an international river such as the Rhine should be considered as the common property of all the riparian States; and whether such a discrimination does not show a lack of appreciation of the economic interdependence of all the countries interested in international navigation on the Rhine—a factor which places them under an obligation to co-operate loyally and effectively in order to maintain that navigation in a prosperous condition.

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(R. RN.)

RHINELAND (*see* 23.242.)—France's "historic Rhine policy," inspired by memories of Napoleonic times, had already taken definite form by the end of 1916. At this time it was not officially made known to Great Britain, but private negotiations with Russia led to that Power's pledging herself on Feb. 12 1917 to support France's plan of erecting a buffer state on the left bank of the Rhine.

The French Plan and the Treaty Settlement.—Russia was no longer an ally when Clemenceau laid his definite plan before Lloyd George and Wilson on Mar. 14 1919. It proposed that "the line of the Rhine be occupied, in virtue of a mandate from the League of Nations, by an inter-Allied military force," together with the bridgeheads. The territories on the left bank of the Rhine, (except Alsace-Lorraine) should be formed into "one or more independent states under the protection of the League of Nations." Even this suggestion was a concession, since Marshal Foch had pleaded, not only a Rhine frontier for Germany, but that the Rhineland countries be grouped with France, Belgium, Luxembourg and Alsace-Lorraine in "one single military organisation;" *i.e.*, the Rhine provinces were to be the French military outposts against Germany, although they were to enjoy autonomy and self-administration. The bridgeheads were to be permanently occupied, and a zone on the right bank of the Rhine neutralised. (*Mémoire* by Marshal Foch of Nov. 27 1918.)

Great Britain and the United States resisted this proposal, and as a compromise, it was ordained (Treaty of Versailles, Art. 428–432) that the left bank of the Rhine, with the bridgeheads, should be occupied by Inter-Allied troops for 15 years; but if Germany fulfilled her obligations faithfully, two zones were to be evacuated earlier: the Cologne zone after five years, that of Coblenz after ten. The left bank, and a 50 km. wide zone on the right bank, were to be permanently demilitarised (Art. 42–44).

The Inter-Allied High Commission was set up by a separate agreement (the Rhineland Agreement) signed on the same day as the Treaty of Versailles, June 28 1919 (British Treaty series No. 7). Belgium, France, Great Britain and the United States were to be represented. The High Commission had authority to issue all ordinances so far as might be necessary for securing the maintenance, safety and requirement of the Allied and Associated forces; but all civil administration unaffected by these powers remained in the control of the German authorities. As, however, the United States did not ratify the Treaty of Versailles, their member had no official voice on the commission. France, since Belgium followed her lead, was in a predominant position. M. Tirard was the first chairman. British troops occupied an area of which the centre was the bridgehead of Cologne; Belgian, the territory to the north of this; French, the whole district to its south, except that American troops occupied Coblenz until Jan. 10 1923.

The Separatist Movement.—A certain mistrust of Protestant Prussia, a relic of past religious quarrels, still lingered amongst the Catholic Rhinelanders. When the revolutionary disturbances of 1919 in Berlin made it seem possible that the capital might become the centre of a Communist Prussia, many prominent personages in the Centre party in Rhineland considered for a brief period the formation of an autonomous Rhineland territory within the Reich.

The French authorities overestimated this movement, which was abandoned within a few weeks of its inception. They set to

work to de-Germanise the Rhine, cautiously utilising the ordinances of the High Commission for this purpose and discreetly supporting certain German malcontents. Considerable efforts were made by propaganda and other means to foster a local movement in favour of an independent buffer state under French influences. The result of this policy was that all responsible German leaders dissociated themselves from these proposals and on July 24 1920, Dr. Dorten, the head of the separatist movement, was arrested by German police in the occupied territory but released under French pressure. French action in the Rhineland was closely, if obscurely, connected with their support of separatist activities in Bavaria. The French policy was not able to make much progress until an opportunity was offered it by the occupation of the Ruhr, Jan. 1923.

The measures applied in the Ruhr (*q.v.*) by military proclamation were enforced in Rhineland by special ordinances of the High Commission passed by the French and Belgians alone, the British abstaining. The local political and other leaders were promptly deported; in many areas every higher official was sent away. Most newspapers were suppressed and the people intimidated by the threat of summary expulsion. The Germans resisted by secret organisations, which on one occasion at least resorted to violence against Separatist "traitors." In the British area the ordinances of the French were not applied, and peace was preserved with French and Germans alike, although the cutting off of the British zone from the rest of Germany by French posts (a species of blockade) and a dispute over the Cologne railways, which the French sought to include in their Regie, made it doubtful at times whether Great Britain could remain on the Rhine.

The Rhineland "Republics."—By Aug. 1923 preparations for a coup d'état were so near completion that secrecy was largely abandoned and in defiance of the Allied ordinances, a "Separatist Army" numbering some thousands was armed and drilled in the French and Belgian zone. When German resistance in the Ruhr began to weaken, a large Separatist demonstration was held in Düsseldorf, culminating in a premeditated attack on the German police in which both sides used firearms and there were many casualties. The French arrested and disarmed the police the same day, and later sentenced some of them to long terms of imprisonment, deporting the remainder. The fear of seeing a French-controlled Rhenish Republic enveloping Belgium led a section of the Belgian military to anticipate the French by organising the proclamation of a Rhineland Republic under puppet leaders in Aix-la-Chapelle on Oct. 21 1923. Though the preparations in the French zone were not yet complete, the Separatists there also now proclaimed a "Republic." The police were regularly disarmed by the French authorities and citizens prevented from forming protective associations; French Régie trains then brought in armed roughs after curfew, who forced an entrance into the public buildings, proclaimed a "Republic," and installed some man, not always of irreproachable antecedents—as local commissar. The population took no part in all this, yet the reign of terror at last brought even the reputable citizens to think seriously of buying peace at the price of some sort of temporary separation. The French indicated that support of the hired Separatists would be abandoned, but only on terms involving such complete separation from Germany that the Rhinelanders recoiled.

Through British influence in Brussels the Belgian Cabinet, which had all along distrusted the adventure, finally ordered the disarming of the Separatists in accordance with Allied ordinances on Nov. 2 1923. The French maintained the "Republic" for several months longer. A special effort was made to separate at least the Bavarian Palatinate. The population was completely terrorised after several months of Separatist rule, but within two days of the French attempt to secure official recognition of the "autonomous palatinate" by the high commission, the "president" and three of his associates were assassinated in a Speyer restaurant on Jan. 9 1924 under the eyes of French officers by a party of German youths who escaped across the Rhine. There was another terrible incident when the population of Pirmasens set fire to the Separatist headquarters; over a dozen Separatists perished in the fighting or in the flames.

Change in French Policy.—With the advent to power of M. Herriot in May 1924 French policy finally changed. The British evacuation of Cologne and the Cologne district, originally fixed for Jan. 10 1925, was postponed by the report of the Control Commission that Germany had not fulfilled the disarmament clauses of the Peace Treaty. It was only effected after long negotiations in Dec. 1925, when the British Army on the Rhine removed its headquarters to Wiesbaden.

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RHODE ISLAND (*see* 23.248), a state of the United States of America. The population of the State in 1925 (state enumeration) was 679,260; in 1920, 604,397; in 1910, 542,610. The increase from 1910 to 1920 was 61,787, or 11·4%; and that from 1920 to 1925, 74,863, or 12·4 per cent. Rhode Island was still in 1920 the most densely populated State, having 566·4 inhabitants to the square mile. The percentages of urban and rural populations in 1925 were urban, 97·8%, and rural, 2·2%; as compared with urban, 97·5%, and rural, 2·5% in 1920; and urban, 96·7%, and rural, 3·3% in 1910. The following are the cities of Rhode Island having a population of over 20,000 in 1925 and their percentages of increase in the 1910–20 and the 1920–5 periods:—

	1925	1920	1910	% Increase 1920–5	% Increase 1910–20
Providence	267,918	237,595	224,326	12·8	5·9
Pawtucket	69,760	64,248	51,622	8·6	24·5
Woonsocket	49,681	43,496	38,125	14·2	14·1
Cranston	34,471	29,407	21,107	17·2	39·3
East Providence	26,088	21,793	15,808	19·7	37·9
Central Falls	25,403	24,174	22,754	5·1	6·2

The proportion of native whites in 1925 was 71·7%, as compared with 69·6% in 1920, and 65·3% in 1910; of foreign-born whites in 1925, 26·7%, as compared with 28·7% in 1920, and 32·8% in 1910. Up to 1910 the largest foreign-born element was the Irish. In both 1920 and 1925 the Irish were numerically inferior to the English and English-Canadian, the Italian and the French-Canadian. In 1925 the French-Canadian numbered 35,548; the Italian, 34,671; the English, 26,885; the English-Canadian, 5,303; and the Irish, 19,800. Since 1910 there has been a remarkable increase in the number of Italian, Portuguese and Polish immigrants and a noticeable influx of Armenians and Syrians.

Agriculture.—There was a decline in farm acreage of 29·3% between 1890 and 1920 when it totalled 331,600 ac., and an even greater decline of 51·2% in improved acreage, which was 132,855 ac. in 1920. The number of farms fell from 5,292 in 1910 to 3,911 in 1925. On the other hand there has been a rise in the value of farms. The value of all farm property in 1910 was $32,990,739, and in 1925, $33,446,425.

Manufactures.—Rhode Island is pre-eminently a manufacturing State. The number of persons engaged in manufacturing industries increased 9·8% from 1909 to 1923 (1909, 122,641; 1923, 134,667); the wages paid 172·4% (1909, $55,234,068; 1923, $150,449,859). The number of establishments increased from 1,951 in 1909 to 2,190 in 1914 and to 2,466 in 1919, but decreased to 1,692 in 1923. The value of products increased 141% from 1909 to 1923 (1909, $280,343,797; 1923, $675,425,020). Textiles still held in 1923 the first place among the manufactures of the State, employing 81,922 persons. From 1909 to 1923, cotton-goods mills (including cotton small wares) increased in number from 106 to 145; in employees from 28,786 to 38,678; in wages from $11,797,000 to $41,411,359; and in value of products from $50,313,000 to $146,702,582. From 1909 to 1923 woollen and worsted-goods mills increased in number from 88 to 91; in em-

ployees from 24,924 to 26,840; in wages from $11,538,000 to $30,293,439; and in value of products from $74,600,000 to $167,772,827.

Hosiery, knit goods, webbing, braid and tire fabrics were also produced in large quantities. In 1923 the machine tools and machine products manufactories and foundries numbered 116 (of these, 51 produced textile machinery and parts), with 11,456 employees, wages $14,267,762, and value of products $41,447,397. In 1923 the number of jewellery and silverware manufactories was 237, with 9,147 employees, wages $10,125,761, and value of products $42,846,043. The percentages of all factory employees who were children under 16 years of age were: in 1910, 3·6%; 1915, 3·16%; 1918, 4·44%; 1920, 3·69%; 1921, 2·72%; 1923, 2·62%; 1924, 2·2%. The State law raising the minimum working age to 15 years (with certain exceptions) went into effect Sept. 1 1924.

Commerce.—The city of Providence owns at Fields Point nearly 300 ac. of land, and is developing a municipal wharf, which was 3,000 ft. long in 1925, with 35 ft. water depth. In 1924, foreign and domestic commerce passing through Narragansett Bay totalled 3,579,191 tons, of which 1,065,048 was brought into Providence. The foreign imports of the customs district of Rhode Island amounted in 1924 to $7,654,115. Providence has since 1910 become the oil distributing centre for New England (1910, 106,216 tons brought in by water; 1924, 1,065,148 tons), and is becoming one of the largest lumber distributing ports in New England (99,542 tons in 1924).

Finance.—The financial position of the State on Dec. 31 1925, was: assessed valuation $1,185,162,654; ratable wealth $2,062,542,549 (about $3,036 *per capita*). For the year ending Nov. 30 1924, receipts were $7,974,306; expenditures $5,588,841; funded debt $12,691,000; and sinking fund $2,399,487. The banking establishments had total resources of $508,325,241. From June 30 1910 to June 30 1925, the number of savings depositors increased from 195,977 to 344,956, the amounts of deposits from $116,913,590 to $267,154,595, and the average for each depositor from $596 to $774.

Social Work.—In 1912 the General Assembly created a Board of Control and Supply to have joint control with the Board of State Charities and Corrections over all State institutions except the State Sanatorium and the Institute for the Deaf. In 1917, both of these boards were abolished and their places taken by the Penal and Charitable Commission, the name of which was changed in 1923 to the State Public Welfare Commission. Beginning in 1925 a placing-out policy has been developed by the State Home and School, until in 1924, of 850 children under its care, nearly 700 were placed out. In 1923, a Mothers' Aid law was passed, and a law providing for a Director of State Institutions.

Education.—The total population between four and 20 years of age as shown by the Jan. 1925 school census was 197,503. Of these 109,382 were of compulsory school age (7–15 years inclusive). During the school year 1924–5 there were in public schools 104,142 pupils; in parochial schools 24,251; and in private schools 3,501. In 1921, 17 towns and cities reported classes totalling 100 conducted for teaching English in compliance with the State compulsory Americanisation law, with 1,226 pupils within the ages covered by the law (16–21), and 117 teachers, of whom 87 were certified as trained specifically for Americanisation work. The total expenditure for education in 1924–25 was $9,178,575, of which the State contributed $1,411,958. In April 1920 the name of the State Normal School was changed to the Rhode Island College of Education. The enrolment of the institution in 1924–5 was 561 students and 34 instructors, with 1,464 in the extension department and 367 in the summer school.

History.—In 1922 the Democratic candidates for governor, lieutenant-governor, attorney-general and general treasurer were elected, although the Republicans retained control of both branches of the General Assembly. A long struggle in the Senate culminated in the Republican members leaving for Rutland, Mass., on June 19 1924, where they stayed until Jan. 5 1925. The Democratic minority continued to meet daily, however, until the newly elected Senate took office. The legislative business of the State was practically at a standstill for a year, and the failure of passage of the annual appropriation bill in 1924 led to the advancing of money to the State by private individuals and by 23 Rhode Island banks.

In 1909 the number of representatives in the Lower House was fixed at 100. The city of Providence, with 40% of the population of the State, has but one member in a Senate of 39. In 1912 the number of congressional districts was increased from two to three. The presidential vote of the State was cast in 1912 for Wilson (Dem.); in 1916 for Hughes (Rep.) (though at the same time a Democratic U. S. Senator was elected); in 1920 for Harding (Rep.); and in 1924 for Coolidge (Rep). Rhode Island ratified the Nineteenth (Woman Suffrage) Amendment to the Federal Constitution; but failed to ratify the Eighteenth (Prohibition) Amendment. The governors since 1910 were: Aram J. Pothier (Rep.), 1909–15; R. Livingston Beeckman (Rep.), 1915–21; Emery J. San Souci (Rep.), 1921–23; William S. Flynn (Dem.), 1923–5; Aram J. Pothier (Rep.), 1925– . (H. Bu.)

RHODES, JAMES FORD (1848–), American historian (*see* 23.257), was awarded in 1910 the gold medal of the National Institute of Arts and Letters. He published in 1913 *Lectures on the American Civil War* (delivered at Oxford in 1912); in 1917 *History of the Civil War*, and in 1919 *History of the United States from Hayes to McKinley*, being the eighth volume of his *History of the United States*, of which the first appeared in 1893 and the seventh in 1906. A revised edition in eight volumes appeared in 1920. He also wrote *The McKinley and Roosevelt Administrations 1897–1909* (1922).

RHODESIA (*see* 23.259).—In 1923 Southern Rhodesia became a self-governing colony and in 1924 the Imperial Government took over the administration of Northern Rhodesia from the British South Africa Company. This marked the end in British Africa of rule by chartered companies. In this article the two Rhodesias are treated separately.

I. SOUTHERN RHODESIA

The white population, which numbered 12,596 in 1904, was 23,606 in 1911, 33,620 at the 1921 census, and was estimated at 40,000 in 1926. Over 90% of the whites are of British stock, a fact which has had great influence on political developments. With the growth of the white population the already nascent aspiration of the Southern Rhodesians for self-government (officially styled responsible government) grew in strength. When the constitution of the Union of South Africa was framed, the ultimate inclusion of Rhodesia in it was contemplated, but the establishment of the Union in 1910 appeared but to increase the Rhodesian desire for independence. At that time the British South Africa Company, under its charter, exercised sovereign rights, subject to partial control by the Colonial Office. A legislative council existed and in May 1911 a step in the direction of self-government was made when Orders in Council gave the elected members a majority of the seats in the Council. By 1913 the position had been reached that the Chartered Company—of which Sir Starr Jameson was president from 1912 till his death in Nov. 1917—was willing to abandon its administrative powers on terms. At that time, however, the rise of the Nationalist (Dutch extremist) party in the Union caused much disquiet in Rhodesia, with the result that, in the elections held in March 1914, 11 of the 12 elected members were pledged to support the maintenance—for the time being—of the company's administration. The Legislative Council nevertheless declared that this did not affect its right " at any time " to the institution of self-government and in April 1914 the Council took action which led to a thorough examination of the whole question.

Ownership of the Land.—In 1913 the directors of the Chartered Company had declared that " the land and minerals belonged to the company," and as to minerals there was no real dispute. As to the land the Chartered Company had acted as owners and it looked to the sale of unalienated land to make good the heavy deficiencies it had incurred in its administrative

capacity. The Legislative Council held that the land was vested in the company " as an administrative and public asset only " and that on the company ceasing to exercise administrative rights all unalienated lands should go as public domain to the Government which succeeded it. In July 1914 the matter was referred to the Judicial Committee of the Privy Council for adjudication. The decision of the Judicial Committee was not given till July 29 1918. It was in favour of the Crown, but the committee also held that the company was entitled to be reimbursed for its deficits on administration. A royal commission, under the chairmanship of Lord Cave, was appointed in July 1919 to assess the amount due to the Chartered Company on the assumption that its governing powers had ceased on March 31 1918. The Cave commission gave its award in Jan. 1920. It found that the sum due to the company, subject to certain adjustments, was £4,435,000, a figure less than half that which the company had claimed.

In the six years these legal proceedings lasted the World War and political developments in the Union of South Africa have influenced Rhodesian opinion. The Rhodesians were ardent supporters of the British cause in the War and in proportion to population no community of the Empire gave a larger contingent towards its prosecution. The growth of separatist and republican sentiment in the Union, and particularly the rebellion of 1914, alienated the almost solid British population of Rhodesia. Those who had begun to favour joining the Union drew back and the strength of the movement for independence was shown at the general election in May 1920, when the responsible government party secured 12 out of 13 seats.

At this period Lord Milner, then Secretary of State for the Colonies, advocated delay, believing that Southern Rhodesia was not in a position to bear the financial burden entailed by self-government. In view, however, of the instance of the Rhodesians, recourse was had to the advice of still another committee, of which Lord Buxton, lately governor-general of the Union, was chairman. This committee acted promptly, reporting in April 1921 in favour of a referendum being taken on the question, the electors to have before them, not merely the principle of self-government, but a definite outline of the proposed constitution. The Buxton committee, however, proposed that under the suggested constitution control of unalienated land should be exercised through the High Commissioner for South Africa on the advice of a specially created land board and that this unalienated land should be charged with the sums to which the Chartered Company was entitled under the Cave award.

The method proposed for dealing with the unalienated land was open to serious objection—obviously it would fetter any Government which succeeded the Chartered Company. Nevertheless the elected members of the Legislature, under the leadership of Sir Charles Coghlan, accepted the recommendations of the Buxton committee and Rhodesian delegates came to London and conferred with Mr. Winston Churchill, who had become Colonial Secretary. A detailed scheme for submission to the electorate was embodied in draft letters patent and the delegates returned to South Africa. At the same time it was arranged that the Rhodesian electors should have before them the alternative of Southern Rhodesia becoming a province of the Union. Gen. Smuts (then Prime Minister of the Union) conducted a double set of negotiations—one with the Chartered Company, one with the Rhodesian delegates.

With the Chartered Company he negotiated for the acquisition by the Union of the unalienated lands and also of the railways both in North and South Rhodesia. In June 1922, an agreement was reached on those lines, the company to receive in all £6,826,000 as compensation. Gen. Smuts then offered generous terms to the Rhodesians, including 10 seats in the House of Assembly and certain special subsidies and development grants. The Nationalist party in the Union, for obvious reasons, looked upon this offer with disfavour.

The Union's terms were made known on July 31 1922. On Oct. 27 following, the referendum was held. Gen. Smuts, with doubtful wisdom, issued an appeal to the electors to vote for entering the Union. The result of the referendum was: for responsible government 8,774; for joining the Union 5,989, a majority of 2,785 for responsible government.

Self-Government Established.—Before the new constitution was established a settlement was reached with the Chartered Company which left Southern Rhodesia in full and untrammelled possession of the unalienated lands. In July 1923 the British Govt. made an agreement with the company, which, in return for £3,750,000, surrendered its claim under the judgment of the Judicial Committee and the Cave award both in Southern and Northern Rhodesia, while retaining its mineral rights and the promise of protection for its railway interests. Of this £3,750,000 (paid in cash on Oct. 1 1923) the British Govt. provided £1,750,000 while Southern Rhodesia paid £2,000,000 (raised by loan) and also repaid the British Govt. £300,000 which it had advanced the company to meet administrative liabilities. The British Govt.'s contribution was substantial evidence of its goodwill towards the people of Rhodesia.

On Sept. 12, the 23rd anniversary of the occupation of Mashonaland, Southern Rhodesia was formally annexed to the British Crown and on Oct. 1 the new constitution was set up. The Chartered Company, whose rule thus ended, had done a great work in opening up the country and had also—though some abuses had been permitted—sought with success to benefit the native races.

The first governor under responsible government was Sir John Chancellor and the first ministry was formed by Sir Charles Coghlan. The country was divided into 15 two-membered constituencies and at the general election held on April 29 1924 the Government (Rhodesian) party gained a decisive majority, nearly all the electors who at the referendum had voted for joining the Union working whole-heartedly to make the new constitution a success. One of the elected members was a woman, Mrs. Tawse Jollie, who had previously held a seat in the old Legislative Council. The franchise is exercised by both sexes and there is no colour bar; Africans and Asiatics could and did obtain the parliamentary vote, though the number of these electors was few. The country prospered and good relations were maintained both with the Union and with Portuguese East Africa—a matter of moment to a country without a seaboard. The chief concern of the ministry, apart from land settlement and agricultural development generally, was that of control of the railways. Negotiations with the Chartered Company on this matter took place in 1926.

Native Affairs.—Under the new constitution the authority and control of the High Commissioner for South Africa (representing the Imperial Govt.) in respect to native affairs was retained. A commission under Mr. (afterwards Sir) R. T. Coryndon was appointed in 1914 to inspect and report on the native reserves. White settlers had complained that certain lands in native occupation were not beneficially used; the natives made similar complaints. The Coryndon commission recommended a number of readjustments, making the total of the native reserves 19,428,691 ac., a net reduction of 1,062,460 acres. These recommendations were accepted by the Imperial Govt. in 1917 and were gradually carried out, with little friction. (To ensure the natives' security of tenure the reserves are vested in the High Commissioner and are inalienable.) Another commission was appointed by the governor in Jan. 1925 to consider setting apart areas of the public domain outside the native reserves for settlement by natives or colonists. This commission reported in 1926 in favour of segregation with some modification of the 38,560 sq. m. available outside of town areas. They proposed that 10,830 sq. m. should be allotted for native settlement, leaving 27,730 sq. m. assignable for white settlers.

Meanwhile charges against the Chartered Company's native administration were formulated by the Aborigines Protection Society. It was admitted that cases of grave injustice had occurred in the earlier history of the territory, but for many years there had been no cause of complaint and in Aug. 1919 Lord Buxton paid a high testimony to the Company's native administration and the attitude of the civil population generally

to the natives. The value of the natives as an asset to the country is now generally recognised. Agricultural and industrial training as well as literary education are provided, and much care in regard to housing, sanitation and labour conditions is bestowed on natives living outside the reserves. Taxation is light, £1 a year on every male adult, but should a native have more than one wife he pays a further 10s. for each additional wife.

Economic Conditions.—The country was affected by the same causes which affected the material progress in the Union, but not so severely as far as adverse factors were concerned. Rhodesia has a very wide variety of products and these were developed with much energy. Gold continued to be of more value than any other single export. The highest export was in 1916 when there was a yield of 930,000 oz. valued at £3,895,000. In 1924 the yield was 627,000 oz. valued at £2,939,000. The Wankie coal fields yielded 180,000 tons in 1910 and 652,000 tons in 1924; all consumed in the country. About half of the world's supply of chrome iron ore comes from Southern Rhodesia (the output was 172,000 tons in 1924) which has also very valuable asbestos deposits. The output of asbestos increased from 290 tons in 1910 to 26,000 tons (valued at £603,000) in 1924.

Of crops the chief are maize and tobacco. As in the Union the maize crop has violent fluctuations according to weather conditions—thus the maize exported in 1922 was but 6,492,000 lb.; in 1924 it was 63,657,000 lb. and had been 157,253,000 lb. in 1923. Rhodesian tobacco finds a steady market and the output in 1924 had reached almost 5,000,000 lb. Since 1922 there has been a promising development in cotton growing and an expansion in the cultivation of citrus fruit for export. Large areas are very favourable for cattle breeding and the raising of cattle for export became a leading occupation. Over 50,000 animals were exported in 1924, but in that year by a convention with the Union, exports were limited to slaughter cattle of good class.

In general exports exceed imports in value. The figures for 1914 were: imports, £3,731,000; exports, £4,130,000; in 1924–5 imports were £4,054,000; exports, £5,120,000 (not reckoning imported goods to the value of £435,000 re-exported). In 1920, a year of abnormal activity and inflated prices, the imports had a recorded value of £7,212,000, while exports were valued at £5,735,000. About half of the imports, which are largely foods and drink and clothes, are from the Union, which takes roughly a quarter of the exports. Most of the rest of the trade is with Great Britain.

Under the Chartered Company's rule revenue increased from £777,000 in 1913–4 to £1,520,000 in 1923–4. Up to 1919–20 expenditure had exceeded revenue. In that year the deficit had been reduced to £1,113 and in 1923–4 the surplus was £164,000. The first budget (1924–5) under self-government showed a surplus, revenue being £1,598,000 and expenditure £1,594,000. For 1925–6 the budget figures showed revenue at £1,582,000 and expenditure at £1,716,000, but the year actually closed with another surplus.

II. NORTHERN RHODESIA

Northeastern and Northwestern Rhodesia were amalgamated in 1911, being thereafter known as Northern Rhodesia simply. In 1924 the white inhabitants numbered 4,182 and the native population was estimated at 1,000,000. The capital is Livingstone (white population 774) on the Zambezi above the Victoria Falls. On April 1 1924, in accordance with arrangements made with the British South Africa Company in the previous July, the British Govt. took over the administration, the first governor being Mr. (later Sir) Herbert J. Stanley. The greater part of the territory is a natural "black man's reserve"—and Barotseland (*q.v.*) is a legal native reserve. Most of the Europeans live in the neighbourhood of the railway which traverses the centre of the territory from the Victoria Falls to the Katanga province of Belgian Congo. Geographically and climatically Northern Rhodesia is part of Central Africa. Its political future remained uncertain in 1926. Union with Southern Rhodesia or a closer connection with the British East African territories were the alternatives.

Development was hampered by the lack of funds, which was specially marked in the native services. The tribes were governed as far as possible through their own chiefs. Though numbering only about a million the natives are divided into many tribes and 30 different languages are spoken. Christianity made many converts, but among the more primitive tribes witchcraft, with its blighting influence, retained its hold. The most promising feature was the confidence placed by the people in the native commissioners and the missionaries. During the World War the natives gave great help by furnishing over 150,000 carriers for the campaign in East Africa while numbers joined the combatant ranks. It was in Northern Rhodesia too that the last act of the War was played, Von Lettow surrendering to the magistrate at Kasama on Nov. 14 1918.

Economic Conditions.—The Europeans are engaged chiefly in farming, including cattle raising, in the areas not affected by the tsetse fly. The chief crop is maize, but since 1922 large areas have been devoted to cotton. In the northeast district, round Fort Jameson, tobacco is the staple crop. The country is rich in minerals. At Broken Hill there are very large deposits of lead and zinc; a dam on the Mulunguoki river to provide electric power for the mines was opened in 1925. At Bwana Mkubwa are copper deposits, an extension of the great copper area in the adjoining (Belgian) Katanga province. The transport of copper from the Kalanga mines to Beira is the chief source of railway revenue, while North Rhodesia supplies many of the needs of the Katanga market.

The trade returns indicate the progress made. Imports in 1911 were valued at £168,000, in 1921 at £741,000 and in 1923 at £528,000. Exports were valued at £107,000 in 1911, at £565,000 in 1921 and at £463,000 in 1923. In opening up the country the Chartered Company's administrative expenditure naturally exceeded revenue. For the last year of their rule (1923–4) the revenue was £278,000 and expenditure £323,000. The figures for 1910–1 had been, revenue £101,000, expenditure £173,000. By the arrangement made with the British Govt. for surrendering their administrative rights in both Rhodesias it appeared that they received, on Northern Rhodesia's account £1,450,000, besides retaining an interest in land sales. In taking over the administration the British Govt. made a loan grant in aid of £138,000 to the territory. An elective but purely advisory council had been established in 1913; under the Crown this was replaced by a legislative council of 10 official and 5 unofficial (elected) members.

BIBLIOGRAPHY.—1. *Official.* Full lists of parliamentary papers relating to Rhodesia are given in the *Colonial Office List* (London, yearly); and annual reports are issued by the British South Africa Company. The first issue of the *Year Book of the Colony of Southern Rhodesia* was published (at Salisbury, Rhodesia) in 1924. *The Report of the East Africa Commission* (1924) has a chapter on Northern Rhodesia.

2. *Unofficial.* C. Gouldsbury and H. Skeane, *The Great Plateau of Northern Rhodesia* (1911); A. Darter, *The Pioneers of Mashonaland* (1914); H. Rolin, *Les lois et l'administration de la Rhodésie* (Brussels, 1918); J. H. Harris, *The Chartered Millions* (1920); J. C. C. Coxhead, *Northern Rhodesia: A Handbook* (Livingstone, 1922); *Guide to Rhodesia*, 2nd ed. (1924); *The South and East Africa Year Book and Guide* (annually). (F. R. C.)

RHODES SCHOLARSHIPS (*see* 23.254).—The scholarship system founded by the will of Cecil Rhodes, proved in 1902, provided for the maintenance in perpetuity at Oxford of about 200 selected scholars for a term of three years each. Under the will the value of each scholarship was £300 a year, but this has since been raised to £400 a year. Thirty-four scholars come each year from the British Empire, distributed substantially as follows. One scholar is elected annually from each province or state of the Dominions of Canada, Australia and South Africa; from four specified schools in the Cape Province of South Africa and from the colonies of Newfoundland, Jamaica and Bermuda. Rhodesia elects three scholars each year, and Malta one every third year. Thirty-two scholars are elected annually from among

the 48 states of the United States. Five annual scholarships were allotted to Germany, but were annulled during the War.

In his will Rhodes mentions the objects he had in view in founding the different scholarships:—

1. *Colonial.*—"I consider that the education of young colonists at one of the universities of the United Kingdom is of great advantage to them for giving breadth to their views, for their instruction in life and manners and for instilling into their minds the advantage to the Colonies as well as to the United Kingdom of the retention of the unity of the Empire."

2. *American.*—"I also desire to encourage and foster an appreciation of the advantages which I implicitly believe will result from the union of the English-speaking people throughout the world, and to encourage in the students from the United States of North America who will benefit from the American scholarships to be established for the reason above given at the University of Oxford under this my Will an attachment to the country from which they have sprung, but without, I hope, withdrawing them or their sympathies from the land of their adoption or birth."

3. *German.*—"The object is that an understanding between the three Great Powers will render war impossible and educational relations make the strongest tie."

Rhodes believed that his objects would be best attained by bringing together for education at Oxford young men selected for certain qualities which he defined as follows:—

"My desire being that the students who shall be elected to the scholarships shall not be merely bookworms, I direct that in the election of a student to a scholarship regard shall be had to (*a*) his literary and scholastic attainments; (*b*) his fondness for and success in manly outdoor sports such as cricket, football and the like; (*c*) his qualities of manhood, truth, courage, devotion to duty, sympathy for and protection of the weak, kindliness, unselfishness and fellowship; and (*d*) his exhibition during school days of moral force of character and of instincts to lead and to take an interest in his schoolmates, for those latter attributes will be likely in after life to guide him to esteem the performance of public duties as his highest aim."

Method of Selection.—Subject to ratification by the Trustees, the nomination of scholars is in the hands of representative local committees, which are appointed by the trustees, and on which ex-Rhodes scholars sit. In general candidates must be citizens of the country, Dominion or Colony, which they are to represent, with at least five years' domicile, and unmarried; and they must have passed their 19th and not have passed their 25th birthday by Oct. 1 of the year for which they are elected. There are no qualifying examinations: candidates are judged on their records and after a personal interview with the selection committee. But, except in four exceptional cases, candidates are obliged to have attended a recognised degree granting college or university for two years at least. At Oxford the scholars are distributed, as Rhodes desired, among all the colleges at the university, as far as possible in accordance with their own wishes, but acceptance of any scholar is determined ultimately by the colleges themselves. No college undertakes to accept more than a limited number of Rhodes scholars in any one year—the number varying from two to five. The offices of the trust are at 17, Waterloo Place, London, S.W.1. (P. K.)

RHONDDA, DAVID ALFRED THOMAS, 1ST VISCOUNT (1856–1918), British colliery owner and politician, was born March 26 1856 in Aberdare. His father, a Merthyr grocer, had prospered in his trade, and in later life enriched himself by speculations in coal. Thomas was educated at Clifton College, and Caius College, Cambridge, where he graduated in the mathematical tripos in 1880. Immediately he joined his father in the coal business, into which he threw himself with great energy and ability. His extraordinary commercial gifts, his insight, his foresight and the sympathy which he brought to bear on conditions of life in the mining industry, soon made him a prominent, and eventually the leading, figure in the industrial world of South Wales. His business combinations brought him great wealth, and culminated in the Cambrian supercombine, which produced some 6,000,000 tons of steam coal a year.

Though he had sat as a Liberal for Merthyr Tydvil for 22 years from 1888, and for Cardiff for a few months in 1910, Thomas achieved no political importance till the outbreak of the World War, when he rendered substantial help to Mr. Lloyd George, both at the Exchequer and at the ministry of munition by organising British industrial resources. He took a lead in "capturing German trade," carrying through, for instance, the acquisition of the Sanatogen business. He went to America to complete important war contracts for the Government, and on his return was saved, with his daughter, Lady Mackworth, from the sinking of the "Lusitania." He went back to America almost immediately, and spent seven months there at his own expense, expediting the output of munitions. He was created a baron, as Lord Rhondda, for his services, in Jan. 1916; and took office in Mr. Lloyd George's Ministry in the following Dec. as President of the Local Government Board, passing to the Food Controllership in June 1917. There he immediately took strong steps to put an end to speculation in the necessities of life; he gradually fixed prices and brought supplies under control.

But he will be mainly remembered as the author of the system of compulsory food rationing, which was carried out with absolute fairness and impartiality. The turnover of his Ministry, apart from the work of the wheat and sugar commissions, amounted to £1,200 millions sterling; with them £2,733 millions sterling. Supplies never failed, and in spite of the German submarines there was no hunger in the United Kingdom. His strenuous labours affected his health, and in April 1918 he tendered his resignation; but pressure was put upon him to remain. He was attacked by pneumonia and died on July 3 at Llanwern, Monmouthshire. Just previously he had been created a Viscount. He married Sybil Margaret Haig, a cousin of Lord Haig. Their only child, a daughter (who married Sir Humphrey Mackworth in 1908, and obtained a dissolution of their marriage in 1923), succeeded to the viscounty of Rhondda under a special remainder. In 1921 Lady Rhondda published a *Life* of her father.

RHYS, SIR JOHN (1840–1915), British archaeologist and scholar, was born in Cardiganshire, Wales, June 21 1840. Educated at Bangor normal college and Jesus College, Oxford, he continued his studies on the European Continent. In 1877 he was elected the first professor of Celtic at Oxford, becoming in 1895 principal of Jesus College. He was Hibbert lecturer in 1886, Rhind lecturer on archaeology at Edinburgh in 1899 and president of the anthropological section of the British Association in 1900. Knighted in 1907, he died at Oxford Dec. 16 1915. Among his published works are *Lectures on Welsh Philology* (1877); *Celtic Britain* (1882, 1904); *Celtic Heathendom* (1886); *Studies in the Arthurian Legend* (1891); *The Welsh People* (with D. B. Jones, 1900); *Celtic Folk-lore* (1901).

RIAZ PASHA (c. 1835–1911), Egyptian statesman (*see* 23.281), died June 18 1911.

RIBOT, ALEXANDRE FÉLIX JOSEPH (1842–1923), French politician (*see* 23.285). In 1909 M. Ribot left the chamber for the Senate and four years later was a possible candidate for the Presidency of the Republic. In June 1914 M. Poincaré summoned M. Ribot to form a cabinet. He succeeded in doing so but the new Government under his premiership fell on the vote of the first ministerial declaration. He returned to office in Aug. 1914 as Minister of Finance in M. Viviani's reconstituted Ministry of National Defence. He held the same office in the Ministry formed by M. Briand on Oct. 29 1915 and again in the reduced cabinet of Dec. 1916. In March 1917 he succeeded M. Briand as Prime Minister and Minister of Foreign Affairs. He gave way in Sept. of the same year to M. Painlevé in whose Government he retained the Ministry of Foreign Affaires, which he resigned in the following month. Between the Armistice and 1923 he was prominent in upholding French claims to reparations and in warning his countrymen of the difficulties that would ensue if the payments were not made. M. Ribot was a member of the Académie Française and of the Académie des Sciences Politiques et Morales. He died in Paris Jan. 13 1923.

RIBOT, THÈODULE ARMAND (1839–1916), French psychologist (*see* 23.286), died in Paris Dec. 9 1916.

RICE: *see* FOOD SUPPLY.

RICHARDS, THEODORE WILLIAM (1868–), American chemist, was born at Germantown, Pa., Jan. 31 1868. He was

educated at Haverford College (S.B., 1885), Harvard University (A.B., 1886; Ph.D., 1888), Göttingen, Leipzig and the Dresden Technical School. After passing through the various grades of promotion, he was appointed professor of chemistry at Harvard in 1901, and was made director of the Wolcott Gibbs memorial laboratory in 1912. He was best known for his researches on atomic weights, of which he revised over a score, including that of uranium-lead. The results were generally accepted, and for his contributions he received the Nobel Prize in chemistry in 1914. He also gave much time to physicochemical investigation, especially concerning electrochemistry and chemical thermodynamics, piezochemistry and surface tension. Of these, his contributions to atomic compressibility, to the relation between the change of heat capacity and the change of free and total energy and to the thermodynamics of amalgams are noteworthy. In 1907 he was Harvard exchange professor at Berlin, and in 1908 Lowell lecturer. He was made a member of the National Research Council in 1916, and became consulting chemist in the Dept. of War and Bureau of Mines 1918. He was president of the American Chemical Society (1914), the American Association for the Advancement of Science (1917) and the American Academy of Arts and Sciences (1919). (*See* ATOMIC WEIGHTS.)

RICHBOROUGH, England (*see* 4.584), a port on the estuary of the Stour, in Kent, 1¼ m. from Sandwich, was established during the World War to relieve the traffic in military stores through Dover. Work was started in 1916 with the widening and deepening of the Stour, and the cutting of a canal across a large bend; 250 ac. of sea marsh were then reclaimed, and nearly a mile of wharfage built and equipped. In six months from the start of the work, which at one time occupied 20,000 hands, regular cross-channel services of barges to Calais and Dunkirk were begun, and later special barges were introduced to take goods direct into the French canals and as near the firing line as possible. The base, begun in a comparatively small way, developed into a gigantic undertaking. In 1917 three special train ferries, each accommodating 54 ten-ton trucks, were constructed, with a lifting bridge at the wharf end. They are now in use on the Harwich-Zeebrugge route. In 1925 the port of Richborough with 1,500 ac. of land, the remaining equipment, and the fleet of ferries and barges, was sold to Messrs. Pearson and Dorman Long for development in connection with their undertakings in the Kent coalfields. There were only 10 residents in the parish of Stonar, in which Richborough is situated, in 1921.

Richborough Castle, where important archaeological excavations are in progress, is one of the most remarkable monuments of the Roman occupation of Great Britain. It marked the beginning of Watling Street, and guarded the wide channel of the Wantsum, then separating the Isle of Thanet from the mainland. Richborough (*Rutupiae*) was a landing place and base for Roman legionaries, and the foundations of its buildings lie to the west of the castle walls. The extant remains of the castle include the north wall of the castellum, 460 ft. long and 22 ft. high. In the centre of the enclosure is a cruciform platform of concrete, 144 ft. long and 104 ft. wide, on a square stone foundation; its purpose is uncertain, but it is believed to have borne a lighthouse. A subterranean passage runs round the foundations of the platform.

RICHMOND, SIR WILLIAM BLAKE (1843–1921), British painter (*see* 23.307), died at Hammersmith, London, Feb. 11 1921.

RICHMOND, Va., U.S.A. (*see* 23.309).—The population increased 34·5% in the decade after 1910, reaching 171,667 in 1920 (88·6 males to 100 females), of whom 54,041 were negroes and 4,713 foreign born. According to an estimate of the U.S. Census bureau, the population had reached 186,403 in 1925 with an additional 30,000 or more in the immediate suburbs. Annexations of territory brought the area to 24 sq. m. by 1920. Richmond was selected as the seat of the Federal Reserve Bank of the Fifth District. Bank clearings reached $3,053,232,722 in 1920, and averaged about $2,750,000,000 per year for the period 1920–4. Manufactures were valued at $47,358,000 in 1909; $156,724,000 in 1919; and $146,412,589 in 1923. The leading industries, after tobacco, were the manufacture of iron and steel products, wooden articles, blotting paper and fertilisers; and printing and publishing. Industrial power was available from three hydroelectric plants, and additional developments were underway.

Modifications in the charter in 1919 provided for five departments in the city government, each with a director appointed by the mayor, subject to confirmation by the city council, these five directors, together with the mayor, forming an advisory board to administer the affairs of the city. Improvements up to 1925, in view of a possible population of 350,000 within 25 years, included the rebuilding of the gas works, the installation of a system of high-pressure water supply, additions to the filtration plant, the protection of the lower areas against flood, the construction of new bridges, the development of a city plan and adoption of zoning ordinances, the erection on an average of two new school buildings each year, and projects for improving the harbour facilities and for straightening the river and establishing a 30-ft. channel to Hampton Roads. The number of pupils in the public schools reached 35,000 in 1924, including 3,500 attending evening classes.

RICHTER, HANS (1843–1916), Hungarian musical conductor (*see* 23.312), died at Bayreuth Dec. 5 1916.

RICKETS: *see* ORTHOPAEDIC SURGERY.

RICOTTI-MAGNANI, CESARE (1822–1917), Italian general (*see* 23.316), died at Novara Aug. 4 1917.

RIDDELL, GEORGE ALLARDICE RIDDELL, 1ST BARON (1865–), British newspaper proprietor, was born in London May 25 1865 and educated privately. He became a solicitor in 1888 and settled in practice at Cardiff. There he acquired an interest in *The Western Mail*, and he eventually turned his energies mainly to newspaper management. He went to London and obtained control over the Sunday paper *The News of the World*, which he developed on popular lines, so that it obtained a huge circulation during the first decade of the 20th century and made its proprietor a wealthy man. He gradually extended his newspaper connections, becoming a director also of George Newnes Ltd., Country Life Ltd. and C. Arthur Pearson Ltd., etc. In 1909 he received a knighthood. He was a prominent member of the Newspaper Proprietors' Association at the outbreak of the World War, and, owing to his intimate relations with Mr. Lloyd George, he gradually became the principal liaison between the Press and the Government so far as all matters of publicity were concerned. In this capacity he represented the British Press at the Peace Conference in 1919 and at all the important Allied conferences subsequently. He was created a baronet in 1918 and raised to the peerage as Baron Riddell of Walton Heath in 1920. His publications include *Some Things That Matter* (1922) and *More Things That Matter* (1925). (*See* CENSORSHIP.)

RIDING (*see* 23.317).—In the earlier days of motoring, riding, as apart from hunting and polo, received a somewhat severe setback. But the decrease in the number of those who rode merely for pleasure was not of long duration, and even before the War there were signs that horsemanship was still a desirable accomplishment, while during the years that have passed since the War there has been a marked increase in the number who ride. In Great Britain the increased interest in riding is due to the admirable series of horse shows which are now held all over the country. Not that the horse show is in itself a novelty, but rather because there has of late years been a determined attempt by the executives of the more important shows to include more riding classes in their programmes, and to make such classes more attractive. The army equestrian schools have developed to an extraordinary degree, and there is a considerable body of public opinion which favours "school" riding, not only as a part of education in horsemanship, but as an aid to successful riding in the hunting field. The facts which have most bearing on the future of riding are the great increase in the number of horsewomen, both in the hunting field, at the show and in the country generally, and the increase in the number of children's riding classes at the shows. These have multiplied 10 times in as many years, and are at the present day not only some of the most interesting, but the most popular of all the riding classes, high-class jumping alone excepted.

RIF CAMPAIGNS: *see* MOROCCO, CAMPAIGNS IN.

RIFLES AND LIGHT MACHINE GUNS (*see* 23.325).—The small arms used by modern armies may be grouped into rifles, light machine guns, machine guns and heavy machine guns. For the two latter *see* the article MACHINE GUNS. Light machine guns are also known as light automatics (Great Britain), *fusils mitrailleurs* (France) and machine rifles (United States).

I. THE MILITARY RIFLE

Definition.—A rifle so constructed as to constitute a complete offensive and defensive arm for one man and of such a size and weight that one man can carry it, together with its ammunition and accessories and the other essentials that a soldier is required to carry, over the ground and distances he is expected to cover in war. The weight of the military rifles of most countries averages 9 lb. without bayonet, which weighs about 14 ounces. The ammunition carried by each man varies from 100 to 150 rounds and weighs from $5\frac{1}{2}$ to $8\frac{1}{2}$ lb. inclusive of the metal clips or chargers, each of which holds five rounds. Subject to minor variations, the military rifles of the principal nations are of the following distinct types: Short Lee-Enfield (British), Mauser (German), Mannlicher (Austrian), Lebel (French), Krag Jorgensen (Norwegian and Danish), Schmidt Rubin (Swiss), Three Line (Nagant) (Russian), and Springfield (United States).

Great Britain.—In 1902 the first short magazine Lee-Enfield ·303 Mark I. rifles (S.M.L.E.) were issued for the British service, and by 1907 this rifle had been improved and advanced to Mark III. Further improvements in matters of detail were under consideration in 1926, but no alterations in the main features of the "action" were contemplated. Mark VII. ammunition was introduced in 1910. The bullet is lighter than that of the Mark VI., has greater muzzle velocity and flies on a much flatter trajectory, thereby increasing the probability of hitting a given mark. Before the World War, however, still greater velocities and flatter trajectories were being sought for and obtained by continental nations. The problem was taken up by the British War Office, and a rifle, bored to ·276, was issued in limited numbers for trial by the troops. The ammunition for this rifle had a rimless cartridge, a lighter bullet than the Mark VII., with much greater velocity but with much increased chamber pressure. To cope with this greater chamber pressure, a rifle was designed with a front locking action similar to that of the Mauser, which was considered stronger and better able to withstand the firing stresses. The experiment was interrupted by the outbreak of war, and the suggested change from ·303 S.M.L.E. Mark III. to the new ·276 was abandoned.

When the War began the number of men enlisted soon reached a figure far in excess of that for which provision had been made, and to provide them with a rifle for home defence and even training purposes became a pressing necessity. Accordingly, large orders were placed in America for the ·276 design of rifle, the only departure from the original being that it was bored to take the ·303 Mark VII. ammunition. This rifle was then issued to the troops and became officially known as the "British Rifle, Pattern 1914" (see fig. 1). It is very accurate, and, when provided with a telescopic sight, is used for "sniping," in which accuracy rather than rapidity of fire is the main desideratum. It was the only new design of rifle adopted by any of the belligerents during the War for use by rank and file. Being manufactured in America, this pattern, bored to take the American ·3 ammunition, was issued to American troops when it became necessary to augment the supplies of the United States Springfield service rifle.

France.—In the Lebel, first issued in 1886 and still the service rifle in 1914, the magazine, which held 8 rounds, consisted of a tube with spring plunger, underneath and parallel to the barrel. This system proved to have many drawbacks, and accordingly in 1915 a box magazine of conventional type was substituted for the tube.

Germany.—During the War, carbines (*i.e.*, very short rifles for mounted troops) were issued to troops in the trenches, apparently with the object of equalling if possible the lightness and handiness of the British S.M.L.E. The main features were identical with those of the ordinary service Mauser rifle, but by reducing the diameter of the body and barrel and shortening the barrel and stock the weight, as compared with the rifle,

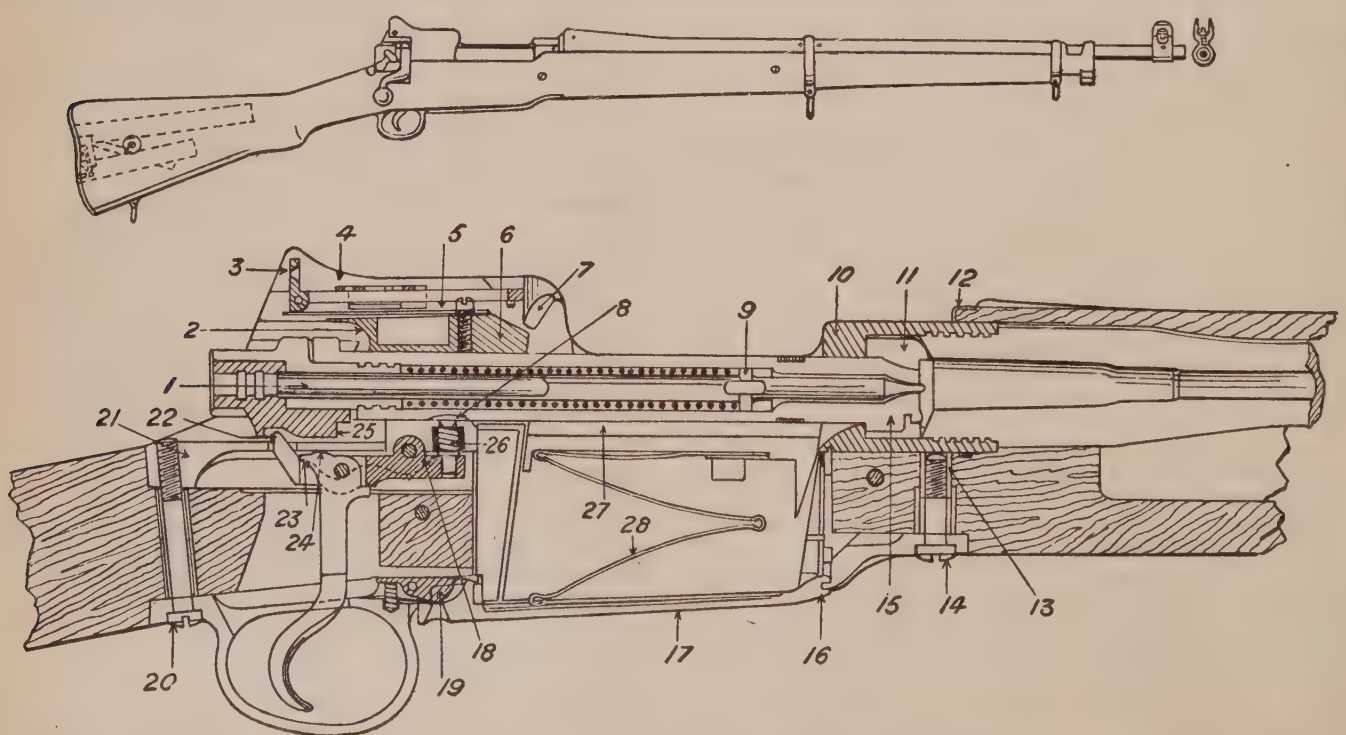

FIG. 1.—·303 in. magazine rifle, Enfield pattern (1914). 1. Striker. 2. Extraction cam. 3. Fixed sight aperture. 4. Wings protecting backsight. 5. Backsight spring. 6. Backsight bed. 7. Charger guides. 8. Sear safety stud. 9. Striker, front collar. 10. Body hood. 11. Bolt, split lug. 12. Ring retaining handguard. 13. Body rib. 14. Trigger guard, front screw. 15. Solid locking lug. 16. Undercut rib of bottom plate. 17. Magazine, bottom plate. 18. Lugs for sear. 19. Magazine catch. 20. Trigger guard, back screw. 21. Body tang. 22. Sear nose. 23. Trigger, 2nd point on head. 24. Trigger, 1st point on head. 25. Cocking piece bent. 26. Sear spring. 27. Magazine platform. 28. Magazine spring.

was reduced from 9 lb. to 7 lb. 13 oz. and the length from 49½ in. to 43½ inches.

After the first appearance of the tanks in the War, the Germans introduced a new form of weapon, the ·5-in. anti-tank rifle, intended for use against tanks only. It was provided with very powerful ammunition, having a high velocity, heavy, armour-piercing, streamline bullet of 801 grains, the extreme range of which has been found to be 7,000 yards. (The ordinary German Spitz rifle bullet weighs 155 grains.) This rifle had a single loading Mauser action without a magazine and, to cope with such ammunition, had to be correspondingly strong and heavy. It weighed 37 lb., was provided with a bipod mounting and was served by two men carrying 124 rounds of ammunition. Periscopic attachments, wire cutting devices and mountings of various kinds were common in all armies during the War, but most of them have since been discarded.

The Automatic Rifle.—An automatic rifle is one in which the operation of reloading is performed by power derived from the explosion of the charge. In order to rank as a complete offensive and defensive weapon it should take the same ammunition and give the same ballistics and efficiency as the ordinary rifle and also lend itself to effective use in close combat when fitted with a bayonet.

The automatic rifle, though undergoing continuous development, had not in 1926 reached such a degree of efficiency as to warrant its adoption. It has been found best not to make the automatic rifle capable of continuous fire, which in a light weapon with great recoil energy would be unpleasant to the user and very disturbing to the aim. Moreover the injudicious use of continuous fire would make still more difficult the replenishment of ammunition supplies. Accordingly the term "automatic" is perhaps unsuitable, and "semi-automatic" or "self-loading" would more aptly describe rifles of this type, in which, for each pull of the trigger only one round is fired.

II. THE LIGHT MACHINE GUN

Definition.—A truly automatic (self-firing) firearm, which is portable but too heavy to be adapted for use as a close-combat weapon. The increased weight (17 to 28 lb.) makes the recoil energy less than that of the rifle, and a rest is provided at the front end which keeps the continuous fire it delivers reasonably accurate under ordinary conditions. To make the best use of this weapon much ammunition must be carried and it is accordingly manned by a team, one man carrying the gun and the others ammunition, spares and accessories.

Light Machine Guns in the World War.—Prior to 1914 the main armament of infantry in all armies was the rifle (with bayonet), and the machine gun averaging 40 to 50 lb. in weight, on a fixed mounting. The light machine gun was a product of the trench warfare of the World War. When trench warfare started the power of manoeuvre disappeared and it was no longer possible to establish a superiority of fire in "the fire fight" by skilful tactics. Superiority in fire power from small arms had to be secured by other means, and hence arose a greater demand for automatic weapons, which, manned by a few men, develop a fire power equivalent to that of a considerable number of men armed with rifles. Further, in the battles fought in the early days of trench warfare, the muddy state of the ground, the obstacles which had to be surmounted and the heavy weight of the existing machine gun with its mounting, frequently prevented the gun team from getting the gun forward into position after an attack. Lightness and mobility were even more important than accuracy and capacity for sustained fire. Accordingly, the light machine gun definitely took its place in the equipment of the armies of most of the countries of the world.

Some of the principal light machine guns employed in the World War and some of the newer types are tabulated below with a few details.

TABLE I. *Light Machine Guns Used in the World War*

Country	Britain		France			Germany			U.S.A.
Guns	Lewis	Hotchkiss	Chauchat	Darne	Lewis	Madsen	Bergmann	Parabellum	Browning
Weight	26½ lb. 18 lb.[1]	28 lb.	19 lb.	15 lb. 14 oz.[1]	Same as British[1]	20 lb.	25 lb., 12 oz.	22 lb.[1]	15 lb., 14 oz.
How Fed	47 rd. Magazine[2]	30 rd. Strip 50 rd. Belt[3] (Used in Tanks)	20 rd. Semi-circular box Magazine[4]	Belt[5]		40 rd. Box Magazine[6]	Belt[3]	Belt[3]	20 rd. Box Magazine[4]
How Operated	Gas	Gas	Recoil 5 in.	Gas		Recoil 2 in.	Recoil 1⅛ in.	Recoil ⅞ in.	Gas
How Cooled	Radiation and Draught	Radiation	Radiation	Radiation		Radiation	Radiation	Radiation	Radiation
How Locked	Locking lugs on rotating bolt	Rotating threaded nut locks with threads on breech bolt	Locking lugs on rotating bolt	Bolt forced up by piston to lock in front of resistance shoulders		Breech Block pivoted to open and close breech	Locking Block forced down into recess in bolt	Toggle joint as on Vickers Machine Gun	Hinged Block rising in front of resistance shoulders in body

[1] Used in aircraft. [2] Horizontal on top of gun. [3] Into right side. [4] Vertical underneath. [5] Into left side. [6] Vertical on top.

TABLE II. *New Light Machine Guns Recently Adopted or Likely to Be Adopted*

Country	Guns	Weight	How fed	How operated	How cooled	How locked	Special features
Swiss, 1924	Fusil Furrer	18 lb.	30 rd. Magazine[2]	Recoil (Long)	Radiation	Knuckle Toggle Joint	Unusual position of Magazine
Japan	Numu 1922	19 lb. 13½ oz.	30 rd. Clip		Radiation		No information available
Spain			15 rd. Belt				Bullet 140 grains
Greece	Gladiateur						Recent purchase
Russia	Fedorou[1]	11 lb.	25 rd. Belt	Recoil	Radiation	2 inter-locking Bolts	·256. Russian rifles take ·3 Ammunition.

[1] More a sub-machine gun than a light machine gun. [2] Into right side.

All these automatic weapons are operated either by gas or recoil.

Gas Operated Guns.—All gas-operated weapons are practically identical in principle, and where differences occur they are usually in matters of detail, the merits of which vary accordingly as they are efficient and cheap, permit of easy manufacture, maintenance and manipulation and are readily understood. Typical of gas-operated weapons is the Lewis gun (see fig. 2).

Recoil Operated Guns.—In recoil operated light machine guns, the mechanical systems employed are more varied than are those used in gas operated weapons, and there is no general principle to which they closely adhere. A feature common to all, however, is the recoiling barrel which overcomes the resistance of antagonistic springs. These, at the finish of its backward travel, return the barrel to its forward position. The length of recoil varies in different guns from about one inch to

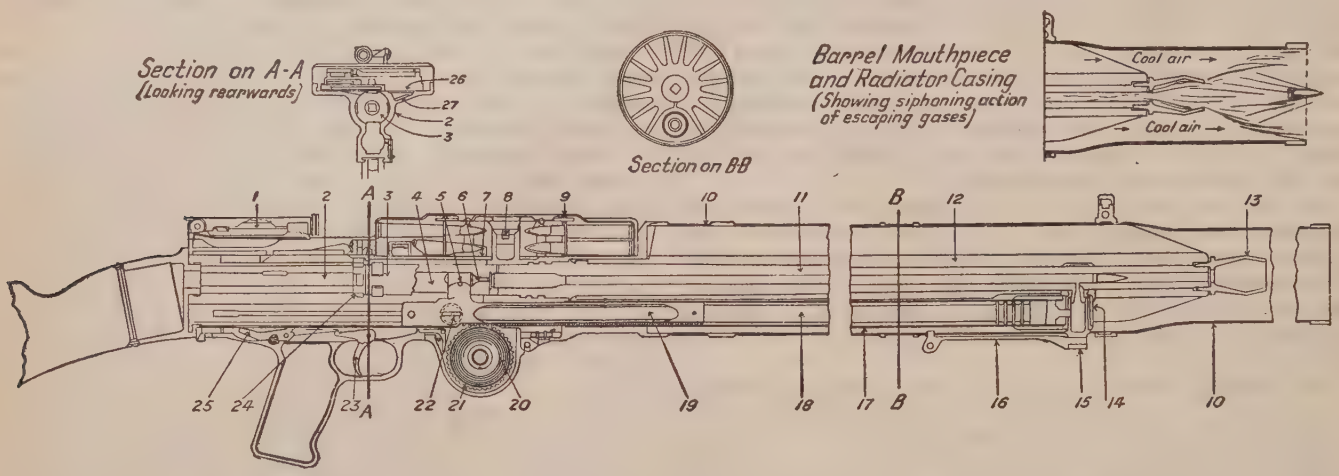
Section on A-A
(Looking rearwards)
26
27
2
3
Section on BB
Barrel Mouthpiece and Radiator Casing
(Showing siphoning action of escaping gases)
Cool air
Cool air
1 2 A 3 4 5 6 7 8 9 10 11 B 12 13
25 24 23 A 22 21 20 19 18 17 B 16 15 14 10

FIG. 2.—Lewis Gun. Total length 50 inches. 1. Backsight. 2. Receiver. 3. Bolt. 4. Extractor. 5. Striker fixing pin. 6. Striker. 7. Feed operating arm. 8. Magazine latch. 9. Magazine top plate. 10. Radiator casing. 11. Barrel. 12. Radiator. 13. Barrel mouthpiece. 14. Gas chamber. 15. Gas regulator cup. 16. Gas regulator key. 17. Gas cylinder. 18. Piston. 19. Rack. 20. Mainspring. 21. Gear. 22. Charging handle. 23. Trigger. 24. Feed operating stud. 25. Sear. 26. Ejector cover. 27. Ejector.

The principle usually adopted in gas-operated weapons is to divert the gas, which is forcing the bullet up the barrel, through a small hole into a gas chamber, and thence on to a piston situated underneath the barrel and free to work parallel to it. On discharge, the piston is driven back, compressing antagonistic springs. At the end of the backward travel, the springs force the piston again to its forward position ready for the next blast of gas to take effect. On its backward journey the piston operates the mechanism for feeding the cartridges into the gun, so that when the piston is fully back, a round is ready for gathering and insertion into the chamber as the piston again goes forward. The piston on going forward brings about the locking of the mechanism against the shock of discharge and the firing of the round, which by that time is fully home in the chamber. Such a system is known as "positively locked," and "mechanically safe" an essential feature of which is that it is impossible for a round to be fired until after the locking has been completed. Moreover, after the explosion of the charge, no unlocking of the action can take place until the bullet is clear of the barrel, and there is no longer any pressure of gas.

The gas chambers are usually designed with a view to enabling the volume of gas that strikes on the piston to be controlled, thus permitting of a reserve of power should friction or other conditions arise which might tend to impede or cause incomplete movement of parts.

five inches; consequently they are classified as "long" or "short" recoil. (The length of recoil is shown in the table.) Another common feature is that the barrel and bolt (or lock) are mechanically locked together for a certain length of the recoil, thereby sealing the breech till the bullet is clear.

In "long recoil" actions, the bolt, having come back with the barrel, is held in its rearmost position, with the extractor engaged behind the rim of the cartridge which is still in the chamber. Accordingly, as the barrel moves forward under the influence of the springs which have been overcome in the backward travel, the round is withdrawn from the breech and ejected. The Chauchat (see fig. 3) is a type of the "long recoil" guns.

In "short recoil" actions, such as that of the Bergmann gun (see fig. 4) of about one inch barrel movement, mechanism is provided whereby the bolt, locked to the barrel for a certain length of recoil (created by firing), is unlocked and withdrawn about three in. from the barrel after the latter has completed its inch of recoil. In this separation of bolt and barrel, extraction and ejection of the empty cartridge case is effected, and a new round is inserted into the chamber.

The Madsen action does not conform to the above description, for in it the separation of breech from bolt is effected by guiding the bolt away from the breech in a vertical plane, the bolt being pivoted in rear to permit of this movement.

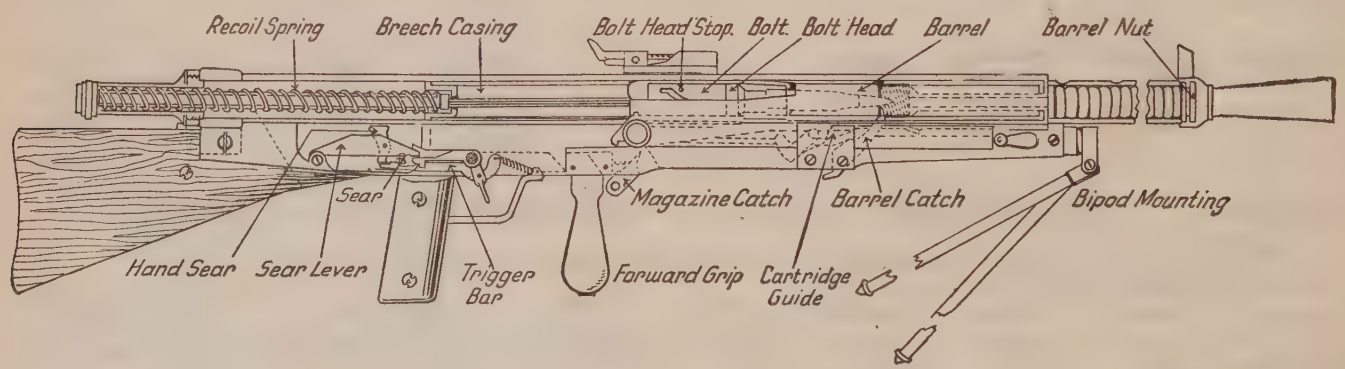

FIG. 3.—Chauchat light machine gun (long recoil). Total length 45½ inches.

FIG. 4.—Bergmann light machine gun (short recoil). Total length about 48 inches.

In "short recoil" guns, the recoil and return of the barrel is the source of power for operating the mechanism which brings about the feeding of the cartridges into the gun, in the same way as does the piston in gas operated weapons. Normally, for such guns, the rounds are contained in a belt which is mechanically led through the gun, the rounds being withdrawn from it during its passage. In "long recoil" weapons, the system of feed is normally by magazine, the rounds being pushed by a spring inside the magazine into the space which is created when the bolt remains back as the barrel goes forward.

The Sub-Machine Gun.—The sub-machine gun is a kind of automatic pistol, but heavier, more powerful, and with a longer range than the usual pattern. It is capable of a high rate of fire but is lighter than other automatics. The ammunition resembles pistol ammunition. In the gas operated Thompson

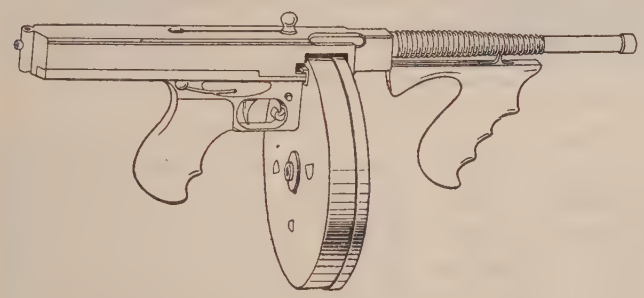

FIG. 5.—Thompson sub-machine gun. Total length 23 inches.

sub-machine gun (see fig. 5) the breech is sealed by the agency of adhering inclined surfaces on those portions of the mechanism which support the bolt against the gas pressures generated within the barrel. (H. R. A.)

RIGA, Latvia (*see* 23.337), the capital and the only large town of Latvia, and one of the three principal ports, had an area of 90 sq. km., and a population of 327,176 in 1925, as compared with 520,000 before the World War. Some 54% were Latvians and only about 8% Russian, but the Russian language is much used, and Latvian comparatively little understood. Although an important and well-organised industrial centre before the War with a large trade with Russia, industry was at a low ebb in 1925: the transit trade with Russia was small; and showed little prospect of improvement. Much of the factory equipment was removed during the War, when the town was damaged by bombardment. Riga remains, however, the industrial centre of Latvia and had 501 manufacturing establishments in 1921, whilst 87% of the trade of the country goes through the port. An agricultural and industrial fair is held yearly. Little building has been done. A scheme has been put forward for developing power for lighting, trams and factories from the Dvina river, but no decision had been taken in 1925. The Riga polytechnic was made into a university in 1919, Dorpat University, which previously served all the Russian Baltic provinces, having become Estonian property. An international exhibition was held in 1924.

RILEY, JAMES WHITCOMB (1853–1916), American poet (*see* 23.343), died at Indianapolis, Ind., July 22 1916. In 1915, by proclamation of the governor of Indiana, his birthday, Oct. 7, was observed throughout the State, in honour of "Indiana's most beloved citizen." In 1913 he issued in six volumes a biographical edition of his works. See Clara E. Laughlin, *Reminiscences of J. W. Riley* (1916).

RILKE, RAINER MARIA (1875–), German poet, was born at Prague Dec. 4 1875. From 1900–10 he, together with Stefan George, held the field in lyric poetry. In his autobiographically-coloured *Aufzeichnungen des Malte Laurids Brigge* (1910) Rilke declares: "Verses are not sensations, as people think—they are experiences. For the sake of a single verse one must see many towns, men and things, one must know the animals, one must feel how the birds fly and in what way the little flowers open in the morning." His works include: *Buch der Bilder* (1902); *Stundenbuch* (1906); *Neue Gedichte* (1907–8); *Sonette an Orpheus* (1923).

RINGWORM: *see* SKIN DISEASES.

RIO DE JANEIRO (*see* 23.353).—According to the census of 1920, the population of the independent municipal commune, or Federal district, which contains the city and is detached from the province of the same name, was 1,157,873, an increase of 43% since 1906. In 1920 there were 1,265 factories, with 46,953 operatives, representing a capital of nearly 270,000,000 paper milreis and an annual production valued at 5,000,000,000 milreis.

The Federal district is governed by a prefect appointed by the president of the republic, and elects three senators and 10 deputies to the national Congress. The legislative power of the municipality is vested in a council of 24 *intendentes* elected for three years. The consolidated debt of the municipality in 1920 was computed at 227,089,200 paper milreis, of which 129,225,450 milreis was an external debt, and 97,863,750 milreis internal. The revenue had grown from 29,070,883 paper milreis in 1910 to 51,182,357 paper milreis in 1919.

Education.—Primary instruction is provided by the municipality, which in 1920 maintained 320 day schools and 68 night schools, with a matriculation of 74,111 pupils in the former and 8,662 in the latter. There were in addition 236 elementary private schools, with 19,825 pupils; over 80 receive a subvention from the Govt. if they adopt the official curriculum and admit a certain number of children free. Secondary instruction is cared for in public *lycées* and private establishments. There is no university, but the capital possesses higher faculties of law, medicine and engineering, besides schools providing instruction in pharmacy, dentistry, commerce, music, drama and fine arts. The national Govt. also maintains a naval academy, a military college and a preparatory school of tactics. The most important libraries are: the National Library, the best appointed in South America, the Municipal, the Cabinete Portuguez da Leitura, that of the Lycée of Arts and Crafts and the collections existing in the ministries and departments.

Streets and Buildings.—During the period 1910–26 the ambitious programme of municipal improvements inaugurated in 1903 was in large measure completed. The port works, including a sea wall over 2 m. long, 8 ft. above mean high tide and lying almost entirely in deep water, enclose a broad reach of reclaimed land and provide the city with the most modern facilities for loading and unloading ships. The Avenida Rio Branco (formerly Avenida Central) is one of the handsomest thoroughfares in the Western Hemisphere. Over a mile long from north to south, it is lined with fine private and public buildings. The military, naval and jockey clubs are situated there, and also the offices of some of the principal newspapers, such as the *Jornal do Commercio* and *O Paiz*, besides fashionable shops, cafés and business places. At the southern end is a group of elegant state edifices: the Municipal Theatre, the Monroe Palace and the National Library and Academy of Fine Arts. The Municipal Theatre, designed in 1904, cost over £2,000,000, although it seats but 1,700 people. The building which houses the National Library, opened in 1910 in commemoration of the centenary of its founding (1808), is also a notable addition to the city. It is a fireproof structure of granite, marble and steel, equipped with every modern library appliance.

One of the important developments of Rio de Janeiro has been in suburban road building. As the hills come practically to the

bay and sea, construction is difficult, but great progress has been made and a 40 m. motor drive over perfect roads joins all the famous beaches with Tijuca and the city. The magnificent bayside drive, the Avenida Beira-Mar, with double motor track and intervening lawns and gardens is particularly remarkable.

Sanitation.—The city, formerly a hotbed of yellow fever and smallpox, has become one of the healthiest tropical cities in the world. The death-rate has fallen to about 20 per 1,000. This is the result of a campaign of scrupulous cleanliness, rigid enforcement of sanitary measures and scientific eradication of mosquitos and other germ-bearing insects, inaugurated under the direction of the celebrated Brazilian scientist, Dr. Oswaldo Cruz, in the first administration of President Rodrigues Alves (1903). In 1920 a law was passed by Congress creating a national Department of Public Health, consisting of three divisions, one in charge of the Federal capital (C. H. H.)

RIO DE ORO (*see* 23.357).—By Franco-Spanish agreements of 1904 and 1912 the Spanish zone in the Sahara—which is bounded east and south by French territory—was extended first from Cape Bojador (the northern limit of the Rio de Oro colony) to Cape Juby, and secondly from Cape Juby to the Wad Draa, the inland frontier being fixed at 8°40′ West. The 1912 agreement settled a matter long in dispute by fixing the southern frontier of Morocco, which had claimed the Cape Juby district, at the Wad Draa. By the agreement in question Spain bound herself not to cede or alienate in any form her rights in her zone of influence. The value of the Spanish Sahara is, however, slight. The greater part of its area, about 102,000 sq. m., is desert; its inhabitants, nomad Arabs or Arabised Berbers, do not exceed 100,000, of whom four-fifths live in the northern half. Here, in the basin of the Saqiyet el Hamra, a river reaching the Atlantic midway between Capes Juby and Bojador, are fertile regions which might repay cultivation, including the oasis of Smara, where is a permanent native settlement and a Kasbah (stone fort). The Spanish headquarters are at Villa Cisneros, on the peninsula forming the Rio de Oro inlet. It has about 500 European inhabitants. In 1916 a small Spanish force was stationed at Cape Juby. The chief advantage Spain derives from possession of the country is its convenience to the Canary Islands fishermen as a curing station and fish depôt. The waters between the Canary Islands and Rio de Oro abound with fish, but the industry is little developed.

See *Spanish Sahara* (1920); British Foreign Office handbook No. 124; also the *Revista* and the *Boletin* of the Royal Geographical Society of Madrid.

RITCHIE, ANNE ISABELLA, Lady (1837–1919), British writer (*see* 26.716), died at Freshwater, Isle of Wight, Feb. 26 1919.

RIVER AND CANAL ENGINEERING (*see* Canal, 5.168; River Engineering, 23.374; Weir, 28.496).—The most important event of the period under review (1910–26) was the opening of the Panama Canal to traffic in Aug. 1914 (*see* 20.666; also Panama Canal).

There has been, since 1911, considerable development of canal and river navigation in France, Belgium, Holland, Sweden, central Europe, Canada and the United States of America, but very little in Great Britain, where the physical, industrial and economic conditions of the country provide little scope for such progress. On the other hand, many tidal rivers in the United Kingdom which afford access channels to important seaports have been improved by deepening and otherwise to keep pace with the development of trade and increases in dimensions of shipping. Similar changes have taken place in many river ports in foreign countries (*see* Port Engineering). Dredging craft of all descriptions have been improved to meet requirements, and at least one bucket dredger has been built capable of dredging material from a depth of 76 ft. below water level as well as suction dredgers of slightly less capacity as regards depth.

I. IN THE OLD WORLD

Great Britain.—The navigation of the Trent between Newark and Nottingham has been improved by the construction of four new locks on this section. Begun in 1921, these will enable 120-ton barges to navigate at all seasons of the year as far as Nottingham. The Anderton lift, which connects the Weaver navigation with the Trent and Mersey canal, is worked by electrical power, each of the two caissons being counter-balanced by weights. The Manchester Ship Canal (*see* 17.550) was in 1925 deepened from 28 ft. to 30 ft. from the entrance locks at Eastham to Ellesmere Port, a distance of about four miles. A petroleum dock has been constructed at Stanlow on the canal, near Ellesmere, and large extensions of quays, warehouses and other traffic facilities have been made both at Manchester and at Trafford Park below the city.

France.—Two important canals were in course of construction in France when the World War commenced, the Marseilles-Rhone Ship Canal and the Canal du Nord. The total length of the former is about 48 m. and it extends from the port of Marseilles to Arles on the Rhone, passing through the mountainous district of Nerthe by a tunnel at Rove, thence through the lagoon of Berre to Port-de-Bouc. The canal is level throughout, but there are two regulating locks and one at Arles between the river and the canal. These are 525 ft. long and 52 ft. wide. The waterway, normally 75 ft. wide at bottom, is 9 ft. 10 in. deep. The Rove tunnel, nearly 4½ m. in length, cut through rock, has a width of 72 ft. and a height of 47 ft. above water-level.

The Canal du Nord, begun in 1907, connects the Sensée Canal at Arleux and the Oise Canal at Noyon, and is 58 m. long. It is noteworthy on account of its considerable rise and fall, crossing two watersheds, its 19 locks, some of which have a rise of 21 ft. 6 in., and two long tunnels. The water supply is obtained by pumping, by means of electricity, from reach to reach the 3 waters of the Sensée, the Somme and the Oise. The maximum bottom width is 33 ft., the depth 8 ft. 2 inches. It is the best example of the standard type of 300-ton barge canal in France. The locks, 360 ft. by 20 ft., are provided with cylindrical sluices and single-leaf gates, all worked electrically. The works, which were wrecked in the course of the War, have been completed. Several tidal rivers of France have been improved at considerable expense by dredging, straightening and regulation, notably the Loire from the port of Nantes to the sea, the Seine below Rouen, and the Gironde below Bordeaux.

Belgium.—The completion in 1921 of the works, which had been carried on spasmodically for over 30 years, of the Belgian Canal du Centre provided a waterway for through traffic between the basins of the Meuse and the Schelde in southern Belgium. The last item of these works, the construction of three out of four barge lifts on the canal, was in hand before the World War and was resumed after the peace. These lifts consist of two steel tanks placed side by side, each measuring 141 ft. by 19 ft., carried upon and lifted by hydraulic rams. The rise of the first lift, constructed on this canal at La Louvière in 1888, is 50 ft. 6 in., while the three later lifts have a rise of 53 ft. 7 in. in every case. They are the only lifts constructed on any inland waterway since 1899, when the Henrichenburg lift on the Dortmund-Ems canal was opened. The Roupel Ship Canal, between a tributary of the Schelde of that name and Brussels, where an inland harbour has been built, was on the eve of completion, after 10 years spent on construction, when War broke out in 1914 and was not finally opened for traffic until 1922. This waterway, about 20 m. long, has a minimum bottom width of 66 ft. and a depth of 21 ft. The three locks are 374 ft. by 52 ft. 6 in. internally. The enlargement of another important ship canal, the Ghent-Terneuzen Canal was completed in 1911. The waterway, 18 m. long, about half of which is in Belgian and the other half in Dutch territory, was practically reconstructed. The canal now has a depth of 28 ft., and large ships can navigate up to Ghent, where an extensive inland port has been constructed.

Holland.—Important inland canal and river engineering works carried out in Holland since 1910 are the improvement of the rivers Waal and Yssel, both branches of the lower Rhine, the construction of the Wilhelmina Barge Canal and its branches, totalling about 50 m., and of the Meuse-Waal Canal. Most important of all has been the deepening and straightening of the waterway, mainly an artificial channel, between Rotterdam and the sea at the Hook of Holland to over 30 ft. at L.W.O.S.T. The enlargement of the North Sea-Amsterdam Ship Canal and the construction of a new entrance lock, which will be one of the largest in the world, and approaches at Ymuiden, were commenced in 1922.

Central Europe.—The construction of the Rhine-Maine-Danube waterway, which will link up the North Sea with the Black Sea, was commenced in 1921, and a portion of the waterway was opened to through traffic as far as Aschaffenburg in 1924. It was expected that through traffic on a limited scale to the Black Sea would be established in 1926, but the completion of the works for the transit of ships of 1,500 tons d.w. capacity is not expected before 1932. The enlargement of the inland navigation harbour of Berlin, which now provides accommodation for barges and sea-going vessels of up to 600 tons capacity was completed in 1923.

Sweden.—The Trollhättan Ship Canal, connecting Lake Vänern in southern Sweden and the Kattegat, completed in 1916, is remarkable for a flight of three contiguous locks, overcoming a rise of 77 feet. The canal is 52 m. long, and the locks are 321 ft. by 45 ft., with a depth of 18 feet. The Hammarby Ship Canal, connecting Stockholm with Lake Mälaren, is now being constructed, and the Södertalje Ship Canal has been enlarged (1924) to take ships of 8,000 tons cargo capacity.

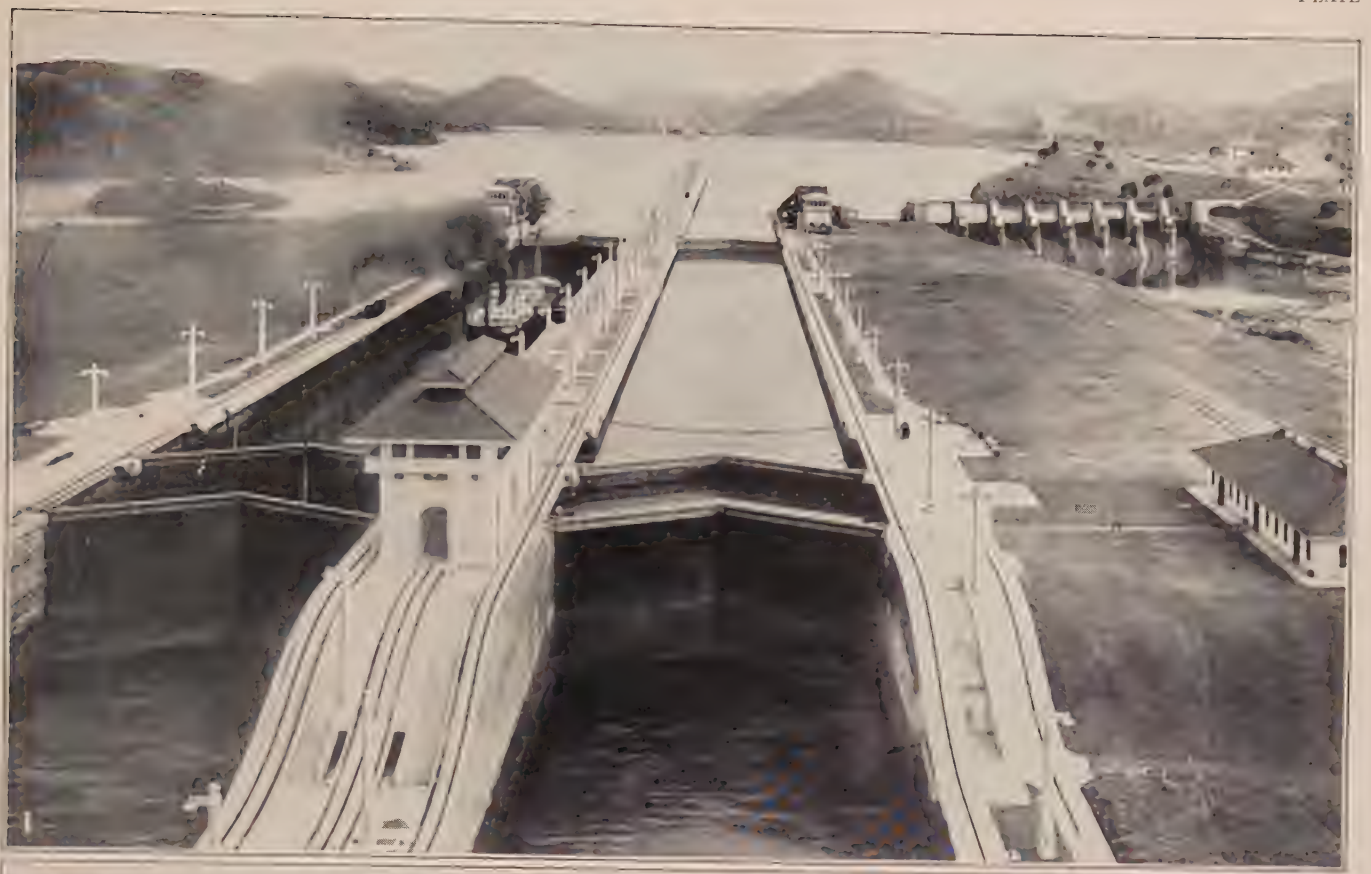

FIG. 1. Panama Canal. View of Miraflores locks, looking north. FIG. 2. Welland Ship Canal. View of No. 2 lock, looking south.
(Fig. 1. Courtesy of Royal Mail Steam Packet Co. Fig. 2. Canadian Dept. Railways and Canals.)

II. IN THE NEW WORLD

The total length of improved navigable rivers in the United States is now upwards of 23,000 miles. At least 40 distinct and separate rivers have been improved by canalisation.[1] Since 1900 an immense amount of improvement of the inland waterways both natural and artificial of the States has been accomplished. As a rule, canalisation is well inland, the lower and middle reaches of the great rivers being open navigations. For instance, on the Hudson, the first lock is at Troy, 153 m. from the sea; on the Mississippi, at Keokuk, 1,461 m.; on the Tennessee, 1,339 m.; and on the Missouri there is open navigation to Fort Benton, Montana, 3,555 m. from the Gulf of Mexico. Only in recent years have locked waterways been constructed near seaports connecting ocean traffic with inland navigations. The New Orleans Industrial Canal and the Lake Washington Canal at Seattle are examples. Apart from improvements effected by the Federal Govt. several of the states have also undertaken canal work, notably New York, in the reconstruction of the New York State Barge Canal.

When traffic on American rivers commenced to become intense, recourse was had to extensive canalisation in cases where shallow water and limited flow gave rise to difficulties, either seasonal or continuous. Among the rivers so improved are the Ohio, with its tributaries the Allegheny and Monongahela; the Kanawha, West Virginia; the Kentucky in Kentucky; the Cumberland in Kentucky and Tennessee; and Tennessee in Kentucky, Tennessee in Alabama; the Black Warrior and Tombigbee in Alabama; the Columbia river in Oregon and Washington, and the Mississippi above Keokuk.

The locks on the Ohio are among the largest on the great rivers of the United States. When the improvements, commenced in 1910, on this river are completed there will be, in a length of 968 m. of canalised river, 50 locks, each 600 ft. by 110 ft. internally, with depths over sills ranging from 9 ft. to 12 feet. The lift of the majority of the locks varies from 6 ft. to 12 ft., but one, completed in 1921, has a lift of 29 feet. The cost of this improvement scheme, including dams, one of which is constructed at every lock, and dredging, is over £20,000,000. Eight locks included in the project are still under construction (1925). All are expected to be completed by 1929.

The Keokuk lock, the lowest on the Mississippi, was completed in 1913. In this case the dam was constructed primarily as a part of a hydroelectric power project. The lock, 380 ft. by 110 ft. internally, with 7 ft. over the sills, has a considerable lift—41 feet. The upper gate is of floating caisson type and is operated by compressed air.

The New York State Barge Canal.—Commenced in 1905 and completed in 1918 at a cost, including terminals, of upwards of £23,000,000, this is a reconstruction of the old Erie Canal and connects the Hudson river at Troy with Lake Erie at Buffalo. Altogether, including branch canals and the Lake Champlain section, there are 525 m. of canal proper, with 57 locks. Ships and barges up to 300 ft. in length and 44 ft. 6 in. beam can navigate the canal. Some of the barges using it have a cargo capacity of 3,000 tons. All the locks have a depth of 12 ft. over sills, and the maximum lift in any one is 40 ft. 6 inches. All lock and other machinery is operated electrically and the canal and its terminal ports are equipped in lavish manner with mechanical appliances. At Oswego, on this canal, is a novel and interesting system of syphons for emptying and filling the lock chamber. So far the traffic on the canal has not justified the expenditure on its construction.

The New Orleans Industrial Canal.—This connects the Mississippi river with Lake Ponchartrain six miles distant. Completed in 1923, at a cost of over £5,000,000, forms an important link of an entirely artificial waterway between the Mississippi at New Orleans and the sea, but in the main its construction was brought about by the desire to provide increased waterside frontage at the port of New Orleans. The lock at the entrance to the canal is constructed on a foundation of 24,000 piles driven through a bed of very fine quicksand. The usable dimensions of the lock are 640 ft. length, 75 ft. width, with 31 ft. depth over sills. The Lake Washington Ship Canal, eight miles long, extending from Puget sound to Lake Washington, was completed in 1916. The sea entrance at Seattle has a large double lock and a smaller one. The large lock has a usable length of 760 ft. and is 80 ft. wide with 36 ft. depth over the sill. Flood water is provided for by the construction of a dam with movable crest gates.

The Cape Cod Canal, connecting Cape Cod Bay on the east side, with Buzzards Bay in the west of the Cape Cod isthmus, is 7⅞ m. in length. Its construction was commenced in 1909 and the waterway first opened to traffic in 1914, since when the works have been completed to give a depth of 25 ft. at low water. There are at present no locks on the canal, and on account of the difference in sea levels at the two ends there is at times a considerable current flowing through it.

The Sault Ste. Marie locks are situated in the St. Mary's river, which connects lakes Superior and Erie. Two new locks, completed in 1914 and 1919, were built to accommodate the largest ships using the Great Lakes. The length between gates of each of them is 1,350 ft. and the clear width 80 feet. Both have a depth of 24 ft. 6 in. over sills and a maximum lift of 21 feet.

Locks and Dams.—Since 1910, practically all locks on inland waterways in the United States have been constructed of concrete. No mechanical lifts or inclined planes are in use, and no provision is made at any of the locks for mechanical haulage of vessels through them. Electric locomotives for rack traction are, however, employed for towing ships through the locks of the Panama Canal. The large majority of the navigable waterways of the states, being rivers of very variable flow, the provision of dams or weirs with sluices has usually been necessary in conjunction with lock construction, and many of these works are of considerable magnitude. Steel lock gates of the double leaf mitred type are now adopted generally for new works, but rolling caisson gates are also used for closing many of the river locks, particularly at the upper and shallow ends of wide locks on rivers. "Tumbling" or flap gates ("bear trap"), hinged on a horizontal axis, have also been used in a few instances. Sluice valves are constructed in the lock walls and are frequently of the "butterfly" type, but Stoney gate sluices and cylindrical valves predominate. The practice of placing sluice valves in the gates has been abandoned. Movable dams of the Chanoine and needle types were formerly much used, but in the dams and weirs of recent construction some form of sliding or hinged sector gates has usually been adopted. The Stoney sluice is typical of the first class and the Taintor gate of the second.

Canada.—The new Welland Ship Canal, connecting lakes Erie and Ontario will, when completed, form the third connecting link between these lakes and will afford facilities for shipping on a far larger scale than the existing Welland Canal, which was reconstructed in 1872 and is 26¾ m. long with 25 locks, 270 ft. by 45 ft., and 14 ft. deep on the sills. The new waterway was commenced by the Govt. in 1913 and is not expected to be completed before 1927. The total cost will be upwards of £21,000,000. It will have seven locks, each 800ft. by 80 ft. internally, with a depth of 30 ft. over sills. Each lock has a rise of 46 ft. 6 inches. In addition, there are regulating locks at either end of the canal. The canal itself is being excavated to 25 ft. depth with provision for a depth of 30 ft. later. An ambitious scheme for a navigable waterway 25 ft. deep between the St. Lawrence river at Montreal and Lake Ontario, combined with hydroelectric development, has been considered by the Governments of the United States and Canada, but no decision to proceed with the work has been arrived at.

Delta Outlets.—The Southwest Pass at the sea outlet of the Mississippi[2] was selected in the project of 1902 for obtaining a depth of 35 ft. across the bar. Converging jetties, about 5,600 ft. apart at their land ends and 2,800 ft. apart at the bar, were substituted for the parallel jetties constructed at the South Pass, and dredging was relied upon to maintain the channel between

[1] Col. E. H. Schulz, U.S. Army, *International Congress of Navigation Proceedings* (1923).

[2] 11th edition, article RIVER ENGINEERING.

them. This dredging was found to be excessive, and in 1916 the project was modified by limiting the channel to a width of 2,400 ft. between the two parallel interior jetties. The depth is at present maintained at about 33 ft. or two ft. less than the projected depth, and although the work of maintenance presents many difficulties, the conditions have become more favourable since the contraction of the channel was effected. The artificial improvement of two mouths of a river is an unique experiment.

The forecast as to the necessity for the prolongation of the training jetties at the Sulina mouth of the Danube[1] has been realised. The cessation of dredging during the World War resulted in rapid decrease of the navigable depth which, combined with the continuous growth seaward of the deltaic deposit, so reduced the depth at and near the jetty ends as to compel resort, in 1924, to a subsidiary channel of limited depth on the north side of the entrance, which is now in use temporarily, while an extension of the jetties, 6,000 ft. seaward, and the dredging of the direct channel between them are being effected. Before 1914 the standard depth in the channel was 24 feet.

III. MECHANICAL IMPROVEMENTS

Since 1910, the use of internal combustion motors as means of propulsion on canals has considerably increased. Even on the smaller canals many barges in all parts of the world are now self-propelled. Towage of barges both by steam and internal combustion motor tugs has also increased.

Mechanical haulage on canals has not developed in so marked a manner as towage. Electric tractors are still employed for barge haulage on the Teltow Canal (Germany) and the Charleroi Canal (Belgium) and petrol road tractors on the Bourgogne Canal (France). All these installations date from before 1910, but in every case the system employed has undergone modification and improvement since. On the Canal du Nord in France, between Saint-Omer and Janville, electric tractors running on rails on the bank haul 300-ton barges in groups of two or more. On the Calais-Saint-Omer section light caterpillar road tractors of the Citröen type were established in 1925 for hauling two or more loaded barges. Electric rail tractors are also employed on sections of the St. Quentin and other canals in the north of France. Mechanical traction by cable towing worked by electric capstans was installed in 1916 over a short length on the Marne-Rhin Canal, but the results obtained have not been entirely satisfactory. Other experiments in cable haulage have been abandoned after trial.

On the whole, the results of mechanical traction on canals do not show any marked decrease in cost compared with other haulage or towage, nor has the speed of the boats been materially increased. The cost of installing and working a system of electric rail traction is only justified in cases where, as on some of the canals in the north of France, the traffic is intense, and on the Nord system light tractors are preferred for the less busy sections. Electric capstans are provided at many French and a few Belgian and Dutch canal and river locks for facilitating the passage of barges through them. In some cases little use appears to be made of these facilities.

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(N. G. G.)

RIVER PLATE: *see* PLATA, RIO DE LA.

RIVERS, WILLIAM HALSE RIVERS (1864–1922), British psychopathologist, was educated at Tonbridge and St. Bartholomew's Hospital, London. He was made university lecturer at Cambridge in physiological and experimental psychology in Dec. 1897, and in 1907, when the two subjects were separated, lecturer in the physiology of the senses. He founded during this period the Cambridge school of experimental psychology, and was made fellow of St. John's College. In 1898, with his pupils C. S. Myers and William MacDougall, he joined the anthropological expedition to Torres Straits led by A. C. Haddon, and had charge of the psychological work. By the genealogical method of social investigation he obtained such valuable results that whereas he joined the expedition as a pure psychologist he returned a convinced ethnologist. *The Todas* (1906) records his investigation on these lines among the Todas in Southern India in 1902. His first expedition to Melanesia was in 1908. He revisited that area later, and in the *History of Melanesian Society* (2 vol., 1914) abandoned the evolutionary theory of society in favour of that of cultural migration. During the World War he obtained many valuable results as a psychopathologist, and while critically interested in Freudian methods of psychoanalysis he came to very different conclusions on matters of principle and practice. His later works include *Instinct and the Unconscious* (1920), *Psychology and Politics* (1923), *Medicine, Magic and Religion* (1924), *Social Organisation* (1924). He was elected president of the Royal Anthropological Institute in 1921 and was nominated a candidate in the Labour interest for the University of London. He died at Cambridge June 4 1922.

RIVIÈRE, BRITON (1840–1920), British painter (*see* 23.387), died in London April 20 1920.

RIVINGTON, FRANCIS HANSARD (1834–1913), British publisher (*see* 23.387), died July 2 1913.

RIVOIRA, GIOVANNI TERESIO (1849–1919), Italian archaeologist, was born at La Manta di Saluzzo in Piedmont Sept. 22 1849. He came of an old Piedmontese family and on his mother's side was descended from the Riccati (*see* 23.288), a family of mathematicians and architects. He trained as an architect and engineer at the University of Turin, entered Rome with the Italian army in 1870 and thenceforth resided there, devoting his life to travel and to the study of the architecture of the later Roman Empire. He published two monumental works, *Le Origini dell' Architettura Lombarda* (1901–7, Eng. tr. 1910), and *Architettura Musulmana* (1914, Eng. tr. 1918). At the time of his death in Rome, March 3 1919, he was engaged upon a third, *Architettura Romana*, which was posthumously published in Milan (1921) by his widow.

RIZA PAHLAVI (1877–), Shah of Persia, was born in Savad Kuh, the son of an army officer. He joined the army in early youth and eventually rose to be one of the senior officers of the Cossack Division. In 1917 he went to Tehran from Hamadan with his regiment and compelled Col. Clergé, the then commander of the Cossack Division, to relinquish his command and replaced him by Col. Starosselsky. In 1921 with a force of about 4,000 men at his disposal he captured Tehran, and as a result became commander-in-chief of the Persian Army and Minister for War. In 1923 he took over the premiership and instituted a series of reforms, rendering assistance to the American Financial Mission which was already in the employ of the Persian Govt. for the purpose of modernising the various departments. In Oct. 1924 on the departure of the Shah, Sultan Ahmad Kadjar, Riza Khan Pahlavi was appointed by the Majliss to be head of a temporary Government until the form of a new constitution was drawn up. On Dec. 13 1925 Riza Khan Pahlavi was appointed Shah of Persia and the sovereignty was vested in the Pahlavi dynasty. The coronation took place in the Gulistan Palace in Tehran April 25 1926. He had married the daughter of Taimur Khan, an army officer of high rank under whom he had served earlier in his career. There was a son of this marriage, by name Mohamed Riza, who thus became vahliad or crown prince and henceforth known as Shahpur Mohamed Riza.

ROAD CONSTRUCTION (*see* 23.388).—The progressive transfer of traffic from railways to roads and the increase in the volume of road traffic and in the consequent strain upon the road surface impel the road engineer to seek more and more permanent and impervious materials which will avoid the vexatious process of frequent renewal.

Incidentally, an impervious surface will prevent the deterioration of the foundation and will enable the camber or crown

[1] 11th edition, article RIVER ENGINEERING.

of the carriage way to be reduced, thereby adding to the safety and convenience of drivers. Cambers of 1 in 24,[1] and even steeper, used to be common. In modern practice this has been reduced to 1 in 48. In the design of new highways sufficient land is frequently acquired to enable all pipes, mains and conduits to be laid under the verges, shoulders or margins, so that the carriageway itself may not be subject to future disturbance. Dimensions of 100 ft. or 120 ft. between fences are becoming common in England, while in the United States even more generous figures are adopted.

Width of Road.—The wide road allows space for tree planting and keeps noise and vibration at a tolerable distance from the householder's windows. Spacious footways and verges on each side of a carriageway extend the motorist's view as he rounds a curve and promotes the safety of vehicles entering from side roads. Drivers gain a wider range of vision on each side and secure an extra fraction of a second for deliberation before venturing into the main stream of traffic.

Sharp bends and abrupt changes of direction are now discountenanced in favour of easy curves of long radius. Where, owing to the configuration of the ground, curves of less radius than 1,000 ft. are unavoidable the outer edge of the carriageway is super-elevated or " banked," following the invariable practice of railway engineers. The width of the carriageway should be increased at such points. Steep gradients which disfigure the rigidly straight Roman roads are avoided by moulding the line to the contours of the hillside. In laying out the new arterial roads in the neighbourhood of London, it has almost invariably been found possible to limit the gradients to 1 in 30. Gradients of excessive flatness (less than 1 in 300) are to be avoided, owing to the difficulty of effectively draining the surface.

Single and Duplicate Carriageways.—In designing new arterial roads, varying opinions prevail as to the relative advantages and disadvantages, on the one hand, of a single wide carriageway, or, on the other hand, of the duplicate carriageways for up and down traffic respectively. While the single carriageway 50 ft. wide will probably carry a greater volume of traffic in the year than two 30 ft. carriageways each reserved for one-way traffic, the separate tracks will conduce to the safety of the driver and to that of the pedestrian who, in crossing each carriageway, knows from which direction the traffic will be approaching him.

Again the duplicate carriageway lends itself to progressive development. In the first instance, while the country alongside the road remains open, a single carriageway can be formed and will meet travellers' needs until such time as population and traffic increase, when the second carriageway can be constructed without interfering with the road which is already in use. The general tendency of road practice to assimilate railway methods, encourages the view that separate carriageways (up and down lines) are likely to prevail in the case of new arterial roads.

In the older and more settled countries where a tolerably complete network of old highways already exists, the road engineer's task is usually confined to the improvement of these, rather than to the construction of entirely new communications. In Great Britain the creation of the Ministry of Transport in 1920 gave a marked impetus to the modernisation of the old highway system. The yield of the Government's Road Fund, derived from the taxation of mechanically propelled vehicles, rose from £11,500,000 in the calendar year 1922 to £17,250,000 in the year 1925, with the result that it became possible to launch in 1925 the so-called " trunk road programme " for the systematic transformation of the most important through routes of the country. In their unimproved state these usually possess a carriageway varying from 14 ft. to 24 ft. in width, with little, if any, footway. Generally speaking, where improvement is now undertaken, sufficient land is being acquired to allow a dimension of 60 ft. between fences. This affords space for a carriageway 30 ft. wide, two 8 ft. footways and two 7 ft. verges. In more rural areas the carriageway is limited for the present to 20 ft., only one footway is constructed, and the verges are widened to absorb the additional space. The work may be briefly sketched as follows:—

Adequate surface drainage, for want of which the older roads have usually suffered, is provided; fences are set back to 60 ft.; all sharp curves are smoothed out, and abrupt bends are eliminated where possible by forming a new length of road along the base of the triangle. In widening and regulating the existing carriageway the ground is excavated on each side, the existing haunches, where weak, are cut back and a foundation is formed of cement concrete from 6 in. to 9 in. in thickness, strengthened with metal reinforcement where requisite. This concrete serves not only as a foundation for the new road surface, but also as a lateral abutment for the arch of the carriageway. Where clay or loam underlies the road, a layer is formed of clinker or other similar material from 4 in. to 8 in. in thickness, to serve, after thorough consolidation, as a bed for the concrete. Both sides of the carriageway are kerbed with granite or reinforced concrete, the latter presenting the advantages that unskilled local labour can be employed in its construction and that saving in transport is effected. The whole width of carriageway is finally covered with an asphaltic carpeting or other impervious material. On some of the steeper gradients, a stonefaced reinforced concrete track is laid alongside the carriageway so as to afford a satisfactory foothold for horses mounting the hill. Elsewhere the grass verges will be of service to horsemen.

[1] The British refer to cambers in this way; in the United States they are referred to as ½ in. to 1 ft. or ¼ in. to 1 foot. (Ed. *E.B.*)

The Making of City Streets

In the principal streets of the world's great cities where highly durable paving materials on a concrete foundation have long been in use—mastic asphalt, compressed asphalt, wood blocks, granite setts, etc.—recent changes of method are mainly confined to the strengthening of the concrete foundation by an increase in thickness or the introduction of metal reinforcement. In some areas in London it is now the practice to lay as a foundation for wood blocks a bed of cement-concrete as much as 12 in. thick, containing a steel reinforcing fabric. Intolerance of traffic interruptions encourages the introduction of time-saving devices, such as pneumatic drills for breaking up old concrete foundations; growing use is made in the busiest thoroughfares of quick-setting cements, such as *ciment fondu* and ferrocrete, which reduce by a fortnight or more the period which must elapse before the road can be opened to traffic. Various experiments have been tried in the use of rubber as a paving material; in some instances it has taken the form of a wearing cap applied to a block of wood or other material; in other instances the entire block is composed of rubber. The elasticity of the material renders it somewhat liable to displacement under the stress of traffic and experiments are still being directed to the attainment of a secure anchorage.

Foundations.—The choice of materials for foundations is usually dictated by considerations of transport, though in certain favoured districts the hard, compact subsoil of chalk or rock needs but little improvement. On a firm stratum of chalk a well-compressed layer of clinker will often serve to carry the surfacing coat. Equally serviceable as a natural foundation is a well-drained bed of coarse gravel; finer gravels, and even so fine a material as sand, are not to be despised, provided that the latter has no opportunity of escaping laterally under pressure. In France a thick bed of river sand is not infrequently used as the foundation for sett paving. The bearing capacity of clay, loam and other similar subsoils is so diminished by the presence of water that great care must be taken to ensure adequate drainage before road-making operations are begun. The want of uniformity and reliability in the chance supplies of materials formerly used as " hardcore " foundation for new roads in areas devoid of quarries has led to a notable extension in the use of cement concrete as a road foundation. Hardcore derived from demolished buildings consists of ingredients possessing every degree of durability from broken fragments of plaster to the hardest vitrified bricks. These heterogeneous materials thrown down pell-mell in a layer 12 in. thick and subsequently crushed under a 10-ton steam roller form the foundation of most of the roads on outskirts of great cities, and it is not surprising that carriageways so constructed show obvious signs of weakness under the stress of modern traffic. The arguments in favour of concrete as a road foundation are somewhat less urgent in regions where supplies of rock are cheaply available in the vicinity of the road. In such cases the old method practised by Telford of forming a foundation with hand-pitched rubble continues to hold its own.

Surfacing Methods.—Water-bound macadam which still remains in use on lightly trafficked roads, does not possess impervious qualities and is therefore usually treated with hot surface

dressings such as tar or various bituminous mixtures, applied in warm, sunny weather to a thoroughly swept, dry carriageway, the surface of which is then "gritted" with chippings or shingle. As surface dressings, various asphaltic or bituminous emulsions are applied cold, regardless of weather. Tar is used as a surface dressing and as a "binder" for mixing with materials prior to their application so as to give cohesive qualities to the entire thickness of the road crust. By this means such materials as limestone and slag can be utilised, which are not so well adapted to waterbound methods.

Natural asphalts after a 60 years' test still remain in high favour for the paving of streets in wealthy cities. During the ten years, 1910–25, however, much research has been devoted to the problem of utilising the valuable properties of asphalts and bitumens in some cheaper form of pavement suitable for wider adoption. Asphaltic and bituminous mixtures are now utilised as a matrix to bind together an aggregate of broken stone or clinker, applied in one or two coats as a road-surfacing material.

In this category fall the processes known as bituminous macadam, grouted macadam, single-coat bituminous carpet, bituminous sand-carpet on a bituminous sand-crust, bituminous clinker carpet on a bituminous sub-crust. In many cases these surfacing materials are laid upon the old macadam road-crust suitably regulated, but where this does not afford sufficient strength a concrete foundation is formed. In all these bituminous surfacing methods, the need for securing the greatest possible compactness by the elimination of voids is achieved by elaborate precautions in grading the materials. It is necessary to determine experimentally the exact proportions of ingredients of varying grades needed to attain the highest degree of density in the resultant mixture.

As an example of the general lines followed by modern practice a few particulars may be quoted from a recent specification for one-coat bituminous clinker surfacing—a process which enables profitable use to be made of a waste product (clinker):—

The one-coat surfacing is to measure 2 in. in thickness after complete consolidation, and to have a crossfall or camber of 1 in 50. The mineral aggregate is to consist of well-burnt hard clinker, free from coke, ash or foreign matter. The bitumen has to comply with certain "penetration" and "solubility" tests. The concrete foundation, after thoroughly cleansing, is painted with a coat of hot bitumen. The clinker aggregate is to be mechanically broken to pass a ½-in. mesh screen, and shall consist of approximately the following proportions of smaller grades:—

	%
Clinker evenly graded, ½ in. to ⅛ in.	33
Clinker passing 10-in. sieve	..
Clinker passing 20-in. sieve	..
Clinker passing 30-in. sieve	20
Clinker passing 40-in. sieve	..
Clinker passing 50-in. sieve	..
Clinker passing 80-in. sieve	5
Clinker passing 100-in. sieve	10
Clinker passing 200-in. sieve	15
Soluble bitumen as specified	17
Total	100

The clinker is to be thoroughly dried and heated to a temperature of 300 to 350° Fahrenheit. It shall be mixed in a mechanical mixer with 17 % of soluble bitumen.

After thoroughly mixing, the material is to be delivered on to the road at a temperature of 300 to 350° F. and spread with hot rakes to the specified thickness.

Rolling shall immediately follow with a light roller (6 to 7 tons), and as the temperature of the materials falls the rolling is to be continued with a 10- to 12-ton roller until no impression is made upon the road surface, which is subsequently to be dusted over with cement, or other approved filler so that a close compact surface may be formed.

Cement-concrete, after gaining a wide vogue in Canada and the United States, is now extending its sphere of use in Great Britain as a running surface for carriageways. Its use as a foundation for asphalt or wood blocks has long been an established practice. Special interest attaches to the application of concrete in view of the wide range of materials utilisable as aggregate, as compared with the very uneven geographical distribution of good road-stone supplies. On the other hand, concrete is somewhat handicapped by the lengthy period of setting and "curing," which is requisite before the new surface can be subjected to the strain of traffic. This unavoidable delay is of less moment in the case of entirely new roads than in that of the reconstruction of existing highways, where acute inconvenience is caused to traffic by any lengthy period of closing. This difficulty may be mitigated in future by the use of quick-setting cements, several types of which (ciment fondu, ferrocrete and other aluminous cements) are now available.

Standardisation.—Standard specifications and practice have not yet been evolved for concrete road construction. There is considerable variety of method. The construction may take the form of one-course work or two-course work, the former consisting of one grade of concrete for the full thickness, while the latter provides two layers of concrete mixed in varying proportions. One-course work is simpler, and avoids the risk of cleavage between two layers of differing consistency. For two-course work a poorer concrete can be used for the lower layer. In America great lengths of new concrete highway are now being constructed across tracts of country hitherto unprovided with modern roads. The concrete measures 8 in. to 9 in. in thickness and 18 ft. to 21 ft. in width, with a scarcely perceptible camber.

Methods of Laying.—In the actual process of laying the concrete, there is much variety of practice, some engineers preferring to proceed continously, while others adopt the "alternate bay" system, in which the carriageway is divided into slabs of uniform length, each extending the full width of the carriageway, The odd numbers would be laid first, separated by gaps representing the even numbers; these gaps would not be filled until the odd numbers had completely set, thus counteracting the effects of expansion and contraction. The transverse joints separating the slabs are sometimes disposed at right angles across the road; in other instances they lie at an angle of 60° or so to the kerb-line, so that the impact of the wheels of the vehicle does not strike any slab simultaneously

The aggregate, consisting of crushed stone or gravel, should be clean and well graded in size, so as to reduce the percentage of voids to a minimum. Risks of failure in the concrete are greatly reduced by washing the aggregate. The sand must pass a rigorous test for cleanliness, and its particles should have the largest possible range of size from fine to coarse; if only one grade is obtainable, coarse is to be preferred. The proportions commonly adopted vary from 1 cement, 1½ sand and 3 gravel to 1 cement, 2 sand and 4 gravel. Only a bare sufficiency of water should be added—a very wet mixture encourages voids. Mechanical mixing plant is generally adopted and the use of mechanical tamping and finishing machines is greatly favoured in the United States, where they are found to play an invaluable part in minimising voids.

The precautions to be taken during the setting of the concrete depend largely on the climatic conditions. In moist weather no harm will arise from leaving the green concrete uncovered for a few hours, but in hot sunny weather exposure will lead to the formation of hair cracks. Heavy canvas is often used for protecting the concrete during the first 24 hours of setting. The canvas is then removed, and a layer of earth spread over the surface about 2 in. thick and left there for a fortnight or so. For the purpose of indurating the surface of the cement concrete, recourse is sometimes had to two or three applications of a weak solution of silicate of soda.

Reinforcement.—Where anxiety is felt as to the soundness of the subsoil on which concrete is laid, and it is accordingly desired to form a slab qualified to serve as a raft or bridge, one or two layers of metal reinforcement are often introduced into the concrete. In other cases reinforcement is adopted owing to the fact that the thickness of the concrete has had for various reasons to be reduced, and it is necessary to compensate for this reduction by conferring additional strength upon the concrete.

There are large numbers of fabrics in use, expanded metal of 6 in. and other meshes, woven wire, mesh fabrics in which the main tension wires of drawn mild steel run longitudinally with cross-wires welded thereto at regular intervals; other systems make use of twisted or vertical bars; double reinforcement is frequently used in "mattress" form, the upper and lower layers being connected by diagonal members. The weight of reinforcement varies in ordinary practice from 5 lb. to 25 lb. per yard superficial of concrete foundation.

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ROBERT-FLEURY, TONY (1837–1911), French painter (*see* 23.403), died in Paris Dec. 8 1911.

ROBERTS, FREDERICK SLEIGH ROBERTS, EARL (1832–1914), British soldier (*see* 23.403). After 1905 Lord Roberts took a leading part, as head of the National Service League, in the movement in favour of compulsory military service for home defence. On the outbreak of the World War he was a frequent visitor at the War Office, and shortly after the arrival of the two Indian divisions in France he crossed the Channel to visit them in the trenches. He was attacked by pneumonia while at the front, and he died at St. Omer on Nov. 14 1914, the title going by special remainder to his elder daughter, Aileen Mary. He was buried in St. Paul's Cathedral, London.

ROBERTSON, SIR GEORGE SCOTT (1852–1916), British soldier and administrator, was born in London Oct. 22 1852. He was educated at Westminster Hospital medical school, and in 1878 entered the Indian Medical Service. He served through the Afghan War of 1879-80, and was for the next eight years civil surgeon in the United Provinces. In 1890–1 he travelled in Kafiristan (*see* 15.630). In 1893 he went as political agent to Chitrál, and in 1895 was besieged there by hostile tribesmen (*see* 6.252). For his services he was created K.C.S.I., and appointed British agent in Gilgit. He retired from the Indian service in 1899 and returned to England. He was Liberal member for Central Bradford from 1906 until his death on Jan. 1 1916. He published *The Káfirs of the Hindu-Kush* (1896) and *Chitrál: the Story of a Minor Siege* (1898).

ROBERTSON, SIR WILLIAM ROBERT (1860–), British soldier, was born at Welbourn, Lincs., Sept. 14 1860. He enlisted as a private in the 16th Lancers in 1877 and served in the ranks of that regiment until 1888, when he won a commission in the 3rd Dragoon Guards, then in India. He eagerly studied his profession in all its branches and he was very successful in learning the native languages. He was appointed railway staff officer in the Miranzai and Black Mountain operations of 1891, and in the following year joined the intelligence department at Simla; while on its staff he carried out a reconnaissance to the Pamirs, and in 1895 served with the Chitral Relief Force, being wounded and receiving the D.S.O. He passed through the Staff College in 1897–8—the first officer risen from the ranks to do so—and then, after a few months at the War Office, went out to South Africa on the Intelligence Staff; he accompanied Lord Roberts on his advance from Cape Colony into the Transvaal and was promoted brevet lieutenant-colonel for his services. He spent the period from 1901 to 1907 at the War Office, being promoted colonel in 1903, and he then went to the staff at Aldershot, where he spent three years. In 1910 he was appointed commandant of the Staff College, was shortly afterwards promoted major-general and in 1913 became director of military training at the War Office.

On the mobilisation of the army for the World War, Sir William Robertson—he had been given the K.C.V.O. in 1913—was nominated quartermaster-general of the Expeditionary Force; he filled that appointment most successfully for five months and then, in Jan. 1915, he became chief of the general staff to Sir John French. In the autumn of that year he was promoted lieutenant-general for distinguished service and in the following December was brought back to the War Office to take up the post of chief of the imperial general staff. There he immediately introduced great improvements in the office organisation. While convinced that the Western Front represented the decisive theatre of war, and fully aware how mischievous was dispersion of force in principle, he saw to it that, where operations in distant regions were unavoidable, the commanders on the spot were furnished with what was deemed essential to achieve success—with the result that the position of affairs in Mesopotamia, on the Suez frontier and in East Africa was completely transformed within a very few months of his taking up his task. His services were recognised by his being promoted general in 1916 and by his being given the G.C.B. in 1917.

In the later months of 1917 he found it more and more difficult, in view of the somewhat disappointing results obtained by Allied offensives in France and Flanders, to persuade the War Cabinet that diversion of fighting resources to Alexandretta, or to Palestine, or to Macedonia, or to the Austro-Italian frontier, endangered prospects of victory at the decisive point and might lead to disaster near home. His anxieties were increased by the manner in which the problem of man-power was treated. He moreover foresaw that the Supreme War Council, introduced towards the end of the year, would not provide effective means for combining the operations of the Allies. In Feb. 1918 he was transferred by the Government to the charge of the eastern command in England—just one month before the success that attended the great German offensive of March proved how correct had been his appreciation of the situation. Three months later he succeeded Lord French as commander-in-chief in Great Britain. On the final distribution of honours for the War he was rewarded with a baronetcy and grant of £10,000, and he was nominated G.C.M.G. in 1919. From April 1919 to March 1920 he commanded the British troops on the Rhine, and, after relinquishing that appointment on the force being reduced, he was promoted field-marshal.

See his autobiographical volume *From Private to Field-marshal* (1921). (F. B. M.)

ROBINSON, EDWIN ARLINGTON (1869–), American poet, was born at Head Tide, Me., Dec. 22 1869. From the public schools of Gardiner, Me., he proceeded in 1891 to Harvard, but withdrew after two years. From 1905 to 1910 he was connected with the New York Customs House, and then devoted his time to literature, especially to poetry. He became a member of the National Institute of Arts and Letters. In 1922 he was awarded the Pulitzer Prize of $1,000 for his collected poems.

His works include *The Torrent and the Night Before* (1896); *The Children of the Night* (1897); *Captain Craig* (1902); *The Town Down the River* (1910); *Van Zorn* (1914), a play; *The Porcupine* (1915), a play; *The Man Against the Sky* (1916); *Merlin* (1917); *Lancelot* (1920); *The Three Taverns* (1920); *Avon's Harvest* (1921); *Collected Poems* (1921); *Roman Bartholow* (1922); *The Man Who Died Twice* (1924); *Dionysus in Doubt* (1925).

ROBINSON, JAMES HARVEY (1863–), American historian, was born in Bloomington, Ill., June 29 1863. On graduating at Harvard University in 1887 he went to Germany, studying history at Freiburg University (Ph.D., 1890). In 1891 he was lecturer on European history at the University of Pennsylvania and in 1892 he was appointed associate professor of history at Columbia University, becoming professor in 1895. He resigned his professorship in 1919 and devoted himself to the organisation of the new school for social research in New York City. The "new history," of which he has been a leading exponent, challenges the traditional choice of material, maintaining that in the past far too much stress has been placed upon the course of politics and state rivalries, and too little on the rôle of thought in world changes. He was associate editor of *The American Historical Review* from 1911 to 1920.

Robinson wrote *The German Bundesrath* (1891); *Petrarch, the First Modern Scholar and Man of Letters* (1898); *An Introduction to the History of Western Europe* (1903); *Readings in European History*, 2 vol. (1904–6); with C. A. Beard, *The Development of Modern Europe*, 2 vol. (1907–8); with C. A. Beard, *Readings in Modern European History*, 2 vol. (1908–9); *The New History* (1911); *Medieval and Modern Times* (1915); *The Mind in the Making* (1921); *The Humanizing of Knowledge* (1923).

ROBY, HENRY JOHN (1830–1915), British scholar (*see* 23.424), died at Grasmere, Cumberland, Jan. 2 1915. He contributed a chapter on Roman Law to the second volume of *The Cambridge Mediaeval History* in 1913.

ROCHEFORT, HENRI (1830–1913), French politician (*see* 23.426), died at Aix-les-Bains June 30 1913.

ROCHESTER, N.Y., U.S.A. (*see* 23.430), increased 35·6% in population in the decade beginning 1910, reaching 295,750 in 1920, of whom 71,411 were foreign born and 1,579 negroes. The

state census of 1925 gave a population of 316,786. About 12 sq. m. were annexed at different times, making the area 32·1 square miles. Between 1910 and 1924 the assessed valuation of property increased 176% (to $456,407,234); the net city debt, 229% (to $42,153,545); the city's expenses, 249% (to $15,370,660); post office receipts, 146% (to $2,582,832); bank deposits, 114% (to $312,985,838); miles of paved street, from 195 to 336; miles of sewers, from 275 to 422; number of pupils in the public schools, 104% (to 53,878). In the six years following the World War 33,820 building permits were issued, representing a value of $105,410,101. There was a substantial development in its well-established and various industries. The value of the output of plant within the city limits was $112,676,000 in 1909; $351,416,000 in 1919; $337,362,162 in 1923, when there were 964 establishments, employing 58,649 wage-earners.

A city planning bureau was created (1917), and zoning ordinances were adopted in 1919 and 1920. In the abandoned channel of the Erie canal a subway, crossing the entire city, was constructed, to provide tracks for interurban, passenger and freight service, and a belt-line connecting all the railways. The harbour and warehouses of the Barge canal (opened in 1918) are on the Genesee river, in the heart of the city. At the mouth of the river, on Lake Ontario, is the port of Rochester. The new medical school and hospital of the University of Rochester (made possible by gifts of $4,000,000 from George Eastman, of Kodak fame, and $5,000,000 from the General Education Board) was approaching completion in 1925; and the university had received gifts amounting to $10,000,000 for expansion in other directions and general endowment. The Eastman School of Music, a department of the university, endowed by George Eastman, was opened in 1921; and the following year the Eastman Theatre, a gift by the same donor, was built and run under the management of the Eastman School of Music.

ROCKEFELLER, JOHN DAVISON (1839–), American capitalist (*see* 23.433), continued after 1910 to live a retired life and, for some years, to give great sums for charitable and educational purposes. In 1921 it was estimated that his bequests exceeded $500,000,000, that he had drawn on his capital as well as his income and that he was no longer, as he had been, the richest man in the world. Be that as it may, he gave the bulk of his fortune to his son who has also made immense gifts.

His son, JOHN DAVISON ROCKEFELLER, JR., was born at Cleveland, O., Jan. 29 1874. He was educated at Brown University (A.B., 1897) and, after engaging for a short time in business, withdrew and devoted his attention to philanthropic objects, continuing the charitable and other work of this nature initiated by the older man. He assisted, by endowments and otherwise, other educational and religious institutions, an instance of which was his financial support of the 1st Baptist Church, New York City, planned for Dr. H. E. Fosdick. Shortly after the War he gave $1,000,000 for repairs to and reconstruction of the palaces at Versailles and Fontainebleau and the cathedral at Reims. In recognition of this he was in March 1926 made a citizen of Versailles by the city council. In 1926 was announced his offer to the Egyptian Govt. of $10,000,000 for the purpose of establishing and endowing a museum of antiquities in Cairo, which was ultimately withdrawn, owing to the unwillingness of the Government to meet the conditions of the gift.

ROCKEFELLER BENEFACTIONS.—It was estimated that up to the end of 1924 Mr. J. D. Rockefeller had given for philanthropic and charitable purposes more than $500,000,000—the largest group of charitable and educational gifts ever made. In this distribution he aimed at stimulating others to give in addition to securing the most effective utilisation of the bulk of his own fortune. Nearly four-fifths of his donations went to the four great benevolent corporations which he created: the Rockefeller Foundation, General Education Board, the Laura Spelman Rockefeller Memorial and the Rockefeller Institute for Medical Research. Quite as significant as the magnitude of these gifts was the fact that they were free from all restrictions, having been given outright for the purposes of the respective corporations, the trustees of which have power to dispose of the principal as well as the income. As the corporate purposes of these organisations are extremely broad, and the gifts free from restrictions, they will always be adaptable to the changing needs of future generations.

General Purposes.—The Rockefeller Foundation was chartered in 1913 under the laws of the State of New York (Congress having failed to enact the legislation necessary for a national charter) " to promote the well-being of mankind throughout the world." To this, the most extensive of his benefactions, Mr. Rockefeller had given in all nearly $183,000,000 by 1925. The income and $11,000,000 of the original gifts were expended from time to time by the trustees. With increasing definiteness the Rockefeller Foundation focused its efforts in the fields of medical education and public health. It supported by appropriations after 1913 the International Health Board, an independent organisation engaged, in co-operation with governmental agencies, in demonstrations for the eradication of hookworm disease in 14 southern states of the United States and 22 foreign states or countries; of yellow fever in five south and central American countries, and of malaria in 11 southern states of the United States. In addition, the International Health Board, with funds provided by the Rockefeller Foundation, organised in 1917, partly as a war measure, the Commission for Prevention of Tuberculosis in France. This commission conducted in limited areas, as demonstrations, vigourous campaigns of popular education in hygiene, and provided for the training of French women as health visitors. The continuation of the work was taken over by the French authorities after 1920.

China Medical Board.—The Rockefeller Foundation established in 1914 the China Medical Board to promote the development of scientific medicine and hygiene in China through medical schools, hospitals and training schools for nurses. The Peking Union Medical College, founded by this board, was opened in 1919, together with pre-medical and nurse-training schools, with the ultimate purpose of vesting control and maintenance of these institutions in the Chinese. The board has made gifts to other institutions in China which offer pre-medical courses, and to hospitals. The foundation gave, up to the end of 1924, $15,793,745 to aid medical education in China. It established, in 1920, a Division of Medical Education, through whose advice large pledges of money were made for the development of medical centres in London and in various cities of Canada.

Public Health Work.—As a part of its public health work, the Rockefeller Foundation also made grants for the teaching of hygiene at Johns Hopkins University, Baltimore, and at the University of São Paulo, Brazil. A special feature of this work was provision for fellowships to persons from many lands engaged in study in medical education and in public health. The Rockefeller Foundation in 1923 co-operated with 32 states of the United States and 77 other states and countries in sanitation and medical education. During 1924, 864 individuals from 33 countries, including the United States, received from the Foundation some form of fellowship stipend to support their training to safeguard public health. During the World War the Rockefeller Foundation contributed nearly $22,500,000 to war work and war relief, including $5,000,000 of its capital; and before the crystallisation of its general policy of limiting its work to medical education and public health, it made appropriations to other causes.

Educational Work.—To the General Education Board, the next largest of his benevolences, Mr. Rockefeller had given, up to Dec. 1924, $129,197,960. Up to July 1923, the board had appropriated for " the promotion of education in the United States of America, without distinction of race, sex or creed." the sum of $106,214,284. Most of this had been given toward endowments of colleges, excluding professional departments, the rule being to make gifts contingent upon the raising of additional sums by the beneficiaries. When colleges, in 1919, were losing valued teachers because their salaries could not meet the suddenly increased cost of living, Mr. Rockefeller made a

special gift to the General Education Board of $50,000,000 to be used in helping the colleges raise enough funds to increase salaries. This averted a severe loss to education. Among medical schools which have received aid from the General Education Board are: Harvard School of Public Health, $1,203,664; Johns Hopkins, $6,232,000; University of Chicago, $2,000,000 (joint fund with the Rockefeller Foundation, 1916); Vanderbilt, $5,500,000 (1919); Rochester, $5,000,000 (1920); Yale, $1,768,000; Columbia University, $2,000,000 (joint fund with the Rockefeller Foundation, 1920) and the Meharry Medical College (for negroes), Nashville, Tenn., $150,000 (1920). Besides the $50,000,000 mentioned, Mr. Rockefeller in 1919 gave $20,000,000 to the General Education Board, both principal and interest to be spent in the United States.

The board that year gave $500,000 toward the endowment of a Graduate School of Education at Harvard, opened the following year; and in 1920 appropriated $1,000,000 to the building fund of Teachers College, Columbia University, the largest gift yet made to any institution for training teachers. To the Rockefeller Institute for Medical Research, New York, which seeks to eradicate diseases by discovering their origins, Mr. Rockefeller gave in all some $40,000,000. He gave, up to the end of 1924, nearly $74,000,000 to the Laura Spelman Rockefeller Memorial, New York, largely to continue charities for women and children in which Mrs. Rockefeller (*nee* Laura Spelman), who died in 1915, had been much interested. Besides these munificent gifts Mr. Rockefeller has given $18,000,000 to Baptist and other churches and about $45,000,000 for various purposes connected with the University of Chicago.

J. D. Rockefeller, Jr.—In his public gifts—$48,000,000 up to 1925—Mr. J. D. Rockefeller, Jr., has carried forward the purpose of his father to promote the well-being of mankind throughout the world. Notable among these gifts have been: to the Northern Baptist Convention, $2,300,000; Bureau of Social Hygiene, $2,000,000; Brown University, $500,000; Inter-Church World Movement, $1,500,000; International House, where hundreds of Columbia University students from many lands and all races live together in amity, $2,360,000; New York Public Library, $3,500,000; Cathedral of St. John the Divine, $500,000; Young Men's Christian Association International Committee, $1,500,000; Hampton Tuskegee Institute (for negroes), $2,500,000; Metropolitan Museum of Art, $2,000,000; toward restoration of gardens of Versailles and the Cathedral of Reims, $1,000,000; toward restoration of the Imperial University of Tokyo, Japan, 4,000,000 yen ($1,540,000); International Education Board, $21,000,000, to advance scientific research and education and to promote agricultural science and practice throughout the world.

RODIN, FRANÇOIS AUGUSTE (1840–1917), French sculptor (*see* 23.447), died at Meudon, near Paris, Nov. 17 1917.

ROERICH, NICOLAS CONSTANTINOVICH (1874–), Russian painter of Scandinavian origin, established his reputation by painting pictures of Russian prehistoric life and the wanderings of Vikings. After beginning with realistic pictures, his manner evolved under the influence of the Byzantine Icon and of Oriental art, towards a purely decorative and monumental style. Roerich studied the technique of ancient Russian frescoes and his wall paintings for the Kazan railway station at Moscow, representing combats between Russians and Tartars, are considered his most important work. He became a member of the "Artistic World" group, director of the school for encouraging art in St. Petersburg, a member of the Imperial Academy, and was also an archaeologist and a poet. He executed a number of works for the theatre: for the Russian ballet he painted the scenery in *Prince Igor;* for Stanislavsky the setting of *Peer Gynt.* He wrote the libretto for and also designed the scenery and the costumes of *The Rite of Spring,* for which Stravinsky composed the music. After the Russian revolution of 1917 he settled in America, and his art grew more and more abstract, tending towards occult mysticism. In 1924 he undertook a journey to India which provided him with much inspiration for his later work.

ROLL, ALFRED PHILIPPE (1846–1919), French painter (*see* 23.465), died in Paris Oct. 27 1919.

ROLLAND, ROMAIN (1866–), French man of letters, was born at Clamecy, Nièvre, Jan. 29 1866. He was educated at Clamecy, and later in Paris, where he had a distinguished academic career. From 1889–91 he was a member of the French School in Rome, in 1892 went with an archaeological expedition to Italy, and in 1895 was appointed professor of the history of art at the École Normale Supérieure, later occupying the same position at the Sorbonne, where he introduced the study of the history of music. He produced many critical and historical works, among them *Les origines du théâtre lyrique moderne, Histoire de l'opéra en Europe avant Lulli et Scarlatti* (1895); *Des causes de la décadence de la peinture italienne* (1895); *Le théâtre du peuple* (1901); besides studies on *Millet* (1902); *Beethoven* (1903) and *Michel-Ange* (1906), *Les Tragédies de la foi, Saint Louis, Aërt, Le Triomphe de la raison* (1913). His most famous work, however, is the romance of *Jean-Christophe* (1904–12), the biography of a German musician. It is in three series, *Jean-Christophe, Jean-Christophe à Paris* and *La Fin du Voyage,* and appeared in 10 volumes, the first *L'aube,* in 1904, and the last *La nouvelle Journée,* in 1912.

When the World War broke out Rolland was in Switzerland, and although his open letter to Hauptmann expressed his horror of the burning of Louvain, he became extremely unpopular in France owing to a series of articles published in the *Journal de Genève* during Sept. and Oct. 1914, and especially by the article *Au-dessus de la mêlée,* in which he deplored these single combats, "Eucken contre Bergson, Hauptmann contre Maeterlinck, Rolland contre Hauptmann." This article later gave the title to a collection of essays of which the ninth edition appeared in 1915. He maintained his pacifist attitude throughout the War. Although his reputation in France suffered from his political views, it increased abroad, and the performances of *Danton* and *Le 14 juillet* (which with *Les Loups* make up his *Théâtre de la Revolution* (1909), caused a furore in Berlin. His work *Mahatma Gandhi* (1924) is an impassioned defence of the Indian leader. His later works include: *Colas Breugnon* (1918); *Les précurseurs* (1919); *Clerambault, Pierre et Luce* (1919); *Voyage musical aux pays du passé* (1919); *Liluli* (1919); *L'âme enchantée* (1922); *Annette et Sylvie* (1924); and *L'été* (1925).

See Jan Romein, *Romain Rolland* (1918); I. Debran, *M. R. Rolland, initiateur de défaitisme* (1918); W. Kuechler, *Romain Rolland* (1919).

ROMAIN, JULES (1885–), French poet and novelist, was born Aug. 26 1885 at Saint-Julien-Chapteuil in the Ardèche. He went early to Paris and spent his childhood and adolescence in Montmartre. He entered the École Normale Supérieure in 1906, and graduated in philosophy in 1909. For 10 years he taught philosophy in Paris and in the provinces, notably at Nice. His claim to fame is principally based on his position as one of the heads of the Unanimist school of writers (Arcos, Vildrac, Duhamel, Chennevière and others). This school conceives of crowds, especially those of modern cities, as possessing an unconscious solidarity by virtue of the communal lines of thought and sympathies that bind them—the equivalent of a socialist Christianity without altars and without militant ideas, and is sometimes known as the group of *L'Abbaye,* after the place of retreat that certain of them chose with the object of working and creating communally. Romain's novels and verse and certain of his plays, *Cromedeyre-le-Vieil* (1920) and *Le bourg régénéré* (1920), exemplify this doctrine. His later plays, *M. le Trouhadec saisi par la débauche* (1922), *Knock* (1925), have a Molièresque humour which made them popular in France.

ROMAN CATHOLIC CHURCH (*see* 23.486).—In reviewing the history of the Catholic Church from 1910 to 1926, it will be seen that its activities range over a wide field of religious and philanthropic interests. These include the maintenance of its faith and discipline; the codification of its laws; the remodelling of its administration; the safeguarding of Catholic education; the training of its home and missionary ministry; the fostering of organisations of charity and piety; the adjustment of its relations

with the civil power; the promotion of Christian reunion; the expansion of its mission work; and the teaching of sound principles from the Christian standpoint as the essential means of securing peace and equity between the nations, and between the classes within the nations.

I. THE CHURCH IN THE OLD WORLD

Modernism.—The three years preceding the War (1911–4) saw the completion and execution of the decrees for the defence of the Faith against modernism. The decisions given, and the measures adopted by the Holy See in 1907, made it clear that the modernist teaching of that time could have no recognition or standing-room inside the pale of the Catholic Church. Its three great leaders had been the Abbé Loisy in France, Don R. Murri in Italy and Father Tyrrell in England. The first two were excommunicated. The third died under censure and was not buried with Catholic ritual. The disciplinary regulations enacted by Pius X. were supported by the episcopate throughout the world, and were maintained by his successors Benedict XV. and Pius XI.

The Church and the War.—Britain declared war on Aug. 4 1914, and 16 days later, Pius X. died—broken hearted, it is said, at the failure of his efforts to prevent the outbreak of hostilities. His successor Benedict XV. was elected on Sept. 3 and lived until Jan. 22 1922, more than three years after the conclusion of the Armistice. His Pontificate thus broadly covered the whole period of the great world conflict. His attitude and action during that time, as shown by the documentary evidence, consisted in taking every means and every opportunity to bring about the restoration of peace. In Feb. 1915 he ordered special services to be held, and prayers to be offered throughout the whole Catholic world. He sent Encyclical Letters to the bishops and clergy in all countries to leave nothing undone to foster the spirit of peace-making and reconciliation. In Aug. 1917, he made a direct appeal to the belligerent powers, and even suggested terms on which they might find a rational settlement of their quarrel.

His conception of peace, and the conditions on which it might be brought about, were found to be too idealistic to have at that moment any chance of consideration. Catholics in all nations, according to the custom of the Church, were free in their prayers for peace to pray for the complete victory and triumph of the arms of their own and allied countries. On the other hand, the Pope, by his position as spiritual father of Catholics in all nations, was bound to maintain an attitude of neutrality in the sense of paternal impartiality. Hence in the mind of Benedict XV., the ideal of peace was one which was not to be attained by the crushing, or crippling, or humiliation of an adversary, or by any one-sided triumph over a fallen foe. As he expressed it in May 1915, the peace which was needed ought to be one "inspired by the spirit of equity and good-will, so that it might be an achievement of justice in harmony with the dignity of the nations." He was convinced that no other peace would be lasting, or free from the complications and animosities which would lead eventually to another war. This ideal of a peace, carefully consistent with the honour and comity of nations, was set forth in all his utterances throughout the War, until the logic of events brought about the Armistice, and with it a more drastic solution. In a public Consistorial Letter in the same month, he denounced "the methods of warfare on land and sea" which are "contrary to the principles of humanity and of international right." In the consistory of Jan. 1915, he had protested against the devastation made in the occupied territory, and the cruelty to the inhabitants, beyond the necessities of war—a rebuke to the invaders, for which he received the thanks of the Belgian Government.

While the efforts of the Church proved unavailing for the stopping of the War, they were directed with greater success to mitigate its evils, by promoting organisations for the care of the wounded, the tracing of missing soldiers, the relief of prisoners of war, their transfer for convalescence to Switzerland and notably for the collection of funds for the starving populations in Russia and in the Near Eastern countries.

Soon after the Armistice, in Dec. 1918, Benedict XV. addressed an Encyclical Letter to all bishops throughout the Catholic world, ordering services to be celebrated in all their churches to thank God for the cessation of hostilities, and to ask His blessing upon the deliberations of the Peace Conference that it might secure a lasting reconciliation between the Powers. On the part of the Holy See, he pledged himself to use "all the influence of his Apostolic ministry to see that the decisions of the Conference for the maintenance of order and tranquility amongst the nations should be gladly accepted and loyally carried out by all Catholics."

The Church and Canon Law.—The spring of the year 1917 marked the completion of a notable enterprise in the domain of the Church's jurisprudence. The laws of the Church had accumulated during the centuries and had to be sought in the *Corpus Juris Canonici*, or in the ponderous collections of Councils, or in the rescripts of the Roman pontiffs or in the decrees of the Roman Congregations and tribunals, which largely make up the case-law of the ecclesiastical courts. The great project of Pius X. at the inspiration of Mgr. (later on cardinal) Gasparri, was to transform this vast material from a Corpus into a Codex, in which the operative Canons of the Church would be collected, amended, re-arranged and while retaining their usual titles of classification, should appear in a consecutively numbered series and thus simplify the work of consultation and reference.

The execution of this colossal task—*Immensum paene opus*, as the Papal Constitution calls it—was entrusted to a Commission in which 29 Cardinals took part, aided by more than 40 Consultors, expert Canonists selected from Rome or various parts of the Church for their proficiency in Canon Law. The work occupied the Commission for 13 years, from March 1904, till May 1917. During that time, the proofs of the new Codex were sent no less than three times over to the entire Catholic episcopate in all parts of the world for suggestions, additions or amendments. As a result, the whole body of Church law has been compressed into a single volume and set forth in 2,414 canons. On the promulgation of the new Code to the world at Pentecost, 1917, Benedict XV. commemorated the event by having a special medal struck and a large tapestry, with portraits of the Commission, made to hang on the walls of the great Consistorial Hall of the Vatican.

Apostolic Visitations.—While the work of codification of the Canons was proceeding, Pius X. took measures to strengthen discipline and to secure their observance. A Visitation or Commission of Inquiry was held in many parts of Italy, to investigate the state of the dioceses, to remedy defects and to promote spiritual progress. In several cases where the incumbents, owing to age or inefficiency, were unequal to their post, they were removed or practically replaced by an Apostolic Visitor until the required changes were effected. Pius X. set the example for this disciplinary reform in his own diocese. As Rome is the capital of the Church, a considerable number of clerics and monks from all parts were usually attracted thither, and these included not only those who came for business or for study, but not a few that would have been more usefully employed elsewhere.

Pius X. issued strict orders to the Cardinal Vicar to see that no cleric or religious should be allowed to reside for any notable time in the city except for satisfactory reasons, and that in such cases they should be subject to the supervision of the ecclesiastical authorities. These regulations were rigidly carried out, and served to restore the more normal proportion of the clerical to the lay population, and to remove causes of complaint and dissatisfaction. At the same time, the Holy See sent letters to the bishops of Italy and of other countries, urging them to encourage missions for the people, and the formation of guilds for teaching Christian doctrine. It further exhorted them to interest their clergy in the social and economic well-being of the people, and to aid in the formation of parochial saving-banks to promote habits of thrift and industry.

The Holy See and Italy.—The attitude of the Holy See towards the civil power in Italy, while abating in nowise its claim to spiritual independence, and all that is required for it, has, owing

to the change of circumstances, during the years under review entered into a new ethos and outlook. The Vatican has followed its policy of neutrality to all political parties, and has refused to identify itself even with the Catholic *Partito Popolare* or with the pacific revolution which was effected by Signor Mussolini and his Fascisti. Nevertheless, under the Fascist régime, the relations between the Papacy and the kingdom of Italy have been more friendly than they have been at any time since the Italian occupation, and the Holy See has welcomed with gratitude the fuller recognition of religion by the civil authorities, and the restoration of religious teaching in the schools.

The Church and France.—For several years before the War, the Church in France was still emerging from the crisis caused in 1905 by the separation of Church and State. The difficulty lay in the collision between the traditional religion of the country and the political ideals inherited in part from the Revolution. Of a population of nearly 40,000,000, a majority may still be said to be traditionally or nominally Catholic. But only a minority make practical profession of their religion or use their political influence in defence of its interests. The bulk of the electorate, and with it, the voting power, and consequently the government of the day, belongs to those who, if not hostile, or indifferent, or respectfully neutral to religion, are averse in principle to any recognition of its place in matters of secular or national import. In the early years of this century, this movement made itself felt in the enactment of a series of laws in the direction of laicisation or secularity. The separation of Church and State followed upon the suppression of the religious orders (save a few that obtained authorisation in view of their work in the East) and the disqualification of their members from holding any official post of teaching.

The abolition of the Concordat brought with it drastic disendowment. The provision substituted for the support of the Church, and known as the *Associations Culturelles*, under the chief control or supervision of civil functionaries, was rejected by the Holy See and the French bishops as infringing on religious liberty, so that nothing remained to the French Church but the permissive use of the cathedrals and parochial church buildings. Left wholly dependent upon the voluntary contributions of the people, the bishops have formed diocesan organisations of their own (*Associations Diocésaines*) and these, although labouring under many difficulties, are said to be fairly successful. It was recently pointed out by eminent French jurists, that it was possible, under the existing law of syndicates, to obtain State recognition for these associations. This plan has been carried into effect at Lyons and elsewhere, and, so far, promises to be a successful solution. On the whole, the condition of the Church in France is said to be stronger than it was under the Concordat, at least in the sense that what it has lost financially, it has gained in liberty. It is now free to found new parishes and build new churches wherever needed, without the hampering civil formalities of former times. In Paris alone, more than 30 new parish churches have been erected to meet the needs of the city and the suburbs. Most of all, the Church is left free to have its bishops chosen without interference of the civil power.

In the programme of laicisation, one of the most acute problems is to be found in the schools. In those which are built and supported by the State, religion has no recognised place in their teaching. Catholics have sought to meet what they feel to be a conscientious need, by building schools for themselves. These free schools (*écoles libres*) fulfil a work of education, but receive no aid from the State, and have to depend upon the generosity of private benefactors. It has been proposed that the sum voted by the nation for the purposes of education should be equitably divided between all schools which teach efficiently, in proportion to the number of children taught or to the results attained. An Association formed to promote this scheme (*Representation proportionelle scolaire*) has an important following, but has not succeeded in obtaining an effective majority, and thus the Church in France in the important matter of religious teaching in the schools has not yet been able to secure the same advantages which are available in England, Holland, Germany and Italy.

The Church in Germany.—In Germany, the Church has had to deal, and, during this period in a more accentuated form, with the spread of socialistic, or communistic, principles amongst the industrial classes. Its policy has been to encourage Catholic workmen to unite together to promote their legitimate interests —notably on the lines indicated in the Labour Encyclical of Leo XIII.—and to protect themselves from the evils which would be wrought by unsound or unchristian theories. For this purpose large associations of workingmen were formed in Eastern Germany under the patronage of Cardinal Kopp, Archbishop of Breslau, and in Western Germany, under that of Cardinal Fischer, Archbishop of Cologne. The aim of both was the same, but certain differences arose in the method of pursuing it. The former wished to confine membership of the Association to Catholics, while the latter deemed it expedient to secure, if need be, the admission or co-operation of non-Catholics.

Pius X. in his letter to Cardinal Fischer (Dec. 31 1910) congratulated him, as he had already congratulated Cardinal Kopp, on his great service done for the labouring population, and laid down regulations by which both systems might be worked efficiently. In a few years, the World War did much to suspend the action of these labour guilds, but in the new conditions after the conclusion of peace, the Church is again at work fostering union, and endeavouring to meet the penetration of subversive doctrines by the spread of sound economic and Christian principles. In Southern Germany, the Church has been helping in the reconstructive work of the new States, and the fragments of the late Austrian Empire.

The Church in S.E. and E. Europe.—The Holy See concluded a Concordat with Serbia and Poland, and also with Czechoslovakia, where a section of the clergy and people had seceded and formed themselves into a separate national church. Benedict XV., addressed an Encyclical to the Czech bishops urging the work of more frequent preaching and of retreats for the sanctification of the clergy, and received in return the assurance of thanks and loyalty from the Archbishop of Prague and the Church of Czechoslovakia. To meet the new post-War conditions, new archbishoprics have been founded at Danzig, at Riga in Poland and at Jasovin, Czechoslovakia. Since 1910, 23 archbishoprics and 47 bishoprics in other countries have been added to the Catholic Hierarchy.

The Church in Spain.—In Spain, the normal proportion of secular priests to the Catholic population has not been notably exceeded, but that of the clergy belonging to the religious orders has, at least, in times past, been considerably above it. In 1903, a Concordat with the Holy See limited the number of religious orders to a few authorised bodies, and to one additional order sanctioned by the Supreme Pontiff. In recent years, the Government and the Holy See have entered into fresh negotiations in which a reasonable restriction has been satisfactorily arranged. In the rural districts, under the guidance of the Church, much has been done to help and organise the agricultural classes in the National Catholic Agrarian Association, which has more than 5,000 local unions. Its activities take the form of establishing savings-banks, encouraging co-operation and adjusting disputes between the employers and the employed. Associations for women and for Catholic young men, have been successfully established.

The Church in England.—In England, a notable constructive change took place in the government of the Catholic Church in 1911, when the Holy See, which had raised it from the rank of a missionary country under the Propaganda to the normal status under the Consistorial, and divided its single province into three, Westminster, Liverpool and Birmingham, and in 1916, placed Wales under the new archbishopric of Cardiff. This widening of the organism has already borne fruit in multiform and increased activities.

The Jubilee Year.—One of the most memorable features in the recent life of the Church has been the celebration of the Holy Year or great jubilee of 1925, which drew to Rome more than 1,250,000 pilgrims. These pilgrimages came from all lands—even from Iceland and Australia and Chile—and have served the

vital purpose of a popular circulation to the centre from all parts of the circumference. They have shown the notable increase in the international character of Catholic Associations, including workmen, women, university students and many other categories. Not the least remarkable was the assembly in the Piazza of St. Peters of 12,000 Catholic Boy Scouts, of whom nearly 1,000 had come from Great Britain. Pius XI. congratulated them on their international organisation, and on their imitating, in this, the Catholic Church, which itself is essentially international. The Missionary Exhibition held at the same time at the Vatican was an object lesson of notable progress in the far-flung line of operations in the Mission field. It may be said that the jubilee year has drawn the whole Catholic world more closely together in the personal contact of bishops, clergy and people of all classes with the Holy See.

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II. THE CHURCH IN THE UNITED STATES

There is hardly any parallel in the history of Catholicism to the rapid growth of the Church in the United States during the 100 years from the death of Archbishop Maréchal (1828) to the present. This growth has given rise to serious discussion among Catholic writers. Some hold the increase from 25,000 in 1785 to about 25,000,000 at present to warrant the stand that there has been no leakage; others, basing their study upon the same figures (immigration, statistics, census reports, etc.) hold that there has been a considerable loss (*cf.* Canevin, *An historical and statistical Examination into the Progress and Population of the Catholic Church in the United States from 1780 to 1920*). The growth of the Catholic Church in the United States is due primarily to immigration, natural increase and conversions. The statistics generally accepted by Catholic writers, based upon the estimates made by John Gilmary Shea in 1891, are as follows:—

1790	40,000
1820	243,000
1830	337,620
1840	661,254
1850	1,767,841
1860	3,392,980
1870	4,901,980
1880	7,026,820
1890	10,419,668
1900	13,537,697
1910	18,483,320
1920	22,733,254

This computation would apparently support the statement that there were in the neighbourhood of 25,000,000 Catholics in the United States in 1925. That these figures do not represent what should be the actual total of Catholics is claimed by some writers. In Canevin's careful study of the question, we read:—

> Among the principal causes of loss to the Church in the United States, particularly during the first half of the 19th century, we may mention: the inadequate supply of priests and churches; the want of Catholic schools; the scandals and schisms arising from trusteeism; mixed marriages; intemperance and the degraded poverty of which it was the cause; social exclusion and sometimes the social and political persecution of Catholics; and the proselytism of orphans and of men and women of weak faith.

Racial Composition.—Racially, the Church in the United States is made up of groups from every nation in the world, with the English-speaking peoples in the majority. Up to the middle of the 19th century, the Irish and the Germans furnished the greater quota of its adherents. Later the French-Canadians, Italians, Mexicans, Poles, Lithuanians, Slovaks, Hungarians and others added notably to the number. There is also an appreciable percentage of Oriental Catholics—Greeks (Uniates), Syrians, Armenians, etc.

External Relations.—This almost unprecedented growth of a religious organisation which had been subject to legal and political disabilities since the 16th century was bound to give rise to misunderstandings in a country so largely composed of Protestants. During the 19th century several organised politico-religious movements were instituted for the purpose of hindering the exercise of the franchise on the part of American Catholic citizens. Chief among these were the Native-American party, the Know-Nothings, the American Protective Assn. and recently the Ku Klux Klan. Being under the protection of the Constitution, and enjoying the advantages of the common law, Catholicism has not met with any official opposition. Such outbursts of political or religious anti-Catholicism as there have been were but temporary or local, and did not represent the more general attitude of American citizens. These anti-Catholic movements never became national in scope but remained mostly sectional and were due to a condition in which political, social and industrial elements were closely intermingled. The political theory of an inherent antagonism between Catholicism and Americanism has given rise to many interesting studies upon the question, chief of which from the Catholic side is the *Catholic Builders of the Nation* (5 vol., Boston, 1923). Many writers on this alleged incompatibility between Catholicism and republican institutions fail to give due allowance to the economic adjustments involved in these sectional antagonisms to the Church.

Internal Development.—The internal development of the Church in the United States has been of a uniform nature. Its doctrinal history offers little of importance. The Church discipline in vogue is similar to that of the other churches of Catholicism. Unity of doctrine, of moral law and of liturgical observance is preserved by an intimate union with the See of Rome. The universal canonical legislation of the Church as reorganised in the New Code of Canon Law (1918), the legislation by papal rescript, the decisions in contentious cases by the Apostolic Delegation at Washington, D.C. and a certain number of customs and practices which have grown up in the American Church during the past century and a half of its organised life form the basis for its domestic relations. Every five years each American bishop is expected to pay a visit to Rome (*ad limina Apostolorum*) and to make a report of the condition of his diocese. A system of diocesan synods provides for local unity among the bishops, clergy and laity. Each province is convened into provincial councils from time to time, and at greater intervals a national or plenary council is held. Three national or plenary councils of the American Church have been held (1852, 1866, 1884) at Baltimore.

Education.—An outstanding factor in the internal development of the Church in the United States has been in the field of education (*cf.* Burns, *Catholic School System in the United States*, 3 vol., New York, 1907–12). According to the *Official Catholic Directory* for 1925, there are 6,819 parochial or elementary schools, in which 2,072,466 boys and girls receive secular and religious instruction. The principal outlay involved in the parochial school system amounted (1924) to over $70,000,000. Catholics at the same time contributed their proportionate share to the maintenance of the public schools. There are 218 high schools, colleges and universities for boys and 727 academies for girls. This system of secondary education is crowned by the Catholic University of America, at Washington, D.C., established (1887) by Pope Leo XIII. and the American hierarchy and endowed with the privileges of the old pontifical universities of Europe. The purpose of the founders of this central institution was to carry the graduates of the Catholic colleges into higher scholarship, and thus prepare teachers for the entire Catholic educational system as well as leaders in the world of science and literature. The Catholic Sisters College, founded as an integral part of the Catholic University of America (1914), gives to the religious women teaching in the Catholic schools equal opportunities for higher training.

Between the years 1920 and 1924 the enrollment in Catholic higher schools increased 80%. There are 32% more lay than religious instructors in the Catholic universities and colleges for men. The education of the clergy is provided for by 121 seminaries, in which there are about 13,000 students. *A Directory of Catholic Schools and Colleges* for the United States has been printed (1926), as well as a *Directory of Catholic Charities* (1922).

There are 352 orphan asylums, with 47,825 inmates. Other charitable institutions number over 2,000 and include every form of private and public charity. Annual meetings of the National Conference of Catholic Charities and the Catholic Educational Assn., composed of all those in charge of educational and welfare organisations, maintain the necessary contacts and promote general progress.

Administration.—The actual government of the Church in the United States is represented by the Apostolic Delegate at Washington, D.C.; four cardinals (Boston, New York, Philadelphia and Chicago); 14 archbishops (Baltimore, Boston, Chicago, Cincinnati, Dubuque, Milwaukee, New Orleans, New York, Oregon City, Philadelphia, St. Louis, St. Paul, San Francisco and Santa Fé); 103 bishops; 17,681 diocesan clergymen, under the sole and immediate direction of their bishops; 6,671 members of religious orders, subject to episcopal supervision—in all, 23,697 clergymen. There are 11,625 churches with resident priests, and 5,955 mission churches—in all, 17,380 churches, to which must be added several thousand chapels. Several hundred daily, weekly, bi-weekly and monthly publications are printed in English and foreign languages. Many of these are religious in content. Others are diocesan organs for current local Catholic news. There exist also several literary and academic reviews, published monthly and quarterly, of a high order of merit. A *Catholic Press Directory* was published in 1925.

Historical Events.—The principal events in the recent history of the Church were: the Third Plenary Council of Baltimore (1884); the First Catholic Congress (1889); the opening of the Catholic University of America (1889); the Catholic Educational Exhibit at the World's Fair in Chicago (1893); the establishment of the Apostolic Delegation at Washington (1893)—Cardinals Satolli (1893–6), Martinelli (1896–1902), Falconio (1902–11), and Bonzano (1911–23) and Archbishop Fumasoni-Biondi (1923–); the publication of *The Catholic Encyclopedia* (1907–14) in 16 volumes; and the formation of the national Catholic war council (1917), from which grew the national Catholic welfare conference, founded in 1919 (*cf.* Guilday, "The Church in the United States" (1870–1920) in the *Cath. Hist. Rev.* for Jan. 1921). An event of international importance in Catholic American history was the Eucharistic Congress, held at Chicago, in June 1926.

National Development.—Students of the social and intellectual forces of Catholicism in the United States are giving considerable attention to the recent development of the Church along national lines. The change in the immigration policy of the country has rendered this development possible, since it permits the racial elements to be more easily assimilated to national ideals. Many agencies are at work effecting this general evolution. Among them are the Catholic Educational Assn., the National Conference of Catholic Charities, the Catholic Hospital Assn., the Central Bureau of the Central Verein, the American Catholic Philosophical Assn. and the American Catholic Historical Association. All these organisations are aided by the central bureaux of the National Catholic Welfare Conference at Washington, D.C. National organisation is also being effected through such societies as the Holy Name Society, the Knights of Columbus, the Daughters of Isabella and the Catholic Daughters of America, the International Catholic Truth Society and the International Federation of Catholic Alumnae.

An annual meeting of the American hierarchy is held in Sept. at the Catholic University of America, Washington, D.C., for the discussion of mooted points in Church discipline and progress. The national Catholic welfare conference, with headquarters in Washington, D.C., is directed by an administrative committee of bishops, who report annually at the aforesaid meeting. A recent development in the Catholic Church of the United States is the creation of the home and foreign missionary board.

Mission Work.—Missionary work has been begun by American priests and sisters in foreign fields. The Catholic Foreign Mission Society of America (Maryknoll, N.Y.), and the Dominicans and the Foreign Mission Sisters of St. Dominic, have stations in China. The Holy Cross Fathers maintain missions in India. The Catholic Students Mission Crusade is an active participant in these projects. There is a bureau for Catholic Indian missions at Washington, D.C., and a national board for mission work among the coloured people, with headquarters in New York City. In social and educational welfare work the Knights of Columbus, with a membership approaching 1,000,000 men, has occupied a position of leadership.

Authorities.—The chief foreign source-collections for the history of the Church in the United States are in Rome (Vatican archives and archives of propaganda), Paris, London (Westminster archives), Seville (archivo general de Indias), Mexico City (national archives), and Quebec (archiepiscopal archives). Transcripts of these documents are in the Shea collection at Georgetown University, in the archives of the Dominican House of Studies (Washington, D. C.), and in the Guilday transcripts at the Catholic University of America. Every episcopal see has its own archives, and considerable material exists at the headquarters of the religious orders and congregations in this country and abroad, particularly in Rome. The Catholic archives of America at Notre Dame University are particularly rich in unpublished material. Printed sources will be found in the quarterly *Records* and *Reviews* of the Catholic historical societies in the United States. The *Catholic Historical Review* contains bibliographical references for all phases of American Catholic history. Ecclesiastical legislation will be found in the *Acta et Decreta* of the Third Plenary Council of Baltimore. The new code of Canon law has been analysed for American purposes in a supplementary volume of the *Catholic Encyclopedia* (1918).

The literature of American Catholic history both of general and special nature is large in extent, although few works of outstanding merit have been published. Shea's four volumes on the *History of the Catholic Church in the United States* (New York, 1886–92) is still the standard work. The *Catholic Encyclopedia* contains articles on practically every noteworthy aspect of American Catholic history and is especially valuable for biographical sketches. The *Lives of the Deceased Bishops*, in two volumes, by R. F. Clarke (New York, 1872), is generally trustworthy, though inadequate. Statistics are given annually in the *Official Catholic Directory* (New York). The bibliography of American Church history, found in Guilday's *Life of Archbishop Carroll* (1922), gives a list of provincial, diocesan and institutional histories. The American Catholic Historical Assn. (founded in 1919) is preparing a *Guide to the Printed Sources for American Catholic History*. (P. Gu.)

ROMANONES, ALVARO DE FIGUEROA Y TORRES, Count de (1863—), Spanish politician, was born in Madrid Aug. 1 1863, and studied law in his native city and at Bologna. On being elected a member of the Madrid municipality, and soon afterwards appointed its president, he exposed and remedied many of the abuses which characterised that body. He next turned his attention to public instruction, first as parliamentary deputy and later as Cabinet Minister. As minister of agriculture and as Home Secretary in 1905 it fell to him to deal with strikes and riots, and he was compelled to suspend the constitutional guarantees. He became Prime Minister in Nov. 1912, shortly after the murder of Canalejas, and passed a bill conferring limited autonomy on the Catalans. During the World War his alleged partiality towards the Allies was a constant source of public discontent. He was again Prime Minister from Dec. 1915 until April 1917, and for the last time from Dec. 3 1918 until April 15 1919, when he had once more to suspend the constitutional guarantees. He was Minister of Justice Dec. 1922–Sept. 1923, and after Gen. Primo de Rivera's *coup d' état* in that month he published a book in defence of the parliamentary parties entitled *Las Responsabilidades Politicas del Antiguo Régimen de 1875 a 1923* (1924).

ROMAN RELIGION (*see* 23.577).—The period since 1910 has produced one masterpiece upon a large scale, the late Dr. W. Warde Fowler's *Religious Experience of the Roman People* (1911), but in the main advance has been by the more intensive study of detail. The facts about the prehistoric peoples of Italy, if still obscure have been made clearer by archaeologists. A beginning has been made of the collection of data concerning local Italic and Celtic cults, and the cautious use of comparative folklore has thrown light upon particular primitive survivals. Here Eitrem's valuable study of ritual practice might be mentioned, or Rose's recent suggestion, which has hardly yet stood the test of critical examination, that Roman marriage customs point to the original existence of a classificatory system.

General Tendency.—In general, however, there has been a sound reaction against wide generalisations based upon random analogies drawn from all parts of the world. Greater attention has been paid to the analysis of the composite religion of historical Rome and to the importance of distinguishing what is Roman from what is Graeco-Roman. For instance, the hypothesis of the existence of early king-gods or of married pairs of deities is now generally abandoned, as being quite inconsistent with what is known of genuinely Roman religion.

Prehistoric Period.—As regards the prehistoric period, there are certain religious phenomena (*e.g.*, the *mundus* or the *pomerium*) which seem to find prototypes in the *Terremare* of the Bronze Age. But none of the attempts which have been made to identify Plebeians and Patricians with the two prehistoric racial elements of which the Romans were composed can be said to have succeeded. That the Etruscans, who are now believed to have entered Italy definitely by sea and probably not before the end of the 9th century B.C., made important contributions to Roman religion is certain, though modern, like ancient, authors may be inclined to exaggerate their extent. The most notable were divination by entrails (augury, upon the other hand, is Italic and may go back to the Terremare), the practice of temple worship and the cult of anthropomorphic gods.

Worship of Numina.—Before Etruscan influences became operative, Roman objects of worship appear to have been not gods, but *numina* or impersonal powers. The difficulty of accounting for the very early existence of two exceptions, Jupiter and Mars, has not yet been solved. About the original character of Mars opinion still differs as to whether he was primarily an agricultural or a warlike deity or a *numen* of growth. That early Romans believed in individual survival after death has become less probable. The view that the *Lar Familiaris* was not a spirit of a dead ancestor but a protector of the fields (see above) has won fairly general acceptance, and there is some evidence to show that while the early Romans performed certain rites in respect of the collective dead the conception of the individual spirit of a dead man or ancestor was quite late in development, possibly under Greek influence.

Hellenistic Influence.—In religion, as in all departments of history, increasing knowledge has emphasised the importance of the civilisation of the Hellenistic kingdoms. The most interesting example, perhaps, is provided by the papyrus containing the regulations of Ptolemy Philopator for the control of the Dionysiac societies in Egypt, which almost certainly formed the model for the famous decree of the senate about the Bacchanalian societies.

Imperial Period.—As regards the imperial period a great deal of work has been done by Bousset, Norden, Reitzenstein, Clemen and Cumont in two main directions: 1, the investigation of the relation of the later syncretism to heretical forms of early Christianity; 2, the disentanglement of the Greek, Egyptian and Iranian elements in this confusedly composite whole. The systematic examination of provincial cults has also progressed, and archaeological discoveries in Rome itself have been rich in new material particularly as affecting the relations of early Christian to pagan religious art. Outstanding are the paintings of the Via Manzoni with their pagan (?) designs of the Good Shepherd type and the twelve figures which are popularly, though erroneously, supposed to be portraits of the Twelve Apostles. Even more remarkable is the richly painted subterranean basilica of some unidentified non-Christian sect, which was discovered in 1917 near the Porta Maggiore.

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ROME (*see* 23.584), the capital of Italy, has become a much healthier city; slum clearances, new drainage works and the removal of the ghetto, have resulted in the gradual disappearance of Roman and typhoid fever, and a reduction of the death rate to about 19 per thousand. The population in 1925 was 746,783. The housing question has been acute since the World War. In 1925, the Holy Year, some 102,000 pilgrims visited Rome in a period of four months. The Via Quirinale is now called Via Ventiquattro Maggio, in honour of the day on which Italy declared war on Austria, and the Via Nationale is named in part Via Cesare Battisti, in memory of a man hanged by the Austrians, and in part Via Quattro Novembre. A fine bridge over the Tiber, the Ponte Vittorio Emanuele, was opened in 1911.

Much work has been done on the remains of ancient Rome since 1910. In 1910, in honour of the jubilee of the unity of Italy, the formation of an archaeological park, extending from the Via Appia to the foot of the Aventine and almost to the Aurelian Wall, was approved by Parliament. It contains the Baths of Caracalla, where another corridor was discovered in 1913. The site of the palace of Tiberius has been excavated, and a bath, staircase, etc. found. What is believed to be the "mundus," which was venerated in connection with the cult of the *manes* as the centre of the furrow made by Romulus, was found on the Palatine in 1914; it is in the form of a well 40 ft. deep. The state apartments in the palace of Domitian were laid bare between 1909 and 1912, the staircase connecting them with the rest of the palace in 1915, and the domestic offices in 1923. The ground under the Arch of Constantine has been dug away to its original level, and a carriage way made through the arch.

Outside the walls, the ancient aqueducts have been widely explored, and excavations under the Renaissance church of San Sebastiano, 1½ m. beyond the Appian Gate, have resulted in valuable discoveries. In the suburb of Porta Salaria, a *hypogeum*, of which the original purpose is doubtful, has been found. In 1911 zoological gardens were arranged in the grounds of the Villa Borghese, and a fine collection of modern Italian art was opened in the Palazzo delle Belle Arti, to the west of the Villa. In 1922 a museum of antiquities from the Forum was arranged in a building adjoining the church of Santa Francesca Romana; and the Museo Petriano, containing objects connected with the foundation and development of St. Peter's, was opened in 1925.

It was proposed in 1922 to make the barracks and storerooms of the castle of St. Angelo into a topographical museum. The Palazzo Venetia, for long the residence of the Austrian ambassador to the Vatican, came again into Italian hands in 1915, and frescoes of the Renaissance period, by Mantegna and Bramante, have been found in it. Among important modern buildings are the Chamber of Deputies, with its principal front on the new Piazza del Parlamento; the Palace of Justice, near the Castle of St. Angelo; and the Polyclinico, a fine hospital on part of the large site, east and south of the Castro Pretorio, requisitioned by the Government for building a new university, and bringing together various institutions scattered about the city. Of this scheme the hospital forms part. A monument to Victor Emanuel II., consisting of an immense platform and flights of steps decorated with fountains and figures, surmounted by an equestrian statue, towers above the Piazza Venetia. The Campitello quarter was cleared to make space for it, and it is proposed to extend the Via Cavour to the Piazza. A further municipal scheme of improvement caused apprehension in 1926, lest a portion of the English College should be scheduled for removal.

RONALDSHAY, LAWRENCE JOHN LUMLEY DUNDAS, EARL OF (1876–), British administrator, was born June 11 1876, the eldest surviving son of the 1st Marquess of Zetland and was educated at Harrow and Trinity College, Cambridge. From 1898–1907 he travelled extensively in Ceylon, India, Persia, Asiatic Turkey, Central Asia, Siberia, Japan, China and Burma. In 1900 he was appointed aide-de-camp to the staff of the viceroy, Earl Curzon, in India. He sat in the House of Commons as Conservative member for the Hornsey division from 1907–16. A member of the royal commission on the public services in India from 1912–4 he was appointed governor of Bengal in 1916 in succession to Lord Carmichael of Stirling. He retained this appointment until 1922, when he was created G.C.S.I. and sworn of the privy council. In 1925 it was

announced that Lord Ronaldshay had undertaken to write the life of Lord Curzon.

Lord Ronaldshay published *Sport and Politics under an Eastern Sky* (1902); *On the Outskirts of Empire in Asia* (1904); *A Wandering Student in the Far East* (1908); *An Eastern Miscellany* (1911); *Lands of the Thunderbolt: Sikhim, Chumbi and Bhutan* (1923); *The Heart of Aryavarta* (1925).

RÖNTGEN, WILHELM KONRAD (1845–1923), German physicist (*see* 23.694), received the Nobel Prize for physics in 1901. He died in Munich Feb. 10 1923.

RÖNTGENOLOGY: *see* RADIOTHERAPY AND RÖNTGENOLOGY.

RÖNTGEN RAYS (X-RAYS) (*see* 23.694).—Physical research has spread itself over 60 octaves or more of electromagnetic waves which are now known to stretch without break from wireless waves 25 m. or more in length, through heat waves, visible light waves, ultra-violet waves and X-rays, to gamma rays of wave lengths of the order of a ten thousand millionth of an inch. In this gigantic gamut of natural activity, that group of radiations encroaching into and extending some 13 octaves beyond the ultra-violet, and possessing wave lengths ranging from about 5×10^{-6} to 5×10^{-10} cm. is now generally styled Röntgen rays, or X-rays. Of these 13 octaves, 10 are extremely absorbable, but the remaining three possess those remarkable powers of penetrating matter which made Röntgen's discovery so arresting when it was announced in 1895 (*Wiedemann's Annalen der Physik*, vol. 64, p. 1). If we include the X-rays which radium emits—usually known as gamma rays—this gives a total of nearly 6 octaves of radiation. With these X-rays the science of medical and technical radiology of the present day does its work. (*See* also RAYS.)

Dangers.—At the outset, the dangers to the X-ray worker should be referred to. These dangers are well known and have caused many casualties in the past. They can, however, be wholly avoided by common-sense protective measures which consist in the main of interposing lead sheet or the like, properly disposed and sufficiently thick, between the X-ray tube and the operator. The Reports of the X-ray Protection Committee[1] contain details of complete safeguards.

Generation of X-rays.—Röntgen's discovery was made with a Crookes tube, that is, a glass bulb exhausted to a low gas pressure through which a high-tension electric current is passed by means of electrodes provided. If the tube is made of special design, in which a converging stream of high-speed electrons (cathode rays) is arrested at its focus by a heavy metal target, then we have a modern X-ray rube—an instrument with an efficiency of about $\frac{1}{10}$%. The X-rays leave the focal spot in all directions (travelling in straight lines with the speed of light. We cannot see them, but they affect a photographic plate or fluorescent screen and they ionise (or render conducting) any gas through which they pass, so that they can be detected and measured by one of these properties.

Tubes.—There are two main types of X-ray tubes—the gas tube and the hot cathode tube. In a gas tube an appreciable amount of gas is left at a pressure ranging from 0·001 to 0·01 mm. of mercury. When the exciting potential is applied the residual ions are accelerated and generate many more ions by collision with the gas molecules. The positive ions are directed by the electric field towards the cathode which they bombard and cause to emit electrons which in turn, under the electric field, bombard the target and so generate X-rays.

Coolidge Tubes.—In the hot-cathode tubes, with which the name of Coolidge is associated, the vacuum is so high that the residual gas plays no part. The electrons are produced by heating the cathode by means of a subsidiary current. For this purpose the cathode takes the form of a spiral of tungsten wire. Separate and precise control over the exciting voltage and the current through the tube is possible with a hot-cathode tube, a remark which does not apply to the gas tube.

For most practical purposes targets are of tungsten or platinum—metals of high atomic number and high melting point. Much heat is generated at the target, and has to be dissipated by water-cooling or the like. So-called metal X-ray tubes are now coming into use.

[1] Copies can be obtained from the Director of the National Physical Laboratory, Teddington.

The intensity of the X-rays from a tube is roughly proportional to NiV^2, where N is the atomic number of the target, i the current through the tube and V the exciting voltage. An X-ray unit of intensity is greatly needed for many purposes.

Excitation.—The X-ray tube is excited by voltages ranging from, say, 50 to 200 kilovolts; the higher the voltage, the greater the speed of the cathode rays, and the shorter the wave length of the X-rays produced. Such voltages are produced by induction coils, high-tension transformers, or some form of constant potential apparatus. In any event the X-rays are very heterogeneous—a continuous spectrum of X-rays being produced. Duane and Hunt (*Phys. Rev.*, 1915) showed that this spectrum is definitely limited at the short wave end, the position of the boundary depending not on the nature of the target but only on the maximum voltage V applied to the tube. The relation is given by Planck's quantum equation, $Ve=h\nu$, where e is the electronic charge, ν the frequency and h is Planck's constant. Substituting the accepted values of these constants, we have:—

Shortest wave length in Å.U. = 12,400 ÷ maximum voltage.

Kaye (*Phil. Trans.*, A., vol. 209, 1909) showed that superposed on this general spectrum of X-rays are the characteristic X-rays discovered by Barkla and Sadler (*Phil. Mag.*, 1906 *et seq.*). These have since been shown to be constituted of groups of spectral lines, the positions of which depend only on the material of the target. For each element there are several groups of characteristic radiations—called K, L, M, N—of which the K group have the shortest wave lengths. Webster (*Phys. Rev.*, 1916) has shown that these radiations are not generated unless the exciting voltage exceeds a value which corresponds to the line with the shortest wave length in each group.

X-rays and Matter.—Three things may happen to a beam of X-rays when it passes through a material. Part of it emerges undisturbed and undeviated and in X-ray photography (radiography) outlines the shadow picture on the plate. Part is "scattered" or dispersed, which is equivalent to stating that, while the rays are not altered in quality, or but slightly so, a considerable proportion of them have their direction altered to a greater or less extent. The rest is "absorbed" with the resulting liberation of characteristic X-rays and electrons.

Scattering Effect.—As regards "scattering," the effect occurs at all depths and increases with the thickness. The heavier elements scatter proportionately more than the light elements, though, owing to the greater absorbing power of the heavier elements, the scattering effect is usually more evident with the lighter elements. C. G. Barkla (*Phil. Trans.*, 1905) found that scattered rays may show partial polarisation. A. H. Compton (*Phys. Rev.*, 1923) has shown that a proportion of the scattered radiation has its wave length slightly lengthened, as would be anticipated on the quantum theory and a recoil of the electron encountered. Scattering is prejudicial to good definition in X-ray photography and has to be specially guarded against in radiometallography.

Absorption Effect.—As regards "absorption," X-rays can penetrate all substances to an extent depending on their thickness and density and on the wave length of the X-rays. In general, the shorter the wave length the greater the penetrating power though, as will be seen presently, this is not so in special conditions. The power of a material to absorb rays of a particular wave length is usually given in terms of its absorption coefficient μ where μ is defined by $I=I_0e^{-\mu d}$ in which I_0 is the intensity of a beam normally incident on a screen of thickness d, and I the intensity of the transmitted beam. For normal absorption μ varies as λ^3 where λ is the wave length. Ordinary X-rays are heterogeneous, so that μ is greater for thin absorbing screens than for thick.

An element shows limited regions of abnormally high absorption for X-rays somewhat exceeding in wave length one of its characteristic radiations. The effect forms the basis of the absorption limits in the spectra first obtained by M. de Broglie (*Jour. de Phys.* 1914, *et seq.*).

Electrons.—The liberation of electrons is an effect attendant on the absorption of X-rays by matter. An X-ray of given wave length may give up a part or the whole of its energy to an electron, the energy of the ejected electron being represented by the loss of frequency of the X-ray. In a proportion of encounters the whole of the energy is transferred and the speed of the electron will reach an upper limit. In other cases, de Broglie has shown that only a part of the energy is given up to the electron, the rest being wholly transferred to a group of characteristic X-rays originating in one of the electronic orbits of the atom. (*See* ATOM.)

Speed.—With reference to the upper limit of the speed of the electrons ejected by X-rays, it is found that this value agrees closely with the speed of the cathode rays in the tube which generated the X-rays. This fact strongly supports the quantum theory of X-rays, a theory which has not yet been reconciled with the conception of spreading waves, so clearly indicated by the diffraction phenomena of X-rays. The difficulty, however, is one which is common to all classes of electro-magnetic waves.

Diffraction of X-rays.—In 1912 Laue (*Ann. d. Phys.*, 1913) showed that X-rays could be diffracted by crystalline matter (*see* CRYSTALLOGRAPHY). The regularly spaced layers or planes of atoms in crystals are at the right order of distance apart to diffract X-rays, just as opals and chlorate-of-potash crystals with their stratified layers can diffract visible light. Very similar optical relations connect the wave length of the rays with the angle of reflection from a particular set of atomic planes within the crystal. If we know the wave length we can derive the regular spacing of that set of planes. If we can find the spacings of three main sets of planes, we have thus ascertained the linear dimensions or lattice constants of the unit cell from which, by continued multiplication, the space lattice of the crystal can be built up. Alternatively, if we know the lattice constant for any particular substance we can determine the wave length of the X-rays.

From this momentous discovery of Laue the science of X-ray spectrometry has grown to great proportions. The main developments deal with emission and absorption spectra, with crystal analysis and with the structure of atoms.

X-ray Spectra.—In optical spectra the number of lines peculiar to an element are frequently numerous and their numerical relations complicated. X-ray spectra, on the contrary, are noteworthy for their simplicity, the number of lines characterising an element being relatively few, readily recognisable and measurable with a precision not inferior to that which obtains in optical spectra. Moseley's great discovery (*Phil. Mag.*, 1913) established a simple proportionality between the atomic number of an element and the square root of the frequency of a characteristic radiation or of an absorption limit. Moseley's law holds for all the known elements and so it is possible to interpret new spectral lines without the complexity associated with optical spectra. It was by X-ray spectrometry that the element hafnium was discovered in 1923; and in 1925 Monnack and Tacke announced the discovery by X-ray analysis, of two new elements which they called Masurium and Rhenium. Thus 89 out of 92 elements are now known, and the X-ray spectral lines of the missing three elements (atomic Nos. 61, 85, 87) are predictable with certainty (*see* ATOMIC WEIGHTS and ISOTOPES).

X-ray absorption spectra are very simply obtained by passing a pencil of X-rays through a sample of the matter and examining the transmitted beam by a crystal spectrometer. The X-rays should be excited by a suitably high voltage. The method is specially applicable to all elements with a strong absorption band, and excels in detecting traces of heavy elements in light elements. Emission spectra are conveniently excited by mounting the material on the face of the target of an X-ray bulb and applying a suitably high voltage. In such spectra every element present is recorded with an intensity which appears to depend only on its concentration and is independent of the presence of any other elements with which it may be mixed or combined. The test, which is very sensitive, is specially applicable to analysis of the platinum group of metals and the rare earths.

Crystal Analysis.—The aim of X-ray crystal analysis is to determine the grouping of the atoms and molecules in the crystal unit, and so to account for the properties of the crystal. The main experimental methods due to Laue, Bragg, Hull, Debye and Scherrer are described in CRYSTALLOGRAPHY. X-ray analysis has shown that most chemical elements, including solidified gases, crystallise in the cubic or hexagonal systems. Already nearly half the elements have been examined, including those allotropes which can arrange themselves in more than one kind of space lattice. As regards alloys, the X-rays have tested the truth of the existence of the several phases of steel and other alloys which metallurgists had differentiated by other means (*see* METALLOGRAPHY). The method has also indicated the atomic features which go hand in hand with ductility, malleability, hardness, etc. It has also been shown that in a solid solution of two elements the replacement of one atom by another is effected by substitution in and distortion of the lattice and not by interstitial insertion. Other points which have been worked on are the effects of annealing, tempering, rolling or other working; the mechanism of deformation and slip in metals; and the general shapes and sizes of atomic domains.

By the use of X-rays, Sir Wm. Bragg has shown that a diamond has an atomic bonding perfect in its symmetry and so possessing intense hardness. On the other hand, graphite (another variety of carbon) with unsymmetrical atomic linking, with weak linking and greatest separation between cleavage planes, is a good lubricant. So-called amorphous carbon is found to consist of minute graphite crystals. The fragility of annealed tungsten lamp filaments is explained by the gradual transformation to a number of single crystals of large dimensions.

Crystalline Forms in Nature.—The X-rays have demonstrated that almost every solid substance in nature shows crystalline form, including such apparently amorphous materials as rubber, cellulose, the fatty acids, soap, leather, bamboo and talc. Colloidal metals are shown to be made up of minute yet perfect crystals so small that they contain only a few score atoms. The molecular arrangements in thin metal and liquid films have been ascertained. In gold leaf, for example, the cubic crystals are found to have their cube faces parallel to the sheet. The method has also been used to ascertain the crystal axes of jewel bearings, and to distinguish between natural and cultivated Japanese pearls.

Medical Applications of X-rays.—The great improvements of recent years in X-ray equipment and technique have given the diagnostic methods of physicians and surgeons a facility and exactitude never dreamt of at one time. X-ray snapshots of any part of the body can now be taken. The detection of foreign bodies is commonplace. Gouty and rheumatic joints, stones in the kidney and gall bladder, incipient tuberculosis in the lungs and joints, tumours, etc., are among the diseases readily displayed. The examination of the alimentary canal is facilitated by the use of opaque meals containing bismuth or barium salts. Dental radiography has made great progress. The X-rays possess valuable properties in the treatment of certain diseases, such as lupus, rodent ulcers, ringworm and skin eruptions. The precise "dose" is important (*see* RADIOTHERAPY AND RÖNTGENOLOGY).

Industrial Applications of X-rays.—The differential absorption of X-rays by different sorts of matter and, as already noted, the diffraction of X-rays have been turned to account in the industries and arts in a variety of directions. Many of the various applications of radiography to industry have come about owing to the fact that the method does not injure the specimen in any way. Further, it provides, in many cases, the only means independent of human judgment of detecting concealed defects in a material or of scrutinising in a structure or sealed enclosure the disposition of component parts which are hidden from view. Incidentally, the mere existence of the method is not without its moral effect on the workman.

Experience differs as to the sensitiveness of the method, but, depending on the area of the inclusion, probably a variation in density equivalent to 2 to 5% of the thickness is necessary to be detected on the photographic plate. These figures require to be

increased for fluoroscopy, but much depends on the luminosity and on the visual acuity of the observer. Definition is, of course, dependent, among other things, on the size of the focal spot in the X-ray tube. Exposures naturally depend on the conditions, and may vary from a few seconds to an hour or more.

As regards the use of X-rays in radiographing steel, while 4 in. is the maximum thickness penetrated so far in the laboratory, the present practicable limit is more nearly 2 in. for photography. Radiography is useful, among other directions, in examining castings and welds, for detecting foreign metallic matter in electrical insulators and for testing the centrality of golf balls, the proportion of ash in samples of coal, and the accuracy of assembly of explosive devices. The X-rays have also proved of service in supplementing the tests for detecting fraudulent antiques and Old Masters.

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ROOSEVELT, THEODORE (1858–1919), 26th President of the United States (*see* 23.707), completed his second term, March 4 1909, the most famous man in his country, with a wealth of personal friends and a reputation as a master of men. Yet from the presidency, like most of his predecessors, he stepped down into a retirement which seemed to forbid a re-entry into public life or a recovery of the headship of his party. In the 10 remaining years of his life he displayed the same qualities of intense thought and action that had characterised him before; within a year after his withdrawal he again became a great force in American society and public life. A sense of fair play to his successor, President Taft, for whose choice he was indeed responsible, and that drawing force of the unknown to which his nature was susceptible, led him to make plans for a hunting and exploring trip in Africa, some months before the end of his presidential term. He was also influenced by invitations to make addresses in England and France.

Accordingly he sailed from New York, on March 23 1909, for Africa, where, in conjunction with his son Kermit and the well-known hunter Selous, he travelled a long distance, shot big game and safely emerged at Khartum in March 1910. Here he plunged at once into politics by addresses at Khartum and Cairo, in which he stood for orderly and vigorous government for Egypt. In both instances the addresses were requested and approved by the local military authorities. From Egypt he proceeded to Europe, and, apparently to his own surprise, found himself an international celebrity. He was received in all the courts of central Europe except the Vatican, where an official interposed between him and the Pope by stipulating guarantees of his conduct in Rome. He left a most interesting account of the impressions made upon him by this journey in a long and intimate letter written at the time to the English historian Sir George Trevelyan and published in Bishop's *Theodore Roosevelt and His Time*. It was in vain for him to claim that he was only a "private citizen with no claim to precedence"; for everywhere he was received with the honours ordinarily paid only to sovereigns. He was warmly received in France, where he made a public address at the Sorbonne. In England, his Romanes lecture at Oxford, and particularly his Guildhall speech on the management of a great empire, were noteworthy; and he was designated by President Taft to represent the United States at the state funeral of Edward VII. His most striking experience was in Germany, where he was received with cordiality by the Emperor, but, as he said afterwards, it was the only country in Europe where he felt that "every man, woman and child was my natural enemy—that is, the enemy of my country."

Returning to the United States, June 18 1910, Roosevelt found that both his African and European experiences had been followed closely by the American people. President Taft had now had a year and a half of experience with the country, with Congress and with reforms and policies which Roosevelt had initiated and expected would be carried out. There was a rift in the Republican party. Some of Roosevelt's friends were in opposition to the Taft administration. In the Ballinger controversy over western public lands, Roosevelt sided against the administration. A group of dissatisfied Republicans, the "insurgents," had arisen in Congress and prepared to dispute the supremacy of the Conservatives in the party, on whom Taft seemed to be relying. To Roosevelt's mind, the "mossbacks" were in control; and a few hours after landing he agreed to throw his personal influence on behalf of Gov. Hughes of New York, who was engaged in a struggle with the Republican Legislature over the direct primary. He made an address at Osawatomie, Kan., Aug. 31, in which he laid down a radical programme of political and social reform to which he gave the name of the "New Nationalism." Plainly he was dissatisfied with Taft's administration. As early as Nov. 21 he discussed with an intimate friend the possibility of his accepting the nomination in 1912, to succeed Taft in the presidency. Through 1911 this quarrel grew. Soon after returning, Roosevelt became an editorial writer, bearing a free lance, in *The Outlook*, and alike in his editorials and in public addresses he took the side of the insurgent element. He regarded Taft as the representative of "the interests." Early in 1912 a group of seven Republican governors united in an appeal to Roosevelt to declare his willingness to be nominated. On Feb. 12 Taft made a bitter speech, in which, without mentioning Roosevelt, he spoke contemptuously of the extremists. This seems to have been the incident that decided Roosevelt's course; for on Feb. 26 he came out openly as a candidate for the nomination by the party convention in June.

Meanwhile the usual campaign for the choice of delegates to the Convention was going on, following the same lines as in 1908. In the southern states, where the Republicans were hopelessly in the minority, delegates were elected by the usual rump and machine-led state conventions. Roosevelt's friends made a campaign in the northern and western states, especially in those which had provided for a choice of delegates through a popular vote in party primaries. A majority of the Republican voters in those states favoured Roosevelt. When the Republican Convention met in Chicago June 22, Taft was strong in the delegations chosen by state and local conventions; and Roosevelt in those representing a predominance of Republican voters. The organisation of the Convention, however, was in the hands of the Taft men, because they had a large majority in the National Committee. Out of the numerous contested seats, only six were finally assigned by the Committee of Credentials to the Roosevelt column. On a test for the choice of temporary chairman, the Taft men showed a narrow margin. The turn of 15 votes—which might have been secured had Roosevelt come out a few weeks earlier—would probably have brought on a "landslide" for him. A speech by Roosevelt a few weeks earlier before the Ohio Constitutional Convention, advocating the "recall" of judicial decisions, also gave alarm to some men who might otherwise have supported him. Once organised, the Taft forces were able to carry through the report of the Committee on Credentials, which assigned them a safe majority.

Roosevelt himself had come to Chicago a few days before the Convention, and was the centre of the hardest battle of his life. He rallied his supporters and addressed an enormous public meeting, ending his speech with "We stand at Armageddon, and we battle for the Lord." Most of his followers stood by him; but they could not break down the walls of precedent and conservatism. The Roosevelt delegates, on their leader's request, remained in the Convention until the end, but refused to vote on the nomination; and Taft was duly nominated for a second term by the vote of about two-thirds of the Convention.

Roosevelt was a party man, who had stood by the party in 1884 when many of his friends bolted. His standpoint in 1912 was that he was trying to save the Republican party from a ruinous yielding to the forces of organised wealth and reaction. He was also a fighter, and felt himself deprived, by technicalities and personal hatreds, of an honour which the majority of his party was eager to bestow upon him. He unhesitatingly decided

to " bolt," and on the evening of the adjournment of the Convention, at a meeting in Orchestra Hall, he advised the formation of a Progressive party. A later Convention of the Roosevelt men throughout the country, including a considerable number of Democrats, nominated Roosevelt, with Gov. Hiram W. Johnson of California for vice-president. Meanwhile the Democrats had nominated Woodrow Wilson, governor of New Jersey. The result was a three-cornered political contest, in which it was clear at the beginning that Taft could not be elected, but that Roosevelt probably could not win enough Democratic votes to prevent the choice of Wilson. Nevertheless, Roosevelt fought vigorously through the campaign, violently attacking Taft as a reactionary and tool of reactionaries. While on a speaking tour at Milwaukee he was shot by a fanatic, but was not seriously injured.

The result of the election was the choice of Wilson, who had 6,000,000 popular votes and 435 electoral votes; Roosevelt, 4,000,000 popular votes and 88 electoral; Taft, 3,500,000 popular votes and 8 electoral. On this showing the Progressives had more votes than their Republican adversaries and therefore hoped to compel a reconstruction of the party. Their Republican opponents, however, kept tight hold of the name, organisation and prestige. They had deliberately accepted defeat in advance in order to put Roosevelt out of the running.

This, the first serious defeat that Roosevelt had ever encountered, was to him a bitter humiliation. He felt that his public career was ended. His first movement was characteristic. He had cordial invitations to visit South America and make addresses in the principal cities. As in his experiences of 1910, this dovetailed in with a plan of exploration. Accordingly, early in 1913, after visiting several South American countries, including Brazil and Argentina, he returned to Brazil, made his way overland, and came down a river, whose uncharted course he followed for 600 miles. The hardships were severe, and he received an injury, serious for a time, and drew into his system the seeds of tropical malaria. The Brazilian Govt. named the stream Rio Teodoro.

On his return to the United States, out of office, a defeated candidate, an insurgent, the personal enemy of the Republican leaders, he seemed justified in his belief that his career was over. But as usual his enemies played into his hands. An obscure journalist ventured publicly to accuse him of drunkenness. In May 1913 he instituted a suit for defamation of character, with the result that the defendant broke down and acknowledged his error. A large section of the American people resented the affront and rejoiced in the vindication. During this period Roosevelt was indefatigable as journalist and writer, first in *The Outlook*, then in the *Metropolitan* magazine and finally through the columns of the *Kansas City Star*.

The outbreak of the World War gave him a new opportunity for his pen and voice. His instinct was against Germany as an oppressor of weak nations; but he stayed his desire for positive action for a time, from the feeling that he ought not to embarrass the President. It was at this time that a personal enemy gave Roosevelt the opportunity of again showing his character to his countrymen, through a publicity which both Roosevelt and the public enjoyed. William Barnes, one of the acknowledged leaders of the Republican party, brought a suit in April 1915 against Roosevelt because of an accusation of unfair and corrupt politics as a " boss " which Roosevelt had made against him. Roosevelt vigorously defended himself and won the suit. For 10 days he was on the witness-stand, and his testimony, which was spread broadcast throughout the land, revealed his undiminished force and appealed to the popular imagination.

The sinking of the " Lusitania " by a German submarine in May 1915 brought his bitterest denunciation, and from that time he foresaw first the possibility and then the likelihood of war between Germany and the United States. He made himself the leading spokesman for " preparedness," and presently drew down the wrath of President Wilson's administration for a speech at Plattsburg. From that time he did not spare sharp criticisms of President Wilson's policy as showing unwillingness to face the dangers of war. His utterances against Germany and in favour of the Allies had great influence. As the election of 1916 drew near, the remaining Progressives, aided by some who had stayed in the Republican party, made an effort to force the Republican Convention to nominate Roosevelt. They called a Progressive Convention to meet at Chicago at the same time as the Republican, hoping to make a joint nomination with the Republicans. Roosevelt did his best to secure the prize, but again the party leaders would have none of him. Hughes was nominated, and this time Roosevelt accepted the situation as a loyal member of the Republican party and supported the nominee.

As the World War went on, Roosevelt became the severest critic of the administration and the strongest advocate of preparedness. He formed a plan for raising a special division, in which he hoped to have a command, and which he would offer to the Government. Early in 1917, when the American breach with Germany came, he offered the services of himself and his sons, all four of whom subsequently enlisted. He requested that he might have a personal command, which was denied by the Administration, although both Houses of Congress united in a bill making his plan possible. During the year he made some of the most notable addresses of his life, especially that before the " Order of Moose " convention in Pittsburgh. By this time the Republican politicians were looking forward to the election of 1920 and began to group themselves about Roosevelt. His most persistent enemies, even William Barnes, accepted his nomination as a foregone conclusion. The year 1918, however, was a sad one for Roosevelt. His son Quentin was killed in the War. Ever since returning from Brazil, Roosevelt's constitution had shown weakness. He was several times in hospitals, and underwent a serious operation for abscess due to infection received during his Brazilian explorations. The hearing of his left ear was wholly destroyed. Still, he continued his writing and speaking and his direct personal influence upon his thousands of friends. Even in the first days of 1919, when he suffered from renewed disease, he looked forward to public service. On Jan. 6 1919 he died in his sleep.

A man who could do so much could not do everything perfectly, though few have ever done so many things so well. It was more true of him than of most men that his defects were inherent in his virtues. There were few half-tones in Roosevelt's moral perceptions and fewer in his vocabulary; he saw things as either black or white, and he forgot sometimes that he had not previously seen them as he saw them at the moment. He had enemies, and even former friends, who charged him with breaking promises, betraying political associates and setting his own wishes and interests above all others. The very intensity of his convictions sometimes blinded him to the sincerity and even to the justice of other points of view. Nevertheless, this intensity, this moral fervour, gave his ideas a momentum and a success which they could never have acquired had they proceeded from a more judicial mind. He scorned " weasel words," and on occasion he did not hesitate to describe his enemies as thieves and liars. His remarkable energy reminded observers of some great elemental force which, like any natural phenomenon, is controlled by its own necessary laws. When Lord Morley was leaving the United States in 1904 he was asked by reporters what in America had impressed him most. " Two things," he replied, " Theodore Roosevelt and Niagara Rapids."

His fearlessness was as conspicuous as his energy. With a courage very rare in political life he attacked the iniquities that had crept into the conduct of American business. He asserted the importance of personal rights when these were being openly denied in the name of property rights. He rallied the patriotic elements of the country against the menace of a private " money power " which not only had frequently dictated the course of legislation but threatened to usurp the authority of the Government itself. He felt strongly that any position involving the exercise of power had its obligations as well as its privileges, and this feeling lent force to his denunciation of " predatory interests " and " malefactors of great wealth." On the other hand, he had little patience with demagogic attacks

on men or corporations merely because they were rich or successful, as was shown in his famous utterance in which he compared the authors of these journalistic attacks with the " muckrakers " in *Pilgrim's Progress*. It was said of him satirically that he had invented the Ten Commandments; but Roosevelt's earnestness in behalf of old truths was of the essence of his service to his countrymen, and more important at the juncture than the discovery of new ones.

His great personal power was used in the furtherance of honesty, fair dealing and patriotic service, when more than lip service to these virtues was vitally needed. He threw all his energy into the effort to bring about a reapplication of fundamental moral principles to American business and political life. While he was unquestionably an astute politician, the secret of his success lay in his imaginative understanding of the views and feelings of his countrymen: his enthusiasm was contagious because he vividly expressed what they already felt and believed to be the truest American ideals. When he spoke for the " square deal," the American people as a people always responded.

Born of a wealthy family, in an aristocratic society, enjoying all his days a literary and artistic atmosphere, he was still a natural democrat. He had a personal interest in every man or woman that he met, and a genuine affection literally for thousands of individual persons. He was a scientific man whose observations and deductions were valued by naturalists and investigators. He was a literary man, very widely read. He was an intellectual man, interested from youth to age in literature and philosophy. He was a politician without a rival in his time for boldness, foresight and an innate knowledge of what his fellow countrymen were thinking about. He was a statesman of the most brilliant ability, who after a crushing defeat returned to power over the minds of the people and was on his way again to the presidency of the United States. His bitterest political enemies accepted his coming back to national leadership. To few men in history has it been given to wield such far-spreading and wholesome personal influence.

BIBLIOGRAPHY.—Between 1909–19 Roosevelt published about 15 books, several of them consisting of articles and addresses. The more important are *African Game Trails* (1910); *Conservation of Womankind and Children* (1912); *Theodore Roosevelt, an Autobiography* (1913, contains little beyond 1909); *Life-Histories of African Game Animals* (2 vol. 1914); *A Hunter-Naturalist in the Brazilian Wilderness* (1914); *Through the Brazilian Wilderness* (1914); *A Book-lover's Holiday in the Open* (1916). His principal later books on public affairs and on the World War are *Realisable Ideals* (1912); *America and the World War* (1915–9); *Fear God and Take Your Own Part* (1916); *National Strength and International Duty* (1917); *The Great Adventure* (1918). Numerous collections of extracts and speeches have been published, especially those of W. F. Johnson (1909); L. F. Abbott (African and European, 1910); W. Griffith (1919); J. B. Bishop, *Letters to His Children* (1919); *Letters to Anna Roosevelt Crowles, 1870–1918* (1924); *Selections from the Correspondence of Theodore Roosevelt and Henry Cabot Lodge, 1884–1918*, 2 vol. (1925). A complete memorial edition of Roosevelt's works, edited by H. Hagedorn, has been published in 20 vol. (1923–5).

The most important biographies are those by J. B. Bishop (1920); H. Hagedorn, *Boy's Life of Theodore Roosevelt* (1919); W. D. Lewis (1919); W. R. Thayer (1919); Bradley Gilman (1921) and H. Hagedorn's *Roosevelt in the Bad Lands* (1921). See also J. F. Rhodes, *The McKinley and Roosevelt Administrations, 1897–1909* (1922), and J. Dennett, *Roosevelt and the Russo-Japanese War* (1925). A useful list of books by and about Roosevelt is J. H. Wheelock's *Bibliography of Theodore Roosevelt* (1920). (A. B. H.)

ROOT, ELIHU (*see* 23.711).—Upon Mr. Root's return in 1910 from The Hague, where he had acted as chief counsel for the United States in the Atlantic Fisheries Arbitration, he was appointed by President Taft a member of the Permanent Court of Arbitration. In the same year he was elected President of the Carnegie Endowment for International Peace, an institution created by Andrew Carnegie to administer, in the interests of peace, the income of a fund of ten million dollars provided by the latter for that purpose. Mr. Root thus took up again the work which he had initiated when Secretary of State, and became the recognised leader of the peace movement in the United States. He strongly supported in the Senate the treaty of obligatory arbitration concluded between the United States and Great Britain in 1912, but failed to prevent amendments to the treaty being inserted during its passage through the Senate which prevented an exchange of ratifications. His pacific tendencies were also exemplified in his support of President Wilson in the matter of the repeal of the preference given to American coastwise shipping passing through the Panama Canal. Great Britain had protested against the Panama tolls as contrary to the Hay-Pauncefote Treaty of 1901, and at the instance of the President the discrimination against Great Britain in this respect was removed. In 1913 he was chosen President of the Hague Tribunal of Arbitration between Great Britain, France and Spain for the settlement of claims against Portugal arising out of alleged confiscation of church property in that country. Owing to the World War it did not meet till 1920 when it heard the case at The Hague, its decision being accepted by the litigating parties.

He took a leading part in the passage of the Federal Reserve bill of 1913, providing for a Federal Bank under Federal control, in order to stabilise the finance of the country—a system which has stood the test of experience in war as in peace. In matters of foreign policy also his opinion had great weight. In 1915 a treaty negotiated by Secretary of State Bryan with Colombia provided for payment by the United States of $25,000,000 to Colombia in settlement of all outstanding claims between the two countries arising out of the independence of Panama. Mr. Root opposed ratification, principally because a statement of regret on the part of the United States which had been inserted in the preamble seemed to him to be an admission on the part of the United States of conduct in the matter inconsistent with the friendly relations of the two countries, though he also considered the sum too much. His opinion prevailed, and later on, in 1922, when the Senate finally ratified the treaty, the clause in question was omitted.

Heretofore, Mr. Root's career had been, on the whole, not unlike that of any other conscientious man of affairs. The outbreak of the World War, however, and the position of the United States as the leading neutral power in a conflict the exigencies of which appeared to test all principles of international law, gave him a new environment. International questions of great moment were forced to the front. Although President Wilson was in control of the foreign policy of the United States, Mr. Root was recognised as an outstanding figure. He was personally known to many European statesmen in whom he had inspired confidence by reason of his judicial mind and breadth of view; and, though a Republican, his Democratic opponents conceded to him an honesty of purpose which made his words carry great weight in his own country.

In matters concerning the World War, he strongly condemned President Wilson's policy, believing that Germany's invasion of Belgium was not only a violation of the rights of Belgium, but a violation of the neutral rights of all neutral nations, which they could, and should, protest. He was opposed to the President's ship purchase bill, the object of which was to empower the Govt. of the United States to purchase and operate German vessels then interned in U.S. waters. The purchase of these vessels would have been in his opinion, an unneutral act, inasmuch as it would compensate Germany for property which it could not use, since, had the vessels left American ports, they would have been captured by British cruisers. Further, the operation of the vessels so purchased, if the enemies of Germany had permitted it, would have caused the United States to embark upon business which would better remain in private hands. The bill failed to pass.

On March 4 1915 his term as Senator expired and he declined to be a candidate for re-election. That summer he was president of the New York State Constitutional Convention, and advocated, among other measures, the short ballot, means for remedying the law's delays, the reduction of costs involved in the administration of justice and measures which would facilitate the impeachment of unworthy public officials. In the course of the Convention he delivered an important address against " invisible government." Mr. Root, as Secretary of War, immediately

following hostilities with Spain, had seen with his own eyes the dangers of unpreparedness. Upon the outbreak of the World War, he immediately urged that steps be taken to place the United States on a war footing, foreseeing that if the nation did not go to the War, the War would come to her. After the declaration of War by the United States, on April 6 1917, he gave his whole support to the Government. He was asked by President Wilson to head the mission which was sent to Russia shortly thereafter with a view to encouraging the Revolutionary Govt. under Kerensky, to carry on the War with vigour. He accepted, but whilst in Russia the overthrow of the Moderates there by the Bolsheviks under Lenin frustrated the purposes of his mission.

At the conclusion of the War, though not a member of the U.S. mission to Paris to conclude peace, his advice was requested in the matter of the Covenant of the League of Nations and his views prevailed to a certain extent. To the Covenant as actually drafted, however, he was opposed. He was, nevertheless, of the opinion that the Covenant and the Treaty of Versailles should be accepted with reservations, to secure the interests of the United States, inasmuch as the President's re-election in 1916 and his presence as negotiator at Paris had led, however erroneously, the other plenipotentiaries to believe that he represented the opinion of his fellow countrymen. In Mr. Root's opinion it would be better to accept the Covenant with reservations, and by subsequent amendments to remove the obstacles which had originally stood in the way of its acceptance.

He accepted an invitation from the League of Nations to become a member of the Advisory Committee of Jurists which met at The Hague in 1920 for the purpose of devising a plan for a Permanent Court of International Justice, in accordance with Art. 14 of the Covenant. His presence enabled the committee to frame a plan acceptable to all by which the judges were to be elected by the separate and concurrent action of the Council (in which the Great Powers had a preponderance) and the Assembly (in which the Small Powers were in a majority), each interest, real or alleged, having thus a veto upon the abuse of power by the other. The plan was accepted with modifications by the Council and Assembly on Dec. 14 1920 and became the Statute of the Court. It functioned perfectly when the judges were elected in 1921, and the Court held its opening session in the Peace Palace at The Hague, Feb. 15 1922. Thus Mr. Root's original proposition made at the Hague Conference in 1907 saw its fruition 13 years later.

Mr. Root was appointed by President Harding one of the U.S. delegates to the International Conference on Armament Limitation, which met at Washington in Nov. 1921. There he secured the adoption of the convention subjecting submarines to the requirements of surface vessels and prohibiting the use of noxious gases in warfare. He devised the Pacific agreements which resulted in the cancellation of the Anglo-Japanese offensive and defensive alliance, and drafted the Four Power Pacific Treaty, which took its place. By this latter treaty the so-called Great Powers, the United States, the British Empire, France and Japan, agreed to respect their rights in relation to their insular possessions in the region of the Pacific ocean and in case of dispute to resort to a joint conference instead of arms. He also brought about the series of agreements on Chinese policies which secured the relief of China from aggression on the part of the Great Powers, and precluded preferential treatment of any of them in Chinese lands. The main idea, underlying the treatment of China by the conference was, as Mr. Root later stated, the encouragement of reforms in that country which would place it upon an equal footing with other nations and bring about the abolition of extraterritorial rights of nationals of other nations in Chinese territory.

He was prominent in the organisation in 1923 of the American Law Institute, which is engaged in a re-statement of the principles of American law with the view of doing away with the existing mass of precedent or case law. When completed this will be in effect, though not in form, a codification of the law. In 1924 Mr. Root resigned the presidency of the American Society of International Law, an office which he had held since the birth of the society 17 years previously. In 1912 he was awarded the Nobel Peace Prize. (*See* PERMANENT COURT.)

A collection of Mr. Root's public addresses has been edited by Robert Bacon and James Brown Scott in six volumes, as follows: *Addresses on Government and Citizenship* (1916); *The Military and colonial policy of the United States* (1916); *Latin America and the United States* (1917); *Miscellaneous addresses* (1917); *North Atlantic Coast Fisheries Arbitration. Argument on behalf of the United States* (1917); *Men and Policies* (1924); He also published *Experiments in Governments and the Essentials of the Constitution* (Princeton Lectures, 1913). (J. B. S.)

ROSCOE, SIR HENRY ENFIELD (1833–1915), British chemist (*see* 23.725), died at Leatherhead, Surrey, Dec. 18 1915.

ROSEBERY, ARCHIBALD PHILIP PRIMROSE, 5TH EARL OF (1847–), British statesman (*see* 23.731), took an active part in the constitutional crisis in 1910 and 1911. He treated the Parliament Bill as a revolutionary measure, which in effect constituted single-chamber government, and did his utmost to arouse the nation to a sense of its danger. While, however, he bitterly condemned the conduct of ministers in going to "a young and inexperienced King" for contingent guarantees, he declined to follow the extreme course, recommended by the "Die-hards," of rejecting the bill. He shrank from the scandal of a great creation of peers. If the bill were allowed to pass, the House of Lords would be left with some vitality; if the creation of peers were forced, they would have none at all. He showed his own estimate of the impotence of the House after the passage of the bill by ceasing to attend its debates; and indeed he took no further part in public life till the outbreak of war in 1914 fired his patriotism. As lord-lieutenant of Midlothian and Linlithgowshire he promoted recruiting and other warlike activities among his own people and helped to hearten the nation and to avert a premature peace by occasional speeches. In 1921 he published a number of collected papers under the title of *Miscellanies: Literary and Historical.*

Lord Rosebery was created Earl of Midlothian in the peerage of the United Kingdom—the earldom of Rosebery being a Scottish earldom—at the coronation of King George in 1911, at which ceremony, as at the coronation of King Edward, he was one of the lords who bore the canopy. He became chancellor of Glasgow University in 1908, as he had long been chancellor of London University, and he was chosen lord rector of St. Andrew's University for the year of its quincentenary celebration in 1911.

The World War cost Lord Rosebery his younger son, Hon. Neil Primrose (1882–1917), whose political advance had been watched by his father with eager sympathy. He became a member of Parliament in 1910, was Under-Secretary for the Foreign Office in 1915 and parliamentary secretary for munitions in 1916. But these appointments were only held in the intervals of fighting as a captain in the Buckinghamshire Hussars, and he died of wounds received in action in Palestine on Nov. 18 1917.

ROSEGGER, PETER (1843–1918), Austrian poet and novelist (*see* 23.734), died June 26 1918.

ROSENTHAL, TOBY EDWARD (1848–1917), American painter (*see* 23.735), died in Berlin, Germany, Dec. 28 1917.

ROSENWALD, JULIUS (1862–), American merchant and philanthropist, was born in Springfield, Ill., Aug. 12 1862, and was educated in the public schools. From 1885 to 1906 he was president of Rosenwald and Weil, clothing manufacturers, Chicago. In 1895 he became vice-president and treasurer of the mail-order house of Sears, Roebuck and Co., Chicago, and in 1910, president. The gross sales of the company, which were $1,750,000 in 1896, increased under his management to $258,300,000 in 1925. He was during the World War a member of the Advisory Commission of the Council of National Defence by appointment of President Wilson. In 1919–20 he served in Washington as a member of the President's Industrial Conference. He devoted much time to work for philanthropic, educational and civic organisations. He gave $250,000 to the fund for Hampton-Tuskegee (negro educational institutions), $250,000 for a building to house Jewish philanthropic organisations of Chicago; and

(with Mrs. Rosenwald) $1,750,000 for new buildings for the University of Chicago. He founded dental infirmaries in the Chicago public schools. During the World War he gave large sums to relief organisations, donating $1,000,000 in 1918 alone. In that year he went on a special mission to France for the Secretary of War. He materially assisted the Hoover Children's Relief Fund in 1920–1 and encouraged the building of rural schools for negroes in the southern states by offering to pay part of the cost. By 1926 more than 3,100 such buildings had been provided, having 353,500 pupils with 7,850 teachers. These buildings cost $13,250,000. The Julius Rosenwald Fund supplied $2,350,000, the remainder coming from public funds and white and negro individuals. Mr. Rosenwald also interested himself in helping to provide Y.M.C.A. buildings for negroes in cities, contributing up to 1926, $450,000 toward the cost of 18 buildings in 16 cities. These buildings cost more than $3,000,000 and served a negro urban population in excess of 1,000,000. He was appointed a trustee of the University of Chicago, Rockefeller Foundation, Hull House in Chicago, the Baron de Hirsch Fund and of Tuskegee Institute.

In Dec. 1921 it was announced that Mr. Rosenwald had pledged $21,000,000 to safeguard the interests of Sears, Roebuck and Co. during the critical period of business readjustment after the World War. In 1920 and 1921 the company had paid no dividends on its common stock and it was apparent that its accounts at the end of 1921 must show a deficit. But Mr. Rosenwald by his action enabled the company to readjust its finances without impairing its capital stock, and protected its stockholders, many of them employees. It was recognised generally that he established a precedent which raised the standards of business when he thus risked heavy loss to protect those who had bought shares because of their confidence in his leadership.

ROSS, SIR GEORGE WILLIAM (1841–1914), Canadian politician (*see* 23.739), was knighted in 1910. He published, amongst other works, *The Life and Times of the Hon. Alex. Mackenzie* (1892) and *Getting into Parliament and After* (1913). He died March 8 1914.

ROSS, ROBERT BALDWIN (1869–1918), British art critic, was born at Tours, France, May 25 1869, a son of the Hon. John Ross, a distinguished Canadian lawyer. He was educated privately and at King's College, Cambridge, and made a reputation as a critic of art and letters. He became recognised as a leading authority on many questions concerning the worth and valuation of works of art, and was an additional trustee of the National Gallery. He had high repute also as a wit and conversationalist, being to the last a faithful friend of Oscar Wilde, whose literary executor he was. A widely subscribed testimonial by his friends was devoted by Ross to the foundation of a "Robert Ross" scholarship at the Slade School. He died in London Oct. 5 1918.

ROSS, SIR RONALD (1857–), British physician and bacteriologist, was born at Almora, India, May 13 1857. He studied medicine at St. Bartholomew's Hospital, London, and in 1881 entered the Indian medical service. In 1892 he commenced a series of special investigations on the subject of malaria, and by 1895 had arrived at his theory that the micro-organisms of this disease are spread by mosquitoes (*see* 17.463; 20.786). In 1899 he retired from the Indian medical service, and devoted himself to research and teaching, joining the Liverpool school of tropical medicine as lecturer, and subsequently becoming professor of tropical medicine at Liverpool University. In 1913 he became physician for tropical diseases at King's College, London, and later, director-in-chief of the Ross Institute and Hospital for Tropical Diseases. During the World War Ross was appointed to the R.A.M.C. and became War Office consultant in malaria. In 1902 he received the Nobel Prize for medicine, in 1911 a K.C.B. and in 1918 a K.C.M.G. He received the Royal Medal of the Royal Society, of which he was a fellow in 1901. He was editor of *Science Progress*, and his other publications include *The Prevention of Malaria* (1910), *Philosophies* (1910), *Psychologies* (1919), *The Revels of Orsera*, a romance (1920) and *Memoirs* (1923) as well as mathematical and medical works. (*See* MALARIA.)

ROSTAND, EDMOND (1869–1920), French dramatist (*see* 23.754), devoted himself during the World War chiefly to the writing of patriotic verse. He died in Paris Dec. 2 1920.

The following posthumous works were published: *La dernière nuit de Don Juan* (1921); *Le cantique de l'aile* (1922); *Le vol de la Marseillaise* (1922). See G. Haraszte, *Edmond Rostand* (1913); J. Suberville, *Le Théâtre d'Edmond Rostand* (1919).

ROSYTH, Scotland (*see* 14.718).—The development of the German navy in the first years of the 20th century rendered it necessary to create a British naval base suitable for a fleet concentrated in the North Sea, and in 1903 it was decided to establish a first-class naval base at Rosyth on the Firth of Forth. Land was acquired and works were planned, but the development of possibilities of torpedo attack soon made it evident that the outer anchorage, as originally designed, would be insecure, and naval opinion became doubtful as to whether the base would be adequate. The plans of construction were, therefore, modified in 1908, but, up to the outbreak of war in 1914, Rosyth was regarded as the principal base and headquarters for the Grand Fleet, though it was decided that initial stations must be established at Cromarty and Scapa Flow. When the World War began, Admiral Jellicoe preferred to establish his headquarters at Scapa Flow, but Rosyth was used as a secondary base, particularly for the battle cruisers.

The original scheme included a high-level main basin covering an area of 55 ac., with an entrance lock from the fairway, a dry or graving dock 750 ft. long and 110 ft. wide, a submarine tidal basin, the construction of an entrance channel, and the erection of workshops and offices, and work was begun in 1909. The whole site of the works was reclaimed from the sea, and a great sea-wall was built to form the southern boundary of the docks, the number of which was increased from one to three. Great progress had been made by the outbreak of war, and it was anticipated that the works would be completed by the summer of 1916. Operations were pushed on vigorously during the War, and a special Act of Parliament was passed in 1915 to facilitate the provision of dwelling houses for Admiralty employees. By the original Act for the construction of the base, the whole area between the town of Dunfermline and the land purchased by the government was brought within the municipal area, which was thus extended from 2,016 to 7,730 acres. It was decided in 1925 to reduce the dockyard to the basis of a "care and maintenance" establishment.

ROTHERMERE, HAROLD SIDNEY HARMSWORTH, 1ST VISCOUNT (1868–), British newspaper proprietor, was the second son of Alfred Harmsworth, and brother of Viscount Northcliffe. He was born April 26 1868 at Hampstead, London, was created a baronet in 1910, Baron Rothermere in 1914 and Viscount Rothermere of Hemsted, after his services as Air Minister, in 1918. He married in 1893 Mary Lilian, daughter of George Wade Share.

At the age of 21 he entered the publishing firm of which his brother, Alfred, was the principal, soon after the date when *Answers* was launched. He assisted in developing the business on sound and economic lines, and for the next 20 years was the close associate of his brother in all his great undertakings. He took an important part in the reorganisation of *The Evening News*, London, was one of the three principals in the establishment of *The Daily Mail* (1896), and was largely responsible for developing its methods of distribution. He founded *The Daily Record* (1895), bought *The Leeds Mercury*, and shared in the purchase of *The Times* (1908). He became known also as a most generous benefactor of charities. By the gift of a large sum he enabled the Union Jack Club to provide worthy accommodation for sailors and soldiers in London; and he gave £10,000 to the Territorial Force County of London Association. In 1910 he founded the King Edward Chair of English literature at Cambridge, and in 1910 he ceased his connection with *The Times*, *The Daily Mail* and *The Evening News*. In 1914 he acquired *The Daily Mirror* from Lord Northcliffe and in 1915 he founded *The Sunday Pictorial*, the first fully illustrated Sunday newspaper in London.

On the death of his brother, Lord Northcliffe, in Aug. 1922, Lord Rothermere by purchase acquired control of *The Daily Mail* and Associated Newspapers Ltd., the company which owns that newspaper among others; and subsequently bought large newspaper properties owned by Messrs. E. Hulton & Co., Ltd. Under

his supervision *The Daily Mail* greatly increased its circulation and continued to prosper. It maintained complete political independence and conducted a continuous and determined campaign for the reduction of national and local expenditure. His trenchant pamphlet *Solvency or Downfall*, published in 1921, attracted great attention. He has always opposed dangerous distant commitments such as the British mandate in Mesopotamia.

In the World War, Mr. Lloyd George, while Secretary for War, appointed Lord Rothermere in 1916 Director-General of the Royal Army Clothing Department. In the following year he accepted the office of Air Minister, under Mr. Lloyd George as Premier. He at once declared himself "whole-heartedly in favour of reprisals," which were the best means of carrying the War into Germany and protecting British towns against air attacks. Suffering from precarious health and his bereavements in the War, he resigned on April 25 1918, after he had carried out the fusion of the Royal Air Force and Royal Flying Corps. "My second tragic loss in the War, 10 weeks since," he wrote to the Prime Minister, "caused me great distress of mind and body . . . I was suffering from ill-health and insomnia."

The tragic losses to which he referred were those of his two sons, Capt. Harold Alfred Vyvyan St. George Harmsworth, M.C. (1894–1918) and Lieut. Vere Sidney Tudor Harmsworth (1895–1916). In memory of Harold, killed in Bourlon Wood Feb. 22 1918, Lord Rothermere founded and endowed the Harold Vyvyan Harmsworth Chair of American history at Oxford in June 1920. In memory of Vere, killed at Beaucourt Nov. 13 1916, Lord Rothermere in 1919 established and endowed the Chair of naval history at Cambridge which bears his name.

Lord Rothermere's third and only surviving son, Esmond Cecil (born May 26 1898), who had served during the last part of the War in the Royal Marine Artillery, was in 1919 elected M.P. for Thanet and was then the youngest member of the House of Commons and the fifth of his family to have a seat in one or other of the Houses of Parliament. (H. W. W.)

ROTOR SHIP.—Wind propulsion for navigational purposes, in the commonly accepted sense, although suited for some particular trades, is practically obsolete for cargo carrying; and the sailing ship, pure and simple, cannot be said to have a definite future. Many sailing vessels are fitted with auxiliary propelling machinery, but, excluding fishing craft, these vessels have not proved an unqualified success.

Herr Anton Flettner, the inventor of the rotor ship, originally intended to construct ships with metal sails, being convinced that the effect of metal sails is much greater than that of canvas sails. The idea was to build the metal sails with sections similar to those used in the construction of aircraft planes. It was intended that the sails should revolve freely around a pivot mast, and then be put by a special rudder blade in such a position that the wind would drive the ship ahead.

Metal Sails.—Experiments were carried out at the University of Goettingen with canvas sails, metal sails and model ships. The result of these experiments showed that the effect of metal sails could be made approximately double that of canvas sails, a necessary condition being, however, that a third part of the sail area should be turnable. Designs were got out, but the plans did not materialise.

In the case of the rotor ship the inventor states that it is not intended to drive ships solely by wind rotors, but that they shall serve as an auxiliary power upon steam and motor vessels. In the vessel under discussion, the power of the wind is not made use of by sails, but by means of large metal cylinders. The ordinary elementary laws of physics do not fully explain the problem of the rotor ship's cylinders; the modern science of currents dealing with liquid and gaseous bodies in their relation to hard bodies must also be considered.

Revolving Cylinders.—In 1922 experiments were carried out at Goettingen with revolving cylinders, and it was then discovered that the pressure exerted upon a cylinder revolving in an air current was considerably greater than had been supposed. Actually, the power exerted on a normal cylinder was about 4–5 times as large as that on a normal sail. When, however, disks of a larger diameter were provided at the ends of the cylinders, it was found possible to increase the effect to nine or ten times the amount of wind effect in the normal sail. One condition for this, however, is that the revolving speed of the cylinders is about 3 to $4\frac{1}{2}$ times as great as that of the wind. An ordinary sailing vessel requires to take down all her canvas in a hurricane, but the rotor ship could continue sailing, with more stability for manoeuvring. The danger from sudden squalls is not so great, as an increase of the wind speed has no influence, providing the circumferential speed of the towers is increased at the same time.

Equipment of the "Buckau."—The vessel selected for the first tests was the three-masted schooner "Buckau." She had a displacement of 960 tons, and was fitted with an auxiliary motor of some 200 horsepower. The canvas rig of the vessel was dismantled, and in place of the fore and third masts, two very strong masts were erected. The new masts were shorter, being 42 ft. in height. These masts were provided with bearings at the upper and lower ends to allow for the free rotation of the cylinders, which were placed over the masts. The cylinders were fitted with disks at either end, the disks being of greater diameter than the cylinders, but built as a part of them. In this particular case the cylinders are of sheet steel of 0·04 in. thickness.

Naturally, the whole structure is suitably stiffened. The cylinders are rotated by means of electromotors, which will give the towers a speed of 125 revolutions per minute. Circumferential speed is approximately 60 ft. per sec., and the power required to rotate the towers is nine horsepower. For working the plant one man only at the switchboard is required. By altering the circumferential speed of one or other of the cylinders the operator can correspondingly change the pressure exerted by the wind upon this, and so alter the vessel's course. When cruising, changing the wind side can be effected solely by the towers, when the ship can be stopped and driven astern; this method being far superior to that of the ordinary sailing ship.

The Magnus-effect.—The explanation of the phenomenon of the rotor ship may be traced to the so-called *Magnus-effect*, explained by Prof. Magnus of Berlin in 1853; who found that a special power is exerted by an air current upon a revolving cylinder. The explanation of the reason for this effect was found, after more than 20 years of investigation, to be briefly as follows. When a cylinder revolves, the nearest stratum of air revolves with the cylinder, owing to the friction of the cylinder being much greater than the friction of the air molecules against each other. The nearest stratum induces the next one also to revolve, but, naturally, this is done at a much slower speed. In the same manner the strata lying more distantly from the cylinder are moved more and more slowly, until at a certain distance the influence stops. If such a rotating cylinder is impinged upon by an air current, the speed of which is slower than the circumferential speed of the cylinder, the streamlines are directed, so that at one side the air is rarefied by the frictional effect of the cylinder, and at the other side it is compressed. These changes of pressure are the causes of the *Magnus-effect*, and they create a power in a direction away from the side of the rarefied air, and through the centre of the densest air patch, or side in which the stream lines are compressed. Actually the real direction of the power is not always at right angles to the wind direction, but diverges in a measure, which is dependent on the speed ratio of the wind current to that of the circumferential speed of the cylinder.

Commercial Aspects and Value.—As with every new invention, the advent of the rotor ship was hailed, obviously by non-technical writers, as a revolutionary step as regards ship propulsion, and many absurd and impossible claims were made regarding the capabilities of such a vessel. Coal and oil for marine purposes were said to be doomed, and a new era opening up as regards sea and ocean transport. Up to a certain point, the claims made by the inventor are justified; but the scope of the ship is very restricted, owing to the narrow limits imposed by the dependence on air currents. There may possibly be a field for such an invention as an auxiliary fitting to steam or motor vessels, and also when applied to tramp ships now dependent on the trade winds,

and in this connection the towers may to a certain extent supersede sails; but it is a very far cry to state that revolving towers will be the motive power of the future for all sea transport. It is possible also that the invention will be useful when it is applied to windmills for stationary use—in generating stations, for example.

The "Buckau's" Trial.—The sea-going trial of the rotor ship "Buckau," from Germany to the Forth, was claimed to be successful. It is, however, obviously impossible to give an unbiased opinion as to the ultimate value of the rotor ship until very full details are to hand regarding the capabilities of the vessel under all the varying conditions which obtain at sea. At present, Germany, apparently, is the only country to which the rotor ship has made an appeal, and rotor ships are under construction in that country. It is not considered that this method of marine propulsion will find favour with British shipbuilders.

See *Marine Engineer Officers' Magazine* (Jan. 1925). (F. J. D.)

ROTTERDAM, Holland (*see* 23.766), population 536,838 in 1923, has increased its port facilities and dock space since the World War, and is very largely used as a transit port, with a great number of river boats, though the general traffic has hardly reached pre-War level. In 1924, 10,085 vessels of 15,089,293 tons entered the harbour, as compared with 10,459 of 13,036,194 in 1913. A new quarter has sprung up on the left bank of the Maas, and the King's Bridge carries the road and railway across the harbour. Coolsingel has been made into a boulevard, and a fine town hall and general post office have been built; the old town hall is used as offices. In 1925 the municipality was faced with a heavy deficit, but the reviving trade of the port was expected to solve the difficulties of the city. The important coffee market is increasing its business, and the transit trade in iron ore is growing.

ROUBAIX, France (*see* 23.767), the chief centre, with Tourcoing, of the woollen industry of France, has regained prosperity after the calamities of the World War. The population was 113,265 in 1921, and a later estimate is 122,723. During the War the city was in the hands of the Germans. All stocks of wool and most of the machinery were removed, and factories were pillaged and the railway station was blown up before the retreat of the enemy; but, as the mills were largely spared, work was started again, with the help of government advances and bank credits, in 1919. In 1923 there were 71 combing, 61 spinning and 66 weaving establishments at work in Roubaix and Tourcoing. In 1925 large sums were being spent, both by the municipality and by manufacturers, in the provision of houses for workers since accommodation for them was very difficult to obtain.

ROUEN, France (*see* 23.768), with a population of 123,712 in 1921, has considerably increased its import trade since the World War. In 1923 the total amount of goods discharged (8,921,000 tons) exceeded the total of discharges and shipments at Marseilles, hitherto the first French port, but shipments at Rouen were small (345,000 tons). The equipment of the port has been much improved, but little progress had been made in 1925 with the larger undertakings, *i.e.*, the deepening of the harbour and provision of new quays and basins. A chapel (of Notre Dame de la Pitié) in the cathedral contains a French War Memorial, and in the chapel devoted to Ste. Jeanne is a plaque in memory of the British dead. There are cemeteries near the town, the first, with 15,500 British graves, being the largest in France. Part of the British Expeditionary Force disembarked at Rouen in Aug. 1914, and thereafter the town was a camp for reinforcements, and a large Army Service Corps centre and contained several base hospitals. The archbishop's palace was the British headquarters.

ROUSSEAU, VICTOR (1865–), Belgian sculptor, born at Feluy-Arquennes (Hainaut) Dec. 16 1865, became a member of the Belgian Royal Academy of Arts, director and professor of the Brussels City Academy, Commander of the Order of Leopold and holder of many Belgian and foreign orders. He began to exhibit about 1890, and his early works showed a lively understanding and a true native sense of technique. Gaining in reputation rapidly, he was soon commissioned to execute works of importance. Rousseau's sculpture denotes both artistic insight and a sense of rhythm, and his art is peculiarly adapted to the translation of thought and emotion. His work is never specious, nor dependent on mere superficial beauty. Among Rousseau's principal works mention must be made of "Les Soeurs de l'Illusion" and "Démeter" (both in the Brussels Museum), the decorative figures on the Fragnée Bridge at Liége, the "Maturité" monument in the Place de la Chancellerie, Brussels, and the Max Waller memorial in the same city. M. Rousseau, who lived in London during the War, was commissioned to design the monument, signifying Belgian gratitude to England, which stands on the Thames Embankment, London, close to Cleopatra's Needle. He also designed the memorial at Forest, near Brussels, to those who fell in the War. (P. L.)

ROUVIER, MAURICE (1842–1911), French statesman (*see* 23.781), died at Neuilly-sur-Seine June 7 1911.

ROWELL, NEWTON WESLEY (1867–), Canadian politician, was born Nov. 1 1867 in Middlesex county, Ontario. He was called to the Bar in 1891, and became head of the law firm of Rowell, Reid, Wood and Wright, Toronto. He stood unsuccessfully as a Liberal for the Dominion Parliament at the general election of 1900. In 1902 he became K.C. He was elected to the Ontario legislative assembly for North Oxford in 1911, and from that year to 1917 was leader of the Liberal Opposition in the Ontario Legislature. In Oct. 1917 he entered the Federal Govt. as president of the council and vice-chairman of the War Committee of the Cabinet, and was elected to the Dominion House of Commons for Durham county, Ontario, Dec. 1917. He was a member of the Imperial War Cabinet and Imperial War Conference, 1918; Canadian Govt. representative at the International Labour Conference at Washington, 1919; and a Canadian delegate to the first assembly of the League of Nations at Geneva, 1920, subsequently becoming vice-president of the League of Nations Society in Canada. He resigned his seat in Parliament in May 1921.

ROWING.—The period from 1910–25 did not exhibit the best class of rowing in any country of the world except in the United States, partly because the first of these years seemed almost universally to coincide with a curious deterioration both in style and in material, but chiefly because the World War had an effect which was far from being limited to the absence of all possible competitors in open events from Aug. 1914 until March 1919, and in some cases later still.

In England, both Oxford and Cambridge and the metropolitan clubs suffered losses even more terrible, proportionately, than those recorded in other forms of first-rate sport, and these losses not merely reduced the number of active oarsmen, but gravely lessened the opportunities of coaching new crews, owing to the casualties sustained. A third reason is to be found in the unavoidable fact that very few boys and young men were able to continue any practice in rowing at all while the War was in progress, and the races organised at Henley between various school crews were far from sufficient to give the competitors—when they survived—enough experience.

The University Boat Race.—The results of the Oxford and Cambridge eight-oared race from Putney to Mortlake (4½ m.) have been as follows:—

			Min.	Sec.
1910 March 23	Oxford won by	3½ lengths in	20	14
1911 April 1	Oxford	2¾	18	29
1912 April 1	Oxford	6	22	5
1913 March 13	Oxford	¾	20	53
1914 March 28	Cambridge	4½	20	23
1915–19	No race.			
1920 March 27	Cambridge	4	21	11
1921 March 27	Cambridge	1	19	45
1922 April 1	Cambridge	4½	19	27
1923 March 24	Oxford	¾	20	54
1924 April 5	Cambridge	4½	18	41
1925 March 28	Cambridge	finished alone	21	50
1926 March 27	Cambridge	won by 5 lengths in	19	29

In view of what has been said above, it is curious to note that both the record for this race (18 min. 29 sec. in 1911) and

the second best time (18 min. 41 sec. in 1924) have been achieved in the period immediately under review; but weather, wind and water have a very great effect on times in this long race at Putney, and the form shown in each case did not come up to that of earlier crews which were not so fortunate in their conditions. These factors also produced the catastrophe of 1925, when the Oxford boat shipped so much water at the start that it was only kept afloat for the next mile by the bladders under the seats, and the crew was obliged to land soon after passing Hammersmith, and Cambridge, who were considered good enough to win in any case, had to finish alone. In 1912 both boats were water-logged, and the Cambridge boat sank before reaching Hammersmith. They rowed again in two days' time and Oxford won.

The results of the Yale and Harvard University eight-oared race at New London, Connecticut (4 m.) have been as follows from 1910–25:—

Date	Won by	Winner min.	Winner sec.	Loser min.	Loser sec.
1910 June 30	Harvard	20	46½	21	04
1911 June 30	Harvard	22	44	23	40½
1912 June 21	Harvard	21	43½	22	04
1913 June 20	Harvard	21	42½	22	20
1914 June 19	Yale	21	16	21	16⅕
1915 June 25	Yale	20	52	21	13½
1916 June 23	Harvard	20	02	20	17
1917	No race.				
1918 June 1	Harvard	10	58	11	04
1919 June 20	Yale	21	42⅕	21	47⅖
1920 June 25	Harvard	23	11	23	46
1921 June 24	Yale	20	41	20	44⅕
1922 June 23	Yale	21	53	22	06
1923 June 22	Yale	22	10	22	35
1924 June 20	Yale	21	58⅗	22	11⅗
1925 June 19	Yale	20	26	20	32⅖
1926 June 25	Yale	20	14⅖	20	21⅗

The record for the Thames river course was made in June 1916, by Harvard who did 20 min. 2 seconds. In June 1918, owing to the World War, the race was reduced to an informal two-mile contest at Derby, Connecticut. The full distance was introduced again in 1919. These races began over a two-mile course on Lake Winnepesaukee in 1852 when Harvard won. In 1855 the course became three miles at Springfield. Then, for nine years, it was rowed on Lake Quinsigamond, and in 1869 on Lake Saltonstall. The crews of 1876 and 1877 rowed four miles at Springfield, Massachusetts. In 1878 the four-mile course at New London, Conn., was inaugurated.

Racing at Henley.—For many years the blue ribbon of the rowing world for open competition in eights has been the Grand Challenge Cup at Henley Regatta, and one of the finest crews which ever won it was that of the Harvard Athletic Assn., from Boston, in 1914. Even the institution of the Olympic Games and the Olympic Regattas of 1908, 1912, 1920 and 1924 have not sensibly diminished the value, in public estimation, of the Henley Grand Challenge Cup, which, since its foundation in 1839, has been won by crews from abroad only in the case of New South Wales (1912) and Belgium (1906, 1907, 1909), in addition to the American crew already named.

The winners of the Grand Challenge Cup (distance 1 m. 550 yd., record 6 min. 53 sec.) since 1910 are the following:—

		Min.	Sec.
1910	Magdalen College, Oxford	7	19
1911	Magdalen College, Oxford	7	2
1912	Sydney R. C. New South Wales	7	6
1913	Leander Club	7	11
1914	Harvard Athletic Assn.	7	20
1920	Magdalen College, Oxford	7	24
1921	Magdalen College, Oxford	6	54
1922	Leander Club	7	36
1923	Thames R. C.	6	45
1924	Leander Club	8	3
1925	Leander Club	6	53
1926	Leander Club	6	56

With regard to these races it should be noted that the race of 1922 was rowed in a storm of wind and rain which must have added nearly 45 sec. to the time. In 1923 a short and perfectly straight course was tried as an experiment. From 1924 onward this straight course was made 1 m. and 550 yd., or exactly the same as the distance in all former races except that of 1923. This course is marked out by piles with long booms which float on the surface of the water. It is now a straight course and the crews row up the centre of the river so that neither get shelter from the bank. This improvement was carried out by the Henley Regatta Committee and the Thames Conservancy.

In the United States there is an inter-university eight-oared race in which five or more eights compete simultaneously over a 4 m. course at Poughkeepsie. The following have been the results since 1912:—

Year		Winner	Second	Third
1912	June 29	Cornell	Wisconsin	Columbia
		19 21⅖	19 25	19 41⅖
1913	June 21	Syracuse	Cornell	Washington
		19 28⅗	19 31	19 33
1914	June 26	Columbia	Pennsylvania	Cornell
		19 37⅘	19 41	19 44⅕
1915	June 28	Cornell	Leland Stanford	Syracuse
		19 36⅗	20 37⅘	20 43⅗
1916	June 17	Syracuse	Cornell	Columbia
		20 15⅖	20 22⅘	20 41½
1920	June 19	Syracuse	Cornell	Columbia
		11 02⅗	11 08⅕	11 21⅕
1921	June 22	Navy	California	Cornell
		14 07	14 22	14 22⅕
1922	June 26	Navy	Washington	Syracuse
		13 33⅗	13 36⅕	13 38¾
1923	June 28	Washington	Navy	Columbia
		14 03⅕	14 07⅖	14 15⅘
1924	June 17	Washington	Wisconsin	Cornell
		15 02	15 09⅖	15 15⅗
1925	June 22	Navy	Washington	Wisconsin
		19 24⅕	19 28⅖	19 58
1926	June 28	Washington	Navy	Syracuse
		19 28⅗	19 29⅗	19 53⅘

In 1920 the race was only 2 m. on Cayuga Lake. The next three years were each 3 m. events. In 1924 the distance must have been about 3 m., and in 1925 there were seven crews competing, Columbia finishing last in 20 min. 15 seconds. Over the full 4 m. course the record of 18 min. 53⅕ sec., made by Cornell in 1901, still stands.

In the Olympic Regattas of 1908, 1912, 1920 and 1924 it will be sufficient to give the winners of the eights and of the single sculling race. The courses have been so different that a comparison of times would be valueless; but the distance is generally 1½ m. (as it was at Henley in 1908) or about 2 kilometres.

Eights

1908	Henley	Great Britain (Leander).
1912	Stockholm	Great Britain (Leander).
1920	Antwerp	U. S. (Navy).
1924	Paris	U. S. (Yale).

Sculling

1908	Henley	H. T. Blackstaffe	(Great Britain).
1912	Stockholm	W. D. Kinnear	(Great Britain)
1920	Antwerp	J. B. Kelly	(United States America).
1924	Paris	J. Beresford Jr.	(Great Britain).

For the professional sculling championship of the world (about 4 m.) the following races have taken place since 1910:—

		Min.	Sec.
1910	R. O. Arnst, beat G. Whelch in New Zealand	21	50
1910	R. O. Arnst, beat E. Barry, on the Zambesi	20	14
1911	R. O. Arnst, beat H. Pearce on Parramatta river	19	40
1912	E. Barry, beat R. Arnst, Putney to Mortlake	23	8
1912	E. Barry, beat E. Durner, Putney to Mortlake	22	31
1913	E. Barry, beat H. Pearce, Putney to Mortlake	24	9
1914	E. Barry, beat J. Paddon, Putney to Mortlake	24	28
1919	A. Felton, beat E. Barry, Putney to Mortlake	25	40
1920	E. Barry, beat A. Felton on Parramatta river	24	32
1921	R. O. Arnst, beat J. P. Hannan in New Zealand	22	38
1922	D. A. Hadfield, beat R. Arnst in New Zealand	19	46
1922	J. Paddon, beat D. A. Hadfield in New Zealand	..	..
1923	J. Paddon, beat D. A. Hadfield in New South Wales	19	19
1924	J. Paddon, beat A. Felton at Brisbane	..	..
1924	J. Paddon, beat Major Goodsell in New South Wales	17	7
1925	Major Goodsell, beat J. Paddon (3 m. 167 yd.) on Parramatta river	22	50

In amateur sculling nothing has yet touched F. S. Kelly's record of 8 min. 10 sec. done in 1905 on the Henley course and hardly anyone has shown such perfect form. In 1913 the Diamond Sculls were won by C. McVilly of Tasmania, in 1914 by G. Sinigaglia of Italy, and in 1922 by W. M. Hoover of the Duluth B.C., Minnesota, U.S.A., who was beaten in 1925. His style was his own and broke nearly every known rule, but he practised it so persistently and sculled so hard that he was always a very difficult man to beat, and was certainly as fast as any American entry for this famous race since E. H. Ten Eyck of Worcester, U.S.A., won it in 1897. For a long while Columbia College was the only entrant from the United States of America that took a Henley prize across the Atlantic, and they won the Visitors' in 1878. This race is now reserved to English college crews for which it was originally intended.

Styles Compared.—The crews sent for the Grand Challenge Cup at Henley from Cornell, Yale, Harvard and Pennsylvania have almost invariably shown that in the United States there are as many styles of rowing as there are famous coaches; and though English coaches like Mr. R. C. Lehmann, Mr. G. Nickalls and others have occasionally coached American crews these differences have always persisted.[1] In England, on the other hand, it may be truthfully said that there is only one accepted and orthodox style, laid down by Dr. Warre of Eton, and carried on by such coaches as Dr. Gilbert Bourne and Mr. Harcourt Gold. All first-rate crews aim at this, and the differences between them may be measured by their respective nearness to a common ideal.

Boats for Rowing.—On both sides of the Atlantic considerable progress in the theory of boat building has been made. The Belgian plan of building their boats in sections for convenience of transport revolutionised certain fixed ideas as to weight. The experiments of Dr. Warre in building a boat only 56 ft. long were also most fruitful; but though she proved faster than usual for a first-rate crew (and certainly won a university race on her merits in a storm), she was also slower than usual for a second-rate crew; and, since the absolute best can never be anticipated with complete certainty, Dr. Warre's model never became popular. Sir William Christie, formerly astronomer royal, designed a boat based on the involute of the circle in such a way that professional boat builders could make their own templates by quite simple methods on purely mathematical principles. Finally Dr. Bourne, combining first-rate experience with high technical acquirements, designed several boats on the streamline principle exhibited in certain fishes, and made a step forward of which the full results have not yet been realised.

Rowing in Other Lands.—France, one of the earliest nations, after the United States, to compete at Henley, does not seem to have contributed much to the technique of oarsmanship as yet, but Holland, which now seems to be following successfully in Belgium's footsteps, is making rapid strides both in style and technique. Italy is also sending crews to English regattas. Sweden and Norway, each devoted to what is known as the English style, have also made very great advances. Germany, whose four (the heaviest yet seen at Henley) was only just beaten in 1914, does not seem to have made that contribution to the theory of boat building which might have been expected from her industry and science. Both Canada and Australia sent very fine crews to England in the 20th century, and their winners are to be found in the lists both of the Grand Challenge Eights and of the Stewards' Fours.

Oars and Other Accessories.—Dr. Warre's style has hitherto been exemplified at its best with fixed rowlocks. But several English crews, and nearly all those of other nations, use the swivel rowlocks which are of course universal in single sculling. The English slide is usually 16 in. long and the oarsman slides right up to his work. But a few English crews and many American and other eights use slides without stops at either end. Not much difference is observable in oars, which are largely influenced by style and rig. Some favour short ones of 12 ft. or less with 6 in. blades, such as the Belgians and most American crews prefer. Others use oars of 12 ft. 3 in. to 12 ft. 5 in. with $4\frac{1}{2}$ in. blades, preferring length of stride to rapidity of action. The choice can only be decided by the coach of each particular crew.

In 1925 the Oxford University Press published a *Text-Book on Oarsmanship* by Dr. G. C. Bourne, which is the most complete treatise on the whole subject which has yet been issued. (D.)

[1] The various American styles are all founded on the English style, the chief difference in America being a longer slide, a harder leg drive and less body swing. (ED. *E.B.*)

ROYCE, JOSIAH (1855–1916), American philosopher, was born at Grass Valley, Cal., Nov. 20 1855. He graduated from the University of California in 1875 and in 1876 went to Johns Hopkins University as a fellow. After receiving his Ph.D. in 1878 he was instructor in English literature and logic at the University of California. In 1882 he was appointed instructor in philosophy at Harvard, where, after holding various intermediate posts, he became Alford professor of religion, moral philosophy and civil polity in 1914. He was the leading American exponent of idealism (*see* 14.284) and his works were distinguished for their literary qualities. He died at Cambridge, Mass., Sept. 14 1916.

Royce was the author of *A Primer of Logical Analysis* (1881); *The Religious Aspects of Philosophy* (1885); *The Feud of Oakfield Creek* (1887, a novel); *The Spirit of Modern Philosophy* (1892); *The Conception of God* (1895); *Studies of Good and Evil* (1898); *The World and the Individual*, 2 vol. (1900–1), Gifford Lectures at the University of Aberdeen; *The Conception of Immortality* (1900); *Outlines of Psychology* (1903); *Herbert Spencer: An Estimate and Review* (1904); *The Philosophy of Loyalty* (1908); *Race Questions, Provincialism and Other American Problems* (1908); *William James and Other Essays on the Philosophy of Life* (1911); *Bross Lectures on the Sources of Religious Insight* (1912); *The Problem of Christianity*, 2 vol. (1913), lectures before Manchester College, Oxford; *War and Insurance* (1914); *The Hope of the Great Community* (1916), war addresses; and the posthumously published *Lectures on Modern Idealism* (1919).

ROYDEN, AGNES MAUDE (1876–), British social worker and preacher, youngest daughter of Sir Thomas Royden, 1st Bart. of Frankby Hall, Cheshire, was educated at Cheltenham and Lady Margaret Hall, Oxford. After leaving Oxford she was for several years engaged in social work, first in Liverpool and later in the country parish of Luffenham, Rutland. In 1908 she became an active member of the constitutional wing of the women's suffrage movement and until 1914 edited *The Common Cause*, the organ of the National Union of Women's Suffrage Societies. The reputation she achieved as a thoughtful and incisive speaker and writer on contemporary religious and social problems brought her in 1917 an invitation to become assistant preacher at the City Temple, London, which she accepted, and thus became the first woman in Great Britain to occupy the pulpit of a regular place of worship. On relinquishing her appointment at the City Temple she founded in conjunction with Dr. Percy Dearmer, the Fellowship Services conducted first at the town hall, Kensington, London and afterwards at the Guild House, Eccleston Square.

Miss Royden's numerous books and pamphlets include *Women and the Sovereign State* (1917); *Sex and Commonsense* (1922); *Prayer as a Force* (1922); *Political Christianity* (1922); and *The Church and Woman* (1924); and she has written copiously for the Press.

RUANDA-URUNDI is a mandated territory in East Africa lying between the first and fourth degrees of south latitude and 29° to 31° east longitude. It is bounded on the north by Uganda, on the east and south by Tanganyika territory, and on the west by the Belgian Congo. It comprises that portion of the former German colony of East Africa which was assigned under Mandate to Belgium after the World War, and covers an area of about 22,000 sq. miles.

The country was occupied by Belgian troops from the Congo in 1916, and in 1920 the frontier between the two Mandates was laid down by what was known as the Orts-Milner boundary. By this delimitation, the Kisaka district, a considerable area along the valley of the Kagera river, was detached from the territory claimed by King Musinga of Ruanda, in order to preserve a line of access for a future British railway to connect Uganda with the central railway of Tanganyika. This reservation deprived the people of Ruanda of some of their most essential grazing lands, and created much consternation among them. At the instance

of the Mandates Commission, the British Govt. consented in 1924 to the readjustment of the frontier, and the Kagera river now forms the greater part of the boundary. There was much delay in issuing the Mandate—for which the concurrence of the United States had to be obtained—and this was further prolonged by the readjustment of the frontier. It was not therefore until Oct. 1924, that the Mandate was formally accepted by the Belgian Parliament. A law was then passed by which the territory should be administered as an integral part of the Congo but with a separate budget.

The pacification of Urundi, which under German rule had been disorganised by internal warfare, was completed in 1921, and reports, inclusive of that year, have been regularly submitted to the Mandates Commission under the draft Mandate, and examined in the presence of an accredited representative.

The country is divided into two distinct units—Ruanda under the despotic King Musinga, and Urundi under a council of regency during the minority of the Chief. Each is supervised by a resident with headquarters at Kigali and Kiteja respectively, the capital being at Usumbura on Tanganyika lake. It is the declared policy of Belgium to support the authority of the native chiefs and to rule through them. There are about 70 European officials.

The greater part of the country is mountainous and lies at a high altitude. Lakes Tanganyika and Kivu form part of its frontiers and there are numerous other small lakes—one, Karago, at an altitude of 6,000 feet. The population is estimated at 5,000,000, the density in some areas being upwards of 300 to the sq. mile. The bulk of the people are of Bantu stock, but the ruling caste are of the pastoral Wahima race, as in Ugana, Unyoro and Ankoli. The wealth of the country consists in its flocks and herds.

The local revenue is about 4,500,000 fr., of which half is derived from a direct tax on the natives. It is supplemented by a grant of 1,400,000 francs from Belgium. Owing to its distance from the sea and the lack of cheap transport, the trade of the country is at present small. A quantity of foodstuffs with livestock and hides is exported (*see* MANDATES). (F. D. L.)

RUBBER (*see* 23.795).—The area devoted to growing rubber trees was in 1924 computed to be as follows, about 75% producing:—

	Planted Ac.	In bearing	% of total
Malaya	2,230,000	1,672,500	56·8
Ceylon	410,000	307,500	10·5
India	127,000	95,250	3·2
Dutch Indies	1,000,000	750,000	24·4
Other districts	160,000	120,000	5·1
	3,927,000	2,945,250	

The following table shows the world's rubber production from 1920–5:—

	Plantation Acreage	Plantation Production	Total Wild Rubber Production	Total World's Production
		(tons)	(tons)	(tons)
1920	3,200,000	304,671	36,464	341,135
1921	3,321,000	276,746	23,903	300,649
1922	3,475,000	378,232	27,878	406,110
1923	3,915,000	379,738	26,685[1]	406,423[1]
1924	4,266,000	386,703	26,396	413,099
1925	4,296,000[1]	470,000[1]	35,000[1]	505,000[1]

[1] Estimated.

I. VARIETIES OF COMMERCIAL RUBBER

Price Range for Crude Rubber.—Demand and supply, and, in a minor degree, speculation, occasioned a wide variation in the price of crude rubber: early in 1925 it was back to the average for 1913, but on July 20 1925 reached $1.21, the price in Aug. 1914. The United States Department of Commerce gives the following as the average monthly price per lb. for spot rubber in New York for the years 1913–24 inclusive:—

Year	$	year	$
1913	.807	1919	.483
1914	.616	1920	.333
1915	.557	1921	.182
1916	.669	1922	.183
1917	.648	1923	.249
1918	.549	1924	.211

The following table shows the approximate world consumption in gross tons from 1920 to 1925:—

	1920	1921	1922	1923	1924	1925
United States	252,922	185,394	301,076	309,139	324,500	384,837
Great Britain	56,572	42,087	11,765	12,558	18,500	26,500
Germany	13,400	22,428	27,551	19,436	22,738	28,263
Austria	4,200	2,000	2,270	1,334	2,500	3,900
Scandinavia	1,100	900	1,600	2,000	2,400	2,700
France	16,606	14,701	27,660	31,108	34,442	39,000
Japan	5,500	23,164	16,581	17,318	18,905	20,000
Russia	140	200	2,100	3,900	2,000	4,000
Belgium, Holland	3,500	1,800	1,200	1,880	2,200	3,100
Canada	11,351	8,259	9,353	13,255	14,391	20,500
Australia	800	900	1,700	2,400	2,900	3,300
Italy	6,800	4,000	6,400	8,490	8,764	10,500
Other countries	1,178	1,225	1,600	1,760	2,100	3,500
World totals	374,069	307,058	410,856	424,578	456,340	550,100[1]

[1] Estimated.

Stevenson Restriction Plan.—To support the price of crude rubber a regulative measure, known as the Stevenson plan (after Sir James Stevenson, chairman of the committee appointed by the British Secretary of State for the Colonies) was, on the recommendation of the committee, adopted by British planting interests late in 1922. Prices were well below production costs (touching 11½ cents per lb. in 1921); so the Stevenson compulsory restriction plan was enacted into law by the legislatures of the Malay States, Straits Settlements and Ceylon, taking effect from Nov. 1 1922. It established as standard production the quantity of dry rubber produced from any holding during the period Nov. 1 1919 to Oct. 31 1920, plus an allowance, if claimed, for untapped trees. The total standard production was estimated at 330,000 tons. Provision was made for a minimum export duty to be levied on that percentage of standard production which producers would be allowed to export under the scheme at the minimum rate of duty, which was not to exceed 1d. per pound. If a producer wished to export more than that allowed at a minimum rate of duty, he would be required to pay an export duty per lb. on his total export during twelve months on the following scale:—

Not exceeding	65% of standard production	4d.
Over	65% but not exceeding 70%	5d.
Over	70% but not exceeding 75%	6d.
Over	75% but not exceeding 80%	7d.
Over	80% but not exceeding 85%	8d.
Over	85% but not exceeding 90%	9d.
Over	90% but not exceeding 95%	10d.
Over	95% but not exceeding 100%	11d.
Over	100%	12d.

At the outset the percentage of rubber exportable was set at 60, based on standard production: but the plan provided also for alteration in the percentage, on the basis of the price of standard quality smoked sheet in the London market: when the average price during three consecutive months had been maintained at not less than 15d. per lb. London landed terms, the exportable allowance would be raised automatically by 5% for the next quarter: should the average price be maintained at not less than 18d. for the three consecutive months the percentage would be raised by 10% for the ensuing quarter: and so on until the point of maximum or full standard production be reached. If, however, during any three consecutive months the price had not averaged at least 12d. per lb. the exportable allowance would be reduced to 55%, and so on by reductions of 5% at the end of each three months until, by control of export, the demand for rubber would bring its price back to the basic 15d. figure. Once lowered, the percentage would not be increased except on the basis of the 15d. price. The standard production for Nov. and Dec. 1925 and Jan. 1926 was adjusted to 369,641 tons.

The table[1] on page 385 shows the percentage of standard production exportable at the minimum rate of duty during each quarter

[1] Reproduced from 17th Report of the Council to the members of the Rubber Growers' Association (Incorporated).

since the inception of the scheme in Nov. 1922, together with the average daily price for spot sheet in London during each quarter:—

Quarter	%	Price s.	Price d.
Nov. 1922 to Jan. 1923	60	1	2·285
Feb. 1923 to April 1923	60	1	4·858
May 1923 to July 1923	65	1	2·242
Aug. 1923 to Oct. 1923	60	1	2·994
Nov. 1923 to Jan. 1924	60	1	2·175
Feb. 1924 to April 1924	60	1	0·917
May 1924 to July 1924	60	.	10·974
Aug. 1924 to Oct. 1924	55	1	2·632
Nov. 1924 to Jan. 1925	50	1	5·998
Feb. 1925 to April 1925	55	1	7·356
May 1925 to July 1925	65	3	2·469
Aug. 1925 to Oct. 1925	75	3	7·269
Nov. 1925 to Jan. 1926	85	3	10·709
Feb. 1926 to April 1926	100	..	..

The export quota remained at 100% for the quarter May–July 1926.

Reclaimed Rubber.—In few other industries is conservation such an important factor as in rubber manufacture. Worn-out vulcanised rubber goods are collected and the basic material recovered to be manufactured again into new articles. So many uses have been found for reclaimed rubber that in 1925 its consumption approached that of the crude product. The element of cost has been an important factor in popularising reclaimed rubber, as articles made of it could be produced and sold for much less than those made with new rubber only: and to a considerable degree the price of the crude product has been kept down by the ample supply of the reclaimed. To meet the growing demand, large companies have supplanted the small reclaimers: such concerns employ not only the most modern machinery, but maintain research and analytic laboratories for control of processes, standardising products, and for the study of reclaiming and compounding problems.

The first attempt to reclaim rubber commercially was made in the early 'fifties of the 19th century when Hiram L. Hall, a manufacturer in Massachusetts, boiled and steamed powdered vulcanised rubber and then sheeted it. An important later development was the destruction of fibre in the ground material by means of acids, chiefly sulphuric, for which processes over 50 patents were granted. The acid process was of use chiefly in the reclaiming of worn-out footwear, but was not of great value in recovering other waste. The alkali process, invented by Arthur Hudson Marks, a manufacturer in the United States, solved the latter problem. In this, caustic soda was used to destroy fabric and incidentally it proved to be the most effective agent in de-sulphurising the mass.

The removal of not only the free sulphur from vulcanised rubber (which modern reclaiming accomplishes) but also of the sulphur which during curing unites chemically with the crude rubber, is the goal towards which experimenters have been striving. Notable progress in this direction was made in England by Dr. David Spence, who used an accelerator, aniline-potassium, but in solution in excess of aniline. He claimed not only the dissolution of the waste rubber but the liberation in soft rubber of from 78% to 90% of the combined sulphur, and the changing of the latter into an insoluble alkaline sulphide. In hard rubber 73% of the combined sulphur was said to be similarly reduced. There are also many processes of a secret nature, most of which tend to the production of higher grades of reclaimed rubber.

The gathering of worn-out or damaged rubber goods, called scrap rubber, is a highly organised business, particularly in the United States. From the junk men it passes into the warehouses of the specialists in rubber waste, who sort and bale it and sell it to reclaimers. The standard grades are, boots and shoes, trimmed arctics, untrimmed arctics: hard rubber, battery jars; inner tubes: mechanical, black scrap, heels, horseshoe pads; hose; red scrap, white scrap: auto tires, bicycle tires, solid tires. The reclaiming factories convert the scrap into reclaimed rubber which they sell to manufacturers of rubber goods. The existing grades of reclaim run into hundreds, but the standard grades are: floating; friction; mechanical; shoe, unwashed; tires, auto; tires, truck; white. With crude rubber at 60 cents per lb. scrap varies from 2 to 8 cents, and reclaim from 8 to 20 cents.

Synthetic Rubber.—Many attempts have been made to produce synthetic rubber, and success has attended these efforts, but the production of commercial rubber synthetically had not been achieved by the beginning of 1926. In the making of synthetic rubber the chief concern of the chemists has been the solution of the following problems: (1) the production of isoprene, an oily, volatile hydrocarbon (C_5H_8), and hemiterpene, with its analogous hydrocarbons, such as butadiene or methyl-isoprene and dimethyl-butadiene; (2) the polymerisation of these products

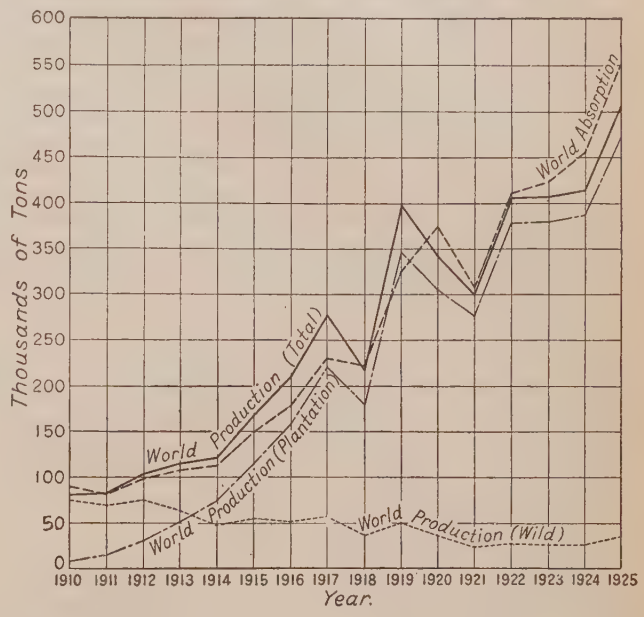

FIG. 1.—During the period 1910–25 both the production and consumption of rubber greatly increased. This chart is based on figures supplied by the Rubber Growers' Association (London). The outstanding features, as shown by the chart, are the great increase in the production of plantation rubber, mainly from British Malaya, Ceylon and the Netherlands East Indies, and the decrease in the output of wild rubber. It is also interesting to note that from 1923 to 1925 consumption outstripped production.

into caoutchouc ($C_{10}H_{16}$); and (3) the grouping of such fundamental caoutchouc molecules into an aggregate having the dimensions, arrangement and properties of the complex molecule of natural rubber bearing the formula $(C_{10}H_{16})_n$.

Isoprene was obtained first by F. C. Himley in 1835, and was noted by Apollinaire Bouchardat in 1837. In 1860 it was properly characterised by Greville Williams, who isolated it and caoutchene through dry distillation of rubber and rectification with sodium. Gustave Bouchardat, in 1879, produced caoutchene, a polymer of isoprene, by treating the latter with hydrochloric acid, obtaining a substance seemingly identical with rubber. Sir William Tilden, in 1882, also converted isoprene with hydrochloric acid into a tough, elastic solid, and noted that isoprene could be changed spontaneously into rubber. In 1884 he produced isoprene by passing turpentine through a hot tube. In the same year he suggested that not only isoprene but its homologues, butadiene and others, should be as readily polymerised. In 1892 he proved that polymerised isoprene could be vulcanised with sulphur. In 1887 Prof. Otto Wallach of the University of Göttingen, polymerised isoprene into caoutchene ($C_{10}H_{16}$) at 260° Centigrade.

Prof. Wilhelm Euler of the University of Stockholm, in 1897, synthetised and polymerised isoprene. A. Heinmann, in 1908, suggested the production of isoprene from methylthiophene, which could be produced from starch hydrolised, oxidised and treated with phosphorous trisulphide. Drs. Fritz Hofman and Carl Coutelle, in 1909, produced pure isoprene, which, on being heated in a closed tube, with other substances, gave a product pronounced pure rubber by Prof. C. D. Harries, of Kiel Univer-

sity. Prof. Harries, who had, in 1905, determined the chemical constitution of natural rubber, in 1910 produced its counterpart by heating isoprene in a closed tube with glacial acetic acid. Starting with commercial alcohol, he worked out a process for producing a material yielding from 60 to 75% of pure isoprene. Prof. Harries and the English investigators, F. E. Matthews and E. Halford Strange, noted independently that sodium greatly quickened isoprene's polymerisation and gave a better product; and German chemists noted other important results of polymerisation in carbonic acid. A German process used ozonisers as catalysers with sodium hydroxide.

The polymerisation of butadiene with sodium has since been effected in three hours, it is stated, with the temperature held between 40 and 50° Centigrade. J. Plotnikow, in 1922, found that ultra-violet rays polymerised vinyl chloride (an acetylene derivative) to caoutchouc chloride, which could be readily turned to rubber. He obtained a similar product and simulated plant photosynthesis by adding a uranium salt to the vinyl chloride and exposing it only to sunlight. Some of the synthetic rubbers are elastic, soluble, and may be readily vulcanised, but they lack the durability, tensile strength, and other qualities of the natural article, imparted to or conserved in the latter by certain resins, protective colloids, etc. A drawback in the manufacture of synthetic rubber is the formation of undesirable by-products which are difficult to remove.

Mineral Rubber.—This is a plastic, inelastic hydrocarbon, or asphaltic pitch, combined with harder bitumens, such as gilsonite, or the product obtained by blowing the still residues from asphalt and mixed base petroleums combined with gilsonite. Mineral rubber may be mixed with natural rubber up to a ratio of seven volumes of the former to 100 of the latter, with beneficial effect on the physical properties of the natural article. It is supplied in solid, liquid and powdered form.

Artificial Rubber.—A factitious rubber, known as factice (though often miscalled rubber substitute) which has physical resemblance and qualities akin to the natural product, artificial rubber comprises a class of material valued for compounding with true rubber, and in the preparation of which vulcanising accelerators may be used. Factice is made from vegetable (rarely animal) oils subjected to the action of metalloids like oxygen and sulphur, of certain chlorides like that of sulphur, and of acids of the nitric type, which under varying temperatures determine the qualities of the product.

Anderson in 1847 was the first to recognise the industrial value of "vulcanisable oils," as they were termed. Nicklès and Rochelder soon afterward noted that by mixing the oil-sulphur compounds with sulphur chloride a substance analogous to rubber could be produced; and Parkes, who discovered the cold-curing process, considered both reactions identical. Experiments by Roussin, Gaumont, Perra, Bruce and Warren led to improved technique in manufacture and extended commercial use. Drying oils like those of linseed, poppy and rape seed are preferred, but castor and some other non-drying oils also yield good factice. Sulphur products are brown; chloride of sulphur, whitish. To the former, resin oils, tars and asphalts are often added; and to the latter, chalk, talc and magnesia. To both kinds, waxes, vaseline and clear mineral oils are added to reduce density chiefly. Factice is insoluble in the usual rubber solvents, but yields to boiling, heavy naphtha, alcoholic soda and acid chlorides, and slightly to warm chloroform.

Chemistry of Rubber.—The caoutchouc molecule had long been known to contain 5 carbon and 8 hydrogen atoms, and had hence borne the formula C_5H_8. But rubber, unlike other hydrocarbons having a similar formula, gives proof of a molecular group formation, the number of such linked molecules being yet unknown, although estimated at 8 or 10. On account of its analogy to the terpenes it was later given the formula $C_{10}H_{16}$, termed a polyterpene, and the index *n* added, indicating an indeterminate molecular grouping. A question still disputed, too, is whether the molecule members form a cyclic or an open chain complex. A recent and plausible theory gives $(C_5H_8)_8$ as the ultimate molecule of caoutchouc, in which 32 carbon atoms form a ring compound. Rubber being of a colloidal nature is not soluble in a chemical sense. It can form only pseudo-solutions or "swellings" in the fluids known as rubber solvents. Investigators, hence, have been seriously handicapped through the lack of a solvent which could resolve the colloidal aggregation (Schidrowitz) into a true, *i.e.*, crystalloid, solution, and thus make possible the direct and final determination of the structure and weight of the caoutchouc molecule.

II. THE MANUFACTURING SIDE

In all commercial rubber caoutchouc exists in two forms, one fibrous or hard, the other viscous and soft. The soft form can be easily dissolved: the fibrous form swells, but does not dissolve. Vulcanisation hardens the viscous portion, and the rubber becomes thus more durable and less sensitive to heat and cold and to the effect of acids and alkalies. A small amount of sulphur in rubber and moderate heat produces soft rubber, more sulphur and greater heat produces hard rubber. In manufacture india rubber is softened by heat until plastic, and calendered; or shaped for making up for vulcanisation; or it is put in naphtha solution, spread, shaped and made up for vulcanisation. It is never melted, as the result would be a worthless sticky semi-fluid.

From the time of Goodyear, rubber footwear was vulcanised by the dry heat cure; that is, in closed rooms filled with hot air. This was very slow, entailing some seven hours of heating. Furthermore, only rubber containing a considerable amount of litharge could be used for this type of cure. The colour was always black, and variety in compounding and stocks was impossible. The discovery of the pressure cure by Augustus O. Bourn, of Providence, Rhode Island, in 1901, however, practically revolutionised the business. In this process the goods were confined in large boiler-shaped shells. These were filled with hot air under pressure and the air from the inner surfaces removed by a vacuum process, the result being that vulcanisation was hastened and a great variety of tough compounds, as for example those used in tire treads, were made available.

In the period 1910–25 much progress was shown in such chemical discoveries as accelerators, and the mechanics of rubber manufacture were revolutionised. For many years rubber, after being cleaned by washing, was dried in airy lofts, often hanging for a year to "age." Hot dryers brought the drying period down to weeks and sometimes days. Eventually with the vacuum dryer a few hours sufficed to extract the moisture. More than 250 fillers and compounding materials are used in rubber manufacture. Their purpose is chiefly to enhance properties or supply certain qualities in which rubber may be lacking. For example, powdered asbestos in quantity makes a compound that is heat-resisting, as in packing and brake linings. Most of the above materials have been known for years. The successful use of organic plastics such as glue is recent, as is the preparation of elaterite in plastic form for rubber compounding.

Direct Use of Latex.—A notable improvement on the acid method of coagulating rubber latex is that of Ernest Hopkinson, by which rubber milk, blown in a mist into a hot compartment, is dehydrated and deposited quite pure in a snowy and velvety mass. By adding sulphur, fillers and accelerators, this may be applied directly to fabrics so as to produce complete "friction" at one operation. Another use for latex is in paper making. According to the process of Frederick Kaye, diluted latex added to pulp in the beater of a paper-making machine and thrown out on the fibre with a coagulant, yields a paper having a marked strength, vellum-like texture and improved folding, moisture and dielectric resistance.

The Wm. Beach Pratt process for de-coagulating crude rubber results in a water dispersion of rubber coagulum, similar to natural latex, which may be recoagulated and vulcanised: and may be made not only of crude rubber but also of vulcanised and acid and alkali reclaimed rubber. The product mills easily, and eliminates solvent, fire and health hazards.

Miscellaneous Soft Rubber Products.—With the interest in pilot and dirigible balloons stimulated by the World War, came marked progress in rubber compounds used in their manufacture.

Of these the most notable were cements of vastly increased tenacity: ingredients and surface coatings that remain unaffected by the sun's rays; and compounds practically impermeable to inflating gases, such as the gas-proof masks evolved by rubber chemists, that effectually protected soldiers from poison gas and are widely used in many perilous industries. Bathing suits and bathing caps of rubber, beautiful in texture, colours and ornamentation, are recent accomplishments. This is due to the production by chemists of colours unaffected by heat and sulphur. An exceptional and novel use is rubber thread in golf-ball manufacture. The standard ball was for years made of solid gutta. In 1898 Coburn Haskell, of Cleveland, Ohio, invented a golf ball with a small ball of rubber as a core around which was wound rubber thread under tension. Outside of this was moulded a thin cover of gutta percha. The ball, because of its long flight, soon took the place of the " gutty " and helped enormously to popularise golf.

Flexible, transparent " rubber glass " has been produced by Fordyce Jones through precipitating rubber from a solution vulcanised by a dual-gas process and obtaining a plastic mass which can be pressed or moulded after the manner of glass. Much progress in the decade 1915 to 1925 has been made in the production of rubber pavements. Their successful use on bridges, not only as a preventative of noise but to remove vibration, promises well for the future. Rubber and fibre soles and soles of crêpe rubber have found a very large market. The rubber heel has also largely displaced leather in medium and high-grade footwear.

Organic Accelerators in Vulcanisation.—The most striking progress in the art of rubber manufacturing, second only to the discovery of vulcanisation, has been achieved through the efforts of chemists to reduce the time required for vulcanising, while enhancing the quality and properties of the products. For two-thirds of a century workers in rubber were content with litharge and a few other mineral substances as curing-quickeners. In the early 'nineties, in consequence of attempts to vulcanise synthetic rubber, the unique value of various synthetic organic chemicals (mostly coal tar derivatives and related to organic dyes) as curing accelerators was revealed by Dr. David Spence and others. As compared with white lead, as used by Goodyear in 1839 and mentioned in his patent of 1844, and formulas which required from 5 to 15%, less than 1% of an organic accelerator would suffice and give both quicker action and better results. Since then their use has fairly revolutionised compounding and vulcanising.

The first mention of a nitrogenous or organic material for quickening vulcanisation occurs in a patent granted in England in 1881 to T. Rowley for the use of ammonia vapour: but no commercial use of an organic accelerator was made until 1906, when in the United States a typical one, aniline oil, proved of practical value. The successful use of piperidine by Dr. David Spence was announced in England early in 1912. Later in this year, after patents had been granted for numerous German preparations of this kind, organic accelerators began to be employed on an extensive scale. Since the World War, however, American organic chemical products have to a large extent replaced those of German manufacture.

The earlier theories advanced to explain the action of organic accelerators assumed that nitrogen was an indispensable constituent, and for several years preference was shown to those containing aniline (amino-benzene) or allied compounds; but the later and successful use of sulphur-bearing compounds led to a different conclusion. A now widely held theory is that velocity of curing is effected by an accelerator which first adds sulphur to itself, forming an extremely active polysulphide, the " super-sulphur " of which is, as soon as formed, shed to the rubber, speedily vulcanising the latter even at low temperatures.

M. André Dubosc, an eminent French chemist, after experiments with hexamethylene-tetramine (the drug urotropin, one of the amino group) which, like thio-carbanilide, is still one of the most widely used of accelerators, concluded that cyanhydric acid was the " active principle " which Dr. Spence had tried to determine; and that its practical effect was the transformation of ordinary divalent sulphur into hexavalent sulphur which could saturate three double bonds in the rubber molecule, while divalent sulphur would saturate but one bond in the same time. The theory is also applied to nitroso bodies, which during vulcanisation generate cyanic acid. The latter, reacting with sulphur, yields sulphurous anhydride and sulphocyanic acid; the latter dissociates and leaves hexavalent sulphur, and the liberated cyanhydric acid again functions as an accelerator.

Organic accelerators are commonly grouped into four classes: ultra rapid, rapid, moderate and slow. Of the first class, two groups are especially notable: *i.e.*, tetra-methyl-thiuram-disulphide, and the metallic salts of dithio-carbamic acid. The first is not only one of the most energetic cure-quickeners known, but is also a vulcanising agent. Using but 3% in a batch, with some zinc oxide as an activator, it will cure the rubber in 5 min. at 20 lb. of steam in the open, or in 10 min. at 60 lb. in a mould, either cure showing a tensile test of about 4,000 lb. per sq. inch. It is an oxidation product of dimethyl-amine and carbon disulphide, is non-poisonous, does not discolour fine stock, and delays ageing of the product.

The second group includes about 40 salts, largely substituted ammonium compounds, many of which are not only powerful cure-quickeners, but are also intense organic colouring substances. A typical accelerator of this group is piperidine penta-methylene-dithio-carbamate, which, with some zinc oxide, will vulcanise rubber in from 3 to 10 min. at 10 lb. of steam, or at room temperature in from 2 to 3 days. Organic accelerators with a wide range of uses and properties include para-nitroso-dimethyl-aniline, mercapto-benzothiasole, piperidonium-piperidyl-dithio-carbamate, di-o-tolyl-guanidine, diphenyl-guanidine, thiocarbanilide, hexamethylene-tetramine, alpha-phenyl-biguanide, quinodine, para-phenylene-diamene, aldehyde and furfural ammonia, hydroxy-quinoline, quinosol, alpha-naphthyl-amine, form-aldehyde aniline, triphenyl-guanidine, anthra-quinone, anti-pyrine, the toluidines, the xylidines, putrescin, bone oil, etc.

Vulcanisation.—Vulcanisation, or curing, is effected generally by either the heat cure or the cold cure. In the first named method either steam or heated air is employed. A wide range of rubber goods, either in moulds wrapped with strips of cloth, or imbedded in French talc to preserve their shape, is very efficiently cured with live steam in various types of vulcanisers. For many other needs the dry-heat cure, in which the goods are placed in a hot compartment without either wrapping or mould protection, has been found serviceable. Still another heat cure, now but little used, is that of solar-vulcanisation, whereby fabrics, coated with a thin skin of rubber, are exposed to the sun's rays. In very exacting work, such as the vulcanising of hard-rubber sheets, curing is effected by immersion in hot water. In the cold cure either the acid or the vapour process is employed. In the former, goods are dipped in solution of chloride of sulphur dissolved in bisulphide of carbon. In the latter, rubber goods are suspended in a heated compartment in which the fumes of chloride of sulphur pass freely over the surfaces to be vulcanised. The period of vulcanising ranges from a few minutes to many hours, depending on the degree of heat employed, the nature of the compound, the thickness of the goods, etc. The rate of cure, shown in England by Dr. Philip Schidrowitz, is affected by the amount of protein or nitrogen in the crude gum, its stay in storage, its density, the amount of smoke, formalin or other preservatives used, quantity of acid used in coagulating the latex, time in drying, age of latex yielding tree, etc.

Since Charles Goodyear (*see* 12.240) in 1839 discovered, and in 1844 patented, his process for vulcanising rubber with sulphur by means of heat, numerous attempts have been made to improve upon his method, but the bulk of the goods produced is still cured by the sulphur and heat method. In the long train of experiments, many of which have led to important results, the curing of rubber has been effected by the use of sulphates, sulphides, chlorides, nitrates, fluorides, bromides, iodides and phosphides of nearly all the common earths and metals, as well as chlorine, sulphurous acid and various gases. The Russian chemist, Ivan Ostromislensky, vulcanised rubber with trinitrobenzene and other nitro compounds, imparting all the

qualities given it by sulphur and effecting the curing more rapidly than with sulphur, with but one-twelfth of the material, and at a lower temperature. Victor Henri, a French chemist, also reported in 1909–10 that he had vulcanised thin layers of rubber solutions by means of ultra-violet rays. Similar researches along the same line have much scientific, if not practical, interest.

An important vulcanisation development is the cold, dual gas process of vulcanisation, devised by S. J. Peachey, the English chemist, in 1918, after an investigation of the behaviour of rubber towards the various allotropic forms of sulphur. Unlike the Parkes process, which yields an addition-product of both sulphur and chlorine, this leads to the formation without the aid of heat of a sulphur addition equal to that produced by the hot-curing process. By it rubber, alone or compounded with fillers and pigments, is exposed in a compartment successively to the action of two gases, sulphur dioxide for 10 min. and hydrogen sulphide for 30 minutes. Diffusing through the rubber and interacting, the gases produce an especially active form of sulphur capable of combining with and vulcanising the rubber at ordinary temperature, and more thoroughly than by either the hot process or the sulphur-chloride cure. A density is acquired, it is said, unattainable by the older methods. The dual gas treatment can be used either for rubber in its original solid form or liquefied with a solvent. When used in the latter form two separate solutions of rubber in benzol or naphtha are prepared, one containing sulphur dioxide and the other hydrogen sulphide; then both are mixed, effecting, among other things, the wet moulding of goods heretofore produced only by the dipping process.

In the two-solution process, as it is called, the gases effect a complete pectisation of the solution, forming a jelly which, on evaporating the solvent, is found to be fully vulcanised rubber. One of the advantages claimed for the two-gas process is that fabrics, as well as organic fillers, such as leather waste, sawdust, woodmeal, etc., that would be more or less scorched or decomposed by the hot cure or the sulphur-chloride cure, could be used with rubber or heavy reformed leathers, linoleums, etc. It may also effect a considerable improvement in the waterproofing of cloth. Rubber footwear, it is stated, may be produced by the new process without either the heat or pressure hitherto deemed essential, and without special machines for stitching and riveting, thus greatly cheapening the product. In a later cold vulcanised process devised by S. J. Peachey, rubber in solid, dissolved, or emulsified form, is treated with a mixture of sulphides of phosphorus in a solid state or in benzol, carbon disulphide, or other solvent.

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RUDDER: *see* FLETTNER RUDDER.

RUHR, the name given to a district of Westphalia, Germany, lying on the right bank of the Rhine and occupying roughly the lower basin of the river Ruhr (*see* 23.823).

Description and Production.—The Ruhr basin, which contains the important towns of Ruhrort, Düsseldorf, Duisburg, Essen, Bochum, Dortmund, Elberfeld, Gelsenkirchen and others, is the most important industrial district of Germany, or, in fact, of the continent of Europe. It is the heart of the German coal and metallurgical industry; the coke produced from Ruhr coal having peculiarly valuable metallurgical properties. The majority of the great German syndicates were formed and had their headquarters there, and the directors of heavy industry in the Ruhr—Krupp, Stinnes, Thyssen and others—controlled the economic destinies of Germany through their activities (metallurgy, coal, coal derivatives, chemical industry, dyestuffs, fertilisers, shipping companies, import and export of raw materials or manufactured foods). In 1913 the production of coal in the Ruhr was 115,000,000 tons out of a total for Germany of 191,000,000, which total was reduced by the loss of the Saar, Lorraine and Polish Silesia to 145,000,000. It produced 9,000,000 tons of cast iron, 10,000,000 tons of steel and a vast quantity of by-products.

Before 1918 the ores of Lorraine and the coke of the Ruhr were complementary, but, when Lorraine passed to France, the German ironmasters invested a great deal of the compensation paid them by the German Government in smelting works and blast furnaces duplicating those lost in Lorraine. At the same time they began to adapt Ruhr furnaces to the consumption of Swedish and other ores instead of those of Lorraine. The French thus saw the value of their newly acquired property in Lorraine threatened from two directions, especially as even without the duplication of plant in the Ruhr, the industry throughout the world seemed bound to suffer from overproduction for many years as a result of post-War impoverishment.

The French Occupation.—According to the Treaty of Versailles only the left bank and bridgeheads of the Rhine were occupied; but on March 8 1921 Ruhrort, Duisburg and Düsseldorf, on the fringe of the Ruhr, were occupied as a military sanction. This gave to French troops occupation both of important blast furnaces and of the parts of the Ruhr and the Rhine through which these were supplied with Lorraine ore.

On Dec. 26 1922, against the vote of the British member, the Reparations Commission declared Germany in voluntary default in respect of timber deliveries and at the Paris Conference of the Allies (Jan. 2–Jan. 4 1923), France claimed that under Clause 18 of the Treaty of Versailles this declaration of default entitled her to take separate action, whereas the British reading of the clause was different. Actually, however, the plan of "productive pledges" had long been cherished in France. M. Dariac, President of the finance committee, had previously laid privately before the French Chamber a report on the feasibility of this plan, which was supported by the majority of the French heavy industrials of the Comité des Forges. France also hoped by this action to assist her policy in the Rhineland

Mr. Bonar Law stated the British view that the French proposals were "likely to have a grave and even disastrous effect upon the economic situation in Europe," and the British Govt. could not therefore "take part in or accept responsibility for them."[1] Germany contended that the occupation constituted a breach of the Treaty of Versailles and a military invasion of a defenceless country in time of peace. She decided to oppose it by every means except armed resistance; subsequent events showed that there was no plan, methods of resistance being improvised as required. The temper of the population was such that the German Govt. required less to urge resistance than to deprecate violence.

The French concentration in Düsseldorf was met by a removal of the Kohlen-Syndikat with all its books from Essen to Hamburg, thus rendering it impossible for the French to obtain a comprehensive oversight of the intricate system of production and despatch of coal and coke over the network of railways and canals in the Ruhr. On Jan. 11, the first two divisions of French troops, preceded by armoured cars, light tanks and cavalry (together with Belgian troops) crossed the frontier and occupied Essen. The crowds were sullen and bitter, the French cold and determined, but correct. The Burgomaster struck the note that subsequently characterised the whole defence action by saying that he could not recognise the French commander's authority and would bow to force alone. The French declared officially that a peaceful mission of engineers had been despatched to Essen with a few troops to protect them. So great was the detestation of the Ruhr workers for militarism that no German troops had ever been stationed in the district; the men's leaders now declared that they would somehow make the French realise that bayonets were ill-adapted to coal-hewing.

Three days later the French occupied Buer, Bochum and Dortmund. The German Govt. prohibited any further reparation deliveries or payments to the invading powers. On Jan. 15 the first blood was shed when French sentries fired into a crowd, killing one man and wounding others. A military order to six directors of Thyssen's, Krupp's and other industrial concerns to deliver coal to France met with a refusal; the directors were arrested and tried by a court-martial which imposed heavy fines. Their return from Mainz to Essen provoked demonstrations of enthusiasm which the occupying powers could not suppress.

A short period of uncertainty followed. The French were taken

[1] *Miscell.* No. 3 p. 756 cmd. 1812 of 1923.

by surprise at the bitter resistance of the dour Westphalians. They occupied the state-owned mines and the Reichsbank branches, but the hostility of the workers and a financial panic led them temporarily to withdraw their troops. Partly owing to outside causes, but largely as the result of the occupation, the already depreciated currency began to plunge catastrophically; prices soared and fears of a blockade led to a rush on food shops.

German Resistance.—The French decided to break German obstinacy at all costs, but the more frequently the troops resorted to physical violence, the more resistance stiffened. The German police now became openly hostile; they were frequently arrested and severely handled or deported. Telegraph and telephone operators refused to work for the invaders, and the French occupied their offices, cutting off the civil population from this means of communication. The railwaymen, in accordance with the orders of their Government, also refused work, and, as troops occupied each station, went on strike, so that gradually all railway traffic ceased except for a few military trains. By the end of the month, not a single ton of coal had reached France, and the resistance only stiffened as the mass arrests and deportations of Germans began. By the end of the Ruhr struggle several thousand persons had been imprisoned and heavily fined, and some 140,000 men, women and children summarily deported at a few hours notice. Over one hundred Germans were killed by French and Belgian troops, who themselves lost about a score through German violence. Those imprisoned often suffered severely: there were many authenticated instances of brutal treatment, especially among those guarded by coloured troops or Separatists. (*See* RHINELAND.) Even where the French prison commandant was humane himself, the overcrowded state of the gaols inevitably made the punishment doubly severe, especially for men in high positions, as were so many of those condemned.

The German resistance aimed at putting the maximum difficulties in the way of the French, but it was realised from the first that time was on the other side. Huge sums were spent on strike pay for the railwaymen and later for the officials of the customs, taxation and forestry departments as these were seized by the French. The whole Ruhr industry—capital, masters and men—had to be indemnified during enforced idleness. Centres of resistance were formed outside the occupied zones by deported officials, secret telephone lines were kept working, courier services to avoid French postal espionage were organised and later employed to convey money when the French began to seize cash in the Reichsbank and elsewhere. Sabotage on the railways and canals began and, although the German Govt. denied responsibility, these acts of violence were certainly welcomed at one period.

The French countered with severe court martial sentences and local reprisals. Many persons were sentenced to death, and one was actually executed for an attempt to derail a coal train. Prominent citizens were forced to travel as hostages on French trains. Collective fines were imposed, and the "curfew" was applied to the towns near the scenes of attempted sabotages. Inhabitants had to be indoors with all windows closed from 4 or 5 P.M. till 6 A.M. Owing to the expulsion of the entire police force, the streets at night were exposed to the double danger of uncontrolled professional criminals and a nervous and irritated soldiery.

The French established a complete military and customs cordon, preventing first the export of coal, then of metals, and finally of all goods, offering to grant export permits on application and the payment of duties. This the German Govt. prohibited, and for many months practically no one applied, but with the lapse of time the French stranglehold began to tell.

German saboteurs, themselves liable to be shot at sight, retaliated from time to time, and several French sentries were killed and wounded. In April a detachment of French troops which had occupied a section of Krupp's works opened fire on a hostile crowd of workmen, killing 12 and wounding 30. The French declared that the directors were responsible, and subsequently sentenced Herr Krupp von Bohlen and four others to periods of from 10 to 15 years imprisonment. They were released after 8 months, however, as soon as the German heavy industry agreed to resume deliveries to the French on the collapse of German resistance. The widespread distress amongst the unemployed and hungry workers resulted in April and May in short-lived Communist control of one or two towns, the French standing aside. In June there was a serious German outrage, when 11 Belgian soldiers were killed by a bomb placed in a train by German saboteurs who escaped arrest.

Behind all this violence, French economic pressure slowly and at great cost began to show results. The railways were seized in the Rhineland and the Ruhr, and handed over to a Franco-Belgian "Régie" which kept a restricted railway service going with imported labour. Small quantities of coke were produced by French workers, and some of the coal accumulated at the pit-heads removed to France. The French issued a franc currency of their own, based on the Régie property. Large sums of money were confiscated and collected as fines, timber was cut down and exported and gradually a small number of merchants began to pay French export duties. No one was allowed to enter or leave occupied territory without a French permit, and finally the frontier was hermetically sealed. Newspapers were suppressed, and their editors deported.

The hopeless struggle continued for nearly 300 days; then the chaotic state of German finance made it impossible for Berlin to continue to supply funds; on Sept. 27 1923 Berlin stopped the Ruhr credits, and orders were given to cease passive resistance. The area was now financially and economically devastated. The German Govt., its currency practically worthless, refused to finance reparations deliveries, and the industrials, in order to export and keep their men working, were forced for a time to do so themselves. There was great distress, and serious industrial trouble in many towns. The French authorities nevertheless persevered in their policy despite the cessation of resistance, and their enterprises at last began to show considerable profits, although at the cost of serious damage to machinery, future production and Germany as a whole. But the French slowly realised that though German resistance was broken, they had not established a lasting system.

When M. Herriot succeeded M. Poincaré in May 1924, new methods were tried. The Dawes plan was adopted at the Conference of London in Aug. 1924 and preparations were immediately made to evacuate the Ruhr. By Nov. 15 1924 there was a total economic "evacuation" of the whole system of pledges, and all exploitation of the railways by the Régie came to an end. The military evacuation began in mid-July 1925; it was completed before Aug. 16. The three "sanction towns" of Düsseldorf, Duisburg and Ruhrort were evacuated on Aug. 25.

Balance Sheet of the Occupation.—The balance of the Ruhr occupation up to Jan. 1925, was estimated by the French and Belgian authorities as follows:—

Receipts	Gold Marks
Coal tax	129,000,000
Customs receipts	163,000,000
Licences and permits	101,000,000
Forests	27,000,000
Profits of railway régie	67,000,000
Passports and miscellaneous	3,000,000
	490,000,000
Expenses	
Costs of collection and administration	16,000,000
Costs of loading coal and exploiting mines	54,000,000
Military expenses (France)	95,000,000
Military expenses (Belgium)	19,000,000
	184,000,000

Credit balance 306,000,000 gold marks. In addition, France and Belgium obtained requisition and deliveries in kind to the estimated value of 491,900,000 gold marks.

Germany presumably reckoned her stubborn if unsuccessful resistance as a moral victory. The total cost of the occupation to Germany and thus indirectly to the world cannot be estimated. By Sept. 1923 German official figures estimated the approximate cost to Germany of the occupation at 3,500,000,000 gold marks. At this date it was unofficially estimated that France had lost about £40,000,000 worth of coal by her action. The great industrialists claimed compensation from the German Govt. amounting to 706,402,500 gold marks.

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RUMANIA (ROMÂNIA), a kingdom of southeast Europe and a member of the League of Nations (*see* 23.825) bounded west by Hungary, northwest by Czechoslovakia, north by Poland, east by Russia, southeast by Bulgaria, southwest by Yugoslavia. As a result of the Second Balkan War and the World War, Rumania has more than doubled in size, having incorporated the provinces of Southern Dobruja (from Bulgaria), Bessarabia (from Russia), the Bukovina (from Austria), Transylvania and parts of the Banat (from Hungary). The area is now 122,282 sq. m., the estimated population (1922) 16,250,000. This includes minorities, some being of very considerable size. They

are of German, Magyar, Ukrainian, Bulgar, Jewish and Gypsy nationality (*see* MINORITIES).

I. POLITICAL HISTORY

Internal Position in 1911.—Towards the end of 1911 the Liberal Ministry, now headed by J. J. Bratianu, was obliged to resign. Its last measures had been a law creating a supreme Consistory of the Church and the conclusion of a Convention with Austria-Hungary. Bratianu's successor was P. P. Carp, who on the death of G. Gz. Cantacuzene, had become head of the Conservative party. Among his colleagues in the new ministry were T. Maiorescu, N. Filipescu and the great lawyer and orator, B. St. Delavrancea.

When Parliament met, a campaign was opened against the new economic policy of the Liberals, which had been inspired chiefly by Vintila Bratianu, brother of the leader of the party, and aimed at combining the interests of private capital with those of communal and state capital in such great transport concerns as the electric tramways at Bucharest. The Liberal Opposition, numerically small, left the Chamber and combined with Take Jonescu, the creator of the new Conservative Democratic party, in a heated campaign for the overthrow of the Conservative Government. The Carp Govt. was reconstructed in April 1912 with Titus Maiorescu as Premier and Take Jonescu as the most important member of the Ministry.

The Balkan Wars.—In Oct. 1912 the Balkan League went to war with Turkey. Rumania, although she had not accepted military alliance with Turkey, was yet bound to Austria-Hungary by her adhesion to the Triple Alliance, and her sympathies were uncertain. She was therefore not taken into the confidence of the belligerents; in fact, Articles 2 and 3 of the Military Convention signed between Serbia and Bulgaria at Sofia (March 13) provided for mutual support in case either belligerent were attacked by either Austria-Hungary or Rumania. At first the Rumanian Govt. expressed *désintéressement* in events beyond the Danube; but the rapid successes of the Bulgarians at Kirk Kilisse (Oct. 23–4) and Lule Burgas (Oct. 28–Nov. 1) aroused uneasiness in Rumania and Austria-Hungary alike. Rumanian public opinion demanded "compensation" in case of a division of Turkey in Europe; and the Government let the Bulgarian Govt. know that some correction of the frontier in the Dobruja would be required. Danev, then President of the Bulgarian House of Deputies, appealed to Austria-Hungary, who was in the difficult position of wishing to secure both Rumania and Bulgaria for allies, and this step aroused anxiety in Rumania.

Danev then proceeded to Bucharest himself in Nov. 1912, where he offered to renounce forever Bulgaria's claims to the Northern Dobruja and to modify the existing frontiers by flattening out salient angles in favour of Rumania. No agreement could be reached. Immediately after Conrad von Hötzendorf, chief of the Austro-Hungarian general staff, was sent to Bucharest (Nov. 29 and 30) to attempt to arrange a modus between Bulgaria and Rumania, to calm Rumanian suspicions and to arrange a military convention between Rumania and Austria-Hungary. These moves were only partly successful. The conversations between Danev, Mişu and Take Jonescu were continued in London, but although Bulgaria was prepared to make concessions, no agreement could be reached as to their extent. At last the case was submitted to the Conference of St. Petersburg (May 17), which assigned Silistra to Rumania.

This arrangement, however, failed to satisfy the country. Carp, supported by Filipescu, was conducting a violent campaign against the Government, which was called upon either to resign or to declare war on the Bulgarians, and when Bulgaria suddenly attacked Serbia at the end of June, Rumania determined on military intervention. Russia advised in that sense, Serbia just then enjoying the support of the Russian Government. On July 10 1913 the Rumanian Army, 500,000 strong

crossed the frontier, occupying on one side the Southern Dobruja as far as Kavarna, and on the other side advancing upon Sofia by Vrattsa and Orkhanie. The exhausted Bulgarian soldiers deserted *en masse*, and the Rumanians sent them back to their homes. As the Rumanian troops, commanded by the Crown Prince, drew near the Bulgarian capital, the Tsar Ferdinand despatched a telegram to King Charles asking for peace. Negotiations were immediately begun at Bucharest, where an Armistice was signed on July 31 1913, between Rumania, Serbia, Greece and Bulgaria. The Treaty of Bucharest was concluded on Aug. 10; Rumania obtained the territory which she had already occupied in the Dobruja and her rights of protection over the Vlachs in Macedonia were recognised.

But the result of this was to render Rumania's position more uncertain than ever. She was bound to Austria-Hungary by her secret adhesion to the Triple Alliance of 1883; her General Staff made fresh arrangements with the Austro-Hungarian Staff as lately as 1912 for the event of war with Russia, and the secret Triple Alliance was renewed for the fourth time in Feb. 1914. But this friendship was largely personal to King Charles and all the efforts of the Central Powers—Francis Joseph's visit to Bucharest, and that of Francis Ferdinand to Sinaia, could not make the relationship cordial. The younger generation was utterly opposed to this policy for two main reasons: the resentment aroused by the Magyar oppression of the Rumanians in Transylvania and Austria-Hungary's diplomatic support of Bulgaria. The latter now had unfortunate results; Austria-Hungary made a diplomatic intervention in favour of Bulgaria at Bucharest; the Austrian Minister there, Prince Fürstenberg, presented a note from Count Berchtold in which the recently-concluded Treaty was referred to as a simple "preliminary arrangement." This conception was energetically rejected, as was that of calling an European Congress to settle Near Eastern affairs "definitely."

Rumania became therefore more and more convinced of the necessity of a national policy in the interests of the entire Rumanian nation, whether in the Kingdom or under Austro-Hungarian or Russian rule. She hoped that Russia would enable her to realise her ambitions; but the visit of the Rumanian heir to the throne to St. Petersburg (March 27 1914) and of the Tsar to Constanța (June 14 1914) did not bring about a definite change of orientation.

Rumania During the World War.—Maiorescu had renewed the Triple Alliance in Feb. 1914; and when the World War broke out, J. Bratianu, head of the Liberal party, had succeeded him with a long programme of reforms—foremost among them being an agrarian law based on the expropriation of the large landowners, and an electoral law establishing universal suffrage except for illiterates. Bratianu had never shown any intention of breaking with King Charles's policy, but in face of Italy's disclaimer of her obligations under the treaty, and Great Britain's declaration of war against the Central Powers, Charles I. and his advisers were forced to adopt the compromise of an armed neutrality. With the German check at the battle of the Marne, M. Take Jonescu passed from the first idea of "loyal neutrality" to that of intervention on the side of the Allies, and in this he was supported especially by the combative energy of Filipescu. The latter did not shrink from dividing his own party, opposing Alexander Marghiloman, who favoured the Central Powers, and, joining hands with his former rival, he effected a fusion with Take Jonescu. Meanwhile, Austria-Hungary and Germany concluded conventions by which Rumania was exploited to feed the population of the Central Powers. There were popular demonstrations against this policy, and Filipescu vehemently demanded rupture with Austria-Hungary. One great obstacle to this was removed by the death of King Charles on Oct. 10 1914.

The Bratianu Govt. continued to negotiate with the Central Powers, but modelled its attitude on that of Italy. When Italy declared war in May 1915, Rumania nearly followed her example; but she still hesitated. In 1916 the Western Powers overcame Russia's objections, and Great Britain, France, Russia and Italy signed a treaty on Aug. 17 1916, by which they guaranteed Rumania the Banat, Transylvania, the Hungarian plain as far as the Tisza, and the Bukovina as far as the Prut, in return for an immediate declaration of war. On the same day Russia and Rumania signed a military convention, Russia undertaking to unite with the Rumanian forces when they entered Transylvania, and to march in concert upon Budapest and also promising to send into the Dobruja troops sufficient to keep watch on Bulgaria. Rumania declared war on Austria-Hungary Aug. 27 1916. (For a fuller account of these negotiations *see* EUROPE, HISTORY.)

The Rumanian troops at once crossed the passes into Transylvania, but Germany began a strong counter offensive and had expelled them by mid-November. Bucharest was occupied on Dec. 6 1916. The army retired into Moldavia to reorganise there, sheltered by the Russian troops; the King, his Ministers and Parliament, had already retired to Jassy.

A counter offensive had begun in July 1917, when the defection of the Russians left Mackensen free to throw all his forces against the Rumanian army, which was rendered incapable of further resistance after the prolonged and glorious struggle of Măşăreşti in Aug. 1917. The Russian army disintegrated into pillaging bands; hostilities were suspended; and eventually it became necessary to submit to the Armistice imposed by the Germans at Focşani on Gen. Shtcherbachev, who had assumed the chief command on the Rumanian front over King Ferdinand's head (Dec. 6 1917).

Agrarian and Electoral Reforms.—Parliament had met at Jassy in Dec. 1916, and had determined to prosecute the war to a finish. Bratianu had formed a coalition with Take Jonescu and his section of the Conservative party. In April 1917 the agrarian question once more became urgent, largely owing to the effect on the public mind of the social revolution in Russia. In May direct and universal suffrage was introduced, raising the number of voters from 180,000 to over 1,200,000. Influenced by the Crown, the Conservatives in May 1917 at last accepted the radical policy of expropriation, to be applied to an area fixed at 2,000,000 hectares. A law was passed by a large majority on July 14, which left the original proprietors with a maximum of 500 hectares per estate (absentees being completely expropriated), and assigned them a compensation in State bonds, the amount not to exceed twenty times the value of the annual return from the property. A scheme for the communal holding by village associations of the land thus obtained was rejected in favour of traditional individual tenure.

The Union of Bessarabia.—On the break-up of the Russian empire, a "National Moldavian Committee" formed itself out of the Rumanian elements in Bessarabia (May 1917); in August the Ukrainian National Rada recognised Bessarabia as a separate unit. In Oct. a Supreme Council (Sfatul-Ţării) for Bessarabia was set up, the various nationalities being represented on it proportionately. On Dec. 17 this body proclaimed an independent Moldavian Republic, and invited Rumania to send troops into the country for its defence. Rumania took this step, partly in order to guard the large food depots which she had accumulated there. Russia protested, and a state of war existed between Russia and Rumania from Jan. 28 1918 till March 9, when an agreement was reached that the Rumanian troops should withdraw. On April 8, the Sfatul Ţării voted for political union with Rumania, Bessarabia, however, to retain a large degree of autonomy. The Central Powers sanctioned this arrangement by the Treaty of Bucharest to compensate Rumania for her other losses. No Russian Govt., however, admitted the validity of these arrangements, as the Rumanian troops had not been withdrawn as agreed, and the Ukrainian representatives of the Sfatul had abstained from voting.

The Treaty of Bucharest.—In face of the equal impossibility of either organising resistance or signing a treaty of renunciation, Bratianu resigned on Feb. 9 1918. Gen. Averescu was charged with the peace negotiations at Buftea, near Bucharest. Von Kühlmann advised that only economic terms be imposed; but Czernin, for Austria-Hungary, insisted on territorial changes. The Dobruja was ceded as far as the Danube, Bulgaria taking over the southern half which she had lost in 1913, while the

Quadruple Alliance administered the northern half conjointly. Rumania was to have a trade route to the Black Sea via Constanța. The Rumanian army was to be demobilised except for eight divisions. The frontier of Hungary was advanced in the Carpathians. The Central Powers secured such terms on the Danube, in the Rumanian oilfields and over the railways, as would have placed Rumania in a state of economic slavery to them for many years. Averescu's Cabinet hesitated to sign and resigned on March 12. Czernin, however, brought a personal message to the King that his dynasty would be endangered unless the peace were concluded. The Germanophile Marghiloman Ministry was appointed on March 18 and the Treaty was signed at Bucharest on May 7 1918.

Marghiloman's Ministry struggled against almost unsurmountable difficulties throughout the succeeding months. In the occupied territory everyone was snatching greedily at the remnants of national prosperity; the Central Powers forced the Banque Générale to issue no less than 2,500,000,000 lei in paper money, and disorganised the finance of the kingdom; while economic ruin was ensured by the exportation of sheep and cattle, the cutting down of forests and the dismantling of factories. The population meanwhile was starving, reduced to famine rations, and the morale of its working-class was being perverted by revolutionary propaganda.

Peace: the Formation of Greater Rumania.—On Nov. 8 1918, when the defeat of the Central Powers was assured, the King called to power Gen. Coandă, an old soldier who had already had diplomatic experience, with Gen. Grigorescu, to whom was due the chief credit for the stubborn resistance at Mărăşeşti, as Minister of War. Coandă repealed all laws introduced by the Marghiloman Ministry and decreed universal, obligatory and secret suffrage for all male voters over 21. The King re-entered Bucharest Nov. 30 after the German troops had evacuated Rumania under the terms of the Armistice. Bratianu again became Minister on Dec. 14.

The new Liberal Govt. had the extraordinarily difficult task of reuniting provinces which had been under the domination of different alien States, Bessarabia was already incorporated in the ancient kingdom, having abandoned the idea of autonomy. Her Council voted for unconditional incorporation on Dec. 9 1918. In Transylvania the Magyar administration throughout the war had ruthlessly oppressed the Rumanians, who formed the majority in the rural districts.[1] The prisons were filled with suspects, who were executed on the slightest pretext; a measure was framed to expropriate in favour of alien immigrants the widows and children of soldiers killed in action. When Vienna and Budapest repudiated the Hapsburgs, a great Rumanian assembly at Alba Iulia declared that Transylvania henceforward formed part of the kingdom of the United Rumanians but that they promised absolute national liberty to their Saxon and Magyar fellow-citizens (Dec. 1). The Saxons gave their adhesion at a meeting held at Mediaş, Jan. 21 1919; but the Magyar bishops, Catholic, Calvinist and Unitarian, did not take the oath of allegiance to King Ferdinand till 1921. A Council of Direction, presided over by Julius Maniu, formed a provisional Government. A general Assembly of the Rumanians in the Bukovina (who, however, by Austrian statistics, numbered rather under one-half of the total population) voted the union of their province with Rumania in a meeting held at Czernowitz, Nov. 28 1918.

During the first few months of its existence, the Liberal Govt. carried on difficult diplomatic negotiations for the recognition by the Allies of the new frontiers. Those fixed by the Agreement of Aug. 1916 were drawn back in places to give the Hungarians a part of the hinterland of Oradea-Mare, and the Yugoslavs the western half of the Banat. A line of demarcation was fixed in Hungary, and Rumanian troops occupied the country up to this line, pending final settlement by treaty. In March 1919 a further "neutral zone" was established and Rumania was given the right of occupying it. Bela Kun's Govt., which now came into power in Hungary, started a campaign, as a result of which the Rumanians advanced to the (Theiss) Tiza, where they were stopped by the Allies on May 9. On July 22 Kun started a new offensive; but the Rumanian army defeated his troops, crossed the Tiza—despite the interdiction of the Allies—and occupied Budapest on Aug. 4. Here they remained in the face of numerous protests until November 14. The Treaties of St. Germain and Trianon recognised as Rumanian the predominantly Rumanian territories of the old Dual Monarchy. Austria quickly agreed; but Hungary resisted till 1921, and Rumania was only able to demobilise in April 1921 (*see* HUNGARY).

Post-War Politics.—The Bratianu Govt. resigned on Sept. 13 1919 as a protest against Article 60 of the Treaty of Trianon (Minorities Clause), especially as two successive measures had already been passed granting full political rights to the Jewish population without distinction between old inhabitants and recent immigrants. New elections were held on Oct. 3 by a provisional "Ministry of Generals," presided over by Arthur Vaitoianu. They gave a large majority for the Peasant party, whose chief was the rural school teacher John Mihalachi, and the National Democrats; the Liberals now formed only one-fifth of the total number of Deputies; a certain number of Socialists made their appearance in this first Parliament of United Rumania. The majority parties coalesced as a *bloc parlementaire*, and on Dec. 9 1919 formed a democratic Government of advanced tendencies. The President was the Transylvanian Alexander Vaida Voevod, who at once visited Paris and London and obtained the formal recognition of a Rumanian Bessarabia.[2] Dr. Lupu was Minister of the Interior. During the Premier's absence, however, the landowners agitated against proposed expropriation, and the court and society felt alarmed at the Bolshevik propaganda. The Cabinet was forced to resign and Gen. Averescu became Premier (March 19 1920) with the support of the "League of the People" which he had founded in April 1917, an organisation which included many Conservatives and some new men. He also concluded a pact with Take Jonescu's Conservative Democrats. Elections were held early in June. Averescu's party won a large majority even in Transylvania. Take Jonescu became Minister for Foreign Affairs in his Government (June 21 1920).

The Averescu Government—The chief object of the Averescu Govt. was what it called "the re-establishment of order." In fact the Bolshevist danger continued on the Dniester, where a real revolutionary movement had been attempted at Hotin under the previous Government; the Soviet Russians no doubt had friends, not only in Bessarabia, but also in the "Ancient Kingdom" and the odious crime in the Senate[3] had shown to what lengths their fanatical ardour could go. It was thought necessary therefore to continue the régime of press censorship, and in May 1921, as the Communists had begun to hold a Congress at Bucharest, which seemed likely to be the beginning of fresh activities, the Minister of the Interior, who held proofs of their relations with the Third International of Moscow, had all the participants arrested and brought to trial, the trial being unduly prolonged. A law on workmen's unions, first of all received with noisy protests in working class circles, soon succeeded in securing agreement to accept State mediation between masters and men, and after that, thanks to a change of attitude on the part of the men, the number and importance of strikes diminished. But, up to the present, except for one school for apprentices, nothing was done for the instruction or education of the urban classes.

Agrarian Reforms.—At the same time the popularity of Gen. Averescu among the rural population forced him to carry through his agrarian reforms. The bill was only introduced in the spring of 1921, by the Minister of Agriculture, Garoflid, a big landowner, who belonged to the "progressive" party of the Germanophiles led by Marghiloman. This experienced economist would have

[1] According to the official Austro-Hungarian statistics of 1910, 2,948,186 in Hungary (Transylvania and the Banat); 275,088 in Austria (the Bukovina)

[2] (s. V. V. Tilea, Actiunea Diplomatica a României (Nov. 1919–Mart 1920), Sibiiu, 1925).

[3] On Dec. 9 1920 an infernal machine exploded in the Senate killing the bishop Radu, and mortally wounding D. Grecianu (the Minister of Justice) and another Senator.

liked a practical organisation of small holdings, giving land only to those who could ensure a good return, and guaranteeing a supply of rural labour to the remaining big estates. In the Chambers, composed of varied social strata and with cross-currents, but with a predominance of the Left Wing, the opposition of the Minister and the hesitations of the President of the Council had to be surmounted in order to secure decisions favourable to the peasantry in general. The principle was recognised that the break-up and distribution of the land was a reward for the sacrifices of the peasants during the war; on this basis several categories were distinguished, not always wisely. There were passionate discussions on purchase price, methods of payment and rights to the subsoil, of special importance in petroleum-bearing districts. The Right Wing of the party, which was a conglomeration kept together by the General's sole authority, was victorious. The State added to the sum to be paid by the new owner a payment to be raised from a special tax on new fortunes, and the subsoil was not allotted to the State, as the Left Wing wished. Later on regulations drawn up by the Liberal Minister of Agriculture were to change in many respects the enactments of the Garoflid law (*see* LAND TENURE).

Fiscal Reform.—After March 1921, before the solution of the agrarian question, the Finance Minister, Nicolas Titulescu (later Rumanian Minister in London), who was considered the eventual successor of Take Jonescu in the Democratic party, from which he was cutting loose at this time, introduced the bill on new taxation. The old taxes, a mixture of oriental features and modern innovations, were impossible. Public opinion demanded an energetic attack on ill-gotten gains, but their possessors had long since assured them against attack. The rural democracy opposed all burdens on the newly acquired small holdings, which were, and still are, badly consolidated. The Minister, who had his own point of view, favoured the French system of taxation, but had to take into account in his legislation all these interests and tendencies, and, while introducing some happy innovations on several points, certainly went beyond what could be carried out in the country.

Foreign Policy.—M. Take Jonescu gave Rumanian foreign policy a definite direction. Marriages were concluded between the Crown Prince and Princess Helen of Greece, March 10 1921, the Princess Elisabeth and the Crown Prince of Greece, Feb. 27 1921 and Princess Marie and King Alexander of Yugoslavia, June 6 1922.

Rumania and Poland were equally threatened by Russia, who had never recognised Rumania's right to Bessarabia, and seemed little satisfied with Poland's right to retain her White Russian and Ukrainian territories. Sapieha's journey to Bucharest brought the conclusion of the Rumanian-Polish Treaty (March 3 1921), which provided for mutual assistance in the event of an unprovoked attack upon either party on their eastern frontier; for common diplomatic action towards their eastern neighbours; and for a military convention. Rumania took cognisance of Poland's agreement with France, Poland of Rumania's agreements with other States for the maintenance of the Treaties of Trianon and Neuilly.

The last-named clause referred to Rumania's relations with the Little Entente. Czechoslovakia and Yugoslavia had already signed a convention for mutual protection against aggression by Hungary (Aug. 14 1920). Immediately after M. Beneš visited Bucharest (Aug. 19), with a view to including Rumania in the agreement. The Hungarian danger was common to all; but Take Jonescu would have desired a wider defensive alliance to include Greece and Poland, for mutual guarantee against any aggressor, including Russia or Bulgaria. The Russophil Govts. of Prague and Belgrade could not agree to this; but Rumania concluded a Convention with Prague for mutual protection against an attack from Hungary (April 23 1921) and with Belgrade against an unprovoked attack from Hungary or Bulgaria (June 7 1921). Since this date Rumania has formed a part of the Little Entente, and as such has taken part in its periodical deliberations, her Eastern policy being regulated by agreement with Poland (*see* POLAND, CZECHOSLOVAKIA and LITTLE ENTENTE). The dispute with Russia remained acute. At Geneva, to which the head of the Government went in person, and at Lausanne, where the Foreign Minister attended, the Bessarabian question was brought no nearer solution. Italy and Japan refused to vote the support which had been granted to the Vaida Government. During 1924 Russia kept up continuous agitation and threat of war; for three days in 1924 there was even a communist republic at Tatarbunar in South Bessarabia. A conference with the Soviet representatives held in Vienna (March 27 to April 2 1924) led to no result, although an understanding was reached at Cetatea Albă to prevent incursions of Bolshevik bands. The Russian danger continued to impose a heavy burden on Rumania.

The Bratianu Government.—From the beginning of the year 1921 the Liberals, who only had four representatives in Parliament, demanded power. A national festival was organised on the occasion of moving the ashes of J. C. Bratianu, the great Minister of King Carol. Great popular demonstrations, artificially promoted, were organised to show the King that the party had regained its popularity among the rural masses.

On the occasion of a vote on a mining concession in the Banat, a concession later on repudiated by the Liberal régime, the entire opposition left the Chamber not to return. The new session of Parliament was opened, Nov. 1921, with bad prospects for the Government. The King formally demanded a détente; Gen. Averescu took offence. Take Jonescu took power (Dec. 17). During Dec. he made efforts to gain a majority. Only the Nationalist Democrats gave him unreserved support; the Transylvanian party voted for him when it came to the decisive moment. But his old associates dominated Parliament; on the re-opening of the session a vote of confidence in the Democratic leader was rejected (Jan. 17 1922).

A coalition ministry was expected, as an outcome of the struggle against the Averescu Govt.; it would have united the Liberals, the Transylvanians, part of the Bessarabians (except the powerful Peasant party) and the Bukovinians, and had also the support of the Nationalist Democrats who had considered Take Jonescu's advent to power as an intermediate solution. However, after indecisive discussions on the division of candidatures, the King was forced to accept M. J. J. Bratianu, as he was convinced of the necessity of retaining in political life this Liberal party of the bourgeois Right Wing, and preferred unity of direction which had been so much insisted on (Jan. 19).

The head of the new Government believed he had a mission to save the country, and a right to the exceptional measures of a dictatorship, and at the same time proposed to strengthen his party so as to avoid in future such bad luck as that through which it had lately passed. The elections were forced and he, owing to his personal unpopularity, was opposed by the People's party, the popular Transylvanians, the Peasant party and the Nationalist Democrats. The opposition parties declared the Parliament illegal and all legislation passed by it null and void in their eyes, and abstained from voting. A party administration took office almost at once. The brother of the president of the council, M. Vintilă Bratianu, was entrusted with the task of re-establishing order in the finances, which were endangered by the quantity of Treasury bonds and unfunded loans.

The Coronation and the Constitution.—But at the same time M. J. J. Bratianu thought it necessary to give the country the imposing ceremony of the coronation of the King and Queen, which had already been prepared for by the preceding Government, and to draw up a constitution. On Oct. 15 1922, Ferdinand I. and Queen Mary assumed the crowns of United Rumania at Alba-Iulia, without the presence of any representative of the party which had given the kingdom this beautiful province. The proposed constitution was only introduced in the spring of the following year, in the Chambers which had no legal right to adopt it. The new law of the Constitution, debated by the Nationalist Democrats only, and with reservations, was adopted March 28 1923. It was only a reproduction of that of 1866, with the addition of the election of deputies by universal suffrage, with a vague right of representation of electoral minorities,

and adding to the Senate the old dignitaries and members of Parliament and representatives of the Chambers of Commerce and Agriculture. The subsoil and forests were nationalised. The admission of Jews to citizen rights was incorporated in the Constitution, but open competition with the newcomers provoked violent trouble in the universities, which was exploited by politicians whose ambitions had not been satisfied, and still continues. A local government law followed tradition, as did also educational reform. In agrarian affairs, in labour questions, in military matters, and above all in foreign affairs, there were no innovations. In the financial sphere the position was long maintained of isolation towards foreign capital; the attempt to commercialise properties and State enterprises did not succeed.

The Opposition was systematically divided, indeed this was the basis of a policy which disdained popular support and showed itself indifferent to Parliamentary criticism. However, at one time the Transylvanians and the Peasant party seemed to have united; then having abandoned united action, the former joined the friends of Take Jonescu, who died on June 21 1921. In 1924 M. Argetoianŭ, the leading member of the Averescu Govt., separated from the General, and joined the Nationalist Democrats. In March 1925 this Nationalist-Popular party united with the Transylvanian party and became the National party. The new party came to an understanding with the Peasant party and the allies gained a great victory in the elections for the Chambers of Agriculture in August.

The Opposition, which had long been so sterile, was thus becoming formidable. In June 1924 a mass meeting of peasants under Averescu demonstrated in the streets of Bucharest, and a tumult was feared. The same year saw a number of financial scandals in the Liberal party. The Opposition coalition produced a programme based on fulfilment of the wishes of the peasants and the national minorities, the abolition of arbitrary government and a new financial policy.

It was generally believed that the long government was coming to its close. It had had its faults—notably its doctrinaire opposition, almost up to the last, to the competition of foreign capital, which was only admitted under irritating restrictions to the exploitation of the oilfields. None the less, it had helped to consolidate the financial position of the country. The Opposition of the National and Peasants' parties abandoned the violent attacks which they had commenced in May and June in view of the approaching end of the régime, while the People's party negotiated with the Liberals in the hope of forming the next government with their support. Nevertheless M. J. J. Bratianu wished to carry his reforms through to the end. The law for the unification of the Church had already been passed, introducing the Transylvanian system of elective councils for each parish, each diocese and for the religious life of the country in general. In the autumn he put forward an Education Bill which was attacked, not only by the national minorities, but even by the Rumanian opposition parties because it infringed on the liberty of private, religious and national education by imposing on it too strict state control.

The Crown Prince Charles.—At the end of Dec. the heir to the throne, the Crown Prince Charles, who had done much for his country by his "institute" of national propaganda, and by his expert advice in military and especially aeronautical matters, left Rumania under circumstances which permitted his enemies to unite against him. At Venice he renounced all his rights, including that of bringing up his little son Prince Michael, and repeated his intention of disassociating himself from his country. Meanwhile, a crown council had met at Sinaia. The King insisted that the party leaders recognise the situation created by the Prince's action. There were some doubts expressed as to the advisability of this measure, but the decision which the Sovereign took on Dec. 31 was not to be shaken. On Jan. 11 1926 the Chamber of Deputies and the Senate met to discuss the new situation regarding the succession to the throne. Gen. Averescu voted for the government plan; the real Opposition abstained from voting. A provisional Council of Regency was immediately formed consisting of the Patriarch Miron Cristea, the President of the Supreme Court of Appeal, Buzdugan and Prince Nicholas, the second son of the King, who was recalled from England where he was studying. The King's recent very serious illness had necessitated this measure.

The Parliamentary Situation.—When the Chambers reassembled, Bratianu forced through an electoral law of the Fascist type. The version presented to the Senate was much more liberal. Any party which received 40% of the total votes cast, the other votes being divided among several political bodies, was rewarded with half the number of seats, without counting what it got on the scrutiny (March 1926). In holding local elections in Feb., the government had believed that it would secure a basis which would enable it to continue in power. It was undeceived. Almost all the large towns voted for the Nationalist and "Peasant" Coalition, which had been joined by Averescu's party. In the country the government machinery was able to prevent the Opposition candidates from coming forward, and the government lists were declared elected in three thousand rural communes. Nevertheless, Bratianu saw that he must retire. Consultations which the King held at the end of March with the Opposition leaders looked as if they would end by forming a National or National Peasant Govt. in accordance with the results of the last election. This would have corresponded to the parliamentary situation. The King, having demanded a ministerial coalition of the three groups, asked for a list for each group. Although the Nationals and Peasants had presented a common list under the presidency of M. Maniu, one of the leaders of the National party, the King entrusted Averescu, who had been joined by the small Progressive group with the task of forming a government.

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(N. J.)

II. DEFENCE

Military service in Rumania is universal and personal. All Rumanians, without distinction of race, language or religion, are liable to service. The duration of service is for 29 years between the ages of 21 and 50, divided as follows: Two years in the regular army, or three years in the navy; 18 years in the reserve and nine years in the militia. On completing 19 years of age, young men are liable to be called up for preparatory training. Certain classes of persons are exempted from service for social reasons, and volunteers are also allowed.

The Army is organised in 7 army corps and 1 corps of mountain light infantry. It consists of 66 regiments of infantry (168 battalions, each with a machine-gun company); 1 regiment of tanks (2 battalions); 20 regiments of cavalry (12 regiments Red Hussars, 7 regiments Black Hussars, 1 regiment Royal Escort); 21 regiments (144 batteries) of field artillery; 4 regiments (96 batteries) field howitzers; 2 groups (6 batteries) horse artillery; 2 brigades (18 batteries) mountain artillery; 4 groups (8 batteries) mountain howitzers; 14 groups (42 batteries) heavy artillery. Besides these "normal" batteries there are special and heavy batteries. There are 6 battalions railway engineers, 2 signal, 2 bridge, 1 motor transport, 4 pioneers, 2 mountain pioneers.

The air force consists of 3 groups of scouting planes, 2 of fighting, 1 of service, 1 of naval; 1 balloon group and 1 air defence regiment. The aeroplanes in use are of very various types. The effectives of the air force (1925) were: 487 officers; 518 re-engaged; 3,450 men; total, 4,455.

The navy consists of a Danube Division with 7 monitors, 7 patrol boats, auxiliary and minor vessels, a land river defence force with mine-laying groups and coastal artillery; a naval river base, including wireless stations and a naval arsenal; and a Maritime Division, consisting of a maritime naval force (2 destroyers, 6 torpedo boats, 5 gunboats, etc.), a land maritime defence force (coast battery, mine-laying group), base and training school. There is a corps of frontier guards, consisting of 20 battalions; and a corps of gendarmes with 14 battalions. The budgetary effectives in 1925 were: officers, 12,344; re-enlisted 10,509; N.C.O.s and men, 116,974; civil servants employed by the army, 3,342. The defence expenditure of the Ministry of War in 1925 was 4,324,650,000 lei, of which 3,853,638,000 were for the Army; 120,619,000 for the Navy; 349,489,000 for the Air Force; and 908,000 for the Army Endowment Fund Expenditure on frontier troops as charged to the Ministry of Finance. Arms and munitions were up to 1925 generally bought in foreign countries; but it was proposed to establish a large munitions factory in Rumania which should cover the requirements of her fighting forces.

III. ECONOMIC AND FINANCIAL HISTORY

Area and Population.—The peace settlement after the World War more than doubled the area of Rumania and nearly doubled the population which is predominantly rural. The total area of the country and the population are distributed as follows:—

	Sq. Km.	Population
Moldavia	38,058	2,233,556
Muntenia	52,505	3,485,859
Oltenia	24,078	1,484,706
Dobruja	23,262	693,190
Bessarabia	44,422	2,344,800
Bukovina	10,442	811,721
Banat	17,980	910,393
Crishana	17,086	1,145,113
Maramuresh	8,592	466,956
Transylvania	57,819	2,685,833
	294,244	16,262,127

Agriculture.—The 23,737,420 hectares of Rumanian agricultural and forest land are used as follows:—

	Hectares	Per Cent of Total
Arable land	11,731,420	49·4
Meadowland and pastures	4,278,659	18·0
Forests	7,241,720	30·2
Trees, shrubs and bushes (including vineyards)	485,248	2·4

Before the War Rumania was still a country of great estates and one of the great wheat-exporting countries of Europe. The peasants were emancipated in 1864, and from time to time distributions of crown land were made, but in insufficient quantities to satisfy the general land hunger. The distribution of arable land in 1905 is given as follows by Mr. Sisešti Jonescu:—

Size of Holdings	Area in hectares	Percentage of total area	No. of landowners
Under 10 ha.	3,153,645	40·29	920,939
10–100 ha.	862,800	11·02	38,723
100 ha. and over	3,810,351	48·69	5,385
	7,826,796	100·	965,047

Distribution was equally unsatisfactory in the newly acquired provinces of Bessarabia and Transylvania, but in Bukovina the peasants already held a considerable share of the land. The pledges given by the Constituent Assembly of 1917 for the division of the land were fulfilled in Agrarian laws for Bessarabia, 1920; for the old Kingdom of Rumania, 1921; for Transylvania and Bukovina, 1921. The Rumanian law provided for total expropriation of landlords resident abroad, foreigners, corporate bodies and for partial expropriation of resident large owners.

THE PROGRESS OF EXPROPRIATION TO NOV. 15 1924.

	Old Rumania.	Transylvania.	Bessarabia.	Bucovina.
Hectares expropriated	2,708,462	1,580,777	1,491,920	73,495
Number of persons still entitled to receive land	599,529	530,694	—	36,800
Number of persons who have received land	413,932	335,073	357,016	19,166
Area in hectares allotted to the latter	1,396,665	411,022	1,098,045	11,440
Communal pasture lands (hectares)	476,348	338,268	—	7,058
Communal forest lands (hectares)	—	218,697	—	—
Reserve—general—(hectares)	80,659	58,840	102,977	7,573
Reserve for districts (hectares)	201	—	—	—
Reserve for Communes (hectares)	42,253	—	—	—
Forests allotted to the State (hectares)	3,006	—	198,405	—
Balance to be distributed	710,330	556,950	—	53,423
Unproductive lands	not ascertained.	not ascertained.	92,493	not ascertained.

The thousands of peasants who took over the land in the first years of the agrarian reform were unskilled in management, inadequately organised on the co-operative side, and lacked machinery and capital. The immediate results of the land reform were a large reduction in the output of wheat and cereals, and a diminution of production generally. The changes in production are shown by the following table:—

In thousands of metric tons				
	1919	1924	1925	Pre-War Averages (Estimate for Present Territory)
Wheat	1,797	1,916	2,850	4,574
Rye	338	151	203	524
Oats	528	610	740	1,504
Barley	786	670	1,019	1,457
Maize	4,142	3,949	4,159	5,912

Rumanian economists are inclined to believe that the division of the land will lead to ultimate increased total production, but not necessarily to the resumption of the pre-War production of wheat. The peasants grow more maize and fodder crops for use on the farm, and individual households consume more. Another reason for the decrease in the cereal export (wheat was actually imported in 1924) is that, whereas Old Rumania was a compact agricultural country, Greater Rumania includes industrial and mining districts which absorb some of the food products formerly exported.

A useful index of the prosperity of Rumanian agriculture is the number of animals maintained. The figures are as follows, but account must of course be taken of the change in frontiers:—

	1911	1920	1925
Cattle	2,667,000	4,730,000	5,399,000
Sheep	5,269,000	8,690,000	13,612,000
Pigs	1,021,000	2,514,000	3,133,000
Horses	843,000	1,485,000	1,845,000

Rural Co-operation.—With the post-War law giving the land to the peasants the rôle of the co-operative societies was changed. The whole organisation had been destroyed by the German Occupation, and it was necessary to begin to build *de novo*. The Central Credit Bank has a capital of 12,000,000 lei, of which two-thirds were found by the State. The nominal capital was increased in 1923. The rural societies provide the peasants with seeds, machinery, etc., and in many cases make arrangements for the collection and export of produce. There were at the end of 1924 over 2,500 societies, with 236,713 members.

Mining.—The chief mineral wealth of Old Rumania lay in the rich petroleum deposits. In 1913 Rumania produced 1,885,000 tons of petroleum, standing fourth in the rank of petrol-producing countries. In the autumn of 1916 an Allied Mission, acting in concert with the Rumanian Govt., put the fields out of action in order to prevent the exploitation of the wells by the Germans. Production fell to 517,000 tons, but by 1925 was restored to 2,316,000 tons (provisional figure), considerably higher than the pre-War figure. This progress was made in spite of heavy restrictions placed on the industry by the imposition of maximum prices in Rumanian markets. A decision of Dec. 15 1923 removed the maximum price limitation and restored freedom to export, subject to an export tax, all petroleum products except crude and residues. The industry was affected by the new Constitution voted in March 1923, Article 19 of which nationalised subsoil rights, though existing rights were respected. When new oil-bearing land is to be exploited permission must be obtained from the Government. In theory 60% of the capital in an industrial enterprise must be Rumanian and there must be a certain percentage of Rumanians on the Board. Rumanians must be employed in all industrial concerns, and if foreign labour is imported, cause must be shown. The majority of the big foreign companies conformed to this ruling, and have found that in practice the new system works reasonably smoothly.

The other principal mineral products are coal, natural gases and salt. The coal supply was formerly insufficient to meet requirements, and supplies were imported, chiefly from Poland. The output of the coal mines is, however, steadily increasing and at the beginning of 1924 the State Railway authorities decided not to purchase any foreign coal. In 1925 the Govt. imposed a high import duty to prevent the import of coal. They were probably influenced in this decision by the continued increase in the supply of petroleum residues which are largely used by the railways.

According to the figures of the Ministry of Industry and Commerce the annual coal output for the years 1922 to 1924 was as follows:—

	1922	1923	1924
	Metric tons	Metric tons	Metric tons
Lignite of 3,000 to 7,400 calories	1,861,579	2,229,410	2,479,083
Stone coal and anthracite of 6,000–8,000 cal.	254,642	291,983	297,288
Total	2,116,221	2,521,393	2,776,371

With the annexation of Transylvania, Rumania acquired the coal, iron, gold, silver, lead and copper mines of that province. The whole of the ore is handled in the three metal works owned by the State. The development of these mines is delayed by the lack of coking coal.

Trade.—The three principal exports from Rumania are cereals, petroleum products and timber. Quantities for the years 1921 to 1924 show a gradual improvement.

(In metric tons, 000's omitted)

	1921	1922	1923	1924	1925
Cereals	1,579	1,278	1,845	1,414	845
Petroleum Products	362	436	403	436	783
Timber [1]	..	1,793	2,225	2,483	2,467

[1] Total not available.

Other exports are hides, wool, vegetable oils, wood manufactures, fruits, etc. The principal imports are manufactured goods (a large part of which are textiles), colonial produce and chemicals. The complete breakdown in the export of wheat in 1924–5 was only temporary and was due to the peasants holding their stocks in anticipation of a rise in prices which did not occur (in fact the world price of wheat fell), to lack of transport and to the increased home consumption and high export taxes already mentioned. In view of the low figure of export trade in 1925 the export taxes were heavily reduced in 1926.

Taking only imports for domestic consumption and exports of domestic produce, Rumania showed before the War a large favourable balance of trade, due to the wheat export. In the years immediately following the War the balance was adverse, but the tide turned in 1922 and the monthly averages after that date indicate the recovery she made, which, however, saw a setback in 1925.

Monthly Averages of Imports and Exports
(In thousands of lei)

	Imports	Exports
1921	1,012,093	682,051
1922	1,027,114	1,169,941
1923	1,626,336	2,050,872
1924	2,182,704	2,318,633
1925	2,501,511	2,383,928

Finance.—The fundamental factor in foreign exchange in Rumania is the grain harvest and the facilities for moving it, for the lei with which Rumanian merchants can purchase foreign goods are the profits on the cereal export. There was much headway to make up, owing to the devastating effect of the German occupation and the temporary chaos in agriculture which followed the expropriation of the large estates. The financial position was made more difficult by the expenses incurred by the invasion of Hungary in 1919 and by the large expenditure on armaments due to Rumania's political situation, and especially to the refusal of the Soviet Govt. to agree to the Rumanian status of Bessarabia. During the occupation the Germans issued some 2½ milliards of lei; they also secured large sums of Rumanian gold by the sale to the peasants of goods, especially sugar, of which there was a great scarcity. Under the peace treaty Germany was to repay her various depredations, but it was eventually agreed between the two Govts. that the demand should be met in part at least by the delivery of locomotives and other goods. On taking over her new territories Rumania also had to take over 8½ million Austrian kronen and 2 milliards of Russian rubles. Further, at the time of the German invasion the bullion of the National Bank, with much private property in jewels and treasure, was sent to Moscow for safety. This property, valued at 315,000,000 lei gold, is estimated as irrecoverable. The decline in the value of the leu was rapid between 1918 and 1922, during which period the amount in circulation increased from 2½ milliards to 15 milliards. The decline in the value of the leu, normally equivalent to the franc, during this period is shown in the following table:—

Mean Rate to the £ Sterling

1919	79	1922	673·16
1920	203·41	1923	948·75
1921	329	1924	896·75
1925	1,008·25		

There was a further subsidence of the exchange in the early months of 1926 owing to the reduction in the grain exports for 1925. The decline in the external value of the leu was much greater than the decline in the internal purchasing power. Large stores of goods (British, French, Italian, Swiss) were sent to Rumania because of this difference of absorption at one period, with the result that the adverse balance was increased.

In 1921 a Government commission considered the question of the exchange. Many decrees were issued, and restrictions imposed, but they proved ineffective. M. Titulescu sought to bolster up the exchange by (1) new taxation, (2) Govt. control of the cereal harvest, and by holding a balance in Paris for purchase of lei offered at low prices. Early in 1923 a Rumanian delegation visited London and Manchester, and came to agreements with British private creditors on liabilities contracted by Rumanian traders since the War. An arrangement was also reached with French creditors.

In 1925 new decrees were issued. The restrictions on the export of wheat and barley were removed. An effort was made to stop inflation. The Rumanian budget had been balanced in 1922. Inflation for the purpose of balancing the budget was now declared to be illegal. The Treasury was to pay the National Debt by yearly instalments, to pay the 11 milliard's owing to the National Bank by yearly instalments of about ¾ milliard lei, and the Bank was to buy gold with the State payments thus made to back the currency. Finally, the Bank was to have power to establish a Mint, and was granted the privilege of issuing currency for a period of 30 years. The capital of the State Bank was raised to 100,000,000 lei gold, to permit the participation of the State to the extent of 33,300,000 lei. The effectiveness of these steps is shown by the following budget estimates for the years 1924, 1925 and 1926:—

(In millions of lei)

	Revenue	Expenditure	Surplus
1924	24,000	22,642	1,358
1925	31,750	31,750	..
1926	29,250	29,250	..

Communications.—A large part of Rumanian trade is carried on the Danube. The main communications of Rumania converge on Braila and Galatz. Rumania receives two-thirds of her imports from the industrial countries of Europe from the Danube river ports, and from those ports are loaded not only Rumanian produce, but the produce of other riparian States from Czechoslovakia downwards conveyed to these ports by river craft. Galatz is the principal port for timber export, Braila for cereals, vegetables, petroleum products, etc. Constanţa is the only Rumanian port open all the year round. For the international régime of the Danube *see* DANUBE. The incorporation of the new provinces, whose communications were naturally directed chiefly to serve the States to which they formerly belonged, have made new railway communications essential to the development of Rumanian trade and industry. A new line from Oradia Mare to Arad obviates a detour through Hungarian territory. New lines, the surveys for which were provided for by credits voted on July 7 1923, are Brasov-Nehoias; Ilva-Mica-Vatra Dornei; Bumbesci-Livezeni; Hamangia-Tulcea. The first of these provides a direct route from Brasov to Constanţa; the second will give a direct connection between the Bukovina and Transylvania; the third will traverse the Vulcan pass, and permit the easy transport of coal from Petrosani to Craiova. Other work in hand includes the transformation of the Bessarabian railways to the normal gauge and the proper linking up of Bessarabia with Danube ports. Before the War the outlet for Bessarabian produce was Odessa and a necessary condition for Bessarabian prosperity under the new conditions is the provision of an easy outlet from Danubian ports.

The railways would be adequately supplied with railway stock, locomotives and rolling stock having been taken over from the Central Powers, if repairing shop accommodation were sufficient. A large part of the reduction in export is due to the condition of the railways which delays the shipment of grain from the interior to the ports, and the development of Rumania depends to a considerable extent upon the improvement of her communications.

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RUMANIAN LITERATURE (*see* 23.844).—The revival of Rumanian literature dates back to about the middle of the 19th century, when, owing chiefly to the awakened interest in Percy's *Reliques*, the poet V. Alexandri published his collection of folk poems—*Ballades et chants populaires de la Roumanie* (1855).

This, together with the *Old Chronicles* (1845), edited by Michail Kogâlniceanu, constituted a living monument of the vernacular. Their importance as an inspiring and stimulating power to the new writers was fully appreciated by Titu Maiorescu, who became the leading critical spirit in Rumanian letters.

Under Maiorescu's influence a group of national writers gathered round the newly founded periodical *Convorbiri Literare*. Among them were I. Creangă, who in *Amintiri din Copilărie* ("Recollections of Childhood") and other tales fresh with many idiomatic expressions embodied the spirit of the Moldavian peasantry; I. L. Caragiale, who, besides a realistic drama and two volumes of short stories and sketches of unsurpassed craftsmanship, showed in his comedies *Scrisoarea din Urmă* (The Lost Letter) and *Noaptea Furtunoasă* (Stormy Night) (*Collected Works*, 1908) the grotesque effect resulting from a hasty introduction of Western manners into a society still stamped with an oriental character; and above all the poet Eminescu. What a magic there was in his verse! The words linked together as by a strange chance, simple in appearance, but suggestive, suffused with emotion, creating a new music of their own, and apt to express—what had seemed impossible with a language as yet rather uncultivated—the highest thoughts that ever beset a great spirit. He has often been compared with Leopardi, on account of a profound, penetrating, overwhelming note of sadness, which affected all his successors, not excepting Al. Vlahutză, a poet with a strong individuality of his own. But there is another side to Eminescu—his broad conception of the Rumanian race. It was this that impressed writers of the later generation such as Prof. Iorga, who, in his *Istoria Literaturii Romîne in secolul al XVIII. lea, 1688–1821*, etc. (1901), arrived at a clearer understanding of what a national literature may be. In his own weekly, *Sămănătorul*, as well as in such other periodicals as *Convorbiri Literare*, under the editorship of Prof. Mehedintzi, *Luceafărul* and *Viața Românească*, was first published almost all the modern writing which artistically reflects the deeper characteristics of the Rumanian people.

A corner of the humble life of Banat is described in Ión Popovici-Bănătseanu's short story, *In Lume* (Out in the Worlds); the romantic Vlach population scattered throughout the mountainous parts of Macedonia, Epirus and Thessaly is represented in Marcu Beza's volume of short stories *Pe Drumuri* (1914) (On the Roads) and his novel, *O Viață* (1921) (A Life). Transylvania has produced the poets G. Coşbuc, Octavian Goga, Stephen Josif. The first-named started a reaction against the pessimism of Eminescu by singing joyfully in rich cadences of everyday peasant life. Goga's poetry, being essentially of an irredentist character, has burned out its flame, its stirring power, in the realisation of national aspirations; but there are still in his second volume *Ne Cheamă Pământul* (The Land Calls On Us), a number of poems imbued with a deep, enduring humanity. He seems for the present lost to poetry, having turned his talent to the writing of vigorous, fiery leaders in his own weekly *Țara Noastră* (Our Country), the name of which speaks clearly of its tendency. To the gentle pen of Josif, a Transylvanian of Vlach paternity, are due the best renderings into Rumanian of Shakespeare's *Midsummer Night's Dream* and Shelley's *To a Skylark* in *Tălmăciri* (1923). It is from the English masters of song, chiefly from Keats, that another poet, P. Cerna, absorbed and made his own that power of soaring to the higher realms of imagination. His untimely death was a great loss to Rumanian literature, as in profundity he ranked next to Eminescu.

During this period public interest in Rumanian authors was awakened, so that even the national theatres of Bucharest, Jassy and other towns were able successfully to produce plays inspired directly by Rumanian history and folklore; such as Barbu Delavrancea's trilogy, *Apus de Soare, Luceafărul, Viforul*—Sunset, The Evening Star, The Storm—in which a strong Shakespearean influence could easily be detected. Victor Eftimiu's poetic excursion into fairyland, *Insiră-te, mărgăritel*, 1911 (String Ye Pearls!) is founded on a popular Rumanian tale; so is Adrian Maniu's versified drama *Meşterul*, 1922 (The Masterbuilder).

Returning to fiction, one has to mention first of all I. Al. Bratescu-Voinesti. In 1925 he was awarded the great prize of the Rumanian Academy, a well deserved recognition of his work, which, though small in output—comprising only two volumes of short stories, *In Lumea Dreptății* (In the World of Justice) (1908) and *In Tuneric și Lumină* (Darkness and Light) (1912) is remarkable for its delicate blending of humour and subdued pathos. Duiliu Zamfirescu in a series of three novels on *Din Viața Comăneştilor* (*The Life of Comăneşti*) shows how the kind, God-fearing old boyar gradually disappears, and his place is taken by unscrupulous adventurers of no definite race or religion. Liviu Rebreanu's novel *Ion* (1921) deals with the peasants' love of the land, amounting sometimes to greediness, and fraught consequently with great calamities; it has rather impressed the public by its size, as it appeared in two large volumes, an unusual thing in Rumanian literature. Micheal Sadonuvea is undoubtedly one of the most prolific writers. He published many books of short stories and narratives, his last, *Venea o Moară pe Siret* (1925) ("A Mill on the Siret"), being considered the best. It really gives a vivid insight into the countryside, and one meets now and again with masterly descriptions, which, however, through their profusion, overshadow in a way the movement of the characters. The World War does not seem to have either altered or much inspired literary production. An attempt to depict the general spirit during the German invasion of Rumania was made in a novel, called after the national colours, *Roşu, Galben și Albastru* (1925) ("Red, Yellow and Blue") by I. Minulescu, known as a disciple of the French symbolists. From the same school proceeded likewise a younger poet, Ion Pillat, who in his *Satul meu* (1925) ("My Village") manifests a definite return to the Rumanian tradition.

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RUNCIMAN, WALTER (1870–), British politician, was born at South Shields Nov. 19 1870, the son of Sir Walter Runciman, 1st Bart., a Newcastle shipowner. He was educated at Trinity College, Cambridge, and afterwards joined his father in his shipping business, being from 1896 to 1905 managing director of the Moor Line of cargo steamers. In 1898 he unsuccessfully contested Gravesend in the Liberal interest, but was elected for Oldham in 1899, although he only held the seat for a year. In 1902 he stood successfully for Dewsbury, and retained this seat until 1918. In 1905 he entered Sir Henry Campbell-Bannerman's Govt. as parliamentary secretary to the Local Govt. Board. He became financial secretary to the Treasury in 1907, president of the Board of Education in 1908, and was president of the Board of Agriculture from 1911 to 1914. From 1912–4 he was also Commissioner of Woods and Forests, and from 1914–6 president of the Board of Trade. On the formation of Mr. Lloyd George's Ministry in 1916 he retired from the Government. In 1920 he unsuccessfully contested North Edinburgh and in 1924 was returned for Swansea West. He was an active member of the Radical group formed within the Liberal party, and was thus opposed to the leadership of Mr. Lloyd George. (*See* LIBERAL PARTY.)

RUNNING: *see* ATHLETICS.

RUPERT (1869–), German prince, the eldest son of King Louis III. of Bavaria, was born May 18 1869 at Munich. In 1906, after extensive travels in India and elsewhere, he was appointed to the command of the I. Bavarian Army Corps. At the outbreak of the World War he was commander of the Bavarian troops (the VI. German Army) and led them to victory in the great battles fought in Lorraine (Aug. 20–2 1914). In the following Oct. he was placed in command on the German front in Artois and southern Flanders, and, after having been advanced to the rank of field-marshal, was entrusted in the spring of 1917 with the chief command of the northern group of armies on the Western Front. In 1900 he married Marie Gabriele, a sister of the Queen of the Belgians; she died in 1912; and in 1921 he married Princess Mitonia of Luxembourg and Nassau.

Through his mother, the Archduchess Maria-Thérèse of Austria-Este, Prince Rupert was the descendant of the Stuart Kings of England and, according to legitimist ideas, in the succession to the British crown. (*See* FRONTIERS, BATTLES OF THE.)

RURAL LIFE.—During the period 1910–26 much has been done in Great Britain to bring to the villages some of the amenities of the town, also to arrest the depopulation of the rural districts.

Women's Institutes.—The Women's Institute movement came to Great Britain from Canada, where Women's Institutes had been in existence for some 25 years, and where their organisation promoted War-time economies and food production and preservation. Mrs. Alfred Watt, who had long been associated with the Canadian movement, had come to England in 1913 to interest Englishwomen in the movement. In Feb. 1915 the Agricultural Organisation Society realised its possibilities in rural England.

The first Women's Institute in Great Britain was founded in Wales at Llanfairpwll in Sept. 1915; the first in England at Wallisdown in Nov. of the same year. In Jan. 1925 there were 3,476 Women's Institutes in England and Wales, with a total membership of over 206,000, and the number was growing steadily. In 1917 the Board of Agriculture became responsible for the propaganda of the Women's Institute movement, as part of the work of the Women's Branch of the Food Production Department. In 1919 the Women's Institute became completely independent, though representatives of the Ministry of Agriculture continued to serve on its executive committee. The importance of the movement lies not so much in the fact that it has given country women a new interest in life, or even that it has set a remarkably high standard in handicraft, as that it has broken down much of the old isolation of village life.

Women's Institute members form a fellowship from which no woman is excluded by creed or politics, and the habit of meeting together monthly to discuss questions of interest to them as individuals and as members of the community is leading to a sense of the power of co-operation which seems likely to go far. Already certain institutes have taken up such questions as water supply, the preservation of footpaths, disposal of rubbish and housing; and on more than one occasion an intelligent district council has sent to the institutes for comment on the plans of cottages they were about to erect, so that the women who would do the work of those houses had a chance to express an opinion on them before they were built. A new sense of public service and a new spirit in local government are slowly making themselves felt which may do much to breathe new life into parish and district councils. Moreover, the linking together of village to village in groups and in county federations, and of county to county in the National Federation, bids fair to give a stability to this movement which has been lacking in previous efforts to develop the social, educational and recreational side of village life, excellent as many of these have been.

Village Clubs.—An attempt to do something of the same sort for men was made, after the War, by the Village Clubs Association, but did not prove successful. Certain parts of the work it had set before it were, however, being carried out by other organisations. Nothing was more striking after the War than the marked increase of interest in adult education (*q.v.*). An interesting experiment in linking together educational and social work from the elementary school to advanced classes for adults, and including the provision of playing fields, is at work under the auspices of the County Council at Sawston in Cambridgeshire.

Rural Community Councils.—A tentative effort to establish closer co-operation between the various statutory and voluntary agencies was made in Oxfordshire in 1920, when a rural community committee was formed, consisting of representatives of voluntary societies interested in educational and social development throughout the country, and of the County Council. Simultaneously, and independently, Nottinghamshire was beginning to move in the same direction. Since then rural community councils have been formed in Kent, Nottinghamshire, Derbyshire, Leicestershire, Gloucestershire, West Sussex, Hertfordshire, Cambridgeshire, Hampshire, Somerset, Forfarshire; and other counties are in process of forming such bodies. These councils not only pool information, and as far as possible resources, thus enabling villages to obtain lectures, concerts, dramatic entertainments and other such things much more surely and economically than could otherwise be the case, but in certain cases they have taken active steps with regard to questions of public health and of rural industries. A further development has been the formation of village community councils on similar lines to the rural community councils. These do not in any sense replace the parish council, but aim at bringing together all sections of village life.

There has been a great increase in the number of village halls during the post-War period. Many have been put up as War memorials, and many have been provided by the village as a whole, not by individual donors. Boy Scouts, the Church Lads' Brigade and Young Farmers' Clubs are all attempting to deal with various aspects of the problem; but it remains to be seen if agriculture can provide adequate counter attractions to town life.

In music, drama and folk dance special efforts are made to cater for the intellectual needs of the villagers. Thanks to the enlightened policy of the Carnegie United Kingdom Trust, in every English county but two, rural libraries have been established, and visits from the village, country town and school concert parties, and from the Arts League of Service, bring music and drama to country audiences. Even more significant is the work of the English Folk Dance Society, the Village Drama Society and the music competition festivals, which are helping villagers themselves to develop artistic expression.

Wireless is in its infancy, and its influence in bringing isolated people into touch not only with music but with great national and political events through the broadcasting of speeches cannot yet be estimated. It undoubtedly suggests great possibilities which as yet are realised only to a very slight extent.

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RUSSELL, BERTRAND ARTHUR WILLIAM (1872–), British mathematician and philosopher, grandson of the first Earl Russell (Lord John Russell) and brother and heir of the second Earl Russell, was born at Chepstow, Monmouthshire, May 18 1872. He became a scholar, and subsequently a fellow, of Trinity College, Cambridge, and with peculiar lucidity propounded the theory of Neo-Realism. During the World War Mr. Russell twice infringed the emergency regulations, was for some time in prison, and was deprived of his fellowship in 1916. Thereafter he lectured and wrote on the major questions of metaphysics without the support of academic authority. He travelled through China and Bolshevik Russia and unsuccessfully contested the Chelsea constituency in the Labour interests. His most important works are: *Principles of Mathematics* (1903); *Principia Mathematica*, in which Prof. A. N. Whitehead collaborated (1910); *Mysticism and Logic* (1918); *The Analysis of Mind* (1921); and two books of popular exposition, namely the *A. B. C. of Atoms* (1923) and the *A. B. C. of Relativity* (1925).

Mr. Russell has been peculiarly successful in eliciting from comtemporary physics those theorems that are most nearly consonant with his temper. He began by trying to impose upon psychological and metaphysical speculation the orderly logic of pure mathematics. As time went on, he came to despair of a successful issue, and in his later work admits that neither materialism nor idealism can wholly satisfy him. He has therefore tried to formulate a neo-realism, the substance of which is the existence of some primary stuff neither mental nor material. But

temperamentally he is a desperate man, loving extremes, and too many of his speculations are deliberately intended " à épater les bourgeois." His works on Russia *The Practice and Theory of Bolshevism* (1920) and China, *The Problem of China* (1922) deepen the impression made by his works on general philosophy. He is, essentially, an intellectual, who believes that the truth may be acquired by well disciplined ratiocination, but does not believe that the Governments of the world, whether despotic or democratic, will ever attain to the perception of truth. Therefore he is a deliberately lonely figure, almost querulously criticising the world's workings, ever ready to champion unpopular causes, slow in accepting any " fait accompli." He has with some justice been called a Huxley who has not found his Darwin. In collaboration with his second wife, Dora, daughter of Sir F. W. Black, he wrote *The Prospects of Industrial Civilization*, 1923. (*See* KNOWLEDGE, THEORY OF; RELATIVITY.) (H. C. HA.)

RUSSELL, GEORGE WILLIAM (1867–), Irish writer and painter, known as Æ, was born at Lurgan, Co. Armagh, April 10 1867. Educated at Rathmines School, Dublin, he entered an accountant's office, but in 1897 joined the Irish Agricultural Organisation Society, and became an organiser of agricultural societies. From 1904 to 1923 he was editor of *The Irish Homestead*, the organ of the agricultural co-operative movement in Ireland. In 1923 he was appointed editor of *The Irish Statesman*, which post he still held in 1926.

Russell's publications include *Homeward: Songs by the Way* (1894); *The Earth Breath* (1897); *Literary Ideals in Ireland* (1899), a collection of essays written in collaboration with W. B. Yeats, W. Larminie and John Eglinton; *Ideals in Ireland* (1901), another book of collaborative essays; *The Nuts of Knowledge* (1903), a selection of lyrics. In 1904 appeared two books of verse, the *Divine Vision* and *New Poems*, an anthology of verses by young Irish poets; and a collection of mystical tales, *The Mask of Apollo*. Other books of verse include *By Still Waters* (1906), *Collected Poems* (1913), and *Gods of War* (1915). *The Hero in Man* (1909) and *The Renewal of Youth* (1911) were imaginative musings, as was *Imaginations and Reveries* (1915). In 1906 appeared *Some Irish Essays*, and in 1907 *Deirdre*, a three-act play. *Co-operation and Nationality* and *The Rural Community*, published in 1912 and 1913 respectively, were pamphlets embodying co-operative ideals, which are further developed in his *The National Being: Thoughts on an Irish Polity* (1917). *The Candle of Vision*, an attempt to discover the element of truth in the mystical imagination, appeared in 1918. This was followed by *The Interpreters* (1920), a symposium in the Platonic fashion in which world politics are related to motions in the *anima mundi*. A volume of poems, *Voices of the Stones*, appeared in 1925.

RUSSELL, ISRAEL COOK (1852–1906), American geologist (*see* 23.862), died at Ann Arbor, Mich., May 1 1906.

RUSSELL, WILLIAM CLARK (1844–1911), British author (*see* 23.865), died at Bath Nov. 8 1911.

RUSSIA (*see* 23.869), now officially known as the Union of Socialist Soviet Republics (U.S.S.R.) The territory of Russia just before the War consisted of about 22,000,000 sq. km., 25.4% of which lay in Europe, 74.6% in Asia. The War reduced Russian territory in Europe, partly by adding parts of it to existing States, but more especially by the creation of new States out of the territory of the former Russian Empire. As a consequence of the separation of Finland the formation of Estonia, Latvia, Lithuania, Poland, the absorption by Turkey of the pashalik of Kars and the occupation of Bessarabia by Rumania, Russia lost 804,000 square kilometres. The whole territory of the Union of Soviet Socialist Republics is now about 21,200,000 sq. km. (8,108,387 sq. m.) with a population of 139,700,000. (For Asiatic Russia *see* SIBERIA).

The Union of Soviet Socialist Republics (U.S.S.R.) according to the constitution of 1923 and subsequent additions, consists of six independent republics as follows: the Russian Soviet Federal Socialist Republic (19,700,000 sq. km.), the Ukrainian S. S. Republic (400,000 sq. km.), the White Russian S. S. Republic (100,000 sq. km.), the Transcaucasian Soviet Federal Socialist Republic (200,000 sq. km.), the Turkoman Soviet Socialist Republic (200,000 sq. km.) and the Uzbek Soviet Socialist Republic (331,900 sq. km.). Some of these are again federations in their turn.

I. DIVISIONS OF THE SOVIET UNION

The following is a complete list of the territorial divisions of the U.S.S.R. with their capitals as they existed in 1926.

THE WHITE RUSSIAN SOVIET SOCIALIST REPUBLIC
CAPITAL—MINSK

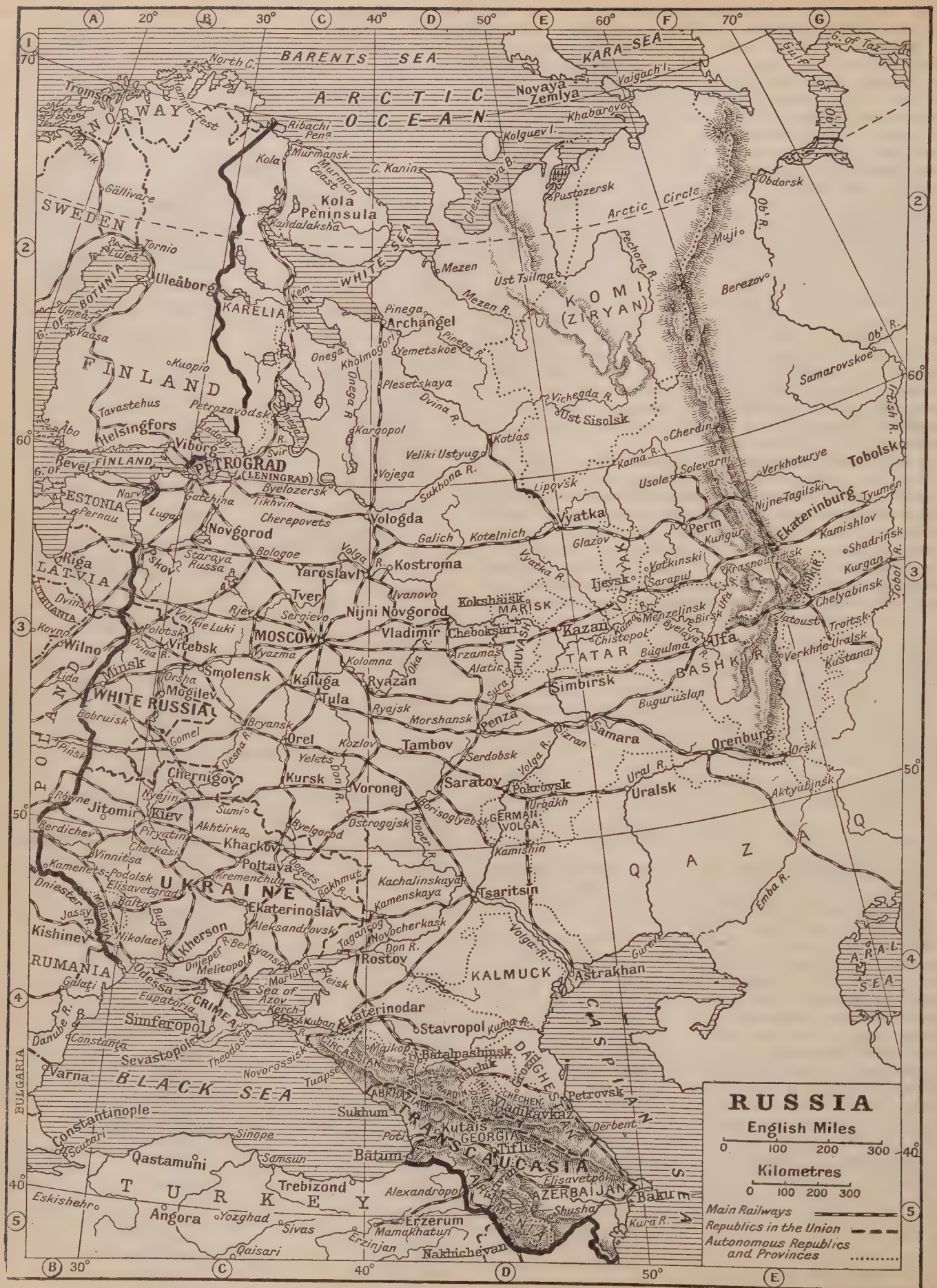
Province	Administrative Centre	Province	Administrative Centre
Minsk	Minsk	Mogilev	Mogilev
Slutsk	Slutsk	Kalininsk	Klimovichi
Mozir	Mozir	Orsha	Orsha
Bobruisk	Bobruisk	Vitebsk	Vitebsk
Borisov	Borisov	Polotsk	Polotsk

TRANSCAUCASIAN SOCIALIST FEDERAL SOVIET REPUBLIC
CAPITAL—TIFLIS

Constituent Republics	Capital
1. Azerbaijan Soviet Socialist Republic	Baku
(*a*) Nakhichevan area	Nakhichevan
(*b*) Nagoini Karabakh	Khan-Kendi
2. Armenian Soviet Socialist Republic	Erivan
3. Georgian Soviet Socialist Republic	Tiflis
(*a*) Abkhazian (autonomous Republic)	Sukhum
(*b*) Adjarian (autonomous Republic)	Batum
(*c*) Southern Ossetian (autonomous region)	Tskhinvali

RUSSIAN SOCIALIST FEDERAL SOVIET REPUBLIC

Province	Capital
Altai	Barnaul
Amur	Blagoveschensk
Archangel	Archangel
Astrakhan	Astrakhan
Bryansk	Bryansk
Vladimir	Vladimir
Vologda	Vologda
Voronej	Voronej
Vyatka	Vyatka
Gomel	Gomel
Grozni (a town with Provincial Status)	
Yenisei	Krasnoyarsk
Transbaikal	Chita
Ivanovo-Voznesensk	Ivanovo-Voznesensk
Irkutsk	Irkutsk
Kaluga	Kaluga
Kamchatka	Petropavlovsk-Kamchatski
Kostroma	Kostroma
Kursk	Kursk
Leningrad	Leningrad
Moscow	Moscow
Murmansk	Murmansk
Nijegorod	Nijni-Novgorod
Novgorod	Novgorod
Novo-Nikolaevsk	Novo-Nikolaevsk
Omsk	Omsk
Orlovsk	Orel
Penza	Penza
Perm	Perm
Primorsk	Vladivostok
Pskov	Pskov
Ryazan	Ryazan
Samara	Samara
Saratov	Saratov
Sverdlovsk	Sverdlovsk
Severo-Dvinsk	Veliki-Ustyug
Severo-Kavkaz (Region)	Rostov-on-Don
Smolensk	Smolensk
Tambov	Tambov
Tver	Tver
Tomsk	Tomsk
Tula	Tula
Tyumen	Tyumen
Ulyanovsk	Ulyanovsk
Tsaritsin	Tsaritsin
Chelyabinsk	Chelyabinsk
Cherepovets	Cherepovets
Yaroslavl	Yaroslavl


BARENTS SEA
KARA SEA
ARCTIC OCEAN
NORWAY
SWEDEN
FINLAND
ESTONIA
LATVIA
LITHUANIA
POLAND
WHITE RUSSIA
RUMANIA
BULGARIA
TURKEY
BLACK SEA
CASPIAN SEA
ARAL SEA
UKRAINE
KAZAKH
KOMI (ZYRYAN)
KARELIA
KALMUCK
GERMAN VOLGA
TATAR
BASHKIR
MARISK
CHUVASH
GEORGIA
ARMENIA
AZERBAIJAN
TRANSCAUCASIA
CRIMEA
Arctic Circle
Murmansk
Archangel
Petrograd (Leningrad)
Moscow
Kostroma
Yaroslavl
Nijni Novgorod
Vladimir
Kazan
Ufa
Vyatka
Perm
Ekaterinburg
Tobolsk
Samara
Orenburg
Saratov
Voronej
Kursk
Orel
Tambov
Penza
Simbirsk
Tula
Kaluga
Smolensk
Ryazan
Vologda
Novgorod
Tver
Vitebsk
Minsk
Wilno
Riga
Helsingfors
Viborg
Reval
Kharkov
Poltava
Kiev
Jitomir
Chernigov
Ekaterinoslav
Kherson
Nikolaev
Odessa
Simferopol
Sevastopol
Kishinev
Rostov
Stavropol
Ekaterinodar
Astrakhan
Tsaritsin
Uralsk
Orsk
Chelyabinsk
Kurgan
Tyumen
Berezov
Obdorsk
Archangel
Kola Peninsula
Novaya Zemlya
Vaigach I.
Kolguev I.
Pechora R.
Ob' R.
Yenisei R.
Lena R.
Volga R.
Don R.
Dnieper R.
Dniester R.
Danube R.
Kama R.
Ural R.
Caspian Sea
Aral Sea
Lake Baikal
Sea of Azov
Black Sea
Constantinople
Angora
Erzerum
Batum
Baku
Tiflis
Kutais
Petrovsk
Derbent
Astrakhan
Kalmuck
Gulf of Ob
Gulf of Taz
Tromsö
Narvik
Luleå
Gällivare
Tornio
Uleåborg
Vasa
Åbo
Kuopio
Tavastehus
Petrozavodsk
Onega
Kholmogori
Pinega
Mezen
Kem
Kola
Murmansk
North C.
Ribachi Pen.
C. Kanin
Cheshskaya B.
Pustozersk
Khabarovo
Obdorsk
Berezov
Samarovskoe
Tobolsk
Ust Tsilma
Ust Sisolsk
Vichegda R.
Dvina R.
Plesetskaya
Kargopol
Onega R.
Vologda
Veliki Ustyug
Vojega
Sukhona R.
Kotlas
Lipovsk
Vyatka
Kotelnich
Galich
Glazov
Kama R.
Cherdinsk
Solevarni
Usole
Verkhoturye
Nijne-Tagilski
Ekaterinburg
Votkinski
Ijevsk
Sarapul
Kungur
Krasnoufimsk
Kamishlov
Shadrinsk
Kurgan
Tobol R.
Ishim R.
Irtish R.
Ob' R.
Menzelinsk
Birsk
Ufa R.
Kama R.
Chistopol
Cheboksari
Kokshaisk
Nijni Novgorod
Volga R.
Oka R.
Sura R.
Vyatka R.
Kama R.
Bugulma
Bugurslan
Buguruslan
Troitsk
Verkhne-Uralsk
Kustanai
Aktyubinsk
Orsk
Samara R.
Ural R.
Volga R.
Pokrovsk
Urbakh
Kamishin
Serdobsk
Borisoglyebsk
Morshansk
Ryajsk
Kozlov
Velets
Bryansk
Orel
Desna R.
Don R.
Oka R.
Moscow
Vyazma
Kolomna
Arzamas
Alatir
Sergievo
Rjev
Velikie Luki
Polotsk
Dvina R.
Kovno
Lida
Orsha
Mogilev
Gomel
Pinsk
Bobruisk
Smolensk
Kaluga
Tula
Ryazan
Vitebsk
Minsk
Wilno
Riga
Pernau
Narva
Luga
Gatchina
Tikhvin
Byelozersk
Cherepovets
Novgorod
Staraya Russa
Bologoe
Volga R.
Yaroslavl
Tver
Ivanovo
Galich
Kotelnich
Vyatka
Perm
Kungur
Glazov
Votkinski
Ijevsk
Sarapul
Kokshaisk
Nijni Novgorod
Vladimir
Cheboksari
Kazan
Ufa
Chistopol
Menzelinsk
Birsk
Ufa R.
Kama R.
Byelaya R.
Bugulma
Bugurslan
Buguruslan
Troitsk
Verkhne-Uralsk
Kustanai
Aktyubinsk
Orsk
Chelyabinsk
Kurgan
Tobol R.
Ishim R.
Irtish R.
Ob' R.
Samarovskoe
Tobolsk
Berezov
Obdorsk
Muji

Autonomous Areas within the R.S.F.S.R.	Capital
Adigeisko-Cherkess	Krasnodar (Temporary)
Votsk	Ijevsk
Ingush	Beslan
Kabardin	Nalchik
Kalmuk	Astrakhan
Qara-Qirghiz	Pishpek
Qara-Qalpak	Turtkul
Karachaevo-Cherkess	Batalpashinsk
Komi (Zirian)	Ust-Sisolsk
Marisk	Krasnokokshaisk
Oirat	Ulala
Northern Ossetian	Vladikavkaz
Chechen	Grozni
Chuvash	Cheboksari

Autonomous Socialist Soviet Republics within the R.S.F.S.R.	Capital
Bashkir	Ufa
Mongol-Buryat	Verkhneudinsk
Daghestan	Buinaksk
Karelian	Petrozavodsk
Qirghiz	Orenburg
(*a*) Adaev County with status of Province	Aleksandrovsk Fort (Uritsk)
(*b*) Akmolinsk Province	Petropavlovsk
(*c*) Aktyubinsk Province	Aktyubinsk
(*d*) Bukeev	Urda
(*e*) Kustanai	Kustanai
(*f*) Orenburg	Orenburg
(*g*) Semipalatinsk	Semipalatinsk
(*h*) Uralsk	Uralsk
Crimea	Simferopol
German Volga	Pokrovsk
Tatar	Kazan
Yakutsk	Yakutsk

TURKOMANISTAN SOVIET SOCIALIST REPUBLIC CAPITAL—POLTORATSK

UZBEK SOVIET SOCIALIST REPUBLIC
CAPITAL—SAMARQAND

Province	Capital
Bukhara	Bukhara
Samarqand	Samarqand
Tashkent	Tashkent
Khwahrezm	Khwahrezm
Ferghana	Khoqand
Tajikstan (Autonomous Soviet Socialist Republic)	Dyushambe

UKRAINE SOVIET SOCIALIST REPUBLIC
CAPITAL—KHARKOV

Province	Capital
Volhynia	Jitomir
Donets	Bakhmut
Ekaterinoslav	Ekaterinoslav
Kiev	Kiev
Odessa	Odessa
Podolsk	Vinnitsa
Poltava	Poltava
Kharkov	Kharkov
Chernigov	Chernigov
Moldavia (Autonomous Soviet Socialist Republic)	Balta

(X.)

The above table is derived from Russian official sources.

II. HISTORY TO THE REVOLUTION

The Last Years of Tsardom.—The transition from an autocratic to a constitutional régime was rendered especially difficult in Russia by the lack of political education among the people, the doctrinaire fanaticism of the intellectual leaders and the selfishness of the Government. The First Duma had ended in a vain attempt to appeal to the country against the Government.

The Stolypin Ministry, which was formed in 1906, started with a programme of co-operation between the Government and "leaders of public opinion," and it sought an agreement with the more moderate sections of Liberals, especially with the Octobrists, the supporters of a policy aiming at putting into practice the manifesto of Oct. 1905. The failure of this attempt is a fact of historical importance in so far as it showed conclusively how irreconcilable the tendencies of the imperial bureaucracy were with the programme of moderate Liberalism. P. A. Stolypin was as fine a representative of Old Russia as the governing class of the time could muster—not a great statesman nor an original thinker, but a fearless, patriotic gentleman with practical experience in provincial administration, accessible to ideas of reform, but constitutionally adverse to radical theories.

The repression of revolutionary attempts and of agrarian revolts was taken in hand with ruthless energy, and it succeeded in driving discontent underground and in re-establishing external order, but it cast its shadow on the constructive work of Stolypin's statesmanship. After the clash with the intractable Second Duma the electoral system was altered by the manifesto of June 3 1907.

This *coup d'état* secured to the Government a numerical majority in the Third and in the Fourth Dumas, while at the same time it weakened the moral authority of these assemblies and made the Moderates more susceptible to the appeals of the Lefts.

In spite of the outward pacification of the country there was no real settlement, and the flames of political passion burst out occasionally with ominous violence. The close of 1910 was marked by an increased agitation among the students—the most sensitive and audacious element of Russian society. Harrowing tales of flogging and tortures practised on political convicts in the prisons of the North and of Siberia had reached the educational centres, and a series of strikes and indignation meetings began in all the various high schools of the empire. The reactionary bureaucrats, however, with M. Kasso, the Minister of Public Instruction, at their head, decided to use these sad occurrences in order to overthrow the self-government of the universities, conceded to these institutions by the Imperial *ukaz* of Aug. 27 1905. M. Kasso issued decrees ordering the establishment of a strict régime of official inspection, the closing of students' unions and societies with the exception of the scientific ones, and, eventually, the direct interference of the police for the maintenance of order within the universities and high schools. In Moscow the Rector (Prof. Maniulov) and his assistants declared that they could not assume responsiblilty for the carrying into effect of the ministerial measures; they were deprived of their chairs; 63 professors and lecturers tendered their resignations as a mark of sympathy with their dismissed comrades. This did not disturb the minister in the least, and he promptly accepted most of the resignations, although this involved the intellectual ruin of the oldest and most famous university of Russia. The "Pride's Purge" in Moscow was followed by a number of dismissals in other educational establishments. The unsparing scourging of the academic corporations produced the desired effect of outward submission, but it brought the feelings of hatred and humiliation among the intellectuals to the highest pitch, and the outcasts and convicts of the university "stories" afterwards formed the principal contingent among the embittered intellectual leaders of the revolution.

Another sign of the times may be discerned in Stolypin's legislation in respect of the Zemstvos of the western provinces (Kiev, Volhynia, Podolia, Mogilev, Minsk and Vitebsk). The introduction of a measure of local self-government would have been in itself a boon to the population of these provinces, but Stolypin made it an occasion for a renewed humiliation of the non-Russian nationalities, strongly represented in these districts. The project of the Government disfranchised the numerous Jewish population, and drove the Poles into a position of inferiority by dividing the electorate according to national colleges and establishing beforehand the preponderance of the Russian colleges by means of an artificial scheme of repartition. The unfairness and political short-sightedness of these restrictions provoked a strong opposition even in the docile Third Duma.

In the Council of the Empire a coalition between the Rights and the Lefts led to the rejection of the bill. Stolypin did not submit in the face of such an assertion of independence. He prorogued the Duma for three days (May 14–17), and in the interval obtained an Imperial decree promulgating the law as an emergency measure on the strength of Art. 87 of the Organic Laws. In consequence of this snub administered to the Legislative Assemblies, the Octobrist Centre could no longer support

the Government; the leader of the Octobrists, A. Guchkov, resigned the presidentship of the Duma, and votes of censure on the Government were passed in both Houses on the resumption of their sittings. Stolypin's position was made untenable by these events. His victories meant in truth the breakdown of his programme. The Premier had again to rely exclusively on the goodwill of the autocratic Tsar as against independent public opinion, and he had to strive for that goodwill in the enervating and treacherous surroundings of Court intrigue, in which obsequious chamberlains were more expert and successful than himself.

The *coup de grâce* came from the midst of the secret police, that had become the mainstay of the Imperial system in its struggle against growing rebellion. One of the agents of this organisation, Bogrov, inflicted a mortal wound on Stolypin at a gala performance in the Kiev Opera House on Sept. 14 1911. The hatred of oppressed nationalities and of the humiliated intellectual class had armed the hand of the assassin, who was a well-educated Jew.

The Agrarian Question

The Stolypin Land Reforms.—One part of Stolypin's activity calls for special examination, his land reform, which may be considered as the immediate introduction to the social revolution of 1917. The agrarian revolts of 1905 attracted the attention of the Government and of society to the deplorable condition of the most numerous and important social class, the peasantry. The causes of the growing impoverishment of the peasantry are to be sought primarily in the manner in which the emancipation of 1861 had been carried out. The plots of land (*nadél*) which the peasants got varied greatly in size in different provinces. "Large" holdings ranged between $2\frac{3}{4}$ (about eight ac.) and 12 dess. (33 ac.), while minimum holdings corresponded to one-half of the maximum ones. The landowner's share comprised, besides his domain land, from one-third to one-half of the land formerly occupied by the peasants, on the condition that the latter should receive no less than the minimum holding. Besides these two principal types of holdings the Emancipation Act of 1861 established also the "beggarly" or "gratuitous" holding, which was to be no less than one-quarter of the maximum one. The gratuitous holding was established by free agreement between the peasants and the landowner; in this case the peasants had to pay no redemption while the landowner kept all the rest of his land. On the whole the quantity of land held by the peasants had been much reduced from that held before emancipation.

The following figures for the province of Saratoff may serve as an illustration:—

In 1861 688,826 peasants received beggarly holdings; they held 502,383 dessiatines. In 35 provinces 921,826 souls [1] were assigned one-half of the large holding each and held 1,530,000, or less than two dessiatines per soul.

The peasants' holdings, which were already whittled down at the time of the Emancipation, were further reduced after it by the increase of the population. A Commission for the investigation of the conditions and needs of the peasantry described the diminution of the peasants' holdings in the following manner: in 1860, 4·8% decrease on the average; in 1880, 3·5 decrease and in 1900 2·6 decrease. Besides losing a portion of the arable land, the peasant lost at the Emancipation the right of using the landowner's pasturage, of cutting wood in his forest, and some other subsidiary rights important in the living of peasant farmers.

The redemption payments were a heavy charge on the peasant's budget. The Agricultural Commission of 1872 found that squires had to spend on taxes less than 14·5 kopecks per dess., while the peasants paid more than 95·5 k. per dessiatine. In addition, the peasants had to pay the poll-tax, the amount of which was about 4r. 45k. per soul. The same Commission states that in 37 provinces the taxes and redemption payments of the meforr State and appanage peasants comprised 92·75% of their net income from land, the payments of former unfree peasants 198·25%. The Government made some futile attempts to relieve the peasants' load of taxes. The salt tax was abolished in 1880, the poll-tax in 1882. But these measures could certainly not solve the financial difficulties of the peasantry. Arrears grew rapidly to enormous proportions. In the province of Tamboo, for example, the arrears amounted in 1898 to 244% of the original charge.

[1] Persons doing the normal work of a villager.

Driven by land hunger, the peasants farmed on lease a large part of the State's appanages and of squires' land, but this expedient cannot be considered as an effective help in the solution of the land problem. The rent paid by the peasants to the landowners was usually very high. It is important to notice that certain plots of land, the use and possession of which was an essential necessity for the whole community, for example strips bordering on watercourses remained usually after the Emancipation in the hand of the landowner. This gave him the power to require exorbitant rent for such land and keep the peasants in permanent fear of losing these grounds, without which village life was practically impossible. This led to continual collisions. Under such conditions the backward and extensive methods of peasant cultivation proved very difficult to reform.

One of the most important defects of the peasant's landholding was the intermixture of strips in the open fields. The land of a community lay only seldom in a compact block. It was usually divided into a number of smaller "shots," sometimes mixed up with lands of other villages and landowners. The blocks of land belonging to the same community were again subdivided into strips, which were sometimes two to three yd. broad and some 100 yd. long. Each household held a certain number of strips 20–30–50, sometimes even 100–150. The strips were scattered at a great distance from the farmyard, and the driving to them entailed a considerable waste of time and work; this hampered greatly the farming arrangements of the villagers. The intermixture of strips separated from each other only by narrow balks obliged the whole community to follow the same system of cultivation, which was usually the three-fields one. The very large extent of fallow land, the carelessness of the holders who were not sure of keeping their land permanently—all this had the most ruinous effect on the peasants' farming. Under such conditions, hampering individual energy and initiative, productivity on the peasants' holdings was very low indeed. In 27 provinces the average value of the gross produce of one dessiatine of peasants' land was 8r. 99k., while the average cost of production per dess. was 5r. 22k.; so that the net produce per dess. amounted only to 3r. 77 kopecks. The productiveness of the squires' estate was 12–18% higher than that of the peasants, but as a large area of landowners' land was taken on lease by the peasants, the difference in the results of cultivation would be much greater.

Decay of the Peasantry.—The impoverishment of the peasantry after the emancipation of 1861 is reflected in a memoir of the Zemstvo of Tula:—

The peasant's life is hard and unsightly even in periods of comparative welfare. Generally he lives in a cottage of 8–9 yd. width and no more than 3 yd. in height. Cottages without chimneys are still very common, the smoke being let out through a hole in the roof. The roof is almost always thatched. In many provinces the walls are covered with dung for the sake of warmth. A peasant's family, sometimes a numerous one, is huddled together in a space of 20–30 sq. yards. The floor of the cottage is almost always bare soil, because lambs, calves, pigs and even cows are put in during the cold weather. Skin diseases are very common among the population. Meat, bacon, oil, butter appear on the peasant's table only on exceptional occasions, perhaps two or three times a year; his usual fare is composed of bread, porridge, kvass, cabbage and onions.

A very characteristic symptom of the decay of the peasants' farming is the reduction of the number of horses and the increase in the numbers of horseless households. A comparison of the figures of the horse statistics in 1888 and 1893–4 shows that in 31 provinces the number of horses had fallen by 10·88%. The number of horseless households had increased during the same period in 23 provinces of central Russia from 21·56% to 26·85%. More than 25% of the households have no horses at all; another 25% have only one horse each.

Let us now examine a peasant's normal budget as it is presented in the remarkable work of Mr. F. A. Shcherbina (edited by Prof. A. J. Chuprov):—

Income from:—	
Corn on his land	16 r. 20 k.
Corn on household land	1 r. 92 k.
Straw and hay	8 r. 16 k.
Gardening	2 r. 63 k.
Cattle-breeding	9 r. 99 k.
Trade or craft	8 r. 47 k.
Sundries	7 r. 26 k.
Total	55 r. 63 k.
Expenses:—	
Corn	18 r. 10 k.
Food for cattle	8 r. 45 k.
Vegetables and fruit	1 r. 30 k.
Meat	3 r. 90 k.
Rent	1 r. 2 k.
Taxes	2 r. 65 k.
Sundries	20 r. 10 k.
Total	55 r. 54 k.

Assuming that 19 poods of corn per head are the minimum necessary during one year and that 7·5 poods are sufficient for fodder, Mr. Maress calculated that 70·7% of the peasant population had less than 19 poods per head, 20·4% had between 19 and 26·5 poods per head, and only 8·9% had more than 26·5 poods per head. This means that 70·7% of the farming population could not live on the income from their land and would be reduced to semi-starvation if they could not find any supplementary means of existence.

The state of mind produced by this situation among the peasantry may be gathered from the opinions expressed by peasant deputies in the Second Duma in the course of the debates on agrarian reform. One of the members of the Right, Prince Sviatopolk Mirski, had said that the ignorant and inexperienced mass of the Russian people had to be guided by the landlords as a flock is guided by shepherds. Kisselev, a peasant belonging to the group of toil, replied:—

"We have had enough of that kind of thing! What we want are not shepherds, but leaders, and we know how to find them without your help. With them we shall find our way to light, to truth, to the promised land!"

Afanassiev, a non-party deputy, an ex-soldier, said among other things:—

"In the Japanese war I led a number of mobilised soldiers through estates (of the squires). It took us 48 hours to reach the meeting place. The soldiers asked me, 'Where do you lead us?', 'To Japan.' 'What for?', 'To defend our country.' They replied: 'What is that country? We have been through the estates of the Lissetskys, the Besulovs, the Padkopailovs . . . Where is our land? Nothing here belongs to us.'"

The same deputy said on another occasion:—

"Work, sweat and use the land! But if you do not wish to live on the land, to till it, to work on it, you have no right to own it!"

In order to meet this disastrous situation the Government made attempts in three directions—the increase of the size of peasants' holdings, emigration and the improvement of agricultural methods. It would be erroneous to think that the deficiency in land could be entirely removed by new distributions from the estates of the squires and the domains of the Crown. In 1906 the distribution of land among different classes of land owners was as follows (*La Réforme agraire en Russie*, Ministère de l'agriculture, 1912):—

Crown land	133,038,883 dess.
Peasants' holdings	119,067,754 dess.
Land bought by communities and associations of peasants	11,142,560 dess.
Land bought by individual peasants	12,944,154 dess.
Land of the gentry	49,287,886 dess.
Land owned by other classes	22,664,493 dess.
Land owned by various institutions	6,985,893 dess.

The enormous area of the Crown lands was mainly covered by forests or situated in the northern and eastern provinces, so that it could not be used for agricultural purposes; the surface of convenient land in the hands of the Crown was only about 3,700,000 dessiatines. The arable land owned by the Church and different ecclesiastical institutions amounted to 1,672,000 dess. (Statistics of the Holy Synod, 1890); the appanages comprised 2,000,000 dess. of arable land. As a large part of the land was covered also by forests, we come to estimate the surface of the arable land owned by squires at about 35,000,000 dess. (Yermolov.) The sum total that could be disposed of would thus amount to 45,000,000 dess., or about 30% of the area of the peasants' holdings; divided among the villagers it would have made less than one additional dessiatine per soul. The insufficiency of the land reserve becomes even more evident if we keep in mind that about 85% of the arable land of the Crown, 90% of the appanage arable land and a considerable part of the squires' land were already leased by the peasantry.

The peasants' revolt of 1905 and the new schemes of Stolypin gave an entirely new direction to the agrarian policy of the State. The Manifesto of Nov. 3 1905 suspended all redeeming payments after Jan. 1 1906. Of the surface of 2,846,620 dess., which the bank sold directly from Jan. 1 1906 to June 1 1913, peasants' communities got 5·5%, peasants' associations 14·8%, individual owners 79·7%. The peasants also acquired from the landowners, with some assistance of the bank, 4,375,163 dessiatine. It is estimated by Oganovsky that the result of the bank activity until July 1 1910 was the creation of 45,000 to 50,000 separate farms and of 130,000 to 140,000 small compact plots, the owners of which live in hamlets.

The law of 1889 had subjected emigration to official supervision. Those were allowed to emigrate who were able to pay the expenses of the journey and of the installation of a new household, provided their departure did not harm the remaining members of the community. No government assistance was given to the emigrants. Permission to emigrate was refused if the local authorities considered that the emigrants could find work in the old district. Those who emigrated without an official permission had to be sent back. These regulations resulted in a great reduction of the emigration movement, which was practically closed to the poorest peasants.

The events of 1905 and the new orientation of the government brought a great change in the emigration policy. Greater facilities were granted, and government assistance was promised by the Provisional Rules of June 6 1906. But the growth of emigration which followed the new regulations was obstructed by a complete lack of organisation.

We have now to consider the third branch of the government activity, directed towards the solution of the agrarian question. The scheme for improving agricultural methods was based on a reform of the distribution of the land. In 1861 a legal confirmation of the peasants' customary commune was considered the best means to secure the return of the money advanced by the State for redemption. The statistics of landownership in 1905 showed that 23·2% of the households and 17% of the land owned by the peasants were held by private tenure; 76·8% of the farms and 82·7% of the peasants' land were in communal tenure. The right of property was attributed not to separate households but to the whole village community, as a juridical person. In the case of communal land tenure only the house close belonged to households in permanent tenure; other land belonged to the whole community, and was subject to occasional redivisions. Former domestic servants were assigned to peasants' communities, but did not obtain holdings: they formed in this way a village proletariat.

In the reign of Alexander III. communal tenure, which had been regulated by the Liberation Act of 1861, came to be regarded as a political safeguard, and its decay was considered to be a national danger. The law of Dec. 14 1893 made practically impossible any transition from communal to household tenure. But the growing impoverishment of the peasantry gave evidence that the existing land system had ceased to be beneficial. The special conference established by an Imperial Order on Jan. 22 1902 recognised for the first time the necessity of a fundamental change in the existing land settlement of the peasants. The majority of the Conference were of the opinion that the communal tenure and the intermixture of strips were the chief causes of the alarming condition of the peasantry.

Stolypin's Land Settlement.—The agrarian disorders of 1906 gave increased importance to the problem, and proved that the settlement of it could not be postponed any longer. In the years 1906–7 the problem of land reform excited the strongest interest in governmental circles, and played a most prominent part in the programmes of different parties and in the debates of the First and Second Duma. Stolypin took the initiative on the part of the government and eventually obtained the support of the Third Duma. His scheme had a political purpose, the creation of a conservative class of small peasant owners who could be counted upon to defend the existing régime. This class had to be strong and progressive economically, as it was clear that the improvement of the peasants' condition could be attained only by more intensive farming. Some measures had been taken to enlarge the area of the peasants' holdings without violating the interests of the squires. But government activity was principally directed to a complete reconstruction of relations inside the village, to the creation of separate farms and to the spread of individual ownership. The Imperial *ukase* of Nov. 9 1906, the Land law of June 14 1910 and the Agricultural law of May 29 1911 were enacted for this purpose. The features of Stolypin's scheme were: Each householder possessed of land in a village community can demand that his land should be constituted a plot in individual property. A simple majority of the village assembly may convert holdings into privately owned land. The land has to be assigned to the claimant, if possible, in a single block. The conversion of the land of the entire community can be decreed by a resolution of the village meeting passed by a simple majority of the members. All the communities where there had not been any redivision of land since 1861 were declared to have passed from communal tenure to individual or household ownership. Formation of compact plots could not be refused if it was asked for by not less than one-fifth of the householders. The Land Commissions created by the *ukaz* of March 4 1906 were entrusted with the redistribution of land under the new land settlement.

In the Duma the Right clung to the opinions which had been prevalent in the time of Alexander III.; the Radicals entertained the hope that the communal land tenure might form the cradle of future collectivism. The Cadets mostly agreed with the principles of the government scheme, but they objected to the coercive character of its methods. The majority of the House supported the government and carried its bill through the Duma. The motives that influenced the deputies of the Duma were well expressed by the chairman of the Land Committee, S. Shidlovsky, in his speech on Oct. 23 1908:—

> Our attitude as regards the decree of Nov. 9 is in substance a favourable one, because this decree aims at the development of individual land tenure and individual land tenure is certainly the necessary condition of improved cultivation, and the latter means the solution of the agrarian problem. . . . The foundation of a State ruled by law consists in a free, independent and energetic personality. Such a personality cannot exist unless you allow the common right of ownership, and no one who wishes the State to be ruled by law should oppose the spread of private property in land. Land is, after all, only a basis for the application of labour and capital, and labour is most productive when the labourer is placed in favourable conditions. In the forefront in this respect we have to place an open door for personal enterprise, free play for creative energy, security against outside interference, personal interest. . . . The avenue towards a permanent improvement in the existence of our peasants is to be found in an immediate increase of production and income from land, and this cannot be achieved without the help of outside capital. . . . A law which opens the way to personal property enables the agricultural worker to display his creative force.

The reform had apparently achieved an immediate and striking success. Before Jan. 1 1913 the Commission had arranged farms on an area of 7,413,064 dess., held by 738,980 households; strips had been concentrated into blocks on an area of 4,359,537 dess., held by 585,571 households, yet most of those who asked for separation held only a small plot, and belonged to the poorer peasantry. Even with government assistance they were unable to start separate farms, as this undertaking involves in the beginning a considerable outlay of capital. Besides, the natural conditions in some parts of Russia were not favourable to separate farms or homesteads. One of the chief difficulties was the lack of water, which in very large tracts of the black soil area can only be found in connection with considerable rivers. This fact, together with the traditional leaning of the peasantry to village life, obliged the Land Commission to keep up on many occasions the village system even after the concentration of the fields.

A memoir drawn up by the conference of Old Ritualists held at Moscow on Feb. 22–25 1906 discloses the views taken by the peasantry on the question of communal land tenure. The opponents of the commune suggested that it made impossible any improvements in agricultural methods and diminished the productive power of the soil; its supporters stated that communal tenure was the only system based on justice; this consideration is characteristic of the traditional feeling among the Great Russians. The government scheme sacrificed justice for the sake of expected increased production. Stolypin himself described the new land settlement as " a stake on the strong."

The small size of the holdings of the new farmers and their economic helplessness had, however, a very unfavourable influence on the expected increase of production. A farmer who held only 8–10 dess. of land could not introduce any extensive improvements in his household in the absence of cheap credit. Stolypin recognised that " primitive methods were used by the peasantry as before."

The land settlement of 1906–10 was carried out with uncommon energy, but the social needs of the population were not satisfied. The government was accused of having destroyed by a stroke of the pen an institution formed by centuries. The sudden change affected not only the economic conditions of the peasants' life, but the juridical relations between the members of the family were also shaken. Before the new settlement the life of the peasants was based on the participation in the common holding of all the members of the household. The new law substituted for this family tenure the individual ownership of the chief householder. All the other members of the family suddenly lost their rights in the land.

Altogether it may be said that Stolypin's agrarian measures could take effect only if they were accompanied by a steady policy making for agricultural education and backed by extensive credit. Even in such a case a long time would have been necessary to enable them to strike root. Their immediate consequence was rather to increase the fermentation in the villages and to excite and embitter the feelings of those who were losing faith in the village community without acquiring any other standard of economic organisation. Thus the legislation of 1906–11 helped to prepare the agrarian upheaval instead of preventing it.

The Struggle for Reform

The Third and Fourth Duma.—The death of Stolypin left a wide gap in the ranks of the government, and the appointment of M. Kokovtsov, the Minister of Finance, to the premiership did not result in a rejuvenation of the bureaucratic system. The new Premier was in favour of continuity in policy; this meant that he wanted to keep on the lines traced by Stolypin's initiative and avoid new departures as far as possible. He was a trained administrator, placed by chance at the head of the country in a time when caution and routine were certainly insufficient to meet the requirements of a critical situation. The principal achievement of the three years of Kokovtsov's rule was apparent success in the management of financial operations. The budget grew every year and reached in 1914 the enormous sum of three milliard roubles, and yet not only was a deficit avoided, but some 1,500 millions in gold were accumulated as a reserve fund to sustain the currency and meet possible emergency calls.

The instability of the vast structure buttressed on the chronic alcoholism of the people was duly perceived by public opinion, and a campaign was started in the Duma to put an end to this shameful and perilous situation. One of the Duma members, Chelyshiv, was the soul of an active agitation in the Legislative Assemblies and in government circles. He succeeded in obtaining the formation of a commission to examine and report on the

subject, but his abolitionist plans were obstructed by the opposition of the Finance Ministry, which did not see its way to balance the budget without the resources supplied by the monopoly of the sale of spirits.

Yet signs were not wanting that the welfare of the country was seriously threatened, in spite of an enormous and duly balanced budget. The harvest of 1911 was so poor that in 1912 Russia was visited by a severe famine. Yet the government refused to let voluntary organisations assist in fighting the disaster; only associations affiliated to the Red Cross or to the Zemstvos were allowed to send agents into the provinces, to collect and to distribute funds. The public works organised by bureaucratic boards were conducted in a very unsatisfactory manner. Some progress was made in connection with insurance against ill-health, but in other respects the employers were left very much to their own way, with the result that strikes, which had decreased considerably in number and intensity after the collapse of the revolutionary movement in 1907, began to multiply again. On many occasions the unrest was quelled by the intervention of Cossacks and soldiers. The most terrible case of the kind occurred in the goldfields of a company largely supported by foreign capital—the Lena Company; a dispute as to wages and maintenance was terminated by a fusillade in which 162 workmen were killed.

The Third Duma had been led by the Octobrist party in conjunction with the moderate Right. This policy had suffered shipwreck through the absolutist bent of Stolypin's administration and the colourless leadership of Kokovtsov. In the last sessions before its dissolution the Duma assumed a frankly hostile attitude towards the Ministry and the leader of the Octobrists, A. Guchkov, pronounced thundering indictments against the "irresponsible influences" which shaped the course of politics from behind the scenes: the egregious mismanagement of the Artillery Department, presided over by the Grand Duke Serge Mikhailovich, and the scandalous influence of the Empress's protégé Rasputin, gave good grounds for these attacks. On the dissolution of the Third Duma the intricate and restricted franchise provided convenient handles for the gerrymandering of elections, and the Government made full use of them in order to secure a Government majority in the Fourth Duma.

The Fourth Duma.—The bureaucracy and the priests mobilised by the Procurator of the Holy Synod were so far successful in this campaign that, thanks to its pressure and to the evident breakdown of the plan of a coalition with the Government, the Octobrists were defeated in a number of districts and their leader, Guchkov, succumbed at the polls.

The party grouping may be tabulated as follows: (1) The Right, 67; (2) Moderate Right, 38; (3) Nationalists, 55; (4) Centre (Krupensky's group), 28; (5) Octobrists, 87; (6) Progressists, 37; (7) Constitutional Democrats, 60; (8) Social Democrats, 14; (9) Polish circle, 13; (10) Mahommedans, 6; (11) No party, 20; (12) Group of Toil, 7; (13) Of unknown party allegiance, 17.

The new Duma was thus apparently more reactionary than the one which had preceded it. But public discontent and the inability of the Government to frame any effective policy of reform produced the unexpected result that a combination was brought about between the groups of the Left, the Octobrists, and even, in some cases, the Right Centre. In a general way the Duma assumed an attitude of opposition to the Government. This line of policy was especially conspicuous in a long series of interpellations and resolutions of want of confidence carried against arbitrary acts of the authorities. When a bill was passed by the Duma to establish rules as to the responsibility of civil servants, the Council of the Empire refused to sanction the most modest requirements in this respect, although even the Minister of Justice had expressed his agreement. On the other hand, the government did not scruple to prosecute a deputy (Kusnetsov) for a speech he had made in the Duma, and the administrative department of the Council of the Empire decided that members of the Legislature were liable to prosecution in such cases.

All measures of home policy, even the most urgent ones, were regarded from the point of view of political strife. The Education Committee of the Duma, in conjunction with the Zemstvos, had worked out a plan for the provision and equipment of a sufficient number of elementary schools in order to secure universal instruction throughout the country. It was calculated that some 10,000,000 children had to be accommodated in the schools, in addition to about 5,000,000 who were already enrolled for a course of three years in the schools of the towns and the Zemstvos. In order to achieve the result by 1924, the Duma proposed to develop gradually a network of schools by means of appropriations successively increased by 10,000,000 roubles a year in the course of 10 to 12 years. This scheme could not be carried out in its entirety and in a systematic form, on account of obstruction from the Board of Education and from the Council of the Empire. These reactionary bodies were opposed to any policy which gave precedence to secular schools over Church schools, although it could not be contested that the former were much more advanced and perfect in teaching and organisation. The comprehensive law of consolidation was wrecked by the Council of the Empire; the "enlightened bureaucrat" Count Witte did not scruple to oppose the bill in alliance with the stalwarts of reaction, because, as he expressed it himself, it was an attempt to obtain paradise by means of child-murder, the murdered child being the Clerical school organisation. Thwarted in its comprehensive policy, the Duma nevertheless proceeded on its course by granting occasional increase of credits for elementary education.

These constant conflicts produced a perceptible sliding towards the Left in the ranks of the Duma legislators. One of the symptoms of this process consisted in the disruption of the Octobrist party. It broke up into three small groups—the Left, hardly distinguishable from the Cadets;[1] the Centre, which professed to devote its activity mainly to strengthening the Zemstvos; and the Right, which still clung to the idea of a possible alliance with a reformed Government. The dismemberment of the Duma into small groups gave influence to the Cadet nucleus, which, though it had few members in the Duma, was under strong discipline and was backed by a powerful press.

In one direction only the majority of the Duma was fairly in agreement with the Government, namely as regards foreign affairs and imperial interests. In spite of certain minor disagreements between the parties of the Left and the Centre and Right, the Duma as a whole was decidedly Nationalist. The Third Duma had bequeathed to the Fourth a definite line of policy concerning the Finland conflict: the Legislature backed the Government in its endeavours to subordinate the autonomy of the Finnish State to the superior claims of the Empire. The view that the union between the Grand Duchy and Russia was a *real* and not a *personal* one led to the assertion of the supreme jurisdiction of the Imperial Senate and of the St. Petersburg Court of Appeal over Finnish tribunals; to the passing of laws commuting the obligation of personal military service for money payments; and to the demand that Russians dwelling in Finland as citizens of the Grand Duchy should be recognised on equal terms with native Finns. Even the Cadets did not contest the general principle from which such demands were derived, although they disapproved of the raising of issues which embittered the intercourse between nationalities and led to unpleasant consequences in the shape of passive resistance. Finnish officials who refused to recognise the legality of the interference of Russian institutions in Finnish affairs, apart from the traditional channel of the governor-general and Senate as representing the authority of the Grand Duke, were imprisoned or deported.

The creation of the new province of Chelm (Kholm), separated from the provinces of Lubin and Sedlitz, envenomed another old national conflict—that between Russians and Poles. The new Government was formed out of districts in which the majority of the population was Little Russian, although this population had been included for centuries within the boundaries of the Polish State and had been recognised as a part of Congress Poland annexed to Russia by the Treaty of Vienna (1815). The Duma passed the law of separation without taking heed of the violent protests of Polish public opinion.

[1] Constitutional Democrats.

The Conflict with the Central Empires.—The Nationalistic orientation of the Third and Fourth Dumas was put to the test by the growing entanglements of foreign policy. Russia had definitely joined the combination of Western Powers against the predominance of Germany, and opinion in the country fully supported this momentous change of front. The annexation of Bosnia and Hercegovina by Austria under the protection of Germany " in shining armour " was strongly resented, not only by Stolypin and Isvolsky as the official exponents of Imperial policy, but by the nation at large. In 1911, during the Agadir affair, Russia was found on the side of Kaiser William's opponents. Matters became especially serious when the Macedonian hostilities, which had been smouldering for decades, burst out into flames in 1912. The coalition between Bulgarians, Serbians and Greeks against Turkey had been rendered possible and effective by the support on which they reckoned from Russia; and O. Hartwig, the Minister Resident at Belgrade, was one of the principal agents in bringing it about. M. Sazonov, the successor of M. Isvolsky at the Foreign Office, cautious, but devoted to the great tradition of Russia's protectorate over the Balkan Christians, was intent on using to the full the favourable situation created by the union between the three Balkan States, the sympathy of Western Liberals and the temporary indecision of the Central Powers. In this he was supported by the Tsar Nicholas, who, however, made it clear to his agents that Russia would not risk an actual war.

The crushing defeat inflicted on the Turks by the Balkan allies seemed to justify completely the combination engineered by Hartwig. But the harvesting of the fruits of victory proved a more difficult task than the actual fighting. The Central Powers had realised the menace of a permanent Balkan League to their ascendancy in the Near East. Austria vetoed any extension of Serbia towards the Adriatic. With the support of Germany she succeeded in depriving the Serbs and Montenegrins of the position they had won in Albania. At the London Conference Russia did not dare to back the latter's claims to the finish and the Western Powers were disinclined to proceed without Russia, The eviction of the Serbs from the west proved fatal to the peace of Europe. They tried to recoup themselves in the east by demanding districts of western Macedonia which had been previously conceded to the Bulgarians. M. Sazonov tried to stop the growing animosity between the Balkan allies by offering the mediation of Russia, and Nicholas II. attempted to exert his personal influence on the wily Ferdinand of Bulgaria as well as on the Serbians. These attempts at conciliation proved unavailing: the Bulgarians broke away first, but were soon checkmated by a coalition between Serbia, Greece and Rumania. The Peace of Bucharest, which gave the Dobrudja to Rumania, western Macedonia to Serbia and important districts of Thrace and Macedonia to Greece, shattered all hopes of an effective Balkan League, and laid Bulgaria open to the insidious intrigues of Austria and Germany. M. Sazonov manifested the chagrin of Russia; but his attitude only emphasised her diplomatic defeat.

All these events were watched by Russian public opinion with keen interest and warm sympathy for the cause of the Slavs. It was realised more and more clearly that the struggle did not concern merely the small States of the Balkans, but also their big neighbours. M. Sazonov found unexpected support from M. Milyukov, the leader of the Cadets. B. Maklakov and V. Bobrinsky came forward as the spokesmen of Slavonic solidarity. In this way, when the climax in the antagonism between Austria and Serbia was reached in the assassination of the Archduke Franz Ferdinand, the Russian public was prepared to back the Government against hostile acts of the Central Powers. The outrageous treatment of Serbia by Austria-Hungary was rightly interpreted as a provocation to the Entente, and especially to Russia. The only person of any weight who advised submission at any price was Count Witte. Everybody else, from the Emperor to the most humble citizen, understood that no choice was left but to fight for existence. (For Russian diplomatic action in the critical period before the outbreak of War *see* EUROPE, pt. ii. *"The Outbreak of War."*)

THE WORLD WAR

A United Russia.—In the light of subsequent events the declarations made on the outbreak of the World War assume a particular significance. The representatives of alien nationalities expressed emphatically their resolve to stand by Russia in the struggle.

The Russian groups expressed their resolve to spare no effort in the struggle, and to support the Government to the utmost in the task of defending the country. Only from the little group of Social Democrats came threatening notes. Their spokesman dwelt on the solidarity of the proletariat all the world round, on the common guilt of all the governments in provoking the war, on the resolve of the proletariat to bring about a speedy peace, on the hope that the present terrible catastrophe would result in the abolition of all wars. These discordant notes were lost in the general display of enthusiasm.

The Tsar's Government was on the crest of a mighty popular wave; it might have steered a course towards victory and national regeneration if it had possessed the moral strength to throw away the tawdry equipment of despotism. Events soon proved that it was not only incapable of such an effort, but that its leadership was in itself a hindrance to success at home and in the War.

At the start, however, two steps in the right direction were taken by the Government: the abrogation of the State monopoly of the sale of spirits, and the promise of autonomy to the Poles. The Gordian knot of the temperance problem was cut by Imperial decree in spite of the difficulties raised by finance experts. The beneficial influence of the measure on the morals and health of the people and of the army cannot be doubted.

The appeal to the Poles was made in a proclamation of the Commander-in-chief, Grand Duke Nicholas. The grant of autonomy was held out as a reward for help against the common enemy, the Germans. It would have been better if the promise had come directly from the Tsar and if instead of vague words something tangible had been conceded at once. As a matter of fact the high bureaucracy began at once to put obstacles in the way of any reform. The damage done by these vacillations was incalculable. Instead of enlisting the wholehearted support of Polish patriots Imperial bureaucracy drove them into a position of distrust and hostility,which became especially keen in view of the tactless and offensive behaviour of Russian authorities in Galicia, and could not be placated by occasional concessions in details. This episode may serve as an example of the stupid policy followed by the Government in regard to all minor nationalities of the Empire: their enthusiastic rally was discouraged in every way, and old enmities were revived and increased at the most critical time. The case of the Jews was especially flagrant: numbers of them continued to perform their military duties faithfully and zealously, but many others took advantage of opportunities to spy and to betray their persecutors, and the round of executions and pogroms set in again with increasing force.

The Effects of Misgovernment.—In the field the old cancers of corruption and favouritism were again producing disappointment and disaster. The army did not lack excellent leaders—the chief-of-staff of the Southern command, Alexeiev, the corps commanders Ruzsky, Brusilov, Radko Dmitriev, were generals of the first rank. The officers and the common soldiers fought with the traditional tenacity and valour; no sacrifices were spared and brilliant victories were won. And yet on decisive occasions incredible things happened. Samsonov's army was destroyed, thanks to a slackness in co-operation between commanders. In Jan. 1915 an intelligence officer, Miassoyedov, actually sold the plans of the northern concentration to the Germans, and brought about a crushing defeat of Sivers' army. Worst of all it became clear towards the spring of 1915 that the army was insufficiently provided with munitions, aircraft, artillery and other appliances of war. The onslaught of Mackensen's and Hindenburg's Germans had to be met by soldiers many of whom had to man the trenches with sticks, in expectation that the death of comrades might give the chance of picking up rifles; batteries were for-

bidden to fire more than a couple of times an hour; the armies were surrounded by multitudes of "Kids"—marauders and deserters. Even in these terrible circumstances the Russians fought stubbornly, retreated step by step, and eventually, with the help of Alexeiev's strategy, succeeded in arresting the stream of the invasion on the lines of the Dvina and the Dniester. But the psychological effect of this desperate campaign was a lasting one. The common soldiers had learned that their blood was wasted without stint by a criminally careless and inefficient government. The way was opened to the insidious propaganda of defeatists and traitors. The revolution of 1917 was prepared on the battlefields of Gorlice and Krasnostav.

The progressive elements of Russian society attempted to save the situation by a great effort. The Zemstvo and Town Unions, which had been doing wonders in hospital work and equipment, offered their services for the fabrication of munitions:—

Towards the end of May 1915, at a congress of representatives of trade and industry, the discussion of technical questions was interrupted by an impassioned speech delivered by one of the leading Moscow millionaires, V. Riabushinsky, just back from the front and full of the impressions of the life and death struggle against the invaders. "The whole of Russia forms the rear of the army," he said. "We cannot busy ourselves with our everyday affairs at the present moment: every workshop, every factory must be used to break the enemy's force." It was not a question of forming this or that committee, but of sinking all differences and appealing to the assistance of every able man, without distinction of parties, as people had done in the West, in France and in England.

Technical committees were created with the participation of leaders of industry, Zemstvo workers, representatives of the working class: they displayed fervid energy and achieved good results. But the main condition demanded by Riabushinsky and Lvov—mutual confidence between the people and the Government—was conspicuously absent. Subordinate officials joined in the efforts of the unions, but the central Government continued to flounder in the morass of Court intrigues and supine reaction. The worthless Minister of War, Sukhomlinov, was indeed dismissed and put on his trial; the ancient bureaucrat Goremykin had to resign the premiership; but the appointment of his successor, Stürmer, provoked a general outburst of indignation. He was known for his reactionary opinions, and had shown his mettle in helping to coerce the progressive Zemstvo of Tver. His great merit was his subserviency and affected devotion to the Imperial family, especially to the Empress Alexandra Feodorovna. This hysterical lady meddled more and more with affairs of State, particularly after the assumption of the supreme command by the Emperor. And behind her stood various favourites, chief among whom was the astute peasant, Gregory Rasputin, whose exploits had made the Petrograd Court a place of scandal for the whole world. No wonder that the opening of the Duma in Feb. 1916 gave rise to manifestations very different from those which had occurred in that assembly in July 1914. The ally of Stolypin, Shidlovsky, speaking on behalf of the bloc of progressive parties, said: "The longing of the entire country towards a situation in which the country could entertain confidence in its Government, and feel in union with it, has been traduced as an incitement to seize power. . . . The forces of the nation, bereft of unity, aim and guidance, have been spent in vain, and the great national effort has weakened under the dissolving influence of discontent and indifference."

The discord between the Government and the Duma found expression on many occasions in connection with important questions of internal policy. A strike at the Putilov works, suppressed by military force, gave rise to a heated discussion in which the Duma, while condemning the strike as "a stab in the back," expressed the desire that the legal activity of trade unions should be given free scope and that courts of arbitration should be founded for the settlement of trade disputes. Perhaps the most significant pronouncement was made in the course of the debates on the budget of the Holy Synod. The Duma voted a resolution to the effect that it considered necessary a reform of the Church administration on the principle of the supremacy of Councils and of a wide application of local self-government. For this purpose a national Council should be convoked without delay. The reform should extend to ecclesiastical courts, especially in the matter of divorce procedure, and to the ecclesiastical schools; the parish should be developed as much as possible; bishops should not be transferred from one See to another, if the consent of the Church had not been obtained. The State should cease to look upon the clergy as a political instrument, and all circulars and orders in this sense should be revoked.

The Government seemed to take delight in ignoring and thwarting all these resolutions. Stürmer was called to one ministerial post after the other. In Feb. he was appointed Home Secretary in succession to N. Khvostov, in July Foreign Secretary in succession to S. Sazonov, who was dismissed because he had urged the necessity of settling the Polish question in the sense of definite and real autonomy. Altogether ministerial portfolios were shuffled like cards at the bidding of the Empress.

It may be sufficient to notice the advent of M. Protopopov, a convert from the ranks of the Liberal bloc to the Ministry of the Interior (Sept. 1916). The dismay and indignation of the country found expression in a series of resolutions demanding the appointment of a Cabinet supported by the confidence of the people. Even conservative institutions like the Council of the Empire and the Association of the United Gentry joined in the chorus.

The Popular Leaders.—Before proceeding with the narrative of events which led up to the actual revolution, let us consider the various currents of thought and party organisation of the intellectuals who were preparing for the coming conflict.

It is not necessary to dwell at any length on the Octobrists and the Cadets. The former drew their main strength from the provincial gentry, the latter from the urban middle class and the liberal professions. The Octobrists pleaded for gradual development from local self-government, while the Cadets placed their hopes on the introduction of a constitutional democracy in which actual leadership would fall to the representatives of Western culture, but in spite of a recognition of the "four-tails" formula (*i.e.*, universal, equal, direct and secret suffrage), the Cadets had no hold on the mass of the people, and relied on the selection of the educated by the uneducated.

Socially and psychologically, the leading groups of the years of upheaval were bound to come from the midst of the extreme revolutionary intellectuals. Three leading currents may be distinguished in the history of revolutionary thought in Russia: militant idealism born of bitter resentment at the backward state of Russia in comparison with the West; the tendency to seek regeneration in a closer contact with the folklore of the common people; the economic materialism proclaimed by Marx. The views of the first group were most vividly expressed by writers like P. Lavrov and N. Mikhaïlovsky. They laid stress on the propaganda of progressive ideas in order to form the minds of irreconcilable fighters for emancipation in all fields of human activity. Lavrov had initiated a philosophical theory (anthropologism) somewhat akin to the humanism of the modern pragmatic school; Mikhaïlovsky had preached "subjective" ideals with great effect as a journalist and literary critic. His violent radicalism was directed not only against the "powers that be"; he repudiated "class struggle" as a "school of bestiality," from which men issued as "live corpses with faces distorted by rage." In contrast to these "Westerners" appeared a group of writers who clung to the conception of a special aptitude of the Russian people for social brotherhood and communal economics (Zlatovratsky, Korolenko, Kacharovsky): their antecedents must be sought in the romantic teaching of the Slavophils as well as in emotional motives in sympathy with the toil and struggle of the peasantry.

In the case of active revolutionaries like Chernov, the radicalism of the Westerners was allied with the romanticism of the Populists, and in various combinations both tendencies helped to shape the views and the policy of the Social Revolutionary party. In the beginning of the 20th century one could distinguish some five groups representative of this party. Their principal organ (the *Messenger of Revolutionary Russia*) proclaimed the necessity of close alliance between revolutionary intellectuals

conspiring proletarians and the struggling peasantry. It laid chief stress on political rights, democratic organisation and the raising of the status and consciousness of the individual. Their methods of terrorism and insurrection were themselves the outcome of the heightened sense of personality and of the importance attached to energetic action and self-sacrifice.

The ways of the Social Democrats were different; they adopted Marx's teaching as a gospel and tried to develop and to apply it in every direction. Their chief exponent was for a time G. Plekhanov, a philosopher and economist who held strictly to the programme laid down by Marx, according to which Capitalism appears as a necessary stage in the development of production and gives way to Collectivism only when the majority of the workers have been turned into wage-earning proletarians. Plekhanov and his followers did not consider the Russian people ready for class war against the bourgeoisie, and insisted, on the contrary, on combined action with the social groups possessed of better education and greater political experience. The "Revisionist" movement, initiated in Germany by Brentano and Bernstein, found adepts in Russia (Struve, Prokopovich).

The burden of increasing taxation, the disastrous conduct of the Japanese War, the reactionary stupidity of the Government—all contributed to revive the revolutionary spirit in the ranks of the Social Democratic party. The history of this revival may be traced from the appearance in Dec. 1900 of the *Iskra* (*The Spark*) a newspaper conducted by Lenin and Martov. Lenin's pamphlets, *What is to be done?* (1902) and *Letter to a Comrade* (1903), express one of the leading ideas of his later activity. He pleads in them for centralised directions and decentralised responsibility, that is, for an oligarchy of leaders and strict discipline as regards the execution of their decisions by subordinate units. Democratic watchwords are set aside and efficiency of organisation is demanded at all costs. This led to the disruption of the party. At the London Congress of 1903 the fateful division between "Bolsheviks" and "Mensheviks" was inaugurated, as a consequence of disagreement concerning the problem of leadership and discipline. The Bolshevik ("Majority") group carried its proposals by a very narrow majority, and captured the Central Council of the party, from which they entirely excluded their opponents. The latter, who had a majority on the staff of the *Iskra*, proclaimed a boycott against Lenin and his adherents. The insignificance of the immediate cause of the split was only apparent: in truth the division arose from fundamental opposition between the democratic orientation of Plekhanov and the oligarchical spirit represented by Lenin.

Questions of principle arose in the course of the Japanese War and the first revolution. While Plekhanov and the Mensheviks were for co-operation with the Liberals in the fight for political freedom and for a gradual introduction of social reforms, Lenin set his hopes on the hatred of the peasantry for the landlords, and preached a ruthless *Jacquerie*. In his pamphlet, *The Agrarian Programmes of Social Democracy*, he contended that orthodox Marxians had failed to grasp the peculiarities of the Russian situation inasmuch as they were still talking about a coalition of the bourgeoisie of the towns, while in Russia the moving power was to be sought in the rising of the peasant bourgeoisie against the squires. He contrasted the abstract views of the town proletariat with the intense revolutionary temper of the peasants who were "ready to fly at the throat of the landlords and to strangle them."

It is hardly needful to point out the close connection between these literary disputes and the Zimmerwald agitation[1] of 1915–6, as well as with the eventual overthrow of the old régime in 1917. Let us note that the Congress of the Social Democratic party in 1917 sided definitely with Lenin and the Bolsheviks.

The Revolution.—The situation in the beginning of 1917 was extremely tense and abnormal. The Emperor had left the capital and taken up his residence at the army headquarters in order to see as little as possible of the ministries, the Duma or the Court, and to lead a "simple life" among the selected retainers of the Stavka; the Empress continued to look for hypnotising inspiration to monks and priests and interfered constantly in affairs of State in favour of reaction. Even the staunchest conservatives, like Trepov, found it impossible to remain in office under such conditions, and the field was left clear for half-insane subjects like Protopopov and bigoted courtiers like Prince N. Galitsin. The army at the front held on sullenly to its positions, but was war-weary and distrustful of its leaders.

(P. Vi.)

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III. THE REVOLUTION AND AFTER

The history of Russia after March 1917 divides into three periods. The first, after the spontaneous collapse of the autocracy, is filled by the gradual crystallisation of leadership out of the interplay of many parties opposed to or favouring a social revolution in a country exhausted by war and for the most part inhabited by peasants hungry for land. In the second period the party gaining the leadership has temporarily satisfied the peasants and ended the war; is forced by a new civil war, which by the intervention of foreign Powers becomes a new national war, to identify itself with economic measures that would have alienated the peasantry if it were not that these still feared that defeat would mean a military restoration of the old landlords. In the third period, military pressure from without has ended, the peasants demand to be allowed to enjoy the fruits of the land which they are no longer in danger of losing, and the victorious party is trying to guide the economic recovery of the country along lines which, while satisfying the peasantry, shall confirm

[1] The Zimmerwald Manifesto of 1915 is full of momentous declarations. The following are some of them:—

"The war that has produced this chaos is the outcome of Imperialism, of the endeavours of capitalist classes of every nation to satisfy their greed for profit by the exploitation of human labour and the treasures of Nature. . . .

"To raise welfare to a high level was the aim announced at the beginning of the war: misery and privation, unemployment and death, underfeeding and disease are the real outcome. For decades and decades to come the cost of the war will devour the strength of the peoples, imperil the achievements of social reform, and hamper every step on the path of progress. Intellectual and moral desolation, economic disaster, political reaction—such are the blessings of this horrible struggle of nations. . . .

"In this intolerable situation we have met together, we representatives of Socialist parties, of trade unions, or of minorities of them, we Germans, French, Italians, Russians, Poles, Letts, Rumanians, Bulgarians, Swedes, Norwegians, Dutch and Swiss, we who are standing on the basis, not of national solidarity, with the exploiting class, but of the international solidarity of the workers and the class struggle. . . ."

instead of liquidating the social revolution brought about during the preceding periods.

The First Period, March 1917–March 1918

The Collapse of the Tsarist Régime.—It would seem that a successful revolution is impossible so long as the existing régime is not rotten throughout. If a régime, however bad, has faith in itself and is coherent, the inertia of tradition will be enough to keep it in place. By the end of Feb. 1917 the imperial régime in Russia had lost all the circumstances of stability except a tradition that had at least been shaken by the attempted revolution of 1905, by the loss of the Japanese War and by a long series of military failures in the war with Germany. The imperial family was divided against itself. The Government was divided in its views of the imperial family. The Duma was divided in its opinion of the Government, and was very far from giving it anything like the whole-hearted support that even a good government needs in the gloomy moments of unsuccessful war. The authority of the Church was shaken by a series of scandals which touched not only the hierarchy but the reigning house. The unsuccessful War had affected everybody in the country, and, whereas most of the leaders of the Duma were dissatisfied because the War was not better conducted, the mass of the people were dissatisfied because it had not long ago come to an end. The army had lost faith in its commanders, and its commanders had lost faith in the Government that failed to supply them with adequate munitions.

Petrograd in Revolution.—It is difficult to decide who was responsible for giving that final jolt. There are a good many reasons for thinking that the initiative was taken not by the revolutionaries but by the old régime. For some time before March 1917 there had been talk of a revolt in Petrograd that could be suppressed and would make less likely the revolution that everybody expected after the War. The police had been trained in the use of machine-guns, and a number of these weapons had been more or less secretly placed in commanding situations in the city—the tops of houses, and, it was believed, in certain bell-towers that would allow them to rake important streets. Further, the authorities had arrested just those representatives of the workmen who had been most active in preventing strikes and in furthering the manufacture of munitions of war. Miliukov, the Cadet leader, found it necessary to declare that someone, disguised as himself, had been urging the workmen to strike. As a matter of fact, the strike, urged by proclamations of the then extremely weak Bolshevik party, did not precede but accompanied and grew with the disorders that had had a very half-hearted beginning in the streets. Eyewitnesses agree as to the strangely artificial and aimless character of those disorders, at least in their early stages, and agree also as to the presence of police agents in the crowds that gathered in the Nevsky Prospekt, urging, for example, these most peaceable crowds to overthrow tramcars. A curiously tactless proclamation of March 9 by the military governor Khabalov threw the blame for a shortage of bread on hoarders, and thus led directly to looting. This proclamation, issued at the request of Protopopov, announced that there was plenty of bread in Petrograd, and was exasperating to people who found they could not buy it.

There was much that suggested conscious provocation on the part of the authorities. The revolutionaries were later inclined to imagine that the responsibility was theirs alone, and that the revolution was planned and led. They did not make these claims at the time, and the ease with which the Duma assumed at least the semblance of authority suggests that the revolting populace were quite unaware that they had had any leaders at all. Some of the leaders of the Duma have also been ready to claim responsibility, but their claim is even less defensible than that of the revolutionaries. The movements of crowds and individuals were, with the exception of the police, visibly without guidance or conscious objective, and the Duma leaders were themselves horrified when they realised that they were face to face, not with a change of government, which they sincerely desired, but with a collapse of the whole régime to which they belonged.

A few bakers' shops were smashed on March 8. A strike movement in protest against the shortage of bread was spreading from factory to factory. On Friday, March 9, though there were crowds in the streets, it seemed that the authorities wished rather to keep them together than to disperse them. The closing of the bridges seemed to promise that something was expected to happen, and it is possible that this prolonged expectancy had something to do with the ultimate nervous, sporadic, unorganised disaffection of the troops, which developed only gradually into active mutiny. It was remarkable on March 9 that the Cossacks were on good terms with the populace and anxious to keep so. It is said that the first blood shed in the revolution (Saturday, March 10) was that of a policeman who was attacked by a Cossack for striking an unarmed workman. Soldiers of the Petrograd garrison, when called out on Sunday, declared that they would not fire on their brothers. In order to destroy the moral effect of the obvious friendliness of the soldiery, and to prove to the crowd that the troops were still dependable, the police took 150 overcoats from one of the regiments and did some firing when thus disguised.

Another account has it that soldiers were dressed in police uniforms, but for this the motive would seem to be lacking. The incident brought the corps concerned and others into revolt. On Sunday, March 11, the 4th company of the Pavlovsky regiment broke barracks, and after some wild shooting fired at the mounted police. On Monday, March 12, almost every factory in the city was idle. The streets were crowded with people without definite objective, waiting to see what would happen. There was no programme. To an observer it was like watching migratory birds instinctively gathering and suddenly resolving on distant and hazardous flight. Here and there, in the streets, in different barracks, in different parts of the town, without communicating, men found themselves "on the side of the people." Soldiers meeting each other would call out, "For the people or against the people?" Whole regiments marching in perfect order, when they came face to face with the crowds they were called upon to disperse, would suddenly break up and give their rifles with kisses to anybody in the crowd who seemed to want them. Small boys were shooting at pigeons in the street with magazine rifles belonging to the Guards.

It was as if the will of the old régime were paralysed. Nothing was left of it but prisons, barracks, government buildings and police stations. Soldiers and populace marched from one barrack to another until all had thrown in their lot with the revolution. The prisons were taken one by one, and the prisoners released regardless as to whether they were criminals or political prisoners. Police stations were burned. Documents of the law courts flung from the windows made grateful bonfires beside the frozen canal. The capture of the arsenal enabled many to experiment with firearms that they had never handled before. Individual policemen, possibly ignorant of what had happened, kept up desultory fire from machine-guns in isolated posts until they were overwhelmed. Some of the members of the Government went into hiding. Others took refuge in the Admiralty, where they were besieged for a night, while to the accompaniment of joy-firing without they composed a proclamation ordering the people not to remain in the streets after eight in the evening.

The Duma and the Soviet.—The old régime had lost its will, but the revolution was as yet without a mind of its own and uncertain as to what to do with its victory. It had yet to become articulate. In the Taurida Palace, the seat of the Duma, were two groups ready to speak for it, one to persuade it that it had but taken the first step, the other to tell it that its work was done.[1] The

[1] On March 12 the Council of Elders of the Duma chose a temporary committee of members of the Duma: Rodzianko, Shulgin, V. Lvov, Dmitrukov, Shidlovsky, Karaulov, Konovalov, Kerensky, Rzhevsky, Miliukov, Engelhardt, Nekrasov and Tchkheidze. On the same date was formed the temporary committee of the Soviet of Workers' Deputies: Gvozdev, Bogdanov, Kapelinsky, Grinevich, Tchkheidze, Skobelev, Frankorussky and others. Tchkheidze was in both groups. On the evening of this day was the first meeting of the Petrograd Soviet. The new Government formally took over office on March 14, with Prince Lvov as Prime Minister.

abortive revolution of 1905 was in the minds of both. The first of these groups was made up of labour members who, with co-opted friends (a likely man had but to put his head into the room to be co-opted by acclamation), formed a "temporary committee" of an as yet non-existent Soviet (Council) of Workers' Deputies. These men remembered the part played by the similar Soviet in 1905, and were persuaded that it would be the chief instrument of revolution in 1917. They called upon the revolting regiments to send one representative from each company and the factories to send one for every 1,000 workmen to the first meeting of the Petrograd Soviet, which was to be held at once. The second was a much larger group of members of the Duma, who remembered with the utmost misgiving the Soviet of 1905, and were anxious at all costs to arrest the movement in Petrograd and to save what they could of the old régime. They had the advantage of being in touch with existing government apparatus, but the disadvantage of being compelled to insincerity in public utterance. In the face of the troops and the populace of Petrograd they had to welcome the revolution which in reality filled them with misgiving and disgust. The essential difference between the two groups in their attitude towards what was happening is best illustrated by their first instinctive actions. The Duma group looked in all directions for armed force that would act without "reasoning why." The Soviet group sought to make the revolution articulate. The Duma group asked the Tsar to abdicate in order to save the country from revolution. The Soviet group, exulting in revolution, appealed directly to it to defend itself against the Tsar or anyone else. What was an undesirable storm for the one was a fair wind for the other.

Troops with and without their officers came to the Taurida Palace, and at the same time declared their readiness to support the Duma and choose delegates to the Soviet. In the prevailing chaos, Duma and Soviet were alike crystallising points. Neither at the moment had any strength, but they seemed to have direction, and, in the general breakup of the organised will of the old régime, for a thing to seem to have direction was enough to make it a straw for drowning men. The Duma rapidly gathered the emblems of power, while the Soviet, by identifying itself with the masses of the factory workers and with the garrison by means of its invited delegates, was gathering the reality. This became perfectly clear in the course of the struggle round the throne. While the Duma was able to collect promises of support from the heads of the armies, the Soviet was able to prevent Rodzianko (President of the Duma) from going to discuss matters with the Tsar. Rodzianko had done his best to persuade the Tsar to take some action that might at least temporarily have appeased the discontent of which everyone was conscious before the revolution broke out.

Abdication of the Tsar.—It was now too late to hope to do more than satisfy the revolution with a change of person. The Tsar was to abdicate in favour of his infant son, nominating the Grand Duke Michael as regent. Guchkov and Shulgin (both confirmed monarchists) were sent on March 14 to the Tsar to obtain his abdication. The Tsar abdicated (March 15) both for himself and for his son in favour of the Grand Duke Michael, but by the time Guchkov and Shulgin returned to Petrograd the revolution had so far crystallised round the Soviet that it was clear that this arrangement for the preservation of the dynasty would not be accepted without a struggle. Miliukov, the leader of the party of Constitutional Democrats (Cadets), who consistently underestimated the forces that had been unchained, and was perhaps inclined to estimate his influence on the people by the devotion given to him in his own party, by announcing that the Duma Committee had decided to leave the dynasty on the throne, had lifted the veil that had covered the real feelings of the Duma Committee, and so had enormously strengthened the Soviet.

Already the fear of that organisation had induced the Duma Committee in forming a Government (March 14), to include representatives from the Left. Kerensky, a lawyer and member of the so-called group of Labour, had dramatically obtained permission from that other room in the Taurida Palace before taking a part in the Government, where he carried particular weight (together with opprobrium) because of his connection with this outside force of which the other members of the Duma committee were instinctively and rightly afraid.

His attitude to the revolution was not that of his new colleagues. He could speak with an enthusiasm which they could not counterfeit. He was not hampered, at first at any rate, by a profound dislike of the events that brought him to power. After the return of Shulgin and Guchkov (who themselves realised that the situation had changed considerably during their short absence from the city) the Duma committee laid the Tsar's abdication and the throne before Grand Duke Michael on March 16, and he, perhaps feeling that he was being offered what at that moment no one had the power to take, refused the throne, and was solemnly congratulated by Kerensky on his refusal. Pushed by events that they were quite unable to control, the Duma committee assumed with as good a grace as possible the nominal government of the Empire, the Soviet contenting itself with insisting that the proclamation of the new government should contain a clause promising that the nation should be allowed to decide the future of the country in a constituent assembly.

The Provisional Government.—In a few days the whole of Russia had learnt that the autocracy was no more, that a new Government under Prince Lvov, with Guchkov as Minister for War, Miliukov as Minister for Foreign Affairs and Kerensky as Minister of Justice was in place not in power, and that there was once again a Soviet in Petrograd inviting the formation of similar Soviets throughout the country.

The Provisional Government, described by Miliukov as having been "elected by the revolution," rapidly obtained a fair measure of apparent stability. It was formally recognised (March 22) by the Allied Governments. The whole civil service transferred to it their former loyalty to the autocracy. Its weakness was that it was content with these things, was deceived by the prestige which it enjoyed among a limited class and by its possession of the old administrative machine, and neither had nor sought to obtain that right to speak and act for the revolutionary masses which was given to the Soviets by their direct connection with factories and troops. The only Government decrees that had any certainty of fulfilment were those that the Soviets would have been ready to countersign. As the Soviet was for a long time unwilling to take supreme control, the result was not "dual power," but actual though not formal responsibility of the Government to a Soviet of the very existence of which most of the ministers heartily disapproved.

In time of peace the natural slackening of political tension in the masses might have brought about a decadence of the Soviets and an eventual concentration of real authority in the hands of the Government. But Russia was at war, and the continuance of the War made any slackening of political tension impossible. If the War lasted long enough it was clear that the Soviets would have to take authority openly into their hands, or submit to being crushed by military forces which would then replace them as keepers of the Government's conscience. It was consequently natural that the first bone of contention between Soviet and Temporary Government should be the control of the army. Rodzianko, and after him the Temporary Government, sought to control the army through its leaders, and hurried to obtain expressions of their allegiance. The Soviet could not hope for support from the officers, and therefore sought to make them powerless while assuring itself of the support of the men.

Remembering 1905, they knew that their existence depended on the inability of their enemies to bring an organised force against them. Not pro-Germanism, but the events of 1905, dictated the famous Prikaz (Order) No. 1, (issued on March 18) which hurried towards its end that process of disintegration in the army which had been begun by inefficient government, officers who had made themselves hated, over-mobilisation and a long succession of military failures.[1]

[1] Prikaz No. 1 was composed by a commission of the Petrograd Soviet headed by N. D. Sokolov. In the name of the "Soviet of Workers' and Soldiers' Deputies," it ordered that committees of

It was proved once again that in the minds of its participants a civil war, and especially a struggle between classes, outweighs any national struggle whatsoever. In the months that followed, the parties of the Right were as ready to weaken the front by bringing disciplined troops to suppress revolution in the rear as were the parties of the Left to weaken the front by destroying the discipline of the troops. Both sides were conscious of enemies nearer and more dangerous than the Germans.

Party Demarcations— Roughly speaking, there were but two sides to the struggle. There were, however, many parties engaged. Scattered remnants of the parties on the Right in the old Duma had clung to the revolution in time to save themselves from being buried in the collapse of the old régime. On this side the only well-organised party was that of the Cadets (Constitutional Democrats), who renamed themselves the party of Popular Freedom, and, after failing to preserve the dynasty, were now trying to arrest the revolution before it should overwhelm the landlords and the factory owners. The Cadets were in open hostility to the Soviets. Then came parties with a foot in both camps, supporting the Temporary Government but unwilling to see the Soviets suppressed, since they were conscious that the parties on their right would not stand on ceremony with them if the Soviets were only out of the way. Of these the most important parties were the Social Revolutionaries and the Mensheviks as they were called.

The Social Revolutionaries believed that social revolution was impossible, but desired an agrarian revolution to the advantage of the peasants who were their chief support. The Mensheviks and the Bolsheviks were the two sections of the old Social Democratic party, which was based on the factory workers of the towns. They were temperamentally divided, the former inclining always towards coalition with the bourgeois parties and doubting the possibility of social revolution in a country in which capitalism was as little advanced as it was in Russia, the latter opposed to any coalition with the bourgeois parties now that their common enemy (the autocracy) was no more, and believing that the World War had so shaken the economic system of Europe that a social revolution was possible everywhere and most possible in Russia. Skirmishing between and around these parties were many small sections of Social Democrats, Maximalist-Internationalists, groups identified with particular newspapers and loosely organised parties of Anarchists.

Social Revolutionaries and Mensheviks had taken a line during the War which, in spite of the arrests immediately before the revolution, had made them much less subject to persecution than the Bolsheviks, who, in Feb. 1917 were in a state of almost complete disorganisation. Nearly all the Bolshevik leaders were in prison, in exile or abroad, harried both in Allied countries and in those of the Central Empires because of their doctrine that the War was exclusively to the advantage of the bourgeois classes, that it was a capitalist quarrel and that the working classes should bring it to an end by refusing to fight each other and by turning in each country against their rulers. No fighting country could tolerate such propaganda, and a series of deportations had left the Bolshevik leaders for the most part in Switzerland, Sweden and America. It was not surprising that Swiss Socialists were easily able to get leave for Lenin to cross Germany with this theoretical baggage. Trotsky (with almost identical views, though not then a Bolshevik) was arrested on Allied soil, but allowed to proceed on the intercession of Miliukov, an intercession which proved sufficiently that real power in Petrograd was in the hands of the Soviet.

soldiers were to be formed in all military and naval units, and to send one representative each to the Taurida Palace next morning. In their political actions units were to be subject to their committees and to the Soviet. Orders of the military commission of the Duma were to be obeyed only when they did not contradict those of the Soviet. Arms were to be under the control of the committees and on no account to be given up if demanded by the officers. Strict discipline was to be preserved when on duty. Salutes, etc., when off duty were abolished. Special titles used in addressing officers, "Your excellency" and references to the officer's noble birth, were abolished. Officers were forbidden to use the second person singular in addressing soldiers.

The Return of Lenin.—Lenin arrived in Russia on April 16 after crossing Germany in a sealed railway car, and then passing through Sweden and Finland. He made his first speech at the railway station, where he was met with mixed misgiving and enthusiasm by his old revolutionary associates. He found only a handful of his party in the Soviet. From the moment of his arrival the Bolsheviks had a definite policy. They set themselves to bring into the open the profound mistrust of the masses that actuated the Temporary Government. They urged that the Soviets should take power (in spite of the fact that they were themselves in a minority) believing that the other parties in the Soviets would lose the confidence of the masses by showing that they had no confidence in themselves. They urged the immediate ending of the War. They were at first comparatively few, but they had none of their opponents' psychological handicap of doubt. Revolution had always been to them of greater importance than any war waged by non-revolutionary Governments.

It was not surprising that they made converts rapidly. The peasants, soldiers and workers had never considered the matter before. Russia was not a homogeneous country. Even invasion left huge areas of it quite indifferent except to mobilisations and economic troubles, for which they did not blame the invaders. Peasants and workers alike were heartily sick of the War, and were besides inflamed by the miracle of the old régime's collapse. Everything seemed possible. The world had been turned upside down, and they had other things to think of than a war in which they had never had any personal interest. Throughout the country the peasants began to settle the land question in their own way by taking the land of the squires. The peasant soldiers wanted to get home anyhow, and began to be afraid of missing their fair share of the land if they remained too long away. None of them wanted to die just as a new world was opening before them. They wanted peace, at once, so that they could settle things to their own advantage in that new world. The masses were, as Lenin rightly perceived, far more "Left" than their representatives in the Soviets.

Continuance of War.—The Temporary Govt. were quite unable to disguise their disagreement with them. The Soviet, however, acted as a buffer between Government and masses, and, while not going so far as to demand an immediate end of the War, sought to remove all obstacles to the conclusion of peace by renouncing all claims to territorial or monetary gains. If Russia was not to make peace without getting Constantinople, the end of the War was not in sight. If she were ready to make a peace based on ethnographical frontiers, she at least would not be to blame for the continuance of war. On April 9 the Temporary Govt. issued a declaration agreeing verbally to these principles, but on May 3 was published the note with which Miliukov had accompanied that declaration in sending it to Russian representatives abroad for transmission to the Governments to which they were accredited. This accompanying note (said to have been unanimously approved by the Temporary Govt.) informed the Allies that in spite of their disturbing views Russia's position with regard to the War was unchanged. The Soviet was indignant. There were angry demonstrations, and Miliukov's resignation (May 15) came too late to undo the work his note had done in helping the Bolsheviks by creating distrust of the Government.

The Government tried to borrow authority from the Soviet by borrowing names from it. In the reconstructed Government Prince Lvov now (May 18) had Kerensky as Minister for War, in place of Guchkov, who had resigned in despair (May 12); Chernov (Social Revolutionary) as Minister of Agriculture; and Skobelev (Menshevik) as Minister of Labour. Tereshtchenko, a clever young sugar magnate, replaced Miliukov at the Foreign Office. The Temporary Govt. thus included landowners and men who had spent their lives in preaching that the land belonged to the peasants, manufacturers and men who believed in the socialisation of industry. It was damaged alike by the support and by the criticism of the Cadets, and by the support and by the criticism of the Socialist parties. A political Joseph's coat of many colours draped a weakness that was betrayed at the

slightest tension in one direction or the other. Meanwhile, without the responsibility, the Soviets were consolidating their position, though becoming increasingly conscious that the masses, interested mainly in land and peace, were steadily transferring their allegiance from the more moderate parties to the Bolsheviks.

Meanwhile the War continued, though in the Russian trenches the din of continual dispute had replaced the silent discontent of the year before. Officers' messes, soldiers' committees and the soldiers were on the front what Government, Soviet and masses were in the capital. Without the sanction of the committees the orders of the officers were not obeyed. The committees were markedly more inclined to support the officers than were the men whom the committees represented. Just as in the rear they could point to the support of the Government by the Mensheviks and Social Revolutionaries, so at the front the Bolsheviks could undermine the soldiers' committees by pointing out how they supported the officers. The officers, however, lumped in common detestation the committees with the Bolsheviks who were undermining them, just as in the rear the parties on the Right helped the Bolsheviks by attacking the Soviets, in which as yet the Bolsheviks were in a minority.

Things were moving in a definite direction. Their speed was increased by the decision that the Russian Army was once more to take the initiative on the front. After an extraordinary oratorical campaign by Kerensky in June the Russians made a spectacular advance[1] in the southwest, naturally sacrificing in doing so a large proportion of that leaven of officers and men who were still prepared to fight. The political meaning of the advance was illustrated in Petrograd by the demonstrations by well-dressed people which accompanied the first news of the victories. But the victories were followed by a series of defeats and a disorderly rout, during which hundreds (some say thousands) of fleeing Russians were shot down by other Russian troops.

The morale of the army was finally broken. The struggle in Galicia was reflected in an intensification of political feeling in the capital, where, though one side shouted "War" and the other shouted "Peace," both were less interested in war and peace than in the struggle for power in which all parties were engaged. In these critical days the Cadets announced (July 16) their withdrawal from the Temporary Govt. (disapproving of its policy in the Ukraine), thus weakening it by an attack from the Right at the very moment when it had to fear an attack from the Left. It was in these days that a large part of the Petrograd garrison, together with many of the factory workers, paralysed the town on July 16 by demonstrations the object of which was to persuade the Soviet leaders to assume the government of the country.

The Executive Committee.—The most important feature of the Soviets in the early period of the revolution was that they were in a continuous state of general election. Agitation was going on all the time by all parties, and successful agitation ended in the recall of the delegate of one political denomination and his replacement by a delegate of another. Opinions changed from day to day, and many people, not merely those without political experience, slipped rapidly through a whole gamut of political allegiances. The result of this was that the Soviets reflected very well the changing political complexion of their constituencies. In the middle of June was held in Petrograd the first All-Russia Congress of Soviets, to which delegates came from Soviets all over the country. It was mainly Menshevik and Social Revolutionary. While in favour of all possible steps towards a general peace, it supported Kerensky on the question of national defence. This Congress elected an Executive Committee, which was to act for the Congress after its dispersal until the next All-Russian Congress should meet. This Executive Committee was thus the chief organ of the Soviets, and not subject to any change of political complexion until the meeting of the next Congress, whereas the masses for whom it was to speak were changing with extraordinary rapidity. Kerensky's advance on the front, which seemed to the masses to mean the abandonment of any hope of peace, brought the Executive Committee within a few days face to face with the fact that it would presently be left high and dry by the movement it sought to control and represent.

On July 16 and 17 regiments of the garrison, a large body of the Kronstadt sailors and bodies of the factory workers made an extraordinary demonstration. For a number of hours the town was entirely in their hands. The Government was powerless. Yet nothing happened. The demonstrators marched to the headquarters of the Executive Committee and called upon them to take power. The Executive Committee replied that they did not wish to do so. The demonstrators, puzzled and disheartened, melted slowly away. Finally the authorities gathered courage and hastened their departure. The effect of these events was to confirm the Executive Committee in its support, such as it was, of the Government, but to frighten the Government into measures which lost them that support until a new move from the left drove Committee and Government together again. From this moment, Kerensky (on whom more and more fell the whole responsibility of governing), together with the Executive Committee, was tossed now to the Left now to the Right by the forces on either side, until by a process of attrition he was left without support and Rights and Lefts faced each other openly in civil war.

The first result of the fright of July 17 was a desperate effort to make an end of the Bolshevik agitation. Comparatively uninfected troops were brought in from the front. The offices of the Bolshevik newspaper *Pravda* were sacked on July 18. The headquarters of the Bolsheviks were seized. Trotsky and many Bolsheviks were arrested; Lenin and Zinoviev only escaped arrest by hiding in disguise. Kerensky, appointed Prime Minister on July 21, formed a third Temporary Government. This Government too felt the sand slipping from under it, and endeavoured to secure for itself at least a semblance of popular support by summoning a State Conference in Moscow in the hope that the atmosphere of Moscow would be less electrical than that of Petrograd. The conference met towards the end of Aug. and was a spectacular affair, but illustrated chiefly the increasing loneliness of Kerensky. On the one hand general after general expressed his views on the disorganisation of the army and the need for a strong Government, and on the other the illusion of popular support was destroyed by a strike of the Moscow workmen.

On Sept. 3 Riga was abandoned to the Germans. Five days later General Kornilov advanced on Petrograd with the object of establishing a military dictatorship. It is said that this adventure began as the result of a misunderstanding (*see* KORNILOV). However that may be, it was warmly approved by some of the representatives of the Allies in the capital, and led to a strengthening in the first place of the Executive Committee and the Soviets (to whom Kerensky had to turn for support against Kornilov), and in the second place of the Bolsheviks who had their thesis on the imminent danger of counter-revolution thus illustrated on a big scale. The Cadet ministers resigned, and did not attend their ministries. The Executive Committee succeeded in stopping the Kornilov troops by talking to them, and instead of hanging agitators from lamp posts, as had been expected, their representatives came into the town in a motor-lorry to explain that they had been misled.

The Directorate.—The Temporary Govt. resolved itself into a Directorate of five with Kerensky at the head of it, and, without waiting for the Constituent Assembly, declared Russia a republic (Sept. 15). The growth of Bolshevik influence throughout Russia was shown by the passing of Bolshevik resolutions in both the Petrograd and Moscow Soviets (Sept. 13 and 15). These were signs more threatening both to Kerensky and to the Executive Committee elected in June than the abortive demonstrations of July. It was not surprising that when Kerensky made yet another attempt to secure for his government foundations in popular support, he found the Executive Committee of the All-Russian Congress of Soviets willing to help him by joining in a conference the obvious purpose of which was to lessen the significance of the Soviets themselves.

This was the Democratic Conference of Sept. 27, at which were present not only the Executive Committee, but representa-

[1] Battles of Brzezany (July 1–6) and Zborow (July 19–26).

tives of the trades unions, co-operatives, town and rural councils, etc. With great difficulty a resolution in favour of a coalition (*i.e.*, not exclusively Socialist) government was passed. It was accompanied by a resolution refusing coalition with the Cadets. The two resolutions cancelled each other. Out of this conference, with the addition of other elements, grew the Council of the Republic (nicknamed the Predparliament—Preliminary Parliament)—which was to be the supreme governing organ until the meeting of the Constituent Assembly. It too was without roots and without influence. Yet another government was formed under Kerensky's premiership, including several Cadets. The Predparliament met on Oct. 20. It was never dissolved but simply faded away. Things were moving too fast for anybody to pay much attention to a wholly artificial body. Both the Petrograd and Moscow Soviets had elected their local Executive Committees with Bolshevik majorities. It was clear to everybody that when the second All-Russia Congress of Soviets met it would be likely to elect an Executive Committee that would no longer oppose the Bolshevik desire that the Soviets should take both formal and actual authority into their hands.

The November Revolution.—Lenin from his hiding place had been pressing for some time for an immediate seizure of power. At last he was able to get the Bolshevik Central Committee to agree with him. On Oct. 29 this committee, together with delegations from the factory committees, the trade unions, the railway workers, etc., agreed upon immediate action. The Petrograd Soviet had formed a Military Revolutionary Committee, which, since its first object had been to prevent troops being moved from Petrograd to the front to be replaced by others on which the Government could rely, had no difficulty in assuring itself of the allegiance of the garrison. The Government showed their lack of confidence by finding it necessary to issue orders to the troops to take instructions only from the district staff. As the second All-Russia Congress of Soviets was to meet on Nov. 8 everyone in the town knew when to expect the revolt. Kerensky in the Predparliament demanded extraordinary authority for its suppression. The Predparliament desperately resolved to ask the Allies to open peace negotiations and to hand over the land to the peasants without delay. It was too late. The trial of strength came at once. The Government ordered the suppression of two Bolshevik newspapers. The Military Revolutionary Committee replied by ordering the Government troops to protect the Bolshevik newspapers. The papers came out as usual.

The Revolutionary Committee made its final arrangements openly over the telephone, and on Nov. 7 detachments of troops and workmen took possession of the Government buildings. On that day Lenin, who had left Finland some days before and was living in hiding, came to the Smolny Institute. The second Congress of Soviets met in Petrograd (Nov. 7) with a big Bolshevik majority; the old Executive Committee was replaced by a new one largely Bolshevik; most of the representatives of the other parties walked out; the Government was declared overthrown, and a Council of People's Commissars was elected by acclamation (Nov. 8). Lenin presided over the Council, which was at first exclusively Bolshevik, but presently included some Left Social Revolutionaries, representing that wing of the Social Revolutionary party which approved of the assumption of authority by the Soviets. Some members of the Kerensky Govt. were besieged in the Winter Palace and captured there. Kerensky himself escaped almost alone to meet the troops he had ordered up for the suppression of the revolt. He joined General Krasnov at Gatchina on Nov. 8 or 9.

For a few days it seemed possible that General Krasnov's force of 1,500 Cossacks would succeed in conquering the utterly undisciplined forces of the revolution, which consisted of soldiers who did not want to fight and workmen who wanted to fight but did not know how. With the help of sailors from Kronstadt and Helsingfors the Cossacks were, however, defeated. Krasnov was taken prisoner on Nov. 14, and released on parole, an act of generosity which the Bolshevik leaders subsequently had cause to regret. There was little serious fighting. It was a struggle between two weak forces, of which one, Krasnov's, had discipline but no convictions and the other convictions but no discipline. The latter were able to make a slightly better show in numbers. Victory in a skirmish at Pulkovo decided the event. Kerensky had fled in disguise before the defeat of Krasnov. The Cadet and the Menshevik parties supported several abortive attempts at a rising in the town of which the most important was a revolt of the Cadets of the Mikhail or other military schools. In Moscow there was nearly a week of street fighting before the Soviets were in undisputed possession.

Elsewhere the new turn in events was rapidly reflected throughout the country, except in the Cossack districts, where General Kaledin had been able to organise resistance, and in the Ukraine, where the expression of separatist tendencies had produced a rather more strongly supported Government than there had been in Petrograd. It was not until Feb. that the whole of the Ukraine was in the hands of the Soviets. The events in Petrograd spread like a spark in a fuze along the Siberian railway, though officers of the old army seized power in the Far East. In various parts there were encounters between forces supporting the Soviets and small bodies migrating from the front towards the Cossack country, which became the natural focus of the counter-revolutionary officers. But these forces were as much opposed to Kerensky as they were to the Soviets, and within a few days there was no town in Russia that still recognised the Temporary Govt., though, so huge is the area of Russia, so limited the means of communication, that years after it was still possible to find in remote districts people who had hardly realised that anything in particular had happened since 1914.

The Bolshevik Government.—The Council of People's Commissars set up by the Congress of Soviets was now the only Government in Russia, but did not, like the Temporary Govt. at the beginning of the revolution, find itself in possession of an almost undamaged administrative machine. Its opponents, regardless of the fact that Russia was still at war, seemed determined to justify the Bolshevik claim that the new Government and the old represented hostile classes—whose hostility was more pronounced than any that could exist between warring countries. The whole of the civil service went on strike with the exception of about a dozen young women. In many cases the civil servants deprived the new Government not only of their services but also of the petty cash of the ministries to which they belonged. A new civil service had to be built up in a hurry out of nothing, and in the beginning the whole of it was housed in the Smolny Institute, formerly an educational establishment for the daughters of the aristocracy and latterly the headquarters of the Petrograd Soviet. In one room was the President, in another the Home Office, in a third Trotsky was conducting Foreign Affairs, in a fourth a few youthful doctrinaires were covering reams of paper with sketches of what they thought should be State finance, in a fifth was the War Office and the General Staff, wrestling wildly with the defence of the capital and very resentful of the President, who insisted on bringing a kitchen table into this room and taking an active part in the military deliberations. In a big room in the building meetings were in continual progress, and one after another the members of the Government would gallop down the long corridors to address excited crowds and then hurry back to go on with their work. Many of them slept in these improvised offices, and, having at first no time for proper meals, lived on enthusiasm, sandwiches and weak tea.

With none of the emblems of authority, but with the confidence given by victory in Petrograd and by the Bolshevik majority in the Congress, which promised victory in the provinces, Lenin began at once to speak in the tone of an established Government. "We are strong," he said, "when we express that of which the masses are conscious." He was not handicapped as Kerensky had been by pressure from both sides. He did not claim to be representing all classes, but saw his Government as an instrument of revolution, with the immediate task before it of strengthening itself by trying to carry out the desires of those classes which had put it in power and by destroying the means

of resistance of those classes which would otherwise destroy it. Hostility between classes was to him a strength, not a weakness, and if the bourgeoisie had not helped him by so clearly showing their hostility he would have had to provoke them into doing so.

The Soviet Govt. proceeded at once (Nov. 8) to declare that all land belonged to the people, to to be used without payment; this decree legalised the agrarian expropriation begun early in the summer, which was the chief thing that the peasants thought to gain by the revolution. The Soviet Govt. decreed an eight-hour working-day (Nov. 11); it abolished titles other than that of "citizen" (Nov. 23); the workers were to control the factories (Nov. 29), placing them under the general guidance of a Council of Public Economy (Dec. 18); it made labour a condition of political rights; it decreed a general arming of the "working" and a disarming of the "possessing" classes; it annulled all secret treaties; it disclaimed responsibility for loans made to previous governments; it nationalised the banks (Dec. 30); declared the independence of Finland (Jan. 4 1918); it introduced the Western European calendar (Feb. 14); it separated Church from State and School from Church (Feb. 5 1918); and while setting up a federation of Soviet Republics in the place of the old Russian Empire, left the question of entry into that federation to the Soviets of the nations and districts concerned.

This was a beginning sufficient to secure the hostility of all foreign Governments and of all but the working classes in Russia, and the instinctive support of most Socialists everywhere. The Bolsheviks, now in almost absolute control of a Government, had spent 20 years in ceaseless debate as to what a revolutionary government should do, and they set about putting their decisions into practice as fast as they could write the necessary decrees — 193 decrees were issued between Nov. 8 and Dec. 31 1917. When, as in the case of the land, they issued a decree that did not represent their own views, they issued one that satisfied the peasant and ensured unwillingness on his part to help in any attempt to replace them by another Government that might issue a decree of a less desirable character.

Attitude Towards the War.—The downfall of the Kerensky Govt. and the accession of a Government supported exclusively by the working classes naturally brought about a radical change in the attitude of the Bolsheviks towards the War. They had from the beginning seen the War as a struggle between capitalist groups, and had declared that revolutionaries in each of the countries engaged should desire the defeat of that country on the ground that the defeat of one capitalist group by another would weaken it not only among its peers but also in the face of revolution from below. They had assumed that German Socialists would desire the defeat of the Kaiser, that French Socialists would desire the defeat of the French Republic. For themselves they did indeed desire the defeat of the Tsar. The year 1870 had given France the experience of the Commune which for 70 days had ruled Paris. The defeats of the Japanese War had resulted in the events of 1905 and the first serious attack on the autocracy. During the War defeatism in Russia had spread far beyond the Bolsheviks, when the most loyal of Liberal monarchists could not help observing that defeats on the front meant that the voice of the Duma counted a little in the Palace, whereas success meant an immediate hardening of the autocracy. The downfall of the autocracy was for the Bolsheviks only a preliminary to the social revolution. Their defeatism continued until the downfall of the Temporary Government. That downfall meant for them that power had shifted from the autocracy to the bourgeoisie and now to the working class. Further defeatism would now be possible only to the enemies of the working class, who would reason that defeat would now be to their advantage.

From the moment that the Bolsheviks took power the defeat of Russia ceased to be desirable by them, whereas the German Empire became the most dangerous enemy of the revolution, because it was the nearest and most powerful non-revolutionary State. On the other hand, a victory of Russia in concert with the Allies was equally undesirable, because it would discredit the revolution in the eyes of the German working class. The only possible course for the revolution was to retire from the struggle if it could, and to use the steps it could take towards peace as a means of rousing the working class of other countries to impatience of the continuance of the War. To understand what followed it is essential to remember that there was for the Bolsheviks no difference in kind or quality between the Governments of the Allies and those of the Central Empires. All were equally rapacious. Some of the Bolsheviks even thought it possible that in the presence of social revolution in Russia the two camps would hurriedly compose their differences and crush the revolution before it had time to entrench itself.

At the moment of taking power, the revolution was powerful against its enemies inside Russia, for these were divided and impotent. But the shaking to pieces of first the autocracy and then the classes that succeeded the autocracy had been accompanied by the complete ruin of the army. After the first month of 1917 desertion had been a rapidly growing tide. The vague idea of land distribution crystallised an already existing weariness of war into a blind determination to leave the front. Even before the Nov. revolution Kerensky's War Minister had told him that the only thing to be done with the old army was to disband it and start afresh to build a new one. The Nov. revolution found the army all but disbanded, in spite of Kerensky's efforts to keep it together. The trains were crowded with soldiers, many of whom took their weapons with them. Most of the men were straggling back to their villages if they knew how to get there. Others simply travelled, boarding any train if it had room on its buffers or on the roof of its coaches, and changing from one train to another without care for its ultimate destination. Stations were camps of migrating soldiers. Officers were going southwest to the Cossack country to raise forces against the revolution. The Germans could easily have walked into Petrograd, and been welcomed as they were welcomed in Kiev by everybody who preferred being ruled by a foreigner to being ruined by a revolutionary.

Peace with Germany.—The Bolsheviks accordingly proceeded at once to keep their promise to take immediate steps to bring the War to an end. Trotsky as Commissar for Foreign Affairs sent out (Nov. 9) alike to the Allies and to Germany an invitation over the wireless to conclude an immediate armistice. Germany agreed. The Allies did not reply except by remonstrances, presented through their military representatives to General Dukhonin, against a separate peace. An appeal was sent (Nov. 28) by wireless to the peoples of the Allied countries urging them to compel their Governments to bring the War to an end. The Russian commander-in-chief, Dukhonin, while himself agreeing that an immediate peace was necessary for Russia, refused for technical reasons to take steps for concluding an armistice along the front. He was dismissed, arrested and lynched while under arrest. Krylenko, a rather elderly sub-lieutenant, was made commander in chief. An informal armistice began at once, a formal one being concluded a few days later (Dec. 5) for the whole front, from the Baltic to the Black Sea.

The Germans were ready to accept in principle the Russian formula of a peace "without annexations or contributions on the basis of the self-determination of peoples," but soon showed that they, like the Allies, had altogether underestimated the Bolsheviks' sincerity. They believed that the Bolsheviks would be ready to hide under that formula the sort of peace that was desirable by the German general staff. In this they were wrong.[1] The Bolsheviks promptly announced (Jan. 27) both to Russia and to the world that the peace the Germans were offering was the sort of peace offered by a wolf to a sheep, too big to be eaten all at once. They hoped that the German working classes would be roused to action on finding that the greed of their rulers prevented the signature of peace. The bourgeois Government of the Ukraine signed a separate peace (Feb. 9) after it had been driven over the Ukrainian frontier, and invited the Germans to enter the Ukraine to replace it in power (*see* BREST-LITOVSK). The Bolsheviks declared (Feb. 10) that they would no longer fight but

[1] An account of the negotiations in Brest-Litovsk which opened on Dec. 21 will be found under that heading.

would not sign the peace. The Germans advanced and could, no doubt, have come to Petrograd and put a Russian bourgeois Government in power to make peace with them.

After a fierce struggle in the Central Committee of the Communist party, Lenin persuaded the Bolsheviks that the best thing they could do was to sign peace at once if the Germans would let them. This was done. The peace signed (March 3) was worse than that originally offered, and, thanks to the action of the Ukrainian Rada, worse even than it seemed on paper. The Germans occupied the Ukraine, and Russia lost the Baltic Provinces. Petrograd was left subject to attack from the Finnish border, only a few miles away, and from the Estonian border, less than a day's journey.

The Government moved to Moscow[1] (March 9) where on March 15 assembled the Fourth Congress of Soviets, which ratified the peace. The Left Social Revolutionaries resigned from the Government, which was henceforth exclusively Bolshevik.

The Constituent Assembly.—By adopting as soon as they came to power the Social Revolutionary land programme, the Bolsheviks had assured themselves of the passive support of the peasants and, in the first moments of the revolution, of part of the Social Revolutionary party. The signing of the Brest Peace, against the will even of those Social Revolutionaries who supported the Bolsheviks, but to the profound satisfaction of the peasants and the soldiers of the old army, destroyed the hold of the Social Revolutionaries on the peasants. These two actions prevented the dissolution of the Constituent Assembly from having immediate political consequences in Russia. The idea of a Constituent Assembly played a part in the Russian Revolution profitable at different times to different parties. In March 1917 the promise of a Constituent Assembly made possible that agreement between the Soviets and the Temporary Govt. on which the very existence of that Government depended. As it was clear that immediate elections to the Assembly would have given an immense majority in the Assembly to parties represented in the Soviets, the parties on the Right desired to postpone it, while the demand for its immediate summoning became a useful lever against them in the hands of the Bolsheviks. As the Soviets became more Bolshevik the postponement of the Constituent Assembly became less desirable except by those who hoped that it would be possible by some military coup to suppress the parties of the Left before the elections. When, after the failure of the Kornilov adventure, these hopes were dashed, the Constituent Assembly became in the minds of the anti-Bolshevik parties a means of drowning the extremist vote of the towns in the slightly more moderate vote of the peasants, and active preparations for the elections were at last begun.

When the Soviets took power in Nov. the Bolsheviks, who now regarded the Constituent Assembly as unnecessary and even dangerous since it might mean what was to them a retrograde step from the hegemony of the towns to a democracy in which the towns would be outvoted, were a little hampered by the momentum of the agitation they had carried on formerly against its postponement. They decided to hurry on the elections, to split the peasant vote and simultaneously to declare that the Soviets were, in a revolution, a higher authority than any assembly in which the possessing classes could take part. If by hook or crook they could get the Assembly to confirm the authority of the Soviets, well and good. If not, they would use the methods of Cromwell. Meanwhile the rival parties prepared to make the Assembly a rallying point for a struggle with the Soviets in the capital. The Social Revolutionaries obtained 21,000,000 votes on a party list which included supporters of the Bolshevik revolution, the Bolsheviks 9,000,000, and the Cadets under 2,000,000. Roughly speaking, the Cadet vote was that of the propertied classes, the Social Revolutionary vote was that of the peasants, and the Bolshevik vote was that of the towns and of a considerable part of the army which, of course, was mainly composed of peasants. The Cadets represented a force active but very small, the Social Revolutionaries a class large but unorganised, scattered and passive, the Bolsheviks a class extremely active, comparatively well organised and, by its domination of the towns, holding all the most valuable strategical positions. The Assembly met on Jan. 18. As soon as it had declared its complexion by electing a Right Social Revolutionary, Tchernov, instead of a Left member of the same party in Marie Spiridonova, as president, the Bolsheviks and the Left Social Revolutionaries allowed it to be told to go home (Jan. 19) by its guards, who expressed the opinion that it had talked enough. An attempt at a demonstration by its supporters was a complete fiasco. It became thenceforward a watchword used indiscriminately by all the anti-Bolshevik parties.

The dissolution of the Constituent Assembly, the temporary settlement of the land question and the signing of the Brest Peace marked the end of the first period of the revolution. The autocracy had gone. The struggle for leadership had ended. Government in Russia was neither half-hearted nor divided against itself, but was a homogeneous body to whose support were committed the most active and determined sections of the town population, while it had definitely assured itself of the neutrality of the peasantry.

March 1918 to March 1921

The second period of the revolution begins with the transfer of the Government from Petrograd to Moscow and the ratification of the Brest Peace. There had been since the overthrow of Kerensky three congresses of Soviets attended by delegates from all parts of the country. The first had appointed the Council of People's Commissars, and the second and third had approved their activities. In all three there had been a considerable and outspoken opposition, but the essential quality of that opposition, had been that it was an opposition of politicians and that the main point at issue (the making of peace) was one on which the Government was taking a line that would have been incumbent on any Government whatsoever. Argument as to responsibility for the past was irrelevant to the plain issue as to whether or not Russia was in a condition in March 1918 to remain fighting. The opposition accordingly was not one of which the Government had any need to be afraid. It had been able to destroy all armed opposition within the country because the forces that opposed it were less willing to fight than its own, weak as these were. It was beginning to build up a new armed force.

The Cheka and the Red Guards.—The first nucleus of this force was the institution afterwards known as the Cheka (Chresvychainaya Kommissia), meaning "Extraordinary Commission," formed in the beginning in the first weeks after the fall of Kerensky to deal with the attempts to organise drunken pogroms in the capital. The Cheka was given control of the only reliable regular troops, the Lettish Rifles. The leaders of the Cheka included Bolsheviks and Social Revolutionaries, who retained their position in this organisation after the members of their party had resigned from their posts in the Government. For practical purposes it was from the beginning controlled by the Bolshevik party. The scope of its work rapidly widened, and it became in the end the organising centre of the political police and the instrument of the Terror which followed on the beginnings of intervention.

The forces that fought in the earlier stages of the civil war were made up from parts of those regiments that had earliest declared themselves against the Temporary Govt., together with "Red Guards," workmen who had had a day or two of drill and the military equipment of a rifle and a cartridge belt, led by a heterogeneous collection of officers who felt that the future of the country was with the revolution, of officers who felt that they could damage the Bolsheviks most by getting control of their armed forces and of enthusiastic Bolsheviks who had or thought they had some slight knowledge of military technique. It was very soon discovered that dissatisfaction with one

[1] Moscow had been the capital until Peter the Great built St. Petersburg on the swamps at the mouth of the Neva. The Soviet Govt. housed itself where it could. Hotels and private houses became Government offices and Lenin himself lived in a room in the Hotel National before moving into the Kremlin.

government is not a sufficient motive to induce a soldier to risk his life for another. The "Red Guards" were extremely inefficient, and the demobilisation that accompanied the Brest Peace scattered what was left of the old army over the Russian railway system. The soldiers found their way home as seemed best to them, on the roofs and buffers of trains already crammed. During the winter months many froze to death in these positions. Every station was a disorderly camp and groups of soldiers would often be found travelling without particular destination on any train they had been able to board. There was no material for an army to be found in these migrating masses. An army had to be formed from the beginning with people willing to fight. Local soviets formed small bodies independently. Guerilla warfare in the Ukraine formed a training ground for many. As early as Jan. 23 a decree had been issued calling for a volunteer army. By March the Soviet Govt. could command the comparatively stable allegiance of 100,000 men.

The Dispossessed Classes.—Meanwhile there was a steady exodus from Russia of the classes who had lost property or privilege through the revolution. Some made their way across the deserted trenches to the Germans. Some joined the Germans in the Ukraine. Some made their way into Finland. Some fled eastwards through Siberia. All took with them a belief, belied by their flight, that the Bolshevik régime could last only a few weeks at most. They played the same part as the refugees from France played in the time of the French Revolution, and even used the same phrases, which were received with the same credulity by Governments similarly disturbed by similar events. Representatives of the Allies in Russia had naturally better means of knowing the old governing classes than the new, and were thus hedged by Russian malcontents from an accurate knowledge of what was happening at their doors. In a revolution the relativity of truth is carried to its utmost limits. Even for the most honest men engaged in a civil struggle the truth tends to be anything that tells against their opponents. In Russia in 1918 it was impossible to expect dispassionate witnesses.

The landlords had seen their estates taken from them by a rabble of peasants who, only 80 years before, had been only serfs, a species of domestic animals rather less valuable than the best horses. Manufacturers had seen their factories turned into debating clubs and themselves and their managers at the mercy of committees appointed by the workmen. Politicians who had spent the best years of their lives in attacking the autocracy had been swept out of the way in favour of men whose theories they despised and of whose incompetence they were convinced. Revolutionaries with a long record of prison and exile were outraged to find that the revolution could do without them. Shortage of everything and rapidly rising prices were natural sources of wide but impotent discontent. Add to all this the fact that the German advance in the West in March 1918 made the representatives of the Allies desperately aware that the country to which they were accredited had by withdrawing from the War eased the task of the Germans, and it is not surprising that, in spite of the lesson of 1917, they were ready to listen to those who promised that if only foreigners would help them to throw out the Bolsheviks they would be able to undertake themselves the more difficult business of fighting the Germans.

Diplomatic Relations.—Intervention did not begin at once, and the Bolsheviks were so far persuaded that Germany would attack them again the moment she felt strong enough to do so, that they were building their new army in the belief that Germany would be the first foreign enemy they would have to meet. When the Germans were advancing in the last days before the signing of the peace, the French military mission offered Trotsky French and English instructors for his newly formed regiments. This offer was accepted by the Russians, but was withdrawn. Now, when the Germans were still advancing (in the Ukraine) Piatakov, whose brother had been flogged to death there, asked for quick-firing rifles to use against the Germans in guerilla warfare. His request was refused, and it gradually became clear that intervention might come equally soon from either side. The Bolsheviks became increasingly conscious that Russia's diplomatic relations with the Allies were of a most abnormal kind. The Soviet Govt. had not been recognised by the Allies, whose representatives, however, were in touch with it, but were in much closer touch with those groups of Russian subjects who were opposed to it.

The British embassy left through Finland. The French was just too late to get through before the Germans occupied Finland on the invitation of the White Finns. English diplomatic representation was entrusted to Mr. Lockhart, formerly Consul-General in Moscow, who with a small staff accompanied the Soviet Govt. when it moved to Moscow. The American, French and other embassies and legations moved to Vologda, a little country town which offered the advantage of two possible lines of flight, to Archangel and through Siberia, and was a very long way from the new capital of Russia. In Moscow there were several military missions of the Allies, and consulates of various nations took upon themselves the management of international politics. If it had not been that serious things were at stake the diplomatic corps in Moscow and Vologda in 1918 would have provided good material for comedy. Some nations (including Great Britain) had several representatives of widely differing political convictions, and as the hopes of each tended to become beliefs it was hard to tell what was or was not the policy of any particular country. The only properly accredited ambassador in Moscow was Count Mirbach, the German, whose business it was to observe, to report and to keep the Bolsheviks aware that they lived under the continual threat of a renewal of the War.

The months of March and April in Central Russia were spent comparatively peacefully, though the bloody suppression of the Finnish revolution, the advance of the Germans through the Ukraine[1] and the resuscitation of White forces in the southeast were a clear warning of what was to come. Still, a British and American mission travelled from Moscow far into Siberia, and reported perfect order until it reached the district affected by the raids of White officers from over the Chinese frontier (*see* SIBERIA).

The New Organisation.—Over a very large area the revolution had a few weeks in which to establish itself. The Soviet system showed itself capable of replacing the old administrative machine. The Government in Moscow was rapidly organising a new civil service. In the country the peasants were settling the land question in their own way. The railways were gradually disburdening themselves of migrating soldiers. The seizure of the banks and the rapid inflation of the rouble were showing themselves more powerful than the decrees that accompanied them—and, as it were, explained their effects—to bring about a social revolution in the towns. Saved money was like fairy gold that turned to dry leaves in the night. The very unwillingness of the propertied classes to believe that the Communist régime could last more than from one week to the next contributed to their disaster. Their action, which consisted in doing nothing, may be described as a general strike of the propertied and privileged classes at a time when their strike funds were not only being spent day by day but were also rapidly turning into waste paper.

Inability or unwillingness of private manufacturers to keep their factories working under conditions which deprived them of effective control eased the task of the Government in nationalising large industry. The workmen saw in nationalisation a guarantee that they would at least get paper salaries regardless of the rapid fall in productivity, a fall due in part to the effects of the War and in part to the effects of the revolution, the disappearance of incentives to production and the substitution of political for productive activity. Shops were closing down for lack of goods, but there was as yet small sign of the "militant communism" that was to come. Speeches by Lenin make it clear that, given peace, he was prepared to proceed at once with what became known years afterwards as the "New Economic Policy." Intervention and the consequent growth of civil war on an enormous scale made that impossible.

[1] The Ukrainian Rada which had invited the assistance of the Germans was replaced (April 25) by the dictatorship of Gen. Skoropadsky.

Intervention.—Intervention was begun by the French use of the troops of Czechoslovak prisoners of war that had been formed in Russia to fight against the Central Empires. Immediately after the signing of the peace of Brest (March 3) these troops declared themselves under the French supreme command, and preparations were made, in spite of German protests, to send them to France. Russia was at this time at least formally at peace with Germany, and as a neutral country could not properly allow the transit of armed troops. The troops, however, were allowed to start on the way to Vladivostok, and had reached various stations on the Siberian railway and branch lines leading to it when signs of impending trouble caused Trotsky to order their disarmament. This was the signal for them to seize (in the last days of May) a long stretch of the railway and a number of towns. They did not proceed towards Vladivostok, but actually advanced westwards, taking Samara on June 8, where a number of members of the Constituent Assembly formed a Government while, similarly sheltered by these disciplined troops, a temporary Siberian Govt. was formed on June 15. Dutov raised the Orenburg Cossacks. Krasnov renewed activity on the Don. The Germans had pushed eastwards through the Ukraine, and within a few weeks the territory held by the Soviets was only a small part of Russia, consisting for the most part of districts in normal times either not self supporting or barely capable of self support. The revolution was cut off from the main sources of iron, coal, cotton, oil, meat and bread.

The Social Revolutionaries' Revolt.—The critical month was July 1918, when the Soviet Govt. was faced within its now strictly limited territory by a revolt from the Left, which had as its object the provocation of further intervention by Germany, and revolts from the Right, which had as their object the encouragement of further intervention by the Allies. The revolt from the Left came first. The Left Social Revolutionaries who had opposed the peace of Brest and wished for "not war but revolt," believing that the cause of revolution would be best served by inducing a German occupation of Russia and destroying that occupation by guerilla warfare of the kind that was keeping the Ukraine in flames, decided to force the Communists into accepting their point of view. At the Fifth Congress of Soviets which met in the first week of July they made a violent demonstration against Mirbach, and accused the Bolsheviks of doing nothing but obey his orders. On July 6 one of them assassinated Mirbach in the house in which the German Embassy was lodged. On the same day they raised a revolt in Moscow, seized a considerable part of the town, and even fired with artillery into the Kremlin. Meanwhile the Communists put a cordon of troops round the Congress. All Communists left the building, and the bulk of the Social Revolutionary members were thus detained. The revolt was suppressed by the evening of the next day, a final engagement taking place outside the town. On hearing of this revolt, Muraviev, a romantic adventurer who had taken an active part in the defence of Petrograd and in the fighting in the Ukraine and was now commanding the Red forces against the Czechs, mutinied unsuccessfully and shot himself. Meanwhile Social Revolutionaries of the Right, encouraged by French promises and believing that their rising would be the signal for an immediate advance of interventionist forces from the north, attempted revolt in several towns. They were most successful under Boris Savinkov in Jaroslavl, where they obtained possession of the town, killed a number of supporters of the Soviets, and were only defeated after a siege, the town suffering severely on account of the inexperience of the troops who, deserted by their officers, did not know when to stop bombardment and blew part of the town unnecessarily to pieces.

While the revolt in Jaroslavl was still in progress an attempt was made to persuade the colony of Allied Representatives at Vologda to come to Moscow. There were several motives for this besides the naïve belief that these representatives would be less hostile to the Soviet Govt. if they were in closer contact with it than with its enemies. On the one hand the Bolsheviks did not know how the Germans would react to the murder of their ambassador, and in the case of a renewal of the War they would have been prepared to ask for Allied help in organising and arming their defence. On the other hand they feared that the Left Social Revolutionaries would be likely to blow up an Allied ambassador or two in order to prove that they had not been agents of the Allies in killing Mirbach, and in order to force the revolution to stand alone without dependence on "imperialists of either camp." Such an event would force Allied intervention on a large scale, which the Bolsheviks still hoped to postpone. They believed that they could better guard the representatives in Moscow than in an isolated village like Vologda in a district where the Jaroslavl revolt showed that their authority was none too secure. The Allied Representatives, however, reasoned that the murder of Mirbach in Moscow was by no means a justification for their going to that city. Intervention had already begun, and was going to develop, and they determined to stay where they were. A British Representative (independent of the Lockhart mission in Moscow) was at Vologda, and a British commercial delegation of four arrived to investigate conditions. It came to Moscow, stayed two nights there and left for the north. The Allies had landed additional troops at Murmansk, and were preparing to take Archangel. The Japanese had sent warships to Vladivostok in Nov. 1917, made a landing on April 5 and on June 29 1918 helped the Czechs and others to overthrow the Soviets in the town.

The Terror follows Intervention.—As in the French Revolution, the intervention of foreign Powers increased the bitterness of the struggle. Political opponents became traitors, and in Russia were repeated all the horrors that followed intervention in France. The deposed Tsar with his family had been moved from Tsarkoe Selo to Tobolsk during the Kerensky régime. In the spring of 1918, for fear of counter-revolutionary rising in Siberia, they were removed to Ekaterinburg (May 2). The advance of Czechoslovak troops and of White troops formed after the Czechoslovak revolt put that town in immediate danger of White occupation, and the local Soviet, rather than risk their falling into the hands of the other side, shot the whole family at night on July 16 in the basement of the house in which they had been interned. The fact was announced on July 18 to the Praesidium of the Central Executive Committee in Moscow which, in view of the circumstances, approved the action of the local Soviet. The news of this killing, horrible in itself, aroused more excitement abroad than in Russia, where, in the prevailing dearness and precariousness of living, life was the only thing that was held cheap (*see* NICHOLAS II.)

On July 2 allied troops had landed at Murmansk[1], on the 31st they took Onega, on which day the Czechs took Simbirsk on the Volga. On Aug. 1 the Czechs took Ekaterinburg, on the 3rd Archangel was occupied by the Allies. On the 10th Kazan was taken by the Czechs, and troops advancing southwards from Archangel took Shenkursk. It seemed that the revolutionary troops could do nothing but retreat when faced by forces stiffened by a leaven of foreigners. The Bolsheviks had proceeded from voluntary enlistment to conscription, and now mobilised ex-officers of the old army to supply, under compulsion, the lacking knowledge of military technique. To these officers they attached Commissars whose business it was to inspire the soldiers and to watch for treachery on the part of the officers, the sympathies of many of whom were naturally on the side of the Whites. Workmen from the factories, partisans driven from the Ukraine and sailors from Kronstadt had to fill the part on the Red side that was taken by trained foreign troops on the side of the Whites. The republic, almost throttled at the start, learnt to fight in the course of the War. Civil war is necessarily of a different character from that of an ordinary war between nations. Mobilisation of conscripts on both sides formed a huge mass of potential deserters. The smallest initial victory was enough to set this current of desertion flowing, while a successful counter-attack

[1] The detachments which had been in Murmansk during the War had remained. They were now largely reinforced after agreement with the local Soviet which imagined that they were to serve as a defence against the Germans in Finland and by no means for intervention in Russia.

would be enough to turn the tide and set it flowing in the opposite direction. Much depended on the administration of occupied territory in such a way as to prevent the growth of discontent in the rear of the fighting forces. In the territory occupied by the Whites, the peasantry were soon given reason to fear that a White victory would mean the return of the landlords. This fear outweighed the requisitions of food, beasts and men, which were carried out by both sides. In the end, it probably decided the issue of the War.

On Aug. 30, a woman Social Revolutionary attended a meeting of working men addressed by Lenin in Moscow, and, waiting for him as he came out, fired two bullets into him at scarcely more than arm's length. Lenin was very badly wounded, and for some time it was thought impossible that he should survive. On the same day another Social Revolutionary killed Uritsky, one of the chief Communist leaders left in Petrograd. These two events were the signal for a wholesale revolutionary terror. Five hundred persons were executed in Petrograd alone as an immediate reprisal.[1] The diplomatic and consular representatives of the Allies, who had hitherto been unmolested in Moscow in spite of the fact that the Powers they represented were actually at war with the republic (Archangel had been taken a month before), were arrested, Mr. Lockhart being accused of complicity in a plan to raise a mutiny in the Lettish troops and to seize the Bolshevik leaders. All were subsequently released, Mr. Lockhart's Mission being exchanged for Bolsheviks arrested in England. The Soviet Govt. abandoned all hope of coming to an arrangement with the Allies, and realised that it was already engaged in a struggle from which it would either emerge victorious or not emerge at all.

Progress of the Civil War.—It was as if this psychological burning of boats had an almost immediate effect in stiffening the Red troops. During this grim month and the month that followed they obtained at least small victories on all the fronts that were more immediately dangerous. By the recapture of Kazan, Samara, Simbirsk and Sysran they recovered the Volga as a line of defence behind which they could prepare for an advance towards the Urals. At the same time they made impossible a juncture between the troops advancing from Archangel and those which had been advancing from Siberia under cover of the Czechs. The Archangel front moved southwards, but was not of great importance, being in a district with only the most limited ways of communication, besides being isolated and far from any vulnerable nerve centre.

When, on Nov. 6 1918, the All-Russian Congress of Soviets met in Moscow, the republic was holding its own, and news was coming from the West that greatly strengthened its belief that it had only to hold out a little longer before the idea which it represented was victorious throughout Europe. Austrian and German regiments exposed to the infection of revolutionary ideas had mutinied in Mohilev and Rovno six weeks before. The discipline of these troops in the Ukraine was falling to pieces. Now came news of the formation of Soviets in Kiel, Berlin and Budapest, the abdications of the German and Austrian Emperors and the armistice on the Western Front. The Congress was one of the wildest enthusiasm. For it, not Allied victory but revolution in Germany had made a scrap of paper of the peace of Brest, which it now (Nov. 13 1918) formally annulled. Lenin seemed justified. Russia was no longer alone. The members of that Congress could hear the tramp and see the banners of that world revolution on which their hopes were based. It took several years of bitter disappointment to dim the sound and vision of that triumphal march.

Although the collapse of Germany made it impossible for Russian emigrés to continue to persuade the Allies that in fighting the Soviet Govt. they were fighting the Germans, its immediate effect was that Allied ships passed through the Dardanelles into the Black Sea and through the Belt into the Baltic. The Germans in the Caucasus were replaced by the Allies. The anti-Bolshevik Governments of the Baltic States were supported by the Allies instead of by the Germans, and the revolution rolling forward on the heels of the retiring Germans found itself arrested by forces that the Allies were now able to equip abundantly with the material no longer needed for the war with Germany. This continuance of the War on the part of the Allies after the annulment of that excuse for interference that was provided by the Brest Peace had two other effects. On the one hand it strengthened opposition to this new war in the Allied countries, whose peoples to a large extent considered that the defeat of Germany and not interference in Russia was the object for which they had been enrolled. On the other hand it gathered to the support of the Bolsheviks a great number of officers who had considered that the Brest Peace was the main reason for opposition to them and held that, the German question being eliminated, the war in Russia was a national war in which the Soviet Govt. was resisting foreigners who were using Russians as their instruments in weakening a country that had been a great Power until it had overstrained itself on their behalf. They were prepared to accept the revolutionary watchwords for the inspiriting of a national defence. Nor were these officers alone.

In the south the forces opposed to the Bolsheviks were headed by a series of dictators, L. Kornilov, Alexeiev, Denikin, surrounded by persons who made no secret of their distaste not only for the Bolsheviks but for politicians far to the Right of them. In the East, the Committee of Members of the Constituent Assembly had been succeeded by the Directorate, which took over the four existing White Governments in Siberia, and Admiral Kolchak had been proclaimed supreme ruler at Omsk on Nov. 18. Members of the Constituent Assembly had been taken from prison and killed by officers who were allowed to go unpunished. The result of this was that members of the Constituent Assembly escaping from Kolchak publicly threw in their lot with the forces on the other side of the barricade. Even in Archangel a comparatively moderate Government under N. Tchaikovsky was seized by a group of officers and only released on the insistence of the Allies. It rapidly became clear that the choice was not between the Bolsheviks and a more moderate Government, but between the Bolsheviks and extreme reaction. The Red Terror was matched by a White Terror that affected far larger sections of the population. Refugees from the country held by the Whites brought into Soviet Russia accounts of such treatment of the working classes as enormously increased the will of those in Soviet Russia to see the struggle through regardless of the daily increasing hardships of a starving and beleaguered camp. If 1918 saw the beginnings of intervention and civil war on a large scale and the gradual growth of disciplined forces during a period of extremely unstable internal equilibrium, 1919 saw those forces become armies to meet more serious attacks from without, which, however, were accompanied by increasing stability within.

The revolution owed much to its opponents, who repeatedly gave it proofs that it was forced to fight in self defence. An example of this was given by the reaction of Reds and Whites to Mr. Lloyd George's and President Wilson's proposal (Jan. 22 1919) that representatives from either side should meet for a conference on Feb. 15 on the island of Prinkipo near Constantinople. The Reds expressed their willingness to come to that aloof island (though they would have preferred a place where their negotiations would have had a better chance of being overheard by the working classes of other countries, to whom they looked to bring intervention to an end), provided that the Powers on their side would undertake not to intervene in the internal affairs of Russia. They even offered to negotiate on a basis of frontiers to be determined by the position of the various forces at the time, which would have given the whole of Siberia and huge districts of European Russia to their enemies. The Whites, confident in the attacks they were preparing, encouraged also by promises of further assistance from the Allies, refused through their representatives in Paris to consider any negotiations whatsoever, and thereby knocked the bottom out of any agitation in Soviet Russia for an end of the civil war. The moderate Socialist

[1] Latsis (*Two Years Struggle on the Internal Front*) says that 8,389 persons were shot by the Extraordinary Commission (Tcheka, later Ogpu) in 1918 and 1919 in the 20 Governments of Central Russia alone. Seventy-five per cent of these were shot in the later months of 1918.

parties in Russia naturally declared that, while disapproving of the Bolsheviks, they would yet support them against all intervention from without. The war continued. Huge supplies of military equipment were given to the Whites. The Archangel front had been pushed southward. Kolchak was striking across the Urals, and when the White forces in the south promised to move northwards it was confidently assumed abroad that the end of the struggle would come during the summer.

That assumption was based on a comparison of material forces. It did not allow for that strange, incalculable *x* of revolutionary enthusiasms which, in Russia in the 20th century as in France in the 18th, continually provided miracles for the discomfiture of logicians. In Russia, thanks to the domination of a single party, there were none of the struggles between tendencies and, thanks to the extraordinary discipline of that party, none of the struggles between individuals that made unity among the Whites impossible. Enthusiasm was not dissipated piecemeal, but directed hither and thither where it was most needed. The Communist party took every member it could spare from the work of organisation, and sent him to the weakest place in the defence. The trades unions did the same. Throughout the Civil War the Communists adopted the opposite method to that of rulers who exaggerate victories and minimise defeats. Huge maps were set up on boardings in the streets of the towns with a thick black line to mark the encircling front. Day by day during the White advances the black line was moved nearer to Moscow. Defeats intensified instead of disheartening the defence, in spite of the appalling conditions in the besieged camp. In this war few of the wounded could hope to survive, for the blockade did not allow the importation even of anaesthetics or the necessary drugs. Outside the territory of the Soviets to be a member of the Communist party was a crime punishable by death. Captured Communists were shot at once. Yet at the worst moment, Oct. 1919, when White forces were within striking distance of Moscow and of Petrograd, thousands of working men poured into the party.

The year 1919 began with the advance on a wide front of Kolchak who, with the whole of Siberia behind him, pushed his lines far into European Russia, and in April reached Kazan and Samara on the Volga. The Communists threw all that they had against him, denuding their other fronts, and in July threw him back over the Urals just in time to let them reorganise to meet the rapid advance of Denikin from the south. Denikin, thanks to a destructive cavalry raid behind the Red front, advanced with extreme rapidity, and in the autumn took Orel (Oct. 13) within easy reach of Moscow. Here he was held for just long enough to allow the effects of his administration in the country he had occupied to show themselves in his rear. So long as Denikin's army consisted exclusively of officers it was a dependable force, but with successive mobilisations as he advanced his swelling army became much less unanimous in wanting him to win. The peasantry judged by the behaviour of his officers what fate awaited them in the event of his victory, and mutinies and revolts soon made his threat to Moscow much less formidable than it seemed upon the maps. He was pushed back from Orel (Oct. 19), and having once begun to retreat could not stop.

But the blow from the south was still to be parried when, with the help of English tanks, an army under Yudenich moved on Petrograd, took Krasnoe Silo (Oct. 16) and came within sight of the Cathedral of St. Isaac. Yudenich seems to have believed that Petrograd would rise to welcome him. No doubt there were plenty of people in Petrograd who looked forward eagerly to his arrival. But these were a small minority who remained indoors while children ran about banging tin cans and waving red rags and their elders dug trenches, set up barricades and prepared for street fighting. Trotsky went to Petrograd to organise the defence. It is possible that even if Yudenich had entered the city his forces, which were not large, would have been destroyed in the streets. At the same time there were several days (Oct. 16–21) when all Moscow believed that Petrograd had fallen or was on the point of falling. Preparations had actually been made for the housing of the refugees. Yudenich was defeated at Pulkovo (Oct. 21), driven back over the Estonian frontier, after his officers, before retreating, had sacked the Palace of Gatchina.

Collapse of the White Armies.—The Yudenich adventure may on the whole be considered as having been a help to Soviet Russia. In failure it destroyed many illusions, and while it still seemed likely to be successful it had greatly contributed to the desire of the Estonians to conclude peace. Estonian troops had advanced with the Russian Whites, but Yudenich's officers, unwisely, did not conceal their contempt for the "potato republic" (an allusion to the chief agricultural produce of Estonia) and, resentful of the national airs put on by what they regarded as a Russian province openly spoke of settling accounts with the Estonians as soon as they had dealt with the Bolsheviks. The Estonians realised that there was little to be gained for Estonia by helping reactionary officers to conquer Russia. In spite of warnings, even threats, addressed to them by the French, they began negotiations with Soviet Russia on Oct. 5 1919, which ended with the signature of a peace treaty on Feb. 2 1920. Estonia's belief that peace was possible made war more difficult for other small Powers. On Jan. 16 1920 the blockade was formally lifted by the Supreme Council. The ring surrounding Soviet Russia was no longer complete. England had already given up active intervention.

Meanwhile Soviet Russia was rapidly recovering the old Russian frontiers. Kolchak had never recovered after the blows of June and July. The burning of villages, wholesale floggings and shootings had roused the whole of Siberia against the Whites. Soviet Russia recovered Omsk on Nov. 15, Semipalatinsk on Dec. 11, Tomsk on Dec. 20, Krasnoyarsk on Jan. 8 1920. On the same days in the south the Red cavalry entered Rostov. On Feb. 19 Soviet troops entered Archangel. On March 2 they took Irkutsk, on March 13 Murmansk, on March 24 Vladikavkaz. With the withdrawal of foreign support and disorders in their own rear, the Whites collapsed with such suddenness that town after town was taken by internal revolt long before their inadequate transport allowed the regular troops of the Reds to reach it.

Three psychological moments tended towards the abandonment of intervention: (1) discontent in all countries at what seemed to be an unnecessary prolongation of war after the defeat of Germany; (2) a wide feeling among the working classes of all countries that a war against the revolution in Russia was indirectly a war against even non-revolutionary labour at home; (3) growing impatience with the Russian Whites who, wherever they were in power, showed an incapacity for government equalled only by their capacity for quarrelling among themselves. It came to be realised by a growing section of opinion in Great Britain that the fact that Russian Whites asked for foreign help against their own countrymen was in itself a sufficient proof that such help ought not to be given. Two Powers only were unwilling to give up intervention in Russia. Of these one was Japan, which had definite territorial designs in Eastern Siberia and retained for some years the Russian part of the island of Sakhalin. The other was France. The French were more grievously affected than the English by the non-payment of interest on the Tsarist debts. They were also afraid of a German revenge for the Peace of Versailles and horrified at the thought that they had lost their Russian ally. They had therefore set their hands to the carrying out of a contradictory policy, on the one hand to create a big Poland to take Russia's place in Germany's rear and on the other to help in the creation of a new Russia which should feel gratitude to France. Expressions of these policies were the Polish attack on Russia in 1920 and the desperate recognition of Wrangel (Aug. 11) by M. Poincaré immediately before that general was driven into the sea.[1]

The Polish War.—For a few weeks in the spring of 1920 it seemed that this was to be the first year of comparative peace, and in that hope the Russians offered to conclude a treaty with

[1] Nevertheless Poland and the Baltic States received a formal warning from the Supreme Council in London in Feb. 1920 advising them not to continue a war which might be injurious or to make any aggression against Russia.

Poland on the basis of the frontiers the Poles then held, which included a good deal of ethnographically non-Polish territory. The French, however, had not accepted the Estonian peace-making with equanimity, and the Poles, assured of French good will, money and munitions, and still dreaming of a Great Poland which was to stretch from the Baltic to the Black Sea and be a sort of Hadrian's wall against the barbarians of the East, advanced further into Russia, and on May 8 took Kiev. This attack by the Poles had the effect of further consolidating elements in Russia otherwise hostile to the revolution in support of what was, after all, the only existing Russian Government. The Poles completed that nationalisation of the Soviet Govt. which had been begun by the interference of the Allies. In a few weeks the Russians routed the Poles, and found themselves in a position to invade Poland. Trotsky was against pushing on. Lenin allowed political considerations to outweigh the views of the military experts. His view, strongly supported by the many Polish revolutionaries who were on the Russian side and played in this matter the same part that the Russian emigrés had played in persuading the Allies to intervention, prevailed. A few weeks later the Russians were at the gates of Warsaw.

But the advance of the Russians into Poland had the same result as the advance of the Poles into Russia, a consolidation of national feeling in the invaded country. The French, besides guns and ammunition, sent the Poles a leader, General Weygand; and Wrangel from the Crimea, acting (whether he intended this or not) as an ally of the Poles and the French against Russia, began an advance in which he had very considerable technical assistance. The Russians' retreat before Warsaw was as rapid as their previous advance, and raised in the minds of their enemies hopes of an immediate and general collapse. This, however, did not follow. The Poles were held and in Oct., by the Peace of Riga, agreed to frontiers which were approximately those which they could have had without fighting in Feb.; and by Oct. 17, the Revolutionary Army had occupied the whole of the Crimean peninsula, Wrangel with the remains of his troops escaping to Constantinople. Peace with Lithuania and Latvia had been signed in July and Aug. during the Polish war. Peace with Finland was signed in October. Raids continued to be made into Russia over the frontiers of countries nominally at peace with her; much of the banditry that naturally follows civil war remained to be put down; but civil war on a large scale had ended.

War Communism.—It is usual, even among Communists, to describe the period of civil war as one of " militant communism." But when the economic measures of those years are separated from the words that accompanied them, it appears that there was little difference in principle between them and measures adopted in other countries during the World War, which again were not different in principle from those that are forced upon any besieged community. Russia suffered from seven years of war. It is not surprising that measures of rationing, of monopoly, had been carried further in Russia than in countries which suffered from only four. Industry in Russia was not highly developed before the War. Russia was accustomed to export agricultural produce and raw material and to import manufactured goods. During the War she could do neither the one nor the other. Her own industry suffered from lack of transport, fuel and raw material and from a catastrophic fall in the productivity of labour. The one industry that had to be maintained at the expense of all others was that of munition-making, which does not provide goods in exchange for which peasants will willingly give corn. In such circumstances whatever measures may be taken amount in the long run to the requisitioning and rationing of existing stores. The towns being unable to produce goods to exchange for corn, agriculture, like industry, became a State monopoly in the sense that all produce over and above the needs of the producer was taken by the State to feed the armies and the towns. Private trade in bread was forbidden because its existence made it more difficult for the State to obtain corn. The co-operative societies were turned into a distributing apparatus to serve the whole of the town population. The rationing of the inadequate supplies distinguished in other countries between the civil and the military population. In Russia it had to go further, and among the civil population to distinguish between those whose work required more physical effort and so more food than those whose work could be got through with less. With a view to the future, milk in the towns was distributed exclusively to children. All these were practical measures which would have been forced on any country similarly impoverished and besieged.

In all countries similar measures taken during the War tended towards State and away from private control. The difference between these measures in Russia and in other countries lies in the point of view of the Government applying them with regard to what may be called their by-products. The Russian Govt. was not like the Governments of other countries, anxious to disburden itself as soon as possible of the factories that during the War had come into its hands. It rejoiced instead of lamenting over the rapid inflation of the currency because this, making money meaningless, facilitated the weakening of the propertied classes. The requisitioning of corn was in the hands of committees of the poorer peasants to whose interest it was to see that the rich peasants did not hold back their stores. The result of this was a general levelling among the peasantry, during which the conflict of interests between rich and poor peasants guaranteed the Government against active resistance by the peasantry as a whole.

It must not be imagined that the Communists were able to make of these measures a complete system. An essential link in the system was missing in the failure of the towns to produce goods to be distributed to the peasants. The factories handed over what they made, but they did not make enough, and a proportion even of what they made was stolen by the hungry workers to exchange for food on the markets that still existed as safety valves for the private trade which, though forbidden, was carried on by " bagmen " who themselves brought sacks of produce to the towns, running the gauntlet of railway and town police and taking back to the country whatever they could get. The existence of this illegal trade meant that the peasant had a chance of getting something for his produce and, while it kept the peasant cultivating, compelled even the Government organs of supply to have recourse to the very markets that it had forbidden. If the system could ever have been put into complete operation money would have ceased to be necessary at all. As it was the printing presses supplied the Government and its employees with the means of buying on the illegal markets the food they had not been able to bring to the towns themselves. Money tended to become valueless (it was easier to buy things from the peasants with a cake of soap or a little salt), but the existence of the illegal market made a use for it and a demand for it just sufficient to keep the rouble alive.

Poverty and Privation Following the Civil War.—Life in Russian towns reached its lowest level in 1920. The almost complete breakdown of transport made it impossible to bring to the towns even the whole of the inadequate supplies that the Government apparatus had been able to get to the railways. In Jan. 1920, the number of locomotives in working order had fallen from 17,000 (1914) to under 4,000, less than a quarter of the number that had been barely sufficient to maintain a very low standard of transport at the beginning of the War. The enlargement of the revolutionary area of Russia that accompanied victory in the Civil War increased the length of the lines of communication much faster than it added to the rolling stock. At the worst moments of the civil war, 80% of the railways had been in the hands of the Whites, and during the struggle, apart from damage to rolling stock and lines, 3,672 railway bridges were destroyed and 381 railway dépôts and repairing shops. Military operations had to come first, and the towns had to do with the crumbs from the soldiers' miserable commissariat. Every town dweller was underfed. There was no fodder for horses. Sledges disappeared. The cleaning of the streets was left to the spring thaw and the autumn rains. All shops excepting State bookshops and a few half empty co-operative stores were closed. Wooden houses were being pulled down to serve as fuel, lack of which prevented the proper heating even of Government offices, brought the tram-

ways almost to a standstill and cut down the supply of electric light. Actors played in unheated theatres to audiences shivering in out-door clothes. Typhus carried off thousands of the population. The very working class on which the Government based itself began to disappear, the town workers—most of whom in Russia retain a connection with their villages—returning to the country, where there was food enough and a skilled man could easily earn a living. During the previous year one in every three workmen had left Moscow or ceased to be a workman. Wagons clogged the stations, because there were none to unload them. Food rotted, and timber lay where it was useless, because neither food nor fuel could be brought to the places where they were desperately needed.

The problem before the revolution was to get work done when it was impossible that it should be immediately rewarded. A comparatively efficient organisation of the factories had been worked out; the more extreme forms of workers' control ceased, the technical staff in the factories as in the army being freed from dependence on the caprice of their subordinates. But the rewards were small and uncertain, and the actual physical capacity of the underfed workers was low, and much of it had to be spent in pursuit of food to supplement their rations. By propaganda and example the Communists succeeded in inducing a high level of self-sacrifice among their own rank and file. Groups of Communists undertook what became known as Saturdayings, when, in holiday hours, they combined in all kinds of labour, shifting wood, unloading trucks, etc., and many non-Communists joined voluntarily in what presently became a duty for members of the party. As the civil war slackened armies not actually fighting were turned to doing whatever work could be done wherever they happened to be. These were called "Labour Armies," and issued "Bulletins from the Labour Front" announcing the building of a bridge as formerly they had announced the capture of a town.

From these beginnings came industrial conscription, a measure never put into general practice but designed in the first place to prevent the complete exodus of the workmen from the towns and to secure the preparation of fuel by peasants in the neighbourhood of the railways. If it had been possible to feed as well as to conscript something might have come of it. As it was, it was found useful in getting things done that were urgently needed. It failed as a general means of organising labour, and was probably more useful to the opponents of the revolution abroad than to the Communists in Russia. Its chief supporter in Russia was Trotsky, who certainly succeeded in getting valuable work in the restoration of the railways done by the labour armies, and was also able to raise the number of repaired locomotives and wagons. Transport was in 1920 the key position of the struggle and though Trotsky's critics pointed out that the productivity of a man in a labour army was less even than that of an ordinary workman, he could reply that it was better to get work done slowly than not to get it done at all. In transport things did by the end of 1920 show unmistakable signs of improvement and improvement here promised it everywhere else. During this period were finished the land works for a huge electric power station on the Volkhov, a power station at Kashira and another on the Shatura peat mosses (which was promptly destroyed by fire). In circumstances in which it seemed possible that Russian civilisation would disappear altogether, starving and ragged engineers were planning the future electrification of Russian industry and rationalisation of Russia's industrial geography.

March 1921 to March 1926

Peasant Discontent.—The end of the civil war removed a motive that had partially reconciled the peasants to much that they disliked in the revolution. They had no longer need to fear a return of the former landowners and, whereas during the War they had grudgingly submitted to the seizure of such corn as they could not hide, they were very certain that they had no intention of feeding the towns in peace-time for nothing. What, they asked, was the good of getting rid of the landlord if you were not allowed to do business with your own crops? Nor was this the feeling of a small class of rich peasants alone. The general levelling brought about during the years of the War had made the peasants more or less homogeneous and united, though not organised, in sullen discontent. Their mood was naturally reflected in the army which was largely composed of their sons. At the same time the removal of the driving motive of the War freed other discontents for expression that would not have been risked while there was still an armed enemy to profit by it. Shortage both of food and fuel in the winter months brought about a crisis. Not only were the peasants hostile, but the cold and hungry workmen of the towns were near the end of their patience.

In Feb. 1921 there were strikes in the Petrograd factories. There was similar trouble in Moscow, where some of the regiments, without revolting, showed their very natural sympathy with the workmen. Then, in March trouble in one of the battleships turned into a general revolt at Kronstadt (March 2). This in its beginnings was explicitly a family quarrel within the revolution, and had none of the aims of a White revolt. But the enthusiasm with which it was greeted by the Whites outside Russia brought about instant calm in both capitals, where the workmen realised that it might mean a resurrection of the civil war. Kronstadt was retaken (March 17) after a first attack over the ice had failed, and once more there was apparent peace.

The New Economic Policy.—The Tenth Congress of the Communist party (at that time 730,000 members) met on March 8 1921 in the atmosphere of those events, and on the invitation of Lenin took the first step towards that New Economic Policy which had been in his mind and on his lips in 1918 when intervention and the consequent development of the civil war had postponed it for three years and brought about the greater part of what was known as "militant communism." This first step did not seem a very big one, nor did it promise much more than to lessen the discontent of the peasant and supply him with a motive for increasing instead of decreasing the area of land that he thought it worth while to till. Instead of the system of assessing the surplus corn and requisitioning it (at a fixed price in practically worthless paper money) it introduced the payment of a tax in corn, which was to be less in amount than the previous assessments and was to leave the peasant free to dispose of what he had left after the tax was paid. The deficit in the State's supply of corn after receipt of the tax was to be made up by exchanging manufactured goods for corn, and this operation was to be left to the co-operative organisations. This meant that buying and selling of corn would no longer be a criminal offence and that the State would have to compete with private local traders for the surplus corn that the peasant had to sell.

Weakness in the co-operative organisations, lack of manufactured goods, together with the famine of 1921, presently hurried the party along the road on which they had thus tentatively set foot.

Reopening of External Relations.—Another influence in the same direction was the reopening of relations between Russia and the rest of the world. Kronstadt was still in the hands of the mutineers when, on March 16 1921, a Trade Agreement between Russia and England was signed in London and a treaty between Russia and Turkey was signed in Moscow. The signature of England was an encouragement to the small border states who had felt hitherto that they were risking the disapproval of England as well as of France in withdrawing from a suicidal conflict with Russia. The Trade Agreement, while not establishing normal relations, set up a *modus vivendi* which made trade possible between the two countries. On May 6 the Treaty of Brest-Litovsk, denounced in 1918, was replaced by a new agreement between Russia and Germany, signed at Berlin. A treaty with Hungary, arranging for the return of Hungarian prisoners of war, was signed on July 28. Norway followed on Sept. 2, a treaty with Mongolia on Nov. 6 and a Preliminary Trade Agreement with Italy on Dec. 6. At an economic conference held at Riga with the Baltic States (Oct. 24–31) the basis of an agreement on transport questions, essential to Russia's export, was reached. Foreign Trade presupposed the possibility of Russian export.

Russian export presupposed a surplus in the hands of the Russian Govt., which retained a monopoly of Foreign Trade. That surplus had to be paid for and the need of payment became the dominating motive of the next period of the Revolution.

The Georgian Revolt.—At the moment of the revolt in Kronstadt there was in progress a revolt in Georgia which had important economic consequences of a different kind. The withdrawal of the Allies after intervention had left a Menshevik Govt. in Georgia which country by the accident of its position controlled the pipe line from the Baku oilfields to Batoum. The revolt in Georgia answered the question whether Russia or Western European powers were to control directly or indirectly the South Caucasian oilfields. On Feb. 16 Tiflis was seized by the revolutionaries. On March 19, the revolutionaries now helped by the Russians, were in Batoum.[1] Baku oil was later on to be one of Russia's most important exports, as it had been before the War.

The Famine of 1921.—The extreme drought of the summer of 1921 affected districts that should normally have been granaries for the rest of Russia. The long series of rainless months turned the Volga country into a desert with neither food for man nor fodder for beasts. The people crowded to the river banks and died there. Women fought for scraps of horse dung and cooked them in the contaminated water of the Volga to postpone their children's deaths. The starving population had no strength to resist the ravages of typhus. Fridtjof Nansen, the American Relief Administration, the Quakers and others, organised assistance to the starving districts (*see* RELIEF). The Russian Govt. had to face not only a complete failure of its plan of obtaining corn by exchange, but also a big reduction in the corn tax which, even in the original plan, was less than their needs. They were unable to supply the factories with the grain they needed for their workmen. They were forced to buy grain where they could, and to buy that grain for money. " We had to grab at the straw of what value was left in the Soviet paper roubles."

Saving the Rouble.—It was clear that the rouble, which had been rapidly dying, and was already a very ghost-like thing, could no longer be considered as a parting guest to be speeded on its way, but had to be saved at all costs. Factories for a time paid their workmen in factory products which the workmen sold on the market and with the resulting money bought bread. It was obvious that the only hope of lasting salvation lay in a stable currency. A stable currency demanded a balanced budget and a stoppage of the printing press, on the activity of which in producing paper money faster than it became valueless the very existence of the State depended. This meant that factories must pay for themselves. Lenin told the party that they " must learn to trade." The State was forced to compete in buying. It must also compete in selling, with the private person. No longer were railway tickets to be free and unobtainable, electric light free and without lamps, trams free and not running. Everything had to pay for itself and so be paid for by whoever used it. Free trade of all kinds was legalised within the country.

Revival of Private Enterprise.—The streets of the towns began to change their appearance in the summer of 1921. Shutters came down from the closed shops and behind the broken and patched windows appeared all kinds of secreted ancient stores. Inessential things appeared first, because it had been easier to keep them hid. Toyshops were among the first to open, together with hat shops, and it was possible to buy cosmetics in old boxes with faded labels long before it was possible to buy the saucepans and kettles and clothes that were really wanted. Private bookshops sprang up in all directions. Private restaurants opened, where better meals could be obtained by those who could afford to pay for them than at any of the State refectories which continued to function. Pedlars flourished exceedingly, no longer slinking round corners out of sight of the militia. The State retained the monopoly of foreign trade, heavy industry and much light industry. But heavy industry was run at a loss, light industry was producing only a very small proportion of its pre-War output, and though there were plenty of shops belonging to co-operatives and to the State, and though the private shops were handicapped by high rents and high taxes, it seemed to the outside observer that in the competition between the State and private enterprise, the State would go to the wall. The new conditions benefited the peasantry, whose discontent with the Soviet Govt. grew rapidly less. They benefited the large class of persons who had previously made a surreptitious living by buying cheap and selling dear when both operations were forbidden. Their beneficial effects were felt later by the workmen, and the new conditions were for some time actually injurious to the large mass of small Government officials, who had not time for trading in their off hours and soon found themselves compelled to pay rent for their rooms, and to buy their food instead of having the necessaries of life provided free. Both in town and village this new economic policy ended the process of social levelling and started a new process of differentiation into classes.

To people both within and without the Communist party, who had identified " Communism " with the economic methods of the civil war, these changes seemed to prove that the revolution had changed its mind. Outside the Communist party and particularly outside Russia, it was assumed that Russia would rapidly " drift back to capitalism." Inside the party among the rank and file there was a feeling that everything they had risked their lives for had been abandoned. Once more rich men were driving in cabs while poor men walked, rich men were fat while poor were thin. Lenin himself had none of this feeling of defeat. Intervention had ended, and he was returning to the plans that it had interrupted. But for his prestige it is doubtful whether the party could have stood the shock of this sudden change of course. Later, as the party learnt to adapt itself to new conditions and saw the effect of those conditions in a rising standard of life and in Russia's economic recovery a new hopefulness took the place of the old fanatic enthusiasm. But, from the beginning of the new economic policy, there existed ground for disagreements on questions of principle more serious than any of the disagreements on questions of tactics which had accompanied the period 1917–20.

In the ensuing period the history of the Revolution is not one of startling events but of slow processes, a long struggle between state and private industry and trade, a gradual development of diplomatic relations between Russia and the rest of the world, a series of debates in the Communist party, reflecting the new tensions and readjustments due to changes not only in Russia but outside.

The year 1922 found the Soviet Govt. with a programme that included the establishment of a stable currency, a pruning of state apparatus, complete legalisation of free trade within the country and the renting out of some of the nationalised factories, etc., to private persons and co-operatives. All these planned measures aimed at the economic recovery of Russia, that is to say, at putting Russia's town population in a position to satisfy by import or by manufacture the needs of Russia's peasantry. It was hoped further to bribe foreign capital to help in the economic development of Russia by giving concessions of a kind which while allowing the concessionaire to enrich himself, should on the expiry of a definite period leave the State the richer by technically equipped and going concerns. None of this programme had anything in it shocking to the western world, and, if that had been all, there would have been no difficulty in the way of securing every kind of co-operation from western Governments and capitalists.

The Third International.—But the Soviet Govt. was an expression not only of Russia but of the Communist party, and the very nature of that party implied a further programme. It had created the Soviet Govt.; it had also created the Communist International. If the programme of the Soviet Govt. was a national programme, that of the International was one of international revolution. Founded in 1919, the Communist International was intended to unite and strengthen Communist parties in all countries. It sought to make itself a supreme general staff for all its members. It aroused greater anxiety in its

[1] The Turkish Treaty of March 16 provided that Batoum was to be ceded to Georgia under conditions of local autonomy.

opponents than any previous international revolutionary association, because it had its headquarters in a revolutionary country, though its attempts to enforce the strict discipline learnt by 20 years of struggle in Russia on the parties of countries which were less afraid of freedom of opinion, led to many schisms and quarrels in those parties. Still, its very existence served as a reminder to foreign Governments that Russia's revised economic programme did not alter the fact that the ruling party in Russia had by no means abandoned its revolutionary aims. At the same time countries with colonies in the East were unpleasantly aware that Russia's policy of ostentatious disinterestedness tended to make oriental nations conscious of a contrast between Russia and countries with large interests in the East which they were unwilling to give up. Russia's policy tended to increase nationalist feeling in all subject countries. In the East, Russia, apparently renouncing claims for material advantages, had actually become more dangerous to the position of western countries there than had been the old grasping Empire of the Tsars. (*See* THIRD INTERNATIONAL.)

The Genoa and Hague Conferences.—Economics and politics accordingly became contradictory motives reacting in positive and negative fashion on the re-establishment of Russia's relations with foreign countries. These motives were illustrated in the conferences of Genoa (*q.v.*) and The Hague (*q.v.*). At Cannes, Mr. Lloyd George had declared the impossibility of the recovery of Western Europe without Eastern Europe. On April 10 1922, Russia met the other powers in conference at Genoa. The French insisted that nothing should be done that could in any way affect the Versailles Treaty. It was stated that the recognition of Russia's foreign debt must be a starting point for any fruitful debate. Thereupon Germany and Russia came to a separate agreement in the Rapallo Treaty (*q.v.*) signed on April 16. Germany and Russia mutually cleaned their slates. Germany gave up all claims for damage done by Russia to German interests inside Russia, unless in the future Russia were to satisfy claims of this kind made by other States. Diplomatic relations were fully resumed. The treaty included a " most favoured nation " clause, subject to a limitation in favour of countries that had been part of the old Russian Empire, of Soviet Republics and of Asiatic states bordering on Russia. The German Govt. declared its readiness to facilitate agreements with Russia made by private firms. This agreement led to the exclusion of Germany from further discussions of the Russian question at the conference in order to calm the French, who declared that they saw in Rapallo an attack on Versailles. The Genoa conference closed on May 19 without further result, excepting an agreement that there should be no aggressive acts on the part of Russia or of any of the Governments taking part in the conference for four months after the close of discussions.

A non-Russian commission was appointed, and Russia was invited to appoint a Russian Commission, both to meet at The Hague on June 26 to consider the questions of debts, foreign property sequestrated in Russia and credits. At this further conference, Russia was ready to agree (1) not to ask for compensation for damage caused by intervention and the blockade; (2) to recognise pre-War debts, without the addition of accumulated interest; and (3) to satisfy foreign ex-owners of confiscated property by giving them in preference their former undertakings as concessions. After much fruitless debate in sub-commission the Russians asked for a plenary sitting. They were told that a plenary sitting would be held to consider any further proposals they might have to make. It was held on July 19, and brought the conference to an end. A suggestion made by Litvinov for a new formula on compensation to foreigners for property nationalised led only to a misunderstanding. Neither side was ready to recede from its position, the one being unwilling to undertake obligations that would cripple its efforts towards economic recovery, the other believing that Russia's economic position was so bad that time would bring about a capitulation not merely on financial questions.

The New Currency.—In the meantime the Soviet Govt. were proceeding slowly with the realisation of their internal programme. They printed (according to decree of Oct. 11 1922) banknotes with a definite cover in gold, foreign currency and foreign securities. These remained stable side by side with the rapidly soaring paper currency[1] in which the bank notes were quoted day by day. Prices were given in gold roubles, represented by the banknotes (a tchervonetz equals 10 gold roubles), and were translated into terms of the ordinary paper roubles. Gradually the paper came to be used exclusively as small change was replaced by smaller notes with similar cover (decree of Feb. 5 1924) and was finally withdrawn from circulation. It became possible at last to issue a silver coinage of values from a rouble down to ten kopecks and copper coinage of values from five to one kopeck. The years 1922–4 saw a rapid reduction in the amount of the deficit that had to be made up by emissions of paper roubles, and the existence of the stable tchervonetz side by side with the unstable Soviet rouble made possible an increasing normality in trade long before the stabilisation of the currency as a whole. This process of stabilisation lasted from 1922 to 1924, when the Soviet roubles were finally withdrawn.

Organisation of Industry.—The restoration of the currency was accompanied by, was dependent on and itself assisted radical changes in the organisation of industry. If Russia were to have a stable currency she could no longer afford to leave costs out of account and to make up for industries run at a loss by printing paper roubles. Industry had to be put strictly on a basis of profit and loss. The first step was to distinguish between paying and non-paying industries, the second to make industries themselves interested in their own successful working. The unwieldy mass of moribund nationalised industry was split into sections called trusts and allowed a certain amount of liberty. At first they were free to do what they could with all surplus production over the amount that corresponded to the amounts of raw material, etc., supplied to them by the State. It presently appeared that the State could not supply them with raw materials, so that they were compelled to supply themselves, thereby to a very large extent becoming independent in their operations and called on by the State to account only for their results. These organisations were financed by the banks, all of which were in the hands of the State. The flax trust was the first of these organisations. It was soon followed by the timber trusts, textile trusts, tobacco trusts, etc. The co-operatives, similarly dependent on credit from the State and similarly independent in their operations, became huge trading concerns, buying in Russia and selling abroad, and buying abroad and selling in Russia under the State monopoly. In the first year after the introduction of the new economic policy production in Russia increased by approximately 46% (Oct. 1921 to Oct. 1922). In the second year production was 44% higher than in the first year. Russian exports and imports which had fallen to nil during the blockade and the civil war rose in the year 1922–3 to 9% and 12% of her exports and imports in 1913. In 1923–4, export had risen to 24% and import to 16% of its value in 1913.

In 1923 Russia exported 170,000,000 poods of corn, as against 40,000,000 in the preceding season. Consciousness of the beginning of economic recovery and anxiety lest that recovery should be jeopardised by any worsening of her international relations, dictated her attitude in the first political crisis of that year and in the second showed that it might come into collision with the revolutionary interests of the Communist party. The first crisis was brought about by a British threat to annul the Trade Agreement, the second by a mistaken belief in the imminence of further revolution in Germany.

Relations with Great Britain.—On May 8 1923, Lord Curzon sent an ultimatum to the Soviet Govt. (which in Dec. 1922 had become the Government of the Union of Socialist Soviet Republics) in which he referred to anti-British propaganda and demanded the withdrawal of certain Russian diplomatic representatives in Persia and Afghanistan, recognition of the three-

[1] Thus on May 5 1923 one tchervonetz was worth 485 roubles of the 1923 issue and on Aug. 28 it was worth 1,850 such roubles. A rouble of 1923 was worth 100 of the 1922 roubles, which were each the equivalent of 1,000,000 roubles of any previous issue.

mile limit in territorial waters, compensation for trawlers seized and accidentally sunk when found fishing within the twelve-mile limit which the Russians claimed, and compensation for an Englishwoman who had been imprisoned and an Englishman who had been killed in Russia, together with the withdrawal of a note in which a minor official of the Russian Commissariat for Foreign Affairs had referred to the imprisonment of Irishmen in English prisons in answer to a note from the British Commissioner in Moscow on the subject of a Russian espionage trial. In the event of non-compliance with these demands the Soviet Govt. was threatened with an immediate rupture of Anglo-Russian relations, which for two years had been those outlined in the Trade Agreement of March 1921. The Soviet Govt. replied in terms which, while not accepting all the English demands, made rupture extremely difficult, and the conflict was abandoned after a Russian note of July 18.[1]

On May 10 two days after the delivery of the Curzon ultimatum, Vorovsky, who had gone to Lausanne as Russian representative to attend the conference that was among other things settling the future of the Dardanelles (in which it was recognised that Russia was interested), was murdered by a certain Conradi. It was felt in Russia that the lack of precautions taken by the Swiss police to protect a man who, though not a fully accredited delegate, had yet received a Swiss diplomatic visé on his diplomatic passport was a reflection of the hostile attitude of the Great Powers. In this way the murder of Vorovsky was connected in the Russian mind with the Curzon ultimatum. A street in Moscow in which many of the foreign missions live was renamed after Vorovsky. Just as, during our own Cromwellian revolution England protested in vain when English Whites in Holland killed a representative of the Commonwealth, so Russia's protests to the Swiss Govt. did not prevent the acquittal of Vorovsky's murderer, in spite of his admitted guilt. All Swiss subjects with the exception of workmen and old residents were expelled from Russia, trade with Switzerland was prohibited, and it was announced that until satisfaction had been given Russia would send no diplomatic or trade representatives to that country. The convention concerning the Dardanelles was eventually signed by a Russian representative in Rome. This convention, against Russian wishes, opened the Straits to warships, whereas before the War, against Russian wishes, the Straits had been closed to them.

Russia's Relations with the East.—Within a few days of their taking power, the Soviet Govt. foreshadowed the character of their Eastern policy in a declaration to "The Mussulmans of Russia and the East," issued on Nov. 22 1917. That policy differs from that of the old Russian Empire and from that of Western powers in its ostentatious refusal of all privileges (capitulations, for example) and its insistence that relations between Russia and Eastern nations are relations between equals. It is a policy that makes more difficult the traditional Eastern policy of Western nations, who have been accustomed to treat the Eastern nations, with the exception of Japan, as races on a lower level of civilisation than themselves. The first practical illustration of this policy was given on Jan. 27 1918 in a note from Trotsky, then Commissar of Foreign Affairs, to the Persian Chargé d'Affaires in Petrograd, denouncing the Anglo-Russian treaty of 1907, which divided Persia into British and Russian spheres of influence. A treaty between Russia and Persia was signed on Feb. 26 1921. On May 27 1919 a Russian declaration recognised the sovereign rights of Afghanistan, and by the end of that year there was a Russian envoy in Cabul and an Afghan envoy in Moscow. A Russo-Afghan treaty was signed on Feb. 28 1921,[2] and friendly relations have in general continued, despite some mutual exasperation when Afghanistan sheltered the forces of the deposed Emir of Bokhara and gave at least moral support to Enver Pasha in his attempt to create a Pan-Islamic movement in Bokhara. Both in Persia and in Afghanistan Russian policy came into conflict with British.

Turkey was one of the signatories to the Brest peace whereby she gained considerable Russian territory, and though a Turkish envoy accompanied Count Mirbach to Moscow in 1918, Russia's relations with Turkey were those of a defeated country with a vassal of the conqueror until after the Peace of Sèvres, the dispersal of the Turkish Parliament by the Allies and the formation of the new Turkish Govt. at Angora. Early in 1920 an emissary from Angora (Halil Pasha) reached Moscow, and by Nov. of that year there was a Russian mission in Angora and a Turkish Ambassador had been appointed, though he did not reach Moscow till early in 1921. Friendly messages passed throughout the year, and on March 16 1921 a Russo-Turkish treaty was signed, by which Russia, in accordance with her general Eastern policy, renounced the capitulations and further renounced all claim to the payment of Turkish debts. On Jan. 2 1922 a treaty was signed between Turkey and the Soviet Govt. of the Ukraine, and on July 9 1922 a railway, post and telegraph convention was concluded between Turkey on the one hand and the R.S.F.S.R. and the Trans-Caucasian Republics on the other.[3]

From April 5 1918 till Oct. 25 1922 there were Japanese troops in Vladivostok. During the period of intervention, Japanese troops pushed far inland, and until May 15 1925 the Japanese retained northern Sakhalin, which they had seized pending satisfaction for the Nikolaievsk massacre. When the Russian Red Army reached Irkutsk, early in 1920, Japan had proposed the setting up of a buffer state, and the Far Eastern Republic was created, which, however, instead of falling under Japanese influence, remained closely tied to Moscow and eventually, after the withdrawal of Japanese troops from the continent, was declared a Soviet Republic by a Constituent Assembly. Negotiations initiated in the autumn of 1922 broke down, but Nikolaievsk was evacuated by the Japanese on Sept. 27, and the Maritime Province on Oct. 25. On Feb. 4 1923, M. Joffre was invited from Peking to Tokyo by Viscount Goto, and there were official negotiations from June 28 to July 31 of that year which were without concrete results. The Japanese earthquake and the refusal by the Japanese Govt. of assistance offered by Russia to Japanese "workers" marked the beginning of a new period of hostility on the part of Japan, but the Japanese elections of May 1924 and possibly the American Immigration Act of that month brought about a change of Government and a renewal of negotiations. These resulted in the Russo-Japanese Treaty of Jan. 20 1925 signed at Peking, which came into force on Feb. 26. (For the terms *see* JAPAN, section *Relations with Russia.*) In accordance with this agreement the Japanese evacuated North Sakhalin on May 15 1925.

Soviet Russia's relations with Japan are the same in character as the relations with the big Western powers. Her relations with China illustrate her policy towards "oppressed" as distinguished from "exploiting" nations. On July 26 1921 the Soviet Govt. informed the Chinese Govt. that Russia would not in future require payments on account of the Boxer Indemnity of 1900, and renounced all special privileges in China. A treaty between Russia and China was delayed by the influence of the Western Powers in China, by minor conflicts and by changes in Chinese administration. A treaty was finally signed in Peking on May 31 1924. At the same time an agreement was signed concerning the Chinese Eastern Railway establishing the equality of Russia and China in the management of the railway, abolishing the extra territorial rights of the railway and putting it under the protection of Chinese soldiery. This agreement could not be put into practice for some months because Marshal Chang Tso Lin, commanding in Manchuria did not recognise the authority of the Peking Government. With that Government's approval a separate agreement to the same effect was signed by Russia and Chang Tso Lin at Mukden on Sept. 20 1924. There have been several conflicts concerning the railway, of which the most serious was that of Jan. 1926. (*See* CHINA; CHINESE EASTERN RAILWAY.)

[1] See British White Papers 1869, 1874, 1890 of the year 1923.

[2] Translation of the texts in *Manchester Guardian* of March 31 1921 and *L'Europe Nouvelle* of May 28 1921.

[3] For details of these treaties see A. J. Toynbee, *Survey of International Affairs.* At the same time (March 1) a Turkish-Afghan treaty was signed in Moscow.

Expectation of Revolution in Germany.—In the autumn of 1923 the Russian Communist leaders believed that there would be a revolution in Germany, as a result of the occupation of the Ruhr and the Separatist intrigues in the Rhineland, which accentuated the economic crisis in Germany. They expected that Poland and France or Poland alone, would attack the German revolution, and the Soviet Govt. sent Victor Kopp as plenipotentiary to seek an arrangement with the countries lying between Russia and Germany, whereby Russia should be able to send corn to Germany, no matter what German Govt. should be in power. The Communists could not have remained indifferent if an attempt had been made to blockade a revolutionary Germany and, being extremely anxious to avoid war, hoped in this way to be able to make such a blockade ineffective without being themselves drawn into an armed struggle. Some of their small western neighbours were glad of even this frail guarantee of peace, but nothing was actually signed, and the motive for seeking such an agreement was removed when the expected day came and there was no German revolution. From that moment the Soviet Govt. began to build alike its external and internal policy upon a belief that for a very much longer period than it had at first anticipated it would be the only Communist Govt. in Europe. There had been a feeling in the minds of the masses that N.E.P. (New Economic Policy) would be thrown overboard as soon as a German revolution made it possible to exchange Russian corn for German goods in an economically independent, self-contained Socialist world. N.E.P. now gathered an atmosphere of permanency, and was henceforward more confidently developed.

Economic Recovery.—Although in Lenin's mind it had always been the policy of a prolonged period, the phrases used in introducing it (" retreat " " a manoeuvre " and " outflanking ") had delayed its acceptation as such. For some time revolutionary hopes and doubts were reflected in alternating moods of repression of and exultation in the growing commercial activity of the towns. For some time minor authorities were not quite clear as to what was and what was not allowed by the new economic policy. Private traders who were too successful found themselves welcomed by the State trusts anxious to sell them goods, arrested as if at haphazard by the administrative authorities, and heavily taxed by those who had charge of the State finances. As one of them put it: " There was sunshine in the morning, but thunder in the air, and you never knew when you would have to take shelter from a downpour." It was only after the definite political stabilisation of Germany that they began to lose this feeling of precariousness. On the other hand they were enjoying a freedom they had not known under the civil war, the rewards were large, and in spite of the way in which the State weighted the scales against them and in its own favour they were extremely active. It was a long time before the State shops could outlive the bureaucratic manners of the period of militant communism. It was for a long time pleasanter and quicker to buy things from a private trader than from a State shop or a co-operative store, and the State had to learn that not in industry alone is it necessary to provide the stimulus of personal interest. But the machine, though at first those of its wheels creaked in which the State was particularly interested, began to move with increasing speed. The measures introduced as a concession to the peasantry were resulting in an extraordinary resuscitation of the towns. As early as 1923 the streets were full of jostling, hurrying crowds, and impartial observers were of the opinion that a stoppage of the New Economic Policy was beyond the power of the Communists even if they had wished it.

Increasing activity in the towns, rapid growth of the tilled areas in the country, and the economic recovery of Russia in general were accompanied naturally by a series of growing pains. The first of these was a crisis which from an image used by Trotsky came to be known as the crisis of the " scissors." The two blades of the scissors represented the prices of agricultural products and the price of manufactured goods. At one time during the civil war a peasant could get a grand piano from its starving owners in exchange for a few sacks of potatoes. With the new economic policy there came about a sharp change. Agricultural products became very cheap and manufactured goods very dear, so dear indeed that the peasants could not afford to buy them. Part of the high price of goods was due to the enormous overhead cost of distribution through the co-operative organisations, part to high cost of organisation, low productivity of labour, etc., etc., and to the new anxiety of the State Trusts to show profit, which led them to screw up the price of goods instead of reducing the cost of their manufacture. The result was a market crisis, in which goods remained unsold in the factories. The Communists were threatened with a rapid growth of private trade unless they could reduce the overhead costs of sale, and with a stoppage of factories unless they could bring about a closing of the scissors—a lessening of the unequal balance between prices of corn and of manufactured goods. At the same time the country was in the throes of its struggle to stabilise the currency, so that there was a shortage of money which resulted in very natural strikes by workmen who had not been paid their wages. The most serious effect of the crisis was a loss of faith on the part of the peasantry, who felt very keenly that they were being exploited by the towns.

Party Dissensions.—These growing pains were reflected in discussions within the Communist party. It seemed to some of the Communists that the result of the New Economic Policy had been to turn the State apparatus into a capitalist organisation, whose interests were no longer those of the working class. The trade unions had already ceased to be part of that apparatus, and had returned to the task of defending the interests of the workers against their employers, whether those were private persons or state trusts, but this did not prevent the formation of two surreptitious groups in the party with a tendency towards syndicalism. These did not include any of the better known leaders. Much more serious for the party was the opposition that appeared in the autumn of 1923, which included members of the Central Committee, and in particular Trotsky. The variety of opinions united in a single block in this opposition was itself a proof that its underlying motives were not those openly put forward and that it reflected a widespread discontent in the ranks. It soon appeared that this opposition questioned the right of permanent leadership that seemed to be claimed by the " old guard." The discussion was used by the " old guard " chiefly to destroy the overwhelming prestige of Trotsky, which, outside the Central Committee, was second only to that of Lenin whereas inside it was never forgotten that Trotsky had only sunk his differences with the party in 1917. Stalin, Zinoviev and Kamenev fell upon Trotsky with great vigour, and were still attacking him when, on Jan. 21 1924, Lenin died.

If Lenin had planned the manner of his dying with the object of preventing his death from shaking the Soviet Govt., he could not have done better than he did. His illness did not take him from the leadership until he had already set the party, the Government and the country on the new road towards Russian economic recovery that the end of the civil war made possible. It took him away for a few months, as it were temporarily, and then allowed him to return. It again removed him and allowed the country to accustom itself for a year to the idea of a Council of People's Commissars over which Lenin did not preside, and the Communist party to the idea of looking for directives to a Central Committee which Lenin no longer personally inspired. If he had died earlier, especially if he had died during the War, there might have been trouble over the succession. As it was, Trotsky had been politically discredited by the Central Committee " just in time," and there was no immediate dispute over the leadership which fell naturally to Stalin, Zinoviev and Kamenev, Rykov taking the part of President of the Council of People's Commissars. At the moment of Lenin's death, when it might have been expected that the position of the party would be shaken, the party was able to throw its gates open to new members from the working class. Many thousands enrolled themselves within a few weeks, and by 1926 the party, which had been reduced to about 400,000 by the purge that accompanied the introduction of the New Economic Policy, had grown to over a million. Lenin died, and it was presently seen that

nothing had happened to weaken the Government. There was a moment of expectation outside Russia, a moment of fear inside Russia among those who had come to look on Lenin's life as a sort of guarantee of Russia's new found stability. Both were unjustified, and within a few weeks it was realised, outside as well as inside Russia, that practically Lenin died not in 1924 but nearly two years earlier, when, in 1922, he had first felt ill.

Great Britain Recognises the Soviet Govt.—On Feb. 1 1924, less than a fortnight after Lenin's death, the new Labour Govt. in England signified its recognition of the Soviet Govt. as the *de jure* government of Russia. Italy, Norway, Austria, Greece and Sweden had taken the same step before the end of March. Others followed. Many countries, following the lead of Italy, at once appointed ambassadors. England postponed doing this until outstanding questions should be regulated, and a conference for this purpose was called forthwith. These negotiations, which became the subject of bitter political controversy in England, began in London on April 14. The Russians, as in former negotiations, insisted that the two questions of recognition of debts and the provision of credit for development of the power to pay must be considered together. Meetings between the Russians and the bondholders ended in a deadlock. After extreme difficulty, two agreements between the Governments were signed on Aug. 8—a general agreement, and one on trade and shipping, which provided for the application of the Export Credits Act to trade with Russia. Russia was to continue negotiations with the bondholders, and an agreement with them was to be included in a further treaty and to be a condition on which the British Govt. would be prepared to recommend Parliament to guarantee the interest and sinking fund of a private loan. On Nov. 4 Mr. MacDonald resigned, and the Conservative Govt. that succeeded him did not offer the treaties for consideration by Parliament.[1] The position remained what it had been before the negotiations began. Sir Robert Hodgson in Moscow, and the Russian representative in England were still in 1926, two years after formal recognition of the Soviet Govt., enjoying only the privileges given to chargés d'affaires.

The Economic Position.—In 1925 Russia was a very different country from the Russia of the politically chaotic period that immediately followed the Feb. revolution of 1917 or from the desperate, starving Russia of the civil war. Both in agriculture and in industry she had recovered a level of productivity only about 30% below the level she had reached before the War. The mist of cross purposes that hung over the visible bustle of the towns had cleared sufficiently to show that the new economic policy had not been a simple retreat towards capitalism, and that Russia's undeniable development had been along lines fundamentally different from those followed by other countries. That difference was much more marked in the towns than in the country. It may be said that the towns in Russia formed islands experimenting in a new economic organisation but surrounded and fertilised by an immense sea of agricultural life which was as yet only very slightly affected by these experiments. No great progress had been made in collective agriculture among the peasants, who, after the general levelling of the revolution, were working exactly as they had worked before it, some showing a tendency to get rich, others becoming impoverished and ready to work for hire instead of for themselves. In the towns, however, were definite signs of the consolidation of a new system, and the fact that the towns controlled export and import gave them an influence in the villages that showed (1926) no signs of diminishing.

[1] During the election campaign which followed the defeat of the Labour Govt. in Great Britain on Oct. 8 1924, there was published (Oct. 24), under a covering letter addressed by a Foreign Office official to Mr. Rakovsky, the Soviet chargé d'affaires in London, a provocative letter purporting to be addressed to the central committee of the British Communist party by the Praesidium of the Third International over the signatures of Zinoviev, McManus, and Kuusinen. Its authenticity was denied, but the publication roused national wrath in Great Britain, and the conversations were not renewed. For the official correspondence and the text of the "Zinoviev letter" see A. J. Toynbee, *Survey of International Affairs 1924* (Oxford, 1926). (Ed. *E. B.*)

In Russian industry the relative proportion of private to State and co-operative industry seemed to be growing less. In the year 1923–4 it was estimated that 76.3% of industry was in the hands of the State and the co-operative organisation. In the year 1924–5, this percentage had increased to 79·3. In trade, whereas in the first six months of 1923 50% was in private hands, and the second six months 34%, in the year 1924–5 only 26% was in private hands, while there was an absolute increase in the trade turnover. Individual interest remains the primary motive of production and trade, in town as in the country, but not many persons are able to live by allowing someone else to use their money for productive trade purposes. Unearned increment is rare. Inheritance is allowed with a scale of high and rapidly increasing death duties. The clash of interests between classes inherent in the ordinary system is present in Russia also, where it is artificially reflected by a conflict of motives between different organisations, mutually independent but subject to partial control by a single centre. Thus, whereas the managers and directors of the trusts are chiefly interested in cheapening and increasing production, the trade unions are chiefly interested in seeing that these objects are not achieved at the expense of the workers employed, while the trading organisations are chiefly interested in preventing high prices from lessening their turnover. The central authority, by controlling credit, can bring pressure to bear on the trusts, while by buying and selling it can influence the market. Rates of pay are for the most part decided by collective treaty under the supervision of the trade unions. Arbitration is used for the settlement of disputes.

The Economic Crisis of 1925.—The concentration of industry and trade in the hands of the State gives to economic crises a character differing from that of such crises in other countries. In other countries a crisis in one industry is felt only in a lesser degree by others. In Russia, by affecting import and export, it affects the whole economic body of the State. Since no part of that body is without some sort of contact with the Communist party every such crisis is at once reflected in a conflict of views within the party. Towards the end of 1925 the Communists were faced by the most serious crisis for several years. They had counted, in view of a fair harvest, on being able to buy enough corn from the peasants to increase very largely Russian export. Assuming that they would have this largely increased export they planned a lavish import of machinery, etc., confident that they could afford this without risking the favourable balance of trade which they regarded as essential to the stability of their currency. They gave large orders, undertaking big obligations, their confidence being increased by each month of favourable weather. Then, after the harvest, it appeared that the peasant was in no hurry to sell. His taxes had been lowered. He had no urgent need of money, knew that the Government needed the corn and hoped that the longer he held the higher would be the price. The favourable trade balance vanished. It could be restored only by a sharp cutting down of import and that meant a loss of slowly gained confidence abroad and the slowing down of the tempo of economic recovery at home. Further, obligations had to be met in foreign currency, on the possession of which depended to a large extent the stability of the Russian bank-note. The peasant, straw in his hair and sunflower seed in his mouth, had put a spoke in the wheel of the whole community.

This was the economic crisis that sharpened the dispute in the Communist party with which the year 1925 closed. It united in opposition to the central committee, though with widely different views, some of its members who, by reason of their particular work, felt the crisis most intimately. Kamenev, as president of the Council of Labour and Defence, with an economic report in his hands (that he was now allowed to present to the party congress) was very conscious that the peasant had put a stop to what had promised to be a triumphal, uninterrupted progress. Sokolnikov, responsible for Finance, saw the peasant threatening the stability of the currency. Zinoviev, of the Third International, felt that peasant domination was likely to injure the prestige of the Russian party in the minds of the Communist

parties of Western Europe. The peasant's application of blue pencil to the Soviet Govt.'s export plan raised anew the whole question of the New Economic Policy. There was no question of abandoning that policy. The question was whether, under N.E.P. the Communists were doing enough to ensure that the general progress of the country was in the direction of socialism or were allowing the strengthening of a class which would eventually compel the country to move in the other direction. The question raised was, " Which class of peasants was most profiting by N.E.P.?" The central committee held that there was no need to exaggerate the influence of the rich peasants, who were in a small minority among those fairly well off, who profited by N.E.P. The economic recovery of the country, and particularly the development of industry was the surest means to acquire a dominating influence over the peasantry. The interests of industrial development were paramount in a situation that made it clear that for a long time to come Russia could not expect revolution in any of the big industrial countries. The leaders of the opposition were attacked and discredited in the same way as Trotsky had been attacked and discredited in earlier discussions, and the New Economic Policy received a further confirmation. (A. R.)

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IV. THE CONSTITUTION

The Constitution of the Union of Soviet Socialist Republics, drawn up on July 26 1923, was confirmed on Jan. 31 1924. This unites in a single body a number of ethnographically and administratively distinct States with essentially similar constitutions.

The Congress of Soviets.—The supreme legislative power rests with the Congress of Soviets, which, when not sitting, delegates that power to an executive committee, made up of the Union Council and the Council of Nationalities. The Union Council is elected by the Congress of Soviets. The Council of Nationalities is made up of five representatives from each of the united and autonomous republics and one each from the autonomous districts. The Executive Committee can veto decrees, etc., passed by its praesidium or by individual congresses of soviets of republics, or their executive committees within the territory of the Union. It is itself responsible only to the Congress of Soviets of the Union. This Congress meets not less than once a year, for which purpose it is elected. In each year there are three sessions of the Executive Committee of the Union. In the intervals between its sessions its authority is delegated to its praesidium of 27 members. The Council of Peoples' Commissars is the executive organ of the central executive committee of the Union. It consists of the President of Council of Peoples' Commissars, vice-presidents and ten peoples' commissars.

The Separate Republics.—Each of the republics forming the Union is ruled by its own Congress of Soviets in matters that do not concern the Union as a whole. The Congress of a Republic elects its Central Executive Committee and this in turn its Praesidium and its Council of Peoples' Commissars, to which it admits, for purposes of co-ordination plenipotentiaries of the Union Peoples' Commissars for foreign affairs, military and naval affairs, foreign trade, ways of communication and posts and telegraphs.

The Franchise.—Every working citizen, male or female, who has reached the age of 18 has a right to take part in elections to the Soviets unless he or she makes profit out of the use of hired labour, out of religion or out of usury (persons living on interest from capital or dividends), is a member of the one-time ruling house in Russia, has served under the old régime in the police, secret police, or corps of gendarmes, or has been convicted of taking or offering bribes, banditry, espionage, etc. The most elementary form of Soviet is the village soviet, to which, roughly speaking, every 100 electors send one delegate. The village soviets in a rural district (volost) send one representative for every 300 inhabitants to a volost congress of soviets, which meets once a year and elects a volost executive committee, which is the chief authority for that district. A town soviet is made by the election of one member for every 1,000 persons. Town and village soviets unite in a district (ouyezd) congress of soviets, though not on equal terms. The town soviets send one delegate for every 200 electors, whereas the village electors are represented through the volost congresses of soviets, which send one delegate for every 1,000 of the population. The ouyezd congresses elect executive committees, which are the supreme authority over the territory of the ouyezd. The Government Congresses of Soviets, subject only to the supreme organs of the republic, are elected by the town soviets and the ouyezd congresses, the town soviets sending one delegate for every 2,000 electors and the ouyezd congresses one delegate for every 10,000 of the population. These congresses elect executive committees, in whose hands is their authority until the succeeding congress. The Congress of Soviets of a Republic, like the Congress of Soviets of the Union, is elected by the town soviets and the Government congresses of soviets. The town soviets elect one delegate for every 25,000 electors, and the Government congresses one delegate for every 125,000 of the population. The effect of this constitution is to give increasing weight to the voice of the industrial population of the towns in the higher organs of authority while leaving very great freedom to the peasants to conduct things in their own way in the villages. The proportion of Communists in the village soviets is extremely small. In the town soviets it is large. It is larger in the Government congresses than in those of the ouyezds (cantons) and larger again in the congresses of republics or of the Union.

The Communist Party.—With the gradual disappearance and break-up of other parties and the certainty that a Communist majority in the Congress of Soviets of the Union and in the Central Executive Committee would invariably support the views put forward by the Communists, public interest in the Congress of Soviets grew less, and interest in the congresses of the Communist party increased. It was clear that what the Communists decided to-day the representative institutions would decree tomorrow. Communist congresses were still held behind closed doors, but their debates were reported at very great length. The mechanism of the Communist party began to be as important as that of the constitution, since, for practical purposes, it was the actual, though not the formal, Govt. of Russia. A congress of the Communist party is attended by delegates from the local branches. It is met by the Central Committee appointed by the previous congress, and hears reports which represent the views of the majority of the Central Committee. It takes these reports as the starting points of its debates. At the end of the debates it passes resolutions which represent compromises between differing views (if such obtain) made with the object of finding formulae that will be supported by votes as nearly unanimous as possible. These resolutions are considered as directives binding upon the Central Committee, which the congress then proceeds to elect. It elects a

Central Committee (63 members with 43 deputies), a central control commission (163 members and a central revisional committee of seven members). (These figures are those of the congress that met at the end of 1925.) Thereafter is held a "plenum" of the Central Committee, together with members of the praesidium of the Central Control commission and the members of the central revisional commission. This "plenum" elects the Political Bureau of nine members with five deputies, the Secretariat of the Central Committee of five members with two deputies, the general secretary of the Central Committee (Stalin, 1926) and an Organising Bureau of eleven members with five deputies. It further appoints the editors of the party newspapers and the representatives of the party newspapers and the representatives of the party in the executive committee of the Third International.

Great efforts are made to preserve unanimity in the Central Committee, and party discipline is extremely strict. A dissenting member of the committee is considered to have infringed discipline if he presses his views outside the committee without its permission. That permission is usually given before a congress, and it is understood that in the event of those views being rejected by the congress the dissenter will wholeheartedly support whatever other views are accepted. By accumulated prestige, fear of schism, control of publication and control of promotion in the party, the Central Committee is in a very strong position in the party in the matter of obtaining support, the Political Bureau is in a strong position in the committee, while the general secretary has an overwhelmingly strong position in both.

The result is a highly centralised instrument for making political decisions which are reflected in the congresses of Soviets and carried out by the Council of Peoples' Commissars. But this instrument is also used in the reverse way, namely, to obtain a wide understanding and support for all the measures of the Government. Every phase in the Government's activities is debated from top to bottom of the party. No important event or change of policy (foreign or internal) takes place without a series of conferences at which the line of the Central Committee (which controls the Government) is explained and discussed. The rank and file of the party are thus kept in close touch with what is going on over their heads, while through these conferences the feeling of the rank and file is reflected back to the committee, and when this feeling seems at all uncertain studied campaigns of explanation are undertaken. This process is carried further through the part played by the rank and file in non-party organisations (trade unions, soviets, etc.) until behind the decisions of the Central Committee is ranged the whole strength of the party and that of a considerable proportion of the non-party workers. This sort of "democratic centralism" is not something newly worked out, but is a fundamental principle of a party which long before the revolution believed at the same time in mass movement and in highly centralised leadership. (A. R.)

V. DEFENCE

It is difficult at the present time to obtain entirely accurate statistics of the armed forces of the Union of Socialist Soviet Republics or to gauge their military value. The political isolation of Russia from the rest of Europe precludes many of the normal sources of information. The following outline may, therefore, be only approximately correct.

Control and Administration.—The Central Executive Committee, which is virtually the supreme governing body of the Union, exercises its control over the armed forces through the People's Commissariat for Military and Naval Affairs, at the head of which is a Commissar, corresponding to a defence minister. He has under him two assistants and a Revolutionary Military Council, from which depend the Inspector General, the staff (*i.e.*, general staff) and the chiefs of political work and of supply. The Inspector General has under him inspectors for naval affairs and for the air force, cavalry, artillery, etc. There is also a body termed the Commissariat for Labour and National Defence, charged with the duty of co-ordinating all activities in the sphere of national defence, and in that of national economics.

In its essentials, therefore, the Soviet system is, in theory at least, very similar to that of other countries. Its peculiar features are the combination of the three Services, army, navy and air force, under a single head, and the prominence of the political department of the military council, which controls political instruction in the services, watches over the political orthodoxy of the forces and has no counterpart in the military system of other countries. The Political Department has its own troops.

Terms of Service.—Compulsory service is in force, and a man's military obligations practically begin at 16 years of age. Between the years of 16 to 18 he has to do preparatory physical training for a period of four weeks or 160 hours, and from 18 to 20 a more advanced course of "pre-conscription training," lasting 10 weeks. Service with the colours in the regular army is for two years in the infantry, artillery and cavalry, for three years in the air force and for 4½ years in the navy. Men then pass into the reserve, where they remain up to the age of 40. Those who are not required for the regular army do four years' service in the territorial army; three months in the first year and a total of five months in the remaining years. All men over 40 are still liable to service in a form of Landsturm, up to the age of 46. The principle theoretically followed is that only workers, peasants and Cossacks may bear arms in the defence of the Republic, the bourgeoisie to carry out non-combatant duties.

Man-Power.—The population of the countries which now acknowledge Soviet rule is approximately 130 millions. The full strength of the annual contingent, after allowing for medical rejections, comes to about 725,000,[1] of which it is estimated that some 400,000 are called up, the remainder being exempted for various reasons. There are, at the present time, probably over 10,000,000 men between the ages of 18 and 31 who have received some form of military training and are available to fill the cadres in the event of a general mobilisation.

Organisation of the Armed Forces.—(a) The land forces consist of the regular army, the territorial army, and certain special troops. The first two of these categories correspond generally to the same categories of the British Army, but the special troops of the political department form an entirely exceptional body. Their rôle is that of internal security, the quelling of civil disturbances, the service of frontier guards and coast guards, intelligence, police and escort work. They are under the control of the Ogpu, and come under the control of the Military Department only for operations. They are in fact the pillar on which Communist rule rests, and they comprise the staunchest elements of the Communist party.[2] They are organised in regiments, battalions, batteries, etc. on the same lines as regular forces, and include a proportion of armoured cars and aircraft.

For administrative purposes, Russia is divided into eight military districts and two "armies," viz.: the Moscow, Leningrad (St. Petersburg), Western, Volga, Ukraine, North Caucasus, Siberia and Kirghiz military districts, the Independent Caucasus Army and the 1st Turkestan Army. These districts are again subdivided into areas corresponding to the territorial divisions and regiments recruited from them, the authorities in which are responsible for all mobilisation preparations and arrangements.

The highest peace formation is the Corps, of which there are 22. They consist normally of three divisions and Corps troops. These latter include medium artillery, tanks and armoured cars, and a gas regiment. There are 12 cavalry divisions, nine independent cavalry brigades, and 66 infantry divisions (regular and territorial). A cavalry division consists of six regiments and includes 12 guns and nearly 200 machine guns, heavy and light. An infantry division comprises three regiments, each of three battalions, with 48 guns and some 450 automatic weapons. The three regiments of the division are each entirely complete and self-contained with their own mounted scouts, close support artillery, transport and so forth, so that they can operate independently. One result of this is the very large amount of transport in a division, over 3,000 vehicles and 9,000 animals.

The total peace strength of the land forces is approximately as follows: Regular forces 400,000; territorial forces (including regular cadres) 470,000; special troops (including their reserves) 150,000. In addition, the Milizie (armed constabulary) number 200,000.

(b) *Air Force.*—The Soviet authorities are making great efforts to create a powerful air force. The peace establishment of personnel is about 10,000. The total number of serviceable aeroplanes available is at present probably about 550, organised into between 40 and 50 air squadrons. Squadrons are allotted in peace to the various military districts. In war they would presumably form "army" and "corps" troops.

(c) *Naval Forces.*—The Russian Navy is divided into two main fleets, the Baltic Fleet and Black Sea Fleet, with strengths as follows:—

Baltic Fleet:—	*Black Sea Fleet*:—
2 battleships, both dating from 1911,	2 armoured cruisers,
3 cruisers,	3 gunboats,
2 gunboats,	3 destroyers,
13 destroyers,	5 submarines, and small craft (minesweepers, etc.).
8 torpedo boats,	
9 submarines,	
A number of auxiliary craft (minesweepers, etc.).	

The Caspian and Oxus flotillas consist of a few small armed vessels.

[1] The total annual class numbers about 950,000; owing to the huge distances, the lack of up-to-date instructors and other considerations the actual contingent is reduced to the figure indicated above.

[2] The percentage of Communists in the ranks of the army is only about 8 per cent. In the Ogpu troops it is much higher; also in the higher command and in certain technical units, *i.e.*, armoured forces.

Estimate of Efficiency of Soviet Forces.—It is difficult to arrive at a just appreciation of the actual military value of the Red forces. The chief features of their organisation are the high proportion of cavalry, to which arm great value is attached; the equipment of the smaller formations, such as the regiment, for independent action; the large numbers of automatic weapons; and the preparation made for the use of gas as an offensive weapon. In this deadly branch of modern warfare, it is believed that great progress has been made. To sum up, the Russian Army on paper is very thoroughly organised and appears formidable. On the other hand, no amount of paper organisation will at once remove failings inherent in the national character or disabilities in the economic position of the country. The old Imperial Russian Army suffered from a shortage of educated officers and non-commissioned officers and of skilled technical personnel; in present-day Russia this defect must be far more pronounced. The lack of power to manufacture her requirements in munitions and the backward state of the communications of the country were fatal to Russia's armies in the late War; it can hardly be said that the manufacturing strength of the country has increased under Soviet rule, while the transport system went from bad to worse, though transport was reorganised by Dzerjhinsky and much improved 1923–4. It seems unlikely that discipline and morale are as high as under the old régime. On the whole, therefore, it may be doubted whether the Red forces would be as formidable in the field as they are imposing on paper. But the Bolshevist authorities have brought to a high degree of efficiency a strategical weapon which is often of more value than armies, that of subversive propaganda. The founder of Soviet policy, Lenin, laid down that "the soundest strategy in war is to postpone operations until the moral disintegration of the enemy renders the delivery of the mortal blow both possible and easy." In other words, the army is intended only as a consolidating agency to occupy the ground already won by political propaganda.

Russia's Defence Problems.—Russia's chief economical and strategical need has always been a free outlet to the oceans of the world. Her northern shores are ice-bound for a great part of the year; and the Baltic on the west and the Black Sea on the south are closed waters of which other nations control the exits. Only in the far east, at an uneconomical distance from her main centres of population, is an unimpeded outlet to the high seas possible.

On land, Russia's unwieldy size and the poor development of her communications have been serious handicaps to offensive action on her part, but have, on the other hand, always in the end baffled enemies who have sought to invade her. The value of the mounted arm in this country of wide plains and great distances has always been expressed by the high proportion of cavalry in the Russian Army.

The changes brought about by the War on the European frontier of Russia have considerably simplified her defence problem on that side, since she is now bordered by a series of small and comparatively weak States, of which Poland is probably the strongest. The Finnish frontier comes uncomfortably close to the former capital (now Leningrad) and to the naval fortress of Kronstadt, but aggression on the part of Finland is hardly a probable contingency. In the south, the possession by Rumania of the former Russian province of Bessarabia may at some date prove a subject of contention. But the western frontier of Russia certainly lies under no such threat as it did in 1914 from Germany and Austria. On the Caucasus frontier Russia is faced by a much weakened Turkey, with whom, moreover, she at present maintains close relations.

In the east, the activities displayed by the Soviet authorities in endeavouring to extend their influence over Persia, Afghanistan and the Chinese Empire may ultimately bring them into clash with Great Britain on the frontiers of India, or with Japan in Manchuria or China. The Bolshevists will, however, assuredly seek, for as long as possible, to gain their ends by propaganda and by fostering internal disorders rather than by an open resort to arms.

In conclusion, an important tendency of the present rulers of Russia may be noted, since it may have eventually no small strategical consequences. It is their policy of encouraging amongst the non-Russian races which form part of the Union the creation of national forces; they have even indicated an intention to place the whole of the armed forces on a territorial basis. This is a complete reversal of the Tsarist policy, which was to split up the non-Russians and incorporate them in small proportions in Russian units. The new system obviously has great advantages from the point of view of morale and efficiency; on the other hand, it may make it easier in the future for territories with a non-Russian population to break away from the former Russian Empire.

For the laws regulating military and naval service, see *Izvestia* Sept. 30 1922, March 23 1924, Aug. 8 1923, Sept. 23 1925. The Report on Military and Naval affairs submitted to the 3rd Assembly of the U.S.S.R. is printed in *Izvestia* May 22 1925. See also *Armaments Year Book* (League of Nations, Geneva 1926). (A. P. W.)

VI. ECONOMIC HISTORY

Population.—The population of Russia on Jan. 1 1913, according to the official census figures, was 178,400,000. The population of the separated territories according to calculations dating from the years 1915–9 were as follows:—

Finland	3,368,000
Estonia	1,750,000
Latvia	2,500,000
Lithuania	2,246,000
Poland	16,022,000
Kars	492,000
Bessarabia	2,213,000
Total	28,591,000

The population of the Union of Socialist Soviet Republics and its principal parts was, in 1924:—

Russian S.F.S.R.	96,700,000
Ukraine S.S.R.	27,700,000
White Russian S.S.R.	4,200,000
Transcaucasian S.F.S.R.	5,400,000
Turkoman S.S.R.	900,000
Uzbek S.S.R.	4,800,000
Total	139,700,000

The comparison of these data, which cannot, however, pretend to a great degree of accuracy, shows that in the 10 years the population of the former Russian Empire has not increased. It is very probable that growth had already ceased during the War. It is certain that the population decreased in the period 1918–21 during the civil war and the famine of 1921–2. Increase only began again in 1922.

On the eve of the War the rural population was 86·3% of the whole, the town population 13·7%. According to statistics of 1923 83·6% lived in the country districts, 16·4% in towns. No deductions, however, can be based on these figures as to changes in the distribution of the population between town and country, for during the revolution many villages were changed into towns. These figures notwithstanding, the town population has probably decreased of late years. This is in any case true of large towns.

Agriculture.—The most important facts are stated in tabular form in which figures are given for the quinquennium before the War 1909–13; the year of the revolution, 1917; the year 1921, when the Soviet Govt. gave up the policy of war communism in favour of the so-called "new economic policy"; and for the subsequent years as far as 1924.

All the figures in this and the following tables relate to the present territory of the Soviet Union:—

	1909–13	1917	1921	1922	1923	1924
Area sown (in million desyatines)	83·1	79·4	58·3	49·3	60	77·2
Total yield of all cereals (in milliard poods)	3·9	3·4	1·7	2·2	2·8	2·8
Wheat	1·1	1·0	·3	·4	·5	·6
Rye	1·1	1·0	·6	·9	1·1	1·1
Barley	·5	·4	·2	·2	·3	·2
Oats	·8	·7	·3	·4	·9	·4
Maize	·1	·1	·1	·1	·1	·1
Potatoes	1·2	1·1	1·3	1·4	. .	1·9

The reduction of the area sown went on systematically till 1922. In 1923 the turning point came and the sown area began to increase. In 1925 it was about the same as in pre-War times.

As to the yield of cereals, the lowest figure is for 1921, when the country suffered from the failure of the harvest. 1924 was again a bad year, so, notwithstanding the increase in the area sown, the yield of cereals was the same as in the previous year. The yield of 1925 was almost as much as in pre-War times. The table shows a marked increase during the last five years in the cultivation of potatoes. In regard to crops not shown in the table it should be said that flax, hemp and sugarbeet rose quickly after 1922, but up to 1923 had not attained their pre-War levels. There has been an increase not only in the cultivation of potatoes, but also in that of sunflower for seed.

Cattle-raising also fell off very much in the time of War and revolution. In 1924 the number of horses had not reached the pre-War level. The quantity of other animals had either reached their pre-War numbers or had exceeded them, but it must be admitted that these figures are not entirely trustworthy.

(In thousand heads)

	1913	1917	1921	1922	1923	1924
Number of horses	31,307	15,804	18,933	15,600	20,035	23,854
Large horned cattle	50,284	25,648	36,817	33,031	38,567	51,420
Smaller horned cattle	83,045	44,442	49,721	40,022	56,744	78,847
Pigs	19,274	12,696	12,491	7,637	9,105	17,672

Mining.—The effects of the War and revolution were even more severe in the mining industry. Its restorations began soon after the introduction of the New Economic Policy, but the results obtained did not in any branch equal pre-War production. The information given before for the period beginning in 1921 refers not to calendar years but to years beginning on Oct. 1 and ending on Sept. 30.

Yield in Million Poods

	1909–13	1917–8	1921–2	1922–3	1923–4	1924–5
Oil	547·6	422·6	276·1	315·4	362·9	424·2
Coal	1,771·8[1]	1,036·9	588·7	659·8	938	956
Iron Ore	429·4	..	10·9	26·1	55·7	109·1

[1] For 1913.

Industry also was very much reduced in 1920–1, and before the introduction of the New Economic Policy this, together with the decrease in the productivity of agriculture, was one of the chief causes of the renunciation of the economic methods of war communism. According to the calculations of authoritative economists the production of industry in 1921 only reached 20% of its pre-War level, taking the total of the chief branches. It may not be out of place to call to mind that at this time no markets existed in Soviet Russia, and the small quantity of goods produced by the factories and workshops was divided among consumers according to "cards" and "orders" under a plan worked out by the organs of the Central Government. The numbers of workers in industry in the years 1910-25 do not give a fair picture of the actual extent of production and the increase which has taken place since 1921. This is due first to the fall in the productivity of labour which accompanied the general disorganisation of all economic life, and secondly to the fact that many persons included in the numbers of industrial workers were unemployed in the most difficult years.

Number of Workers in Industry

1913	1,889,000	1923–4	1,263,000
1921–2	829,000	1924–5	1,493,000
1922–3	1,120,000	1925 (end of the year)	1,828,000

Production (in million poods[1])

	1909-13[2]	1921–2	1922–3	1923–4	1924–5
Cast Iron	233·6	10·6	18·3	40·1	70·6
Iron and Steel	204·6	19·3	36·0	60·1	113·2

[1] A pood is 36 lb. or roughly $\frac{1}{60}$ of a ton.

[2] The data refer to the territory of the former Russian Empire, *i.e.*, they include the production of Poland, about 10% of the whole.

In order to complete the comparison of the present state of production (1923–4–5) with its condition just before the War, it will be useful to quote some calculations of the State General Organising Commission of the autumn of 1925. One of the chief tasks of the Commission was the comparison of present with pre-War data. We will here confine ourselves to percentages. Pre-War production is taken as that of 1913. The data for 1924–5 are still provisional only.

Relation to pre-War Production

	1924	1925
	%	%
Chief cereals	53·0	78·8
Potatoes	116·1	126·7
Flax	94·1	115·5
Cotton	44·9	85·5
Coal	54·7 (1923–4)	54·9 (1924–5)
Oil	64·0	71·7
Cotton spinning and weaving	35·1	65·5
Sugar	23·2	35·9

Foreign Trade.—The foreign trade of the Soviet Union almost disappeared during the civil war and so far is still much below the pre-War level. The statistics quoted below are given as the actual prices for the years before 1914 and for the subsequent years at 1913 prices in millions of gold roubles.

(In millions of gold roubles)

	Imports	Exports	Turnover
1909–13	1,139·7	1,501·0	2,640·7
1914	1,098·0	956·1	2,054·1
1915	1,138·6	401·8	1,540·4
1916	1,716·5	476·4	2,192·9
1917	1,965·8	464·0	2,429·8
1920	29·0	1·5	30·5
1921	210·0	20·2	230·2
1922	269·8	81·6	351·4
1922–3	147·9	133·3	281·2
1923–4	206·8	332·9	439·7
1924–5	356·1	320·2	676·3

The import and export of commodities under the chief groups are distributed during the last two years as follows:—

(In million roubles at 1913 prices)

	1923–4		1924–5	
	Import	Export	Import	Export
Foodstuffs	17·5	195·2	86·	104·2
Raw material and half-finished products	126·3	136·4	156·7	213·
Various	63	1·3	113·4	3·0
Total	206·8	332·9	356·1	320·2

The large amount of imported foodstuffs in 1924–5 is explained by the bad harvest of that year and the consequent necessity of importing wheat flour to feed the large industrial centres.

The Currency of the Soviet Union is made up of several parts.

(1) Bank-notes issued by the State Bank in a monetary unit called the chervonets.

(2) Treasury notes issued by the Peoples' Commissariat of Finance in a monetary unit called a rouble.

(3) Silver and copper money.

One chervonets is the equivalent of 10 roubles.

Bank-notes are issued in denominations of from one to 25 chervonets; treasury notes in denominations of one rouble, three roubles and five roubles; silver money from 10 kopeks to one rouble; copper money from one kopek to five kopeks (one rouble = 100 kopeks).

Bank-notes must have a minimum cover of bullion and foreign exchange as to 25%, the remainder must be covered by short dated bills and easily realisable commodities. The law has not laid down any obligatory cover for treasury notes. Except, however, for 48,000,000 roubles issued for the redemption of the former paper money in 1924 and for replenishing the state treasury prior to July 1924 all the remaining treasury notes

have been issued through the State bank; *e.g.*, they bear a direct relation to the value of business transactions.

On Jan. 1 1926 the issue of bank-notes amounted to 781,363,600 roubles (the cover consisting of 216,131 roubles' worth of gold and platinum and 48,874,700 roubles' worth of foreign currency, dollars and sterling); 387,737,300 roubles had been issued in the form of treasury notes, 1,419,481,800 roubles in silver coins and 7,623,700 roubles in copper.

The Budget.—The state budget for 1924–5 was passed at 2,558,525,934 roubles. The revenue is made up as follows:—

A. *Ordinary Receipts:*—	
1. Direct taxes	442,729,000
2. Indirect taxes	525,500,000
3. Taxes on transactions	100,655,000
4. Post and telegraph	88,400,000
5. Transport	855,000,000
6. State property and undertakings	188,948,000
7. Other receipts	33,279,406
Total ordinary	2,234,511,406
B. *Extraordinary Receipts:*—	
1. Realisation of state funds	23,000,000
2. Credit operations	141,000,000
3. Receipt from currency issues	80,000,000
Total extraordinary	244,000,000
Grand total	2,478,511,406

The budget for 1925–6 is not yet passed in its final form. It probably approaches four milliards. Nominally it will exceed the last pre-War budget (1913), which showed as receipts 3,452,577,000 roubles and expenditure 3,382,912 thousand roubles. In reality, however, it is less than the pre-War budget by about one-quarter, if we take into consideration on the one hand the loss of territory and population, on the other the different purchasing power of the rouble in 1913 and 1925.

The Russian National Debt (beginning with the loans concluded in 1922) amounted on Jan. 1 1926 to 437,200,000 roubles.

Bibliography.—L. Segal and A. A. Santalov, *Commercial Year-Book of the Soviet Union* (London, 1925); *Vess S.S.S.R.* 1925–6 (Supreme Economic Council, Moscow, 1926); E. Z. Volkov, *Agrarno-economicheskaya Statistika Rossii* (Moscow, 1925); *Narodnoye Khoziaistvo Sovietskoy Rossii* (Economicheskaya Zhizn, Moscow, 1925); *Promishlenaya Rossia* (Economicheskaya Zhizn, Moscow, 1925); *Obzor Vneshney Torgovly Rossii, 1884–1925* (Moscow, 1925); *Soviet Union Monthly: Vneshnyaya Torgovly* (weekly); *Economicheskoye Obozreniye* (monthly); *The Economic Bulletin of the Institut de Conjoncture* (monthly, in Russian). (L. N. Y.)

Agrarian Policy

One of the first decrees of the Soviet Govt. was the decree on lands (Nov. 8 1917) under which private ownership in land was abolished without compensation and private, crown and church estates passed into the hands of the commune and district councils for distribution to the peasants. The decree registered (*see* Political History above) a process which was already in the course of being accomplished. The fundamental law on land socialisation was promulgated on Feb. 19 1918. The abolition of private ownership was strongly confirmed; possession was only granted to those who cultivated by their own labour. No private transaction in land was permissible. Distribution was to be on the basis of the work-power of the family; taking a man as a unit, the work power of women, youths, girls and boys were assessed at ·80, ·75, ·60 and ·50 respectively.

Collective Farming.—In addition to the distribution to families the law contemplated the grant of land to associations of agricultural labourers, and a scheme was drawn up for the settlement of farming communities. Under the regulations for the Socialist Agrarian Organisation of the Land laid down on Feb. 14 1919 provision was made for the taking over of large model estates, the best conducted estates of the former landowners, which it was obviously bad policy to divide, into Soviet farms, the management of which lay with provincial committees and in some cases directly with the Commissariat for Agriculture in Moscow. The managers were appointed from Moscow, and the interests of the workers were entrusted to a workers' committee on each farm. The farms leased to the co-operative societies, which by a decree of Sept. 7 1921 were allowed to resume their productive activities without restriction, were run on a similar basis. Further, by an agreement with the Nansen Action in Moscow in 1923, two large estates in the Saratov and Ekaterinoslav Govts. (about 50,000 ac.) were taken over for a period of years by that organisation with the object of demonstrating modern production methods and of assisting the neighbouring peasants by tractor ploughing and harvesting. Similar large scale developments were undertaken on a concession basis by Krupps in the Kuban and by other companies. On both the state and the co-operative farms overhead charges for the supervising personnel tended to be high, and the hired labour expensive, with the result that some enterprises had to be abandoned. The three-shift system of labour which had to be adopted in order to meet the requirement of an eight-hour day entailed heavy expenses. The importance of the maintenance of model and experimental farms in a great agricultural country need not be stressed. The chief mistake in the Soviet farms system seems to have been the policy of excessive centralisation. Other forms of collective farming exist. The law permitted the leasing of land to associations of peasants acting as an *artel* for the purpose of farming, or to rural communes as such, in which case a general scheme of tillage and of rotation was prescribed. Important as these experiments are from the point of view of the development of better methods of cultivation, the improvement of stock and the introduction of modern machinery and methods, they only cover a very small part of the field. The total area occupied by collective farms of various kinds is still only about 5% of the total farmed area.

Position as Regards 19,800,000 Farms out of 22,700,000—100,200,000 Inhabitants out of 114,200,000—and 41,700,000 Workers out of 45,900,000: 1924–5

	Group I. of size 0–4 dess.		Group II. of size 4·1–8 dess.		Group III. of size 8–15 dess.		Group IV. of more than 15 dess.	
	Millions	Percentage	Millions	Percentage	Millions	Percentage	Millions	Percentage
No. of farms	6·2	31·3	9·8	49·5	3·0	15·2	0·8	4·0
No. of workers	11·9	28·5	19·9	47·7	7·2	17·3	2·7	6·5
Area sown	6·9	11·7	27·4	46·3	15·3	25·8	9·6	16·2
Draught animals	2·9	19·1	7·0	45·0	3·6	23·7	1·7	11·2

International Labour Office, *Industrial and Labour Information*, vol. xiv., No. 13.

Although the 1917–8 distribution increased the total area of the peasants' holdings in Russia from 70 to 96% of agricultural land, and in Ukraine from 55·5% to 96%, the average increase for each holding was very small. Moreover, it varied from province to province and from district to district with the type of farming, the nature of the soil, and according to the former existence there or not of great estates. In addition, the famine sent into the country many new claimants for land. Redistribution involved the redivision of the existing peasant lands. A final and equitable settlement could hardly be reached in the period of revolution and civil war.

The New Economic Policy.—During the period of war communism, levies of food in kind had increased the general dislocation of production. Under the N.E.P., a decree was issued by the Soviet Govt. on March 21 1921 introducing a tax in kind, graded according to the extent of the sown area and the livestock in each holding, the assessment to be made with the assistance of local peasant committees. The total food tax in Great Russia (the R.S.F.S.R.) was fixed at 240,000,000 poods of grain. A year later (May 22 1922) a new Agrarian Code laid down exact regulations on the terms on which land may be held, the forms of land tenure and the machinery for distribution, the conditions of labour and the legal rights of the peasant household, the movement of rural populations and the regulation of disputes (see the Agrarian Code of the R.S.F.S.R. Moscow,

1923, in Russian); see also the *Report on Economic Conditions in Russia* (1922) of the League of Nations.

The Agrarian Code introduced two fundamental changes. It permitted the letting of land on a cultivating lease to a tenant who can cultivate the holding by the labour of himself and his family for a maximum period of six years. A peasant may let his whole farm under certain emergency conditions. Part III. of the Agrarian Code also sanctioned the employment of "auxiliary" labour on farms. This, however, was subject to numerous restrictions. Further, the Agrarian Code contained no details as to the rent conditions of the employment of paid workers, and could be interpreted in a very arbitrary manner.

A Decree of the Council of People's Commissaires of the Soviet Union dated April 18 1925 and entitled Provisional Rules for the Employment of Auxiliary Labour in Agriculture completes the Agrarian Code and determines its interpretation. Under the decree in certain circumstances, by agreement between the parties, hours of work per day may exceed eight, the wages paid may not be less than the official minimum wage, wages may only be paid in kind if the wage earner consents to it, the employer is to find suitable accommodation for the worker; if the employer has at least three wage-earners, he must insure them with an insurance fund which will cover all his risks. The most striking feature in this decree is that the Government has now almost without reserve authorised the employment of paid work in agriculture, and is endeavouring to fix certain rules for this employment. These two points institute a radical change in Soviet policy.

The Code provisions for land settlement proceeded on traditional lines with the object of improving the position of the communities. In the years that followed the settlement of small villages and of individual settlements went on side by side. Where the land is rich and the water supply good, as in the Ukraine and White Russia, individual homesteads have been increased although tenure by the community is still the rule; in the Volga districts village settlement is the rule; the tendency to collective cultivation is stronger in the central industrial districts than elsewhere, though here agriculture is usually a part-time employment. In some districts, where the holdings were remote from the village, new villages have been established in a better position. To facilitate land reorganisation the Russian and the Ukraine Agricultural Banks issue loans to individual peasants and collective farms.

The Single Tax.—The Agrarian Code was followed by the regulations for the collection of the food tax. With the option to pay in money the amount of the tax collected in kind decreased, and in 1924 money payment entirely superseded collection in kind.

For a full list of the various publications on Russian agriculture and Russian land settlement, see M. Tcherkinsky, "Agrarian Policy in Soviet Russia," in *International Review of Agricultural Economics* (Rome, Oct.–Dec. 1924). (J. H. Go.)

VII. RUSSIA'S FOREIGN DEBTS

Foreign Debt Before the War.—An estimate made by the Bankers' Trust Company of New York [1] places the national debt of Russia on Jan. 1 1914, for which the State was directly or indirectly (by State guarantee) responsible, at $6,568,000,000, of which probably from 44 to 50% was in foreign holdings. Of the total interest, about $199,000,000, paid annually on the external part of this debt—62–79% was remitted to France, 7·75% to Great Britain, 11·63% to Holland and the remainder to other countries. Thus France was by far the most considerable creditor. Of the gross total $4,541,000,000 was direct debt, 63% of which had been incurred for the general needs of the State, especially for military expenditure, and the remainder for railroad construction. The latter charge may be taken as partly a defence measure, since the railways were largely strategic. The guaranteed debt amounts to $2,026,506,000; the State, having guaranteed issues made by the railroads themselves amounting to $965,816,000, undertook in 1913 a further liability as guarantor for $423,912,000 bonds for the Nobles Land Bank and for $636,838,000 bonds of the Peasants Land Bank.

Since the national wealth of Russia before the War was estimated at 58,400 million dollars—approximately equal to that of France—the direct debt of the State, 4,541 million dollars, was not excessive when compared with that of France, but the large percentage held abroad made Russia's debt potentially a much heavier burden. Up to 1917 payments were punctually made.

War Debts.—During the War large commitments were incurred to the principal Allies, especially to Great Britain, France and the United States, as follows: Great Britain, $2,766,000,000; France, $762,000,000; United States, $279,000,000; making, with advances from Italy and Japan, a total of $3,969,000,000. This external war debt was principally incurred for financing the purchase of war materials in Allied countries, though there was not necessarily a direct correspondence between the obligations incurred in any one country and the purchases made there. Great Britain, in fact, acted as an intermediary in the balance of accounts. The details of the credits advanced to Russia were discussed at successive Allied Conferences, notably at Paris (Feb. 1915), London and Boulogne (Sept. 1915) and London (July 1916), under which Russia obtained the credits indicated. In connection with the arrangements made by the Russian Finance Minister, M. Bark, with Great Britain [2] certain shipments of gold were made to Great Britain, amounting in all to $292,000,000 in addition to a purchase of gold of $39,000,000 made by the British Government against credit in Oct. 1914. The last gold shipment was made in Feb. 1917 on the eve of the revolution. These shipments, except for the first delivered in Liverpool, were made from Vladivostok to Japan and Canada on account of the submarine danger. In the United States Russia opened certain credits in New York through a syndicate of banks during the early part of the War. After the entry of the United States into the War, the American Govt. opened a credit of $325,000,000 on Russian behalf. By Nov. rather more than half of this credit had been exhausted, and the issue of credits ceased with the Bolshevik revolution in that month.

Commercial Investments in Russia.—Russia entered the world market principally as a grain exporter, and it is by her grain exports that Russia has continued to finance her need for extensive credits abroad. These needs have been, and are, conditioned mainly by the huge area and the need of communications in sparsely populated and undeveloped districts, and by the impossibility of developing the immense mineral wealth of the country with Russian capital. Railway and municipal investment has already been mentioned. The following estimate of the distribution of foreign pre-War investments in Russian commercial enterprises was made by the Soviet Govt. in 1922. The largest amount was invested in mining and cognate industries; then, in order of importance, real estate, banking and the textile industries.

Geographical Distribution of Foreign Pre-War Investments in Russian Commercial Enterprises

(In "currency" dollars—000,000 omitted).

	Amount	%
France	$377	32·6
Great Britain	261	22·6
Germany	227	19·7
Belgium	165	14·3
United States	61	5·2
Holland	19	1·6
Switzerland	17	1·5
Sweden	12	1·1
Denmark	8	0·7
Austria	4	0·4
Italy	1	0·1
Norway	1	0·1
Finland	1	0·1
Total Soviet Estimate	$1,154	100·0

[1] H. E. Fisk, *The Inter-Ally Debts* (1924).

[2] "A consideration received by Russia (under the 1915 agreement) was an arrangement by which the British Govt. agreed to open in favour of Russia a non-negotiable credit for $973,000,000, which appeared on the balance sheet of the Bank of the State as 'gold abroad' and afforded a basis for the issuance of bank notes in Russia. This plan was made effective in the following manner—Great Britain made an exchange of obligations with the Russian Govt., the Russian Govt. depositing with the British Treasury non-interest bearing Russian Treasury bonds, while the British Govt. gave in exchange intangible credits. This arrangement was to expire not later than one year after the conclusion of peace, when these obligations of equal value of both parties were to be redeemed. Thanks to this arrangement, which was pure camouflage, in banking parlance 'kiting,' the decrease in the gold stock resulting from the exportation of the gold was not perceived by the public at large. Indeed, the decrease of specie under the heading of 'gold coin, ingots and vouchers of mines' was more than compensated by the increase in the quantity of specie under the heading of 'gold abroad.' This was one of the financial secrets of the War, which only came to light after the fall of the Tsarist Govt."—*The Inter-Ally Debts*, pp. 137–8.

Classification by Industries of Pre-War Investments in Russian Commercial Enterprises
(In "currency" dollars—000,000 omitted)

	Amount	%
Mining	$429	37·2
Metallurgy	202	17·5
Real Estate	134	11·5
Banks	122	10·6
Textile Industries	99	8·6
Chemical Industries	43	3·7
Commercial Industries	42	3·7
Manufacturing of Foodstuffs	19	1·7
Printing	16	1·4
Shipping	14	1·2
Lumber Industry	13	1·1
Mineral Exploitations	9	0·8
Animal Products	7	0·6
Insurance	5	0·4
	$1,154	100·0

French capital was dominant in the metallurgical, locomotive and shipbuilding industries; English capital was principally invested in the petroleum, copper, thread and tobacco industries; Belgian interests were extremely various; and American investments were mainly through insurance companies. Though Germany came third on the list of investors, her financial and industrial influence was by far the most important because of the direct participation of German banking interests in Russian industry, and of the number of Germans engaged in the management of finance. German permeation succeeded because of direct and personal contact.

Repudiation.—On Feb. 8 1918 the Soviet Govt. issued a decree repudiating the State internal loans, the guarantees given to various concerns and foreign loans. Certain modifications were declared with regard to internal indebtedness, but the repudiation of the foreign obligations of the State was absolute. It may be pointed out here that in any apportionment of Russian debt under post-War conditions, a certain proportion, especially of the guaranteed debt for railway construction and municipal enterprise, harbours, etc. would fall on Poland, the Succession States on the Baltic and Rumania.

Debt Negotiations.—Although the Soviet Govt. repudiated the debt of their predecessors, they came to realise that foreign capital was essential if the devastation of war, revolution, famine and civil war was to be repaired. In 1919 a tentative suggestion of the general settlement which the Soviet Govt. were prepared to accept was telegraphed from Helsingfors to the American Delegation in Paris. It included, subject to the acceptance of the existing position in Russia, the raising of the blockade, a general amnesty and the restoration of diplomatic relations, an offer to recognise the responsibility of the financial obligations of the former Russian Empire to foreign States parties to the Agreement. The offer was subject to a time limit (April 10), and lapsed. In the Anglo-Russian trade agreement of March 16 1921 the Soviet Govt. recognised its obligation to compensate private citizens to whom payment for goods and services is due.

In the proposals for a European economic conference which preceded the Genoa conference (*See* GENOA, CONFERENCE OF), the fundamental conditions of success laid down by the principal Allied Powers included the statement that governments desiring foreign credit must "recognise all public debts and obligations which have been or may be undertaken or guaranteed by the State, by municipalities, or by other public bodies, as well as the obligation to restore or compensate for loss or damage caused to them when property has been confiscated or withheld."

The Genoa conference failed. In the Rapallo Treaty signed with Germany there was a mutual shelving of public claims, subject to the reservation that in the event of a debt settlement with other countries Germany might claim equivalent advantages. At Genoa and at the subsequent conference at The Hague a formula might probably have been reached on the pre-War Tsarist debt, given *de jure* recognition by the Powers concerned of the Soviet Govt., as the writing down of war debts was a foregone conclusion; the failure came nominally on the question of compensation to former owners of nationalised property.

In the draft treaty between Great Britain and Russia signed on Aug. 8 1924, but never ratified, the Soviet Govt. recognised the claims of British holders of Russian State and guaranteed loans "other than holdings acquired by purchase since March 16 1921 and were in other than British ownership at that date." The actual settlement was to be by negotiation between the parties concerned, but the British Govt. had to be assured that the terms were accepted by the holders of at least one-half of the capital value of the loans. The whole of the war debts and claims were reserved for future discussion, including the gold transferred to London, and the gold handed to Germany after Brest-Litovsk. The financial settlement was subject to the floating of a Russian loan on the London market. After the failure to secure ratification conversations were not renewed. Steps were, however, taken by the Russian Govt. to initiate conversations in Paris.

There seems to be no reason to suppose that, given an improvement in Russian trade, Russia would not be economically able to renew payments of interest on her pre-War loans, subject to certain necessary adjustments. The question of war debts, as other inter-allied negotiations have shown, is another matter (*see* INTER-ALLIED DEBT).

See *British Public Accounts* (annual); H. Moulton and L. Pozvolsky, *Russian Debts and Reconstruction* (1924); H. E. Fisk, *The Inter-Ally Debts* (Bankers' Trust Company, New York, 1924).

(H. E. F.)

RUSSIA, CAMPAIGN IN.—The campaign in north Russia continued long after the signing of the Armistice in 1918. It must not be regarded as an isolated incident of the World War, but as a definite part of the Allies' plan for the defeat of the Central Powers, and although the direction of the operations was entrusted to the British authorities the campaign was international. Contingents were sent from Great Britain, the United States, France, Italy and Serbia, whilst detachments were also formed from Polish, Finn, Czech, Russian and Chinese refugees.

Position after the Russian Revolution.—The revolution in Russia had brought about the collapse of the Eastern Front, and the separate peace concluded between Germany and the Soviet Govt. in 1917 had enabled the Germans to transfer large forces from east to west, thereby rendering the position of the Allies in France most difficult. The future attitude of the Soviet Govt. towards the remaining combatants being uncertain, it was felt by the Allies that the building up of even a portion of the old Russian front might prevent further transfers of German troops to the west. An Allied contingent in north Russia might certainly hope to obtain assistance from all Russian elements dissatisfied with the Soviet rule and the great stores of war material accumulated at Murmansk and Archangel would be saved from falling eventually into the hands of the Germans.

Allied Expeditionary Force.—The original force consisted of 150 British marines who landed at Murmansk in April 1918. They were followed by 370 more at the end of May, with a further reinforcement of infantry and machine-gunners to the number of 600 on June 23. The strength of the forces gradually grew until the maximum strengths reached by the main contingents were as follows: White Russians, 20,000; British, 18,400; United States, 5,100; French, 1,800; Italian, 1,200; Serbian, 1,000.

Maj.-Gen. F. C. Poole, the commander-in-chief of the Allied forces in north Russia, arrived at Murmansk on May 24 1918 and found that the Allies were holding the Kola Peninsula with detachments at Kandalaksha. He pushed southwards down the Petrograd railway, and by the end of June had secured Kem and Soroka, the point where the road to Archangel *via* Onega branches eastwards. The ice-free port of Murmansk was thus fully protected against any possible raid by the German forces in Finland and the stores on the quays rendered secure. There could now be no chance of German submarines being sent up by rail for employment against the Allied shipping from a new and dangerously situated base.

Poole then turned his attention to Archangel. Leaving the Murmansk area in charge of Maj.-Gen. C. M. Maynard, he occupied the port on Aug. 3 with a force of 1,500 men under Brig. Gen. R. G. Finlayson, supported by British and French warships and a force of Serbs and Russians under Col. Thornhill moving overland *via* Soroka and Onega. The Bolshevik Govt. in Archangel was overthrown by the local inhabitants and replaced by a Provisional Govt. under M. Tchaikovsky. Columns were at once pushed out to the south to secure adequate protection. Onega, Obozerskaya on the Vologda railway, Bereznik, at the junction of the rivers Dvina and Vaga, and Pinega were occupied in turn. The safety of the port and the town with its many refugees was thus assured.

Although the Bolsheviks had evacuated the town of Archangel hurriedly, they offered an obstinate resistance to Finlayson's troops fighting for elbow-room. Conditions of great heat, myriads of mosquitoes and bottomless bogs in the deep forests followed one another as summer turned to autumn, and by the end of Oct. tropical rains had rendered all movement except

by water impossible. Operations had perforce to stop until the coming of the snow. Transport vehicles and river vessels had to be collected in great haste and manned by available volunteers. The difficulties of language were often acute, for in addition to the several tongues of the Allies there was the main language, Russian, to be considered and none of the contingents were anything but poorly equipped with Russian interpreters. Early in Oct. 1918 Gen. Poole proceeded to England, and in Nov. Maj.-Gen. W. E. Ironside, who had been chief general staff officer in north Russia, was appointed to succeed him. The commands of Archangel and Murmansk were then made independent of one another.

The question of the maintenance of the Allied forces in north Russia had been early considered by the authorities. Murmansk, being an ice-free port, could be used all the year round, and the troops based upon it could be withdrawn at any time. But with Archangel the case was different. The port becomes frozen up from early Nov. till late April of each winter, access being at all times difficult and often impossible even with the help of modern ice-breakers. The War in France had not yet come to an end in Oct. 1918, nor could it be said with certainty that it would cease before the spring of 1919. It was of the utmost importance to prevent the resources of Russia becoming available to the Germans, should they be able to continue fighting throughout 1919. The decision was therefore made to remain at Archangel during the winter.

The expedition to north Russia in the summer and autumn of 1918 undoubtedly did much to complicate the plans of the Germans, who feared an overthrow of the Soviet Govt. and a general reconstruction of the Eastern Front. There is definite evidence that the German military authorities were unable to continue the transference of troops from east to west in the final stages of the War, despite the urgent demands of Hindenburg and Ludendorff. The original object of the expedition was therefore fully achieved.

Peculiar Difficulties of the Campaign.—The winter campaign in north Russia may well be termed unique in the history of war. Never before had troops been called upon to fight under such severe climatic conditions. The Armistice in Europe also, coming as it did just at the closing of the White Sea with ice, could not be acclaimed joyfully as it was on other fronts. For the north Russian force a new campaign was beginning, and all knew that relief could not come for at least six months. The feeling that demobilisation was being carried out on all other fronts had a demoralising effect upon all ranks of the force. Furthermore, the object of the campaign was obviously no longer the same. Germany as an enemy had disappeared from the scene, and the Allied troops were never again quite clear as to the reasons for the continuance of the fighting. In their efforts to reconstruct the Eastern Front, the Allies had espoused the cause of the White Russians and had called upon the Czech ex-prisoner of war units in Siberia to march westwards to join them. In this action they had come into conflict with the Soviet Govt. and they could not now abandon the White Russians who had joined them in the campaign. It was thus that the Bolsheviks became the new adversaries of the Allies.

For the British authorities the campaign was a serious responsibility. Food, clothing and munitions had to be unified as far as possible for the simplifying of supply. Each contingent required special items in its ration—rum for the British, wine for the French, coffee for the United States troops, onions for the Italians and a double ration of bread for the Russians. The town of Archangel contained at least three times its normal population owing to the influx of refugees, and it was impossible to let the population starve. Large supplies had to be imported for this purpose.

Winter of 1918–9.—The transition stage from summer to winter proved a difficult period for the Allies. The freezing of the Dvina came unusually late in Nov. 1918 and the Allied gunboats were withdrawn too soon for wintering in Archangel. The Bolshevik gunboats were thus enabled to descend the river from their more closely situated winter quarters and bombarded the Allied positions with their long-range guns with impunity. Many casualties were caused and much damage was done to the carefully prepared winter quarters of the troops. The situation was at one time critical, British and Americans, supported by Canadian artillery, fighting desperately to maintain their positions.

At Archangel during the winter the attitude of the Allies was purely defensive, covering the mobilisation and training of the new troops of the North Russian Provisional Government. In the Murmansk area their task was to maintain a perpetual threat towards Petrograd and to divert as much of the Bolshevik forces as possible from Archangel. Fighting continued throughout the winter in both areas at irregular intervals, the enemy becoming steadily more efficient and exerting greater and greater pressure on the Allied columns. The intense cold and the continual darkness tried even the stoutest heart. Exposure after a wound meant certain death, and to touch metal with the bare flesh was to brand oneself as with a red-hot iron. The curious noises in the forest in intense cold made sentry duty most trying. Machine guns could only be used in warmed blockhouses, the field of fire of which might be destroyed in a night by a heavy fall of snow. Flying conditions were intolerable, even with electrically heated clothing. Aerodromes were only made possible for starting and landing by marching whole battalions over the snow. Only the strictest discipline could save the troops from heavy casualties through frostbite and sickness.

The war-worn Allied troops may well be proud of their efforts during this critical winter. All the main Archangel positions were maintained intact against the repeated attacks of a superior enemy. In May 1919, when the frost broke, the forces of the Provisional Government had been raised in numbers to 20,000 men of all arms, properly clothed, equipped and organised. In the Murmansk area, Gen. Maynard's troops had succeeded in seizing the northern end of Lake Onega, thus making their threat against Petrograd an effective one, and containing a considerable force of active Bolshevik forces.

Arrival of Relieving Force.—The general thaw commenced in the first week of May, and by the 12th the river was free of ice. Two relief brigades under Brig.-Gens. Grogan and Sadleir-Jackson arrived at Archangel on May 26 and June 10 respectively, having had to force their way through the pack-ice of the White Sea. Evacuation of all troops which had spent the winter in north Russia commenced at once.

Evacuation of North Russia.—The evacuation of all Allied personnel from north Russia before the arrival of winter in 1919 having been ordered, preparations for this were at once begun. The old contingents were embarked in turn, the British being the last to leave. Then followed those elements of the population which had elected to leave the country. In all, some 17,000 persons were transported from north Russia in British ships at a time when shipping had been much reduced through the German submarine campaign. By the end of July nothing remained but the fighting troops of the relief force and a few necessary administrative services.

It had been hoped to make a junction with Adm. Kolchak's troops advancing from Siberia, but the defeat of the Siberians made this impossible. Nothing remained but to disengage the British troops from their advanced positions with a view to leaving the local Russian troops in the best defensive positions possible. A gradual substitution of Russian for British troops and administration was therefore commenced, the process being accompanied by several outbreaks of mutiny amongst the new troops. The fronts of the various columns were cleared by vigorous action on the part of Brig.-Gens. Graham and Sadleir-Jackson, ably supported by the naval flotilla under Capt. Altham. By Aug. 10 the Russian commanders were handed over a satisfactory situation, and the withdrawal of the British troops to the inner defences of Archangel commenced.

Gen. Lord Rawlinson arrived at Archangel on Aug. 12 and approved of the plans already arranged. Withdrawal continued without a hitch, and on Sept. 27 the last 5,000 men were embarked simultaneously from 13 different points and the evacuation of Archangel was complete. The long withdrawal in the

Murmansk area was then completed under the direction of Brig.-Gen. H. C. Jackson, who had replaced Gen. Maynard on Sept. 20 owing to the latter's illness, the last man leaving the port on Oct. 12.

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RUSSIA IN ASIA (*see* 2.741).—The greater part of the Asiatic possessions of the former Russian Empire were incorporated under the Soviet system in the Russian Socialist Federated Soviet Republic (R.S.F.S.R.), which is a constituent State of the Union of Socialist Soviet Republics (U.S.S.R.). These territories are divided into Siberia and the Far Eastern Province, which are directly under the Moscow Govt. and the autonomous Socialist-Soviet Republics of Yakutsk, Mongol-Buryats and Qirghizstan, which enjoy considerable local autonomy under the general direction of the R.S.F.S.R. The country known as Russian Turkestan consists of two independent Socialist Soviet Republics, Turkomanistan and Uzbegistan, which are constituent States of the U.S.S.R. (*See* SIBERIA; TURKESTAN.)

RUSSIAN LITERATURE[1] (*see* 23.914).—The death, in 1910, of Tolstoy, is not a landmark of Russian literary history. Ever since his conversion he had, as it were, passed out of time into eternity, and ceased to fit into the scheme of literary values. The publication of his posthumous work (three vol. 1911, and a fourth 1926) in spite of its immense intrinsic significance, stands outside the current of history. But the influence of Tolstoy, especially that of his later work, *Ivan Ilyich* (1891, Eng. trans. 1895), and *Master and Man* (1895, Eng. trans. 1895), is very apparent on the one hand in the problem stories of Andreyev, Bunin, Artsybashev and Sergeyev-Tsensky; on the other, in the philosophical writings of Shestov.

The Realists.—The traditions of the older realistic school were continued into the 20th century by numerous writers of the older generation, none of whom are of importance, except Vladimir Korolenko (1853–1921). His autobiography *The History of My Contemporary* (five vol. 1909–22) is his longest and one of his best works.

At the end of the 19th century the realistic narrative form had been reformed and renewed by Anton Chekhov and about the same time a group of young writers came forward, whose work, realistic like that of the older tradition, but cruder and less reticent, produced the impression of a literary renascence. Its chief exponent was Maxim Gorky (b. 1869), whose early work (1895–1901) took the Russian and foreign reader by storm and was one of the greatest booms of the European book market. It was inspired by a semi-romantic spirit of freedom and revolt, which in conjunction with an audacious realistic style was what made for its success in Russia. After 1900 Gorky became absorbed in politics. His work of 1904–12 is tendencious and revolutionary. It marks a distinct decline and coincided with an eclipse of his popularity.

But in 1913 Gorky published *My Childhood* (Eng. trans. 1915), the first volume of an autobiography, which revealed him once more as a powerful and, this time, quite unromantic realist. It was followed by two more autobiographical volumes *Among Strangers* (1915) and *My Universities* (1922), a volume of *Recollections* (1924) and *Fragments from my Diary* (Eng. trans. 1924). These books are objective, dispassionate, unsweetened paintings of Russian life. The author is present in them only in so far as he sees with his eyes and selects out of his store of vision. His attitude may be described as a fascinated disgust at the ugliness of Russian life, and an equally fascinated attraction towards all the great, the good and the original, that stands out in bold relief against the drab and joyless background. The volume of *Recollections* contains a memoir of Tolstoy which is one of the best things ever written of that great man.

Of the other writers who gathered about 1900 round Chekhov and Gorky the most famous is Leonid Andreyev (1871–1919). His best stories are in the tradition of Tolstoy's *Death of Ivan Ilyich* and *The Kreuzer Sonata. Once Upon a Time There Lived* (1901); *In the Fog* (1902); *The Governor* (1906, Eng. trans., 1921); *The Seven Who Were Hanged* (1908, Eng. trans., 1909) are problem stories of death and sex written in a sober realistic style. But Andreyev early succumbed to the lure of a cheap and rhetorical "modernism" and his style degenerated into a tedious succession of gaudy and insincere clichés (*The Red Laugh*, 1904, etc., Eng. trans., 1905). The main theme of Andreyev is the vanity of life and of all earthly things and the "craving void" of man before the elemental forces of death and madness. More artistic and more traditional than Andreyev's is the work of Ivan Bunin (b. 1870), a disciple of Turgenev and of Goncharov, as much as of the older Tolstoy. A sense of the vanity of all earthly values in the presence of nature and death is as apparent in Bunin as in Andreyev. But it is diluted by his sentimental attachment to the decaying life of the provincial gentry. Bunin's most important works are *The Village* (1910, Eng. trans., 1923), and especially *Sukhodol* (1912), which, together, give an impressively gloomy picture of the spiritual decay and cultural poverty of the Russian peasantry and provincial gentry. They are among the most terrible pieces of special pleading against the whole of Russian life ever written.

A more detached and less local style is that of *The Gentleman from San Francisco* (1915, Eng. trans., 1922), a story, in the Tolstoyan tradition, of the vanity of the things of this earth before the face of death. The same theme of vanity and emptiness moves many other writers of this group, among whom the best known is Michael Artsybashev (b. 1878). In his drearily didactic novel *Sanin* (1907, Eng. trans., 1915), he preached, in a style unintelligently aped from Tolstoy, the gospel of complete submission to sexual impulses. More significant and sincere are his stories of death: *The Death of Lande* (1904, Eng. trans., 1915); *Breaking Point* (1911–2, Eng. trans., 1915). On the whole Artsybashev is a very inferior writer, but he is representative of the devastated generation of Russian intellectuals who had lost their old revolutionary faith and acquired none instead. More significant is the work of S. Sergeyev-Tsensky (b. 1876), a writer of real originality and, unlike the foregoing, the master of an individual style. The theme is again death and the vanity of life, but it is treated with greater sincerity and imaginative power. The masterpiece of his early period *Movements* (1910) is one of the most powerful stories of dying after *The Death of Ivan Ilyich*. Since then he has struck a more optimistic note, but he has also lost much of his power over words (*The Inclined Elena*, 1914, *Transfiguration*, 1923).

Of the other writers belonging to the "realistic party" Alexander Kuprin (b. 1870) acquired great popularity by his novel of army life published during the Japanese War (*The Duel*, 1905, Eng. trans., 1916), and by the cheaply realistic and journalistic brothel story *Yama* (1913). But in his shorter stories he has shown himself an excellent master of simple and forcible narrative of a kind that is rare in Russia and which recalls Kipling.

Other "realists" are Semen Yushkevich (b. 1868), stories of Jewish life, especially *The Adventures of Leon Drey*; Ivan Shmelev (b. 1875), *The Waiter* (1912), *That Which Happened* (1921, Eng. trans., 1926), one of the best war stories in Russian; V. Ropshin (pseudonym of the terrorist and politician Boris Savinkev 1879–1925), *The Pale Horse* (1909, Eng. trans., 1915) largely autobiographical, a powerful revelation of the terrorist mentality, and *The Black Horse* (1924), a story of the Civil War; Boris Zaytsev (b. 1881), stories of "atmosphere," which become almost flabby in their tendency, often present in Russian fiction, to do without skeleton or outline; and the humorist Teffi (pseud. of Mme. Buchinsky).

The Mystics.—While the "realists" occupied the front of the literary stage, a movement was going on that was to transform the appearance of Russian literature. It is difficult to define it

[1] In this article the titles of all works have, for the convenience of the reader, been translated into English, although the books themselves may not have been so treated. When, however, they have been translated the date of the publication of the translation is, as far as possible, given.

in a word. Those who did not belong to it called it "modernism." It included a great variety of currents, but they all have this in common, that they brought forward precisely those cultural and spiritual values that had been neglected by the "intelligentsia" civilisation of the 19th century. In terms of personality it was largely an assertion of the spirit of Dostoievsky as against that of Tolstoy. It was also a victory of mystical and metaphysical religion over ethics, and of aesthetics over politics. In its first stages it brought with it a great wave of new foreign influences; Ibsen, Wilde, Baudelaire, and above all Nietzsche were the most important. One of its first spokesmen was Dmitri Merezhkovsky (b. 1865) who in the 'nineties and at the beginning of the 20th century did excellent work as the interpreter of foreign cultural values—the historical novels *Julian* (1895) and *Leonardo* (1901). His later work, dominated by a sophisticated and essentially hollow "religious" philosophy, is of much less value. *Alexander I.* (1913), *14 December* (1918, Eng. trans., 1923), are interesting for their historical material, but their style is disagreeably hysterical and the construction disfigured by artificial and meaningless "ideas." As a "religious" philosopher, Merezhkovsky is an obvious nonentity.

The real revivers of Russian mystical and religious thought were, after Vladimir Soloviev, Vasili Rozanov (1856–1919), and Leo Shestov (b. 1866). Rozanov is also the greatest modern master of Russian non-narrative prose. His later works, especially *Alone With Myself—Uedinennoe* (1912) and *Fallen Leaves* (1913), place him in the front rank of Russian prose-writers of all times as well as in that of the greatest thinkers and discoverers of the human soul. By rejecting what he called the "Guttenberg" style he made prose as flexible, unexpected and spontaneous as spoken language. He was a profound irrationalist, organically adverse to logical constructions, but possessed of a sense of intuition and insight unequalled by any man. His religion was mainly a religion of sex and procreation, but he had a deeply ingrained sympathy for the traditions and the soul of Russian Christianity. Shestov is also a mystic and an irrationalist, but he is as spiritual as Rozanov is vital. In his war against reason he uses with consummate skill the weapons of the enemy. The central impulse of his work is the search for God, who is above good. His style is akin to Tolstoy's and is admirable for its lucidity and pungency.

Rozanov and Shestov are the biggest figures of the "religious-philosophical" movement begun about 1903, which has very largely displaced the traditional agnosticism of the Russian intelligentsia by some kind of mystical religion. It produced numerous writers, who, though they are not comparable in significance and originality to these two, have had a notable part in the history of the Russian mind. The most noteworthy are Sergius Bugakov (b. 1870), who, beginning as a Marxist later became an orthodox priest; Paul Florensky, a mathematician, who likewise became an orthodox priest, the author of a most remarkable, sophisticated and subtle book of theology, *The Pillar and Foundation of Truth* (1913); Nicholas Berdyaev (b. 1874); Michael Gershenzon (1869–1925); and Vyacheslav Ivanov, who besides being a remarkable poet is the most magnificent contemporary master of ornate Russian prose. *A Correspondence Between Two Corners*, by Gershenzon and Ivanov (1920) is a remarkable book discussing the value of culture before the terrible realities raised by the revolution.

The Symbolists.—The most important expression of the "modernist" movement was the Symbolist school of poetry. The name came from France, but except in its first stages the Russian movement was not derivative and its most significant poets were the genuine heirs of the great national tradition. At first the Symbolists (or Decadents as their enemies called them) were regarded as mountebanks and charlatans and were not admitted into the literary rank. But to-day it is universally recognised that the poetry of the Symbolists was the most important thing in Russian literature in the 10 or 15 years preceding the great revolution. The Symbolist movement was, first and foremost, a general revival of poetry and poetic culture after the ignoble stagnation of the later 19th century. But besides that, the Symbolist poets have certain characteristics common to all of them; these are the "Symbolist" attitude, *i.e.*, a perception of the world as a system of symbols and "correspondences" (the word came from Baudelaire's well-known sonnet); and a predominance of the musical over the logical, of the "romantic" over the "classical" element of poetry. In its early stages Russian Symbolism was imitative of foreign (French and English) models. The work of the first leaders of the school, Constantine Balmont (b. 1867) and Valeri Bryusov (1873–1924) have a translated and un-Russian flavour.

Balmont, a genuine poet with a great gift of song, wrote his best poetry between 1894 and 1904, Bryusov, a laborious craftsman who compared his inspiration with an ox in the plough, in the first decade of the 20th century. The importance of these two poets was chiefly that of a ferment. They liberated poetical understanding and taste and raised the general interest in problems of form. Bryusov, especially, had a powerful technical influence; few poets who began writing verse in the first decade of the century escaped it. For many years he was practically dictator of the advanced literary world of Moscow. By their side there were other poets of a more original and at the same time more native and traditional inspiration. Fedor Sologub (pseudonym of Fedor Teternikov, b. 1863) who is also one of the most remarkable modern novelists, is the most traditional and the most perfect of the Symbolist poets. His poetry is sober and severe and almost classical in its adequacy of expression. It is dominated by a complete and consistent conception of the Universe, which is its essence is Manichaean. The evil world of life, diversity, desire, light and heat, symbolised in the hateful dragon of the sky, the Sun, is opposed to the blessed realm of death, coolness and peace. Zinaida Hippius (in Russian Gippius, maiden name of Mme. Merezhkovsky, b. 1867) is also a metaphysical poet. Intensely intellectual, in her best poems she is one of the most genuine and powerful spiritual children of the darker side of Dostoievsky. She is also a craftsman of great originality and has had an appreciable influence on the evolution of poetical technique.

Another metaphysical poet is Vyacheslav Ivanov (b. 1866). Sophisticated and complex, soaked in knowledge and in culture, his poetry is the expression of a mystical philosophy that aspires to the synthesis of all religions. Of all Russian poets he is the most full of Greek reminiscences. His style is archaic and magnificent, the most artificial and ornate style in the language. From 1906–12 he was as much a dictator of poetry in St. Petersburg as Bryusov was in Moscow. His principal works are *Pilot Stars* (1903); *Cor Ardens* (1911); and *Winter Sonnets* (1920). The poetry of Innocent Annensky (1856–1909), like V. Ivanov a scholar and a translator of Euripides, is curiously devoid of all classical influences. Exiguous in extent, it all belongs to the last years of his life (*The Cypress Chest*, 1910). It is an infinitely subtle personal poetry of emotions, free from metaphysical sophistications, but condensed and elliptical to the point of obscurity. He is the subtlest and most refined of the Symbolists, but for intensity of human appeal he has no equal except Blok.

Alexander Blok (1880–1921) is unquestionably the greatest poet of modern Russia. His early work *Verses of the Beautiful Lady* (1904) was inspired by a mystical love for a feminine hypostasis of the Deity in the vein of Vladimir Soloviev's mystical poetry. It is purely immaterial and musical, woven of the thinnest atmospheric gossamer, and to the immediate perception almost elusive. But soon Blok lost his mystical visions, and his later verse is full of a passionate home-sickness for the lost ideal. It is distinctly romantic in style and in matter dominated by the unbridgeable and hopeless opposition between life and the higher reality lost touch with. Much of his later poetry is "realistic" and instinct with a grim and hopeless irony. More than any other poet, Blok was a "prophetic soul." He lived the life of the nation with passionate intensity, and much of his verse reads strangely in the light of later events. The third volume of his collected poems (1908–16) contains most of his best work. He accepted the revolution as an expression of the

mystical and craving soul of Russia, and in 1917 wrote his most widely famous and in certain respects his most significant poem *The Twelve* (Eng. trans. 1920), a sublime symphony made out of realistic dirt. After 1917 he wrote practically nothing. Besides his lyrical poetry he wrote several lyrical plays *The Puppet Show* (1906); *The Stranger* (1907); *The Rose and the Cross* (1913), in which he gives the most powerful expression of his "romantic irony," and a narrative poem *Retaliation* (containing the life story of his father), at which he worked for over 10 years and left unfinished. It contains passages of exceptional historical intuition.

Closely connected with Blok is the personality of Andrey Bely (pseudonym of Boris Bugaev, b. 1880), the most original and "advanced" of the younger Symbolists. His poetry is mystical in content, experimental in form, and frequently realistic and humorous in tone. He carried the musical and antilogical tendencies of Symbolist poetry to their furthest limits, and in his efforts to do altogether without the cement of sense has much in common with the early Futurists. His principal works, however, are his novels.

Most of the inner Symbolists followed in the footsteps of Bryusov and V. Ivanov. Their poetry is intensely, often coldly, formal and is chiefly concerned with the visual symbolism of abstract ideas. The most notable are Maximilian Voloshin (b. 1877), whose poems on the revolution (1917 and following), splendidly ornate and highly sophisticated, became widely popular among the émigrés; and Vladislav Khodasevich (b. 1886), who treats Dostoievskian "underground" themes with a neat and abstract "wit" reminiscent of the 18th century, and is the favourite poet of the unpoetical reader.

Post-Symbolist Poetry.—The exclusively metaphysical character of Symbolism produced a reaction towards more concrete and less sophisticated poetry. The tendency appears already in the affectedly naïve and exquisitely refined poetry of Michael Kuzmin: *Alexandrian Songs* (1906); *The Seasons of Love* (1907). About 1912 it took form in the movement that called itself the *Acmeists* and centred round the Poets' Guild in St. Petersburg (Leningrad). Its leader was Nicholas Gumislev (1886–1921, executed by the Bolsheviks), the only Russian poet to have fought in the World War. His poetry is a strange mixture of aestheticism with a manly romanticism. It is the most "masculine" poetry in the language. His best books, *The Quiver* (1915), *The Pyre* (1918), *The Pillar of Fire* (1921), contain poems of great force and vitality. He was a great craftsman, and all the younger poets of St. Petersburg were deeply influenced by his example and his teaching. The poetry of Anna Akhmatova, exiguous in extent and exquisite in form, is also an assertion of the human against the mystical poetry of the Symbolists. It is personal and emotional. By far the greater part of it is concerned with love. It is marked by a reticent and condensed intensity of emotion and by an exquisite and delicate economy of poetic means: *Beads* (1914), *The White Flock* (1917), *Anno Domini* (1922). Like almost all the greater contemporary Russian poets, Akhmatova has also written remarkable poems inspired by the great sufferings of her country.

Connected with the Poets' Guild is also the poetry of Osip Mandelstam (*The Stone*, 1916; *Tristra*, 1922), the greatest master in modern Russia of the grand oratorial style, which, however, is combined in his poems with a construction along purely associational lines that makes his poetry akin to the tendencies of early Futurism.

The Futurists.—Russian Futurism dates from soon after 1910. In St. Petersburg it was merely an assertion of the rights of vulgarity. The poetry of Igor Severyanin (b. 1887), *The Thunder-Seething Cup* (1912), which at one moment fascinated even the most discriminating critics, is merely the expression of the mentality of a shop assistant, who happens to be endowed with exceptional rhythmical power. Much more significant are the Moscow Futurists. Victor Khlebnikev (1885–1922), whom they regard as their founder, was a delver in language rather than a poet. His poetry, which is purely linguistic, is caviare to the general, but has been a powerful stimulant to his fellow-craftsmen. His historical importance lies chiefly in the fact that he started the movement of what may be called the "de-Italianisation" of Russian. To give the language of poetry a more rugged and virile accent and to tear it away from the withering background of traditional associations was the principal task of the Futurists. Besides trying to transcend the limits of sensible language, they destroyed the traditional conceptions of the "poetical" and the "musical," introduced the vocabulary of the street and new subject-matter from all quarters of life.

The most outstanding of the Futurists is Vladimir Mayakovsky (b. 1893), a poet with powerful lungs and a voice like the roar of waters. His powerful, unrefined, hammering poetry is at its best in his own delivery. He is a poet of the street and of the open air. Much of his verse is political; like most of the Futurists, he is a Communist. Totally lacking in the "finer touch," it is intensely original and skilful and is one of the most vital and vigorous literary growths of modern Russia. Though loyal Communists, the Futurists are regarded by the Soviet authorities with distrust as too individual and undisciplined. An official effort was made from the beginning of the new régime to create a more reliable "Proletarian culture" and "Proletarian poetry." The "proletarian poets" are numerous and have been regularly trained by masters of the craft, such as Bryusov, in the secrets of verse writing. But in spite of this, all they write is nothing but rhetoric. The only exception is Vasili Kazin, a young workman of Moscow, who is free from rhetorical ambition and has written lyrics of exquisite freshness not unlike those of Mr. W. H. Davies.

Peasant Poets.—Another group of poets connected with the revolution are the "peasant poets" who saw in it an assertion of the mystical aspirations of the Russian people. Of these peasant poets Nicholas Klyuev is a genuine mystic and genuine poet, imbued with the traditional lore of North Russia. The other peasant poet, Sergey Esenin (1895–1925), was only transiently attracted by the conceptions of mystical socialism. He was a purely lyrical poet akin to the Russian folk song, to Blok and to the tradition of the 19th century. His best verse has an exquisitely piercing lyrical accent. A wistful and uneasy melancholy dashed through by a dare-devil "hooliganism" are the main motives of his poetry.

At one time Esenin was connected with the "Imagist" movement, which is spite of its noisy prominence in the years immediately following the revolution produced no poet of importance. In general, except the Futurists, most poets of the post-Symbolist generation belong to no movement or school, and display a great variety of individual genius. The most absolutely independent of all is perhaps Tikhon Churilin, whose *Spring after Death* (1915) breathes the spirit of genuine madness and startling originality. Externally connected with Futurism, but in essence quite independent, is the poetry of Boris Pasternak (b. 1891), in the opinion of most fellow-craftsmen the greatest poet of the young generation. His principal book of lyrics, *My Sister Life*, was written in 1917 and published in 1922. Few Russian poets have escaped its overpowering influence. Pasternak's poetry is marked by an absolute freshness of perception and vision combined with a tensity of lyrical emotion that is to be found only in the greatest lyrical poets. He sees the world in his own way, like Adam or a new-born child, and his poems sound as if no verse had ever been written before them. But he does not always succeed in keeping in control the excessive abundance of his poetic vision and becomes at times incoherent and confused.

Equally original and equally fresh is the poetry of Marina Tsvetayeva, the only important poet of the younger generation living outside Russia. The variety and richness of her rhythmical imagination, the spontaneity and abundance of her inspiration, combined in her latest work with an unerring mastery and discipline of form, the absolute originality of her accent, the vitality and exuberance of her genius, make her one of the most powerful of the poets of to-day. This vitality and high-spiritedness is a common feature of almost all the major poets of the younger generation and marks them off distinctly from the

Symbolists. Marina Tsvetayeva's latest poems are her best: *Molodets*, a fairy tale (1924), *The Poem of the End* (1925), *The Ratcatcher* (1925). Among the very youngest poets the most important seem to be Nicholas Tikhonov and Ilya Selvinsky, both of whom have written some powerful and concentrated ballads of the civil war.

The New Prose.—Many of the Symbolists wrote prose fiction but they failed to create a new school of prose. Some derived from Dostoievsky (Z. Hippius), others indulged in "Impressionism"; others again fell back on foreign or ancient models and wrote what is called in Russian "stylised" prose. The most remarkable of the "stylisers" are Valeri Bryusov, whose historical novel of the German renaissance, *The Fire Angel* (1917), is no doubt the best Russian novel on a foreign subject and the most genuine work of the author; and Michael Kuzmin. The greatest of the Symbolist novelists is Fedor Sologub. His principal novel, probably the greatest Russian novel since Dostoievsky, *The Little Demon* (1907, Eng. trans 1916), has all the appearance of a realistic story of provincial life, but is subordinate to a symbolistic conception. The central figure, the schoolmaster Peredonov, the incarnation of joyless evil, is one of the grimmest and weirdest creations of the Russian imagination. Others of his stories have a more or less fantastic or conventional setting. The series, *The Created Legend* (*Drops of Blood*, *Queen Ortruda* and *Smoke and Ashes*) (Eng. trans. 1916) is a strange symbolical novel dominated by the same Manichaean philosophy that permeates his poetry, but couched in the form of a thrilling romance of intrigue of the "Prisoner of Zenda" type.

The revolution that corresponds in Russian prose to the Symbolist revolution in poetry was started by two men of the younger Symbolist generation, Bely and Remizov. Both of them use, in their principal work, the material of contemporary life, and both have greatly intensified the expressive means of Russian prose. Their prose is what has been called "ornamental" (not ornate), that is to say it is always charged with the utmost expressiveness and saturated with the most varied effectiveness; it is the antithesis of the transparent prose of the realists of the 19th century. Bely has been strongly influenced by Gogol. Unlike the other Symbolists, he has a genuine gift of humour. His first novel, *The Silver Dove* (1909), is the story of an intellectual allured and enmeshed by mystical sectarians. *Petersburg* (1915), the atmosphere of which is reminiscent of Dostoievsky's *The Double*, is a symbolic story of Petersburg, as the incarnation of "nihilism." *Kotik Letaev* (1917) and its sequel *The Crime of Nicholas Letaev* (1922) are written under the influence of the anthroposophy of Steiner. The rhythmical intensity of the style reaches its farthest point. It is the story of a childhood, and of the gradual formation of the child's idea of the world. Besides these novels Bely has written the remarkable *Recollections of Alexander Blok* (1922).

Alexey Remizov (b. 1877) is a writer of great complexity and versatility. All his work is marked by a supreme sense of style and an exceptional mastery of Russian idiom. He rejects the ordinary literary syntax of Latin and French extraction and aims at creating a written Russian that will be more akin to the genius of the spoken language. The variety of his work is very great. It includes novels of "compassion" in the line of Dostoievsky, *The Pond* (1905), *The Sisters of the Cross* (1910); stories of provincial life, *The Story of Stratilatov* (1909), *The Fifth Pestilence* (1912) in a manner that has more than anything else affected the destinies of Russian prose; *In a Field Azure* (1922), the delightful and simple story of the childhood of a little girl; adaptations of folk tales and legends; dreams that are real dreams with all their illusive logic; *Recollections* (especially *Kukkha*, 1923, about Rozanov); poems in prose; plays, based on the popular Russian theatre. More than anyone Remizov has been a sensitive record of the ordeals of his country's life in the terrible years 1917–21, and the book, including his diary of these years and stories of dying St. Petersburg (*Russia in the Tornado*, to be published in 1926) is one of the greatest books produced by the revolution.

Remizov (especially as a stylist and as the author of *The Story of Stratilatov*) has had an enormous influence on almost all subsequent fiction. A new realism, emancipated from the "civic" ideas of the 19th century and attracted by the characteristic and grotesque rather than by the commonplace, arose about 1910, largely owing to him. The most popular and gifted of these neo-realists is Count Alexey Tolstoy (b. 1882), who began with a delightful book of folk tales (*Magpie's Tales*, 1909), and has written more stuff that is at the same time generally readable and intrinsically valuable than any other living Russian author. At times he becomes ridiculous, but the verve and vitality of his narrative manner is inimitable. One of his best books is *Nikita's Childhood* (1922) that holds its own by the side of the best "childhoods" in Russian literature. More Remizovian is the work of Michael Prishvin (b. 1873), whose *The Beast of Krutoyarsk* (1913), the story of a dog, is the masterpiece of Russian animal fiction, and the early work of Evgeni Zamyatin (b. 1884), who later developed into an original and independent master. He is an imagist and impressionist trying to attain the maximum of intensity by the use of significant detail and by constructing his stories round a unifying symbolical image. His principal work, *We*, a novel of the future, was still unpublished in 1926 owing to the Soviet censorship.

The World War remains almost unreflected in Russian literature, and Russia has little to compare with the War literature of the Western nations. The only war poetry of any merit is Gumilev's. The very few war books that deserve notice are *Letters of an Artillery Subaltern*, by Fedor Steppun (1918); *The Face of War*, by Ilya Erenburg (1920); and *The People at the War* (1918) by Sophia Fedorchenko, a wonderful collection of fragments of conversations overheard by an army nurse from private soldiers. The revolution of March 1917 remained as alien to the Russian imagination as the War. Not so the Bolshevik revolution of eight months later and the ensuing civil war. The external result of these events was the division of all intellectual Russia into two hostile camps, which has now become a geographical division between those who have remained in the U.S.S.R. and the *émigrés*. Roughly speaking, it may be said that the older generations are pretty equally divided between the two sections, but the younger generation (under 30) is producing valuable work only at home. Of the vast memoir literature created by the revolution and civil war the most significant books are *1920* (1921) by the monarchist deputy of the Duma, Vasili Shulgin, and *A Sentimental Journey* (1923) by the gifted and influential critic Victor Shklovsky. With the memoirists may also be counted Mark Aldanov (Landau), who has written clever personal articles on contemporary public men and historical novels of the age of Napoleon.

The years of the civil war witnessed the almost complete disappearance of prose fiction, but since 1921 a galaxy of young novelists have come up who choose their subjects almost exclusively from the revolution, the civil war and contemporary Soviet life. The majority of these writers have been more or less influenced by Remizov, Bely or Zamyatin and belong to the "ornamental" school. Their besetting sin is their inability to tell a story, and an over-emphasis on style and formal originality. The most typical of these writers are Boris Pilnyak (b. 1894), Vsevolod Ivanov (b. 1895) (stories of civil war in Siberia), and Leonid Leonov (b. 1899). More original is the work of Constantine Fediin (b. 1892), whose *Cities and Years* (1924), an ambitious and in many ways successful attempt to show the evolution of an "intelligentsia" mind against the background of war and revolution, is the most notable Russian novel written since the revolution. Isaac Babel is the author of *Tales* (1925) of the Cavalry Army of Budeny. For the most part they are "intensified anecdotes" written with great artistic concentration.

Their atmosphere is mingled horror, irony, and hero worship. He uses dialect in an imaginative way that is reminiscent of Synge. The young Communist, Artem Vesely (whose work at this time was uncollected), has a unique genius for the painting of mass scenes and is a consummate master of language. Quite apart from the others stand the *Tales* (1925) of the poet Boris

Pasternak. They are written with the same freshness and novelty of vision that mark his poetry. *The Childhood of Luvers* (1918), the story of how a little girl forms her perception of the world around her, is particularly remarkable. The greatest part of modern Russian fiction is conspicuously devoid of narrative interest, and it is no wonder that the Soviet reader prefers less original and intense or careful work as long as it is "interesting." Their tastes are best met by the novels of Ilya Erenburg (b. 1891), whose *Adventures of Julio Jurenito* (1922) is a grim and significant satire of the capitalist world, but whose later novels are typical best sellers adapted to the tastes of the Soviet reading public.

Drama.—The Russian drama has been in a state of stagnation ever since the death of Chekhov and cuts a poor figure by the side of contemporary poetry or even of fiction. The plays of Gorky (*The Lower Depths*, 1903, Eng. trans. 1910), and of Andreyev, written in imitation of the method of Chekhov, miss precisely all the inner "musical" logic that justifies the non-dramatic construction of Chekhov. The "modernistic" dramas of Andreyev (*The Life of Man*, 1907, etc., Eng. trans. 1915), are crude rhetoric in black and red. More satisfying is the symbolic melodrama, *He Who Gets Slapped* (1916, Eng. trans. 1922), which was later turned with great advantage into a film. The genuine Symbolists failed to produce a theatre of their own, and with the exception of the beautiful dramas of Blok, which are lyrical rather than dramatic, gave nothing to the stage.

For the Russian theatre the period was one of rapid development and of remarkable achievement. But the drama did not keep pace with it. Of the reforming producers who revolutionised the Russian stage, Nicholas Evreinov (b. 1879) is also a playwright. His theatre is subordinated to his semi-religious idea of transforming life into art by the aid of the theatre. His work has points in common with that of Pirandello. The realistic tradition has been definitely abandoned by dramatists and the dominant form of play in Soviet Russia is a kind of conventional puppet play of ideas, where the characters, stripped of all reality and humanity, are made to symbolise abstractions. Such are the crude and mediocre plays of Lunacharsky. On a much higher artistic level are the plays of the regretted Leo Lunts (1901–24) who endeavoured to create a pure and simplified tragedy of pure action that would be once again suited to the expression of genuine heroical feeling. The Futurists made attempts to create a high standard, boldly Aristophanesque propaganda drama. The only successful attempt is *A Mystery Bouffe* (1919) by Mayakovsky, a vigorous and effectively crude play of Bolshevik satire. There exist English translations in book form of works by Gorky, Andreyev, Bunin, Artsybashev, Kuprin, Shmelev, Ropshin (Savinkov), Merezhkovsky, Shestov, Z. Hippius, Sologub, Blok, Remizov, Aldanov, Pilnyak, Evreinov and Lunacharsky.

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RUSSO-POLISH CAMPAIGN.—This campaign, of 1920, which resulted in the defeat and rout of the Soviet Army when it was within sight of the Polish capital, is full of dramatic incident. Organisation of command, staff and administration was lacking on both sides, but above all it was the want of a proper system of supply which accounted for the sudden collapse of troops engaged in a victorious advance. The thinly populated territory lying between the Niemen in the north and the Dniester in the south was incapable of supporting large bodies of troops, and as both sides attempted to live on the country during their advances the failure of their operations followed quickly each success.

Cause of the War.—During the course of 1919 and early 1920, the Soviet Govt. had succeeded in clearing their territory of the White Russian detachments under Kolchak, Denikin and Yudenich. They were thus at liberty to examine the situation on their frontiers. With such a mixture of races living side by side in the disputed regions no delimitation of frontier would have suited all parties, and in the absence of authority to enforce a decision, trouble quickly arose between the Soviet and the newly formed Polish State. Poland was determined to maintain her new liberty and had called up fresh levies to support the various legions which had been repatriated from the fronts upon which they had been fighting in the World War. The Soviet began to concentrate their troops towards the west. Inflammatory speeches in Moscow and a fierce propaganda amongst the Polish working people brought Polish public opinion to a fever heat. From seven divisions in Jan. the Soviet had, by March, increased the number of their troops facing the Poles to 20 divisions, with three cavalry divisions. Poland decided that she could not wait quietly for the inevitable Soviet attack by which she would certainly be destroyed, and that she must act at once.

Polish Offensive.—Strategically, the territory in dispute may be divided into two separate areas: White Russia in the north and Volhynia and Podolia in the south. The marshes of the Pripet divide one area from the other. Acting in collusion with Petlura, the Hetman of the Ukraine, who had promised to raise his country against the Soviet, the Poles advanced in April as far as Kiev. By the beginning of May the Polish-Soviet front ran from Dvinsk in the north along the course of the Dnieper to Kiev and thence to the Dniester near Kamenets. No sooner were the Poles established in Kiev than the Soviet northern army began to advance. The Poles were able to transfer troops from the south and counter-attacked the Soviet forces which had already penetrated as far west as Lida and Baranoicze. By the end of May the line held at the beginning of the month had been restored. Operations had been most ably carried out by the Polish Minister of War, Gen. Sosnkowski, but there were indications that the Soviet were transferring more and more troops to the west and that a renewal of their attacks might be expected.

At the beginning of June, in the southern area there appeared a new Soviet cavalry leader, Budenny, who completely altered the situation. Budenny had been a non-commissioned officer in the old Russian Army and soon proved himself a man of action. Within a month he had driven back the Poles a distance of 200 m. until their line in the south ran just east of Pińsk and Równe (Rovno) to the junction of the Dniester and Siret (Sereth) (*see* EASTERN EUROPEAN FRONT: MAP).

Russian Success.—Fighting in the northern area continued intermittently during the month of June, preventing the Poles from transferring troops to the hard-pressed south. Despite the operations in the south it was clear that the main Soviet attack was coming in the north. On July 4 the blow fell. The whole Polish line gave way. Wilno (Vilna) and Minsk were lost in the first week. Grodno fell on July 20 and Białystok on July 25. By the end of July the Soviet advance guards had reached the Bug. In 25 days the Poles had lost 300 m. of territory. The main cause of the collapse was their failure to constitute reserves. In their desire to protect their new territory they had been led into a linear defence where they were strong nowhere. Their forces were insufficient to defend a line nearly 800 m. in length.

Disposition of Troops.—The Polish situation was now critical. On the Bug their men fought with desperation and the Soviet advance was checked. No time was to be lost, however, or the Soviet would carry out fresh concentrations. With the help of the French military mission, under Gen. Weygand, a plan for a great counter-attack was evolved on Aug. 6. The situation of the opposing sides on that date was as follows:—

Soviet: (1) Northern group. Four armies—IV., XV., III. and XVI.—on the Bug from Rozan to Brest-Litovsk, with a cavalry corps on the extreme north skirting the East Prussian frontier and aiming to outflank the Polish left.

(2) Southern group. Two armies—XII. and XIV. with Budenny's cavalry, along a line from Kowel through Brody to Tarnupol. The men of the Soviet Army were unfed and worn out with a month's marching. Only the thought of the rich booty to be obtained in Warsaw maintained them in the ranks.

Poles: (1) Northern group. Four detachments—Roja force, I. Army, IV. Army, Sikorski's force—facing the Soviet northern group from Brest-Litovsk to the East Prussian frontier at Chorzele. This group was formed of units which had been retreating for over a month, strengthened by reinforcements thrown in hastily as they came up. Much material had been lost and the men were tired and hungry. The situation presented a picture of great disorder, but the approach to the line of the Vistula was beginning to simplify the supply of food and munitions.

(2) Southern group. Three armies—VI., III. and IV.—facing the Soviet southern group. Here the situation of the Poles was much better. Pressure from the enemy had been by no means so severe as in the north and many of the divisions still retained their original fighting value.

Polish Plan of Attack.—The Polish plan was to withdraw all but a minimum of force from the southern area and to attack the Soviet northern group with the greatest possible strength. The operation bears a close resemblance to Ludendorff's manoeuvre at Tannenberg. In many respects the situation was similar. The Russians were advancing in two main groups divided by the Pripet marshes instead of the Masurian lakes. Here the Soviet southern group was advancing slowly like Rennenkampf's army in 1914. The situation would become critical as soon as the two Soviet groups converged upon the Polish Army. No time was to be lost. Would the commander of the Soviet armies in the south allow himself to be deceived in the same manner as Rennenkampf?

On August 6 orders for the following fresh groupings were issued from Polish headquarters.

(1) Three armies—II., I. and V.—under Gen. Joseph Haller, were to withdraw slowly to the line of the Vistula from Dęblin to Modlin with the V. Army pushed well forward on the left to prevent any outflanking of the Polish left between Warsaw and the East Prussian frontier.

(2) Two armies, III. and IV.—were to concentrate behind the Wieprz between Chełm and Dęblin, ready to strike due north. The advance of these two armies to commence on Aug. 16.

(3) One army, VI.—would withdraw as necessity arose in the direction of Lemberg, tempting the Soviet southern group away from the critical point in the north.

By Aug. 12 all the armies, with the exception of the two on each flank, had reached their assigned positions without incident. In the south the III. had found the XII. Soviet Army advancing and had been forced to throw out a detachment on its right flank to cover its concentration. It had been delayed in consequence. In the north, the V. had been driven back by overwhelming strength and had been unable to prevent the enemy outflanking movement.

Enthusiasm in the Polish Army had risen surprisingly in the days since the momentous decision to attack had been taken. The chief of the Polish State, Marshal Pilsudski, had himself taken command of the III. and IV. Armies. With the help of Weygand and his staff the service of supply had been restored. New bodies of reinforcements were moved forward from the depôts in Western Poland and the depleted units began to raise their heads again. National optimism returned. The enemy in the south made no determined move and appeared to have no inkling of what was afoot. Every hour that he delayed meant more chance of success for the Polish plan.

Polish Advance.—Gen. Sikorski's V. Army in the north was the first to move. The Soviet movement round his left had assumed alarming proportions and had to be stopped. On Aug. 14 he pressed forward from his defensive position at Modlin and at once encountered the Soviet XV. Army advancing to the attack. Sikorski persisted in his attacks all through Aug. 15 and 16, his men fighting with determination. Not even the appearance of elements of the Soviet IV. Army in his left rear turned him from his purpose. Throwing out covering detachments to watch his rear he attacked again on Aug. 17. His determination reaped its reward, for the enemy gave way in front of him, their retreat rapidly developing into a rout.

In the south Pilsudski's armies made good progress. The blow against the left of the Soviet XVI. Army came as a complete surprise and they offered little resistance. During Aug. 16 and 17 the Poles covered over 50 miles. By Aug. 18 the III. Soviet Army, which lay between the XV. destroyed by Sikorski, and the XVI. broken by Pilsudski, turned also in hopeless confusion.

On the extreme Soviet right their IV. Army, containing some of the most famous Communist regiments, together with the cavalry corps, had reached the Vistula between Toruń and Płock in their great turning movement. They were preparing to roll up the Polish left when Sikorski suddenly advanced. Had they advanced resolutely even then, all might have been well, but they hesitated and were lost. Their half-hearted attacks against Sikorski's left had little effect. It was not till Aug. 20 that the order for a general retreat reached them. On Aug. 22 at Mława, and Aug. 23 at Chorzele, they were successful in cutting themselves a passage, but on Aug. 24 at Kovno they ran up against Pilsudski's IV. Army blocking the way. Almost without making an effort to attack they passed ignominiously over the East Prussian border to internment.

The pace of the Polish pursuit was remarkable. From Aug. 16 to Aug. 25 the advanced units of the II. Army had covered 200 m. as the crow flies. The IV. Army averaged 25 m. a day in their advance. The service of supply was left far behind. The troops existed as they could upon the exhausted country. Luckily the Soviet resistance was so completely broken that there was no further fear of counter-attack and the Polish units had ample time in which to reorganise.

Conclusion.—The results of the battle of Warsaw, as it has been named, are only exceeded by those of Tannenberg. The Poles captured 70,000 prisoners, 200 guns and 1,000 machine-guns. From 50,000 to 100,000 Soviet troops passed over into East Prussia. The victory of the Poles was due to the adoption of a determined offensive based upon a sound plan. The raising of the *morale* of the beaten troops by the Polish authorities, roused to enthusiasm themselves by the inspiring presence of Gen. Weygand, is little short of miraculous. The crisis of the battle was undoubtedly Aug. 15–16, when Sikorski's V. Army cleared its front. If it was Pilsudski's force which completed the Soviet defeat, it was undoubtedly the magnificent fighting of Sikorski and his men which made victory possible.

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RUSTLESS STEEL.—Rusting under usual atmospheric conditions is a universally recognised characteristic of iron. It is everywhere accepted, like the law of gravity, as an unquestionable fact. Those who use iron or steel in exposed places always take into account that it must be protected from rust or be ultimately replaced. The rusting of iron has been studied by chemists for many generations. In the journals of chemical and physical societies, and in books, the subject has been discussed at great length in relation to a variety of explanatory theories.

Experimental Test.—A useful idea which seems to lead to the root of the matter can be acquired by an interesting and very simple experiment. On placing a few bright iron nails in a test tube filled with water the iron is observed, in the course of a few days, to be covered with rust. Some particles of rust may be observed on the inside of the tube above the nails. These particles may have risen from below or fallen from above the position in which they are found. If they have fallen from above it should be possible, by interposing a diaphragm, to collect them and keep them separate from such rust as may form on the bright iron at the bottom of the tube. A suitable diaphragm can be made from cotton wool or a piece of lightly rolled blotting paper. Having added two or three bright iron nails, filled up the tube with recently boiled water and adjusted the diaphragm at different heights in several tubes otherwise similarly prepared, the tubes are kept in a quiet place away from direct sunlight. During the first few days nothing appears to happen. After two or three weeks the nails are still bright, but a faint band of rust may be noticed on or in the white diaphragm. As weeks and months go by the band of iron rust in the diaphragm grows more distinct and broader.

It seems certain that the iron visible in the diaphragm, as rust, could be found inches above the nails only if iron from the nails had dissolved in the water and diffused upwards. It seems equally likely that the band of iron rust becomes visible in the diaphragm because the oxygen of the atmosphere in contact with the upper surface of the water has dissolved there and diffused downwards. In an open tube the reaction between the dissolved oxygen and the dissolved iron

forms rust which falls onto the bright nails. In a tube correctly fitted with a suitable diaphragm the two diffusing substances meet and react within or above the diaphragm and the solid product is held there, leaving the nails bright and smooth but slowly losing weight as the years go by.

One of the characteristics of pure iron is that rusting leaves it with a smooth surface. On the other hand rusted steel has generally a pitted surface. Also mild steel rusts more quickly than good wrought iron. The reason for this is worth mentioning. If polished and etched, the surface of pure iron is seen, through a microscope, to consist of a conglomeration of grains, each white like its neighbours; the grains are irregular in shape but may be visualised as so many silver coins lying on the banker's counter. When similarly polished and etched, a piece of mild steel is seen to consist of dissimilar grains; some are white in appearance and others black. These may be visualised as a mixture of silver and copper coins lying side by side on the banker's counter.

On placing a clean half-crown on either side of the tip of the tongue there is no perceptible taste. On placing silver coins on each side of the tongue and nipping the free ends of the coins together whilst the tongue is between them there is no perceptible taste. On going through the same performance with copper coins similar results are obtained. If, however, the experiment be repeated with one silver and one copper coin, which singly are tasteless, it will be found that when in contact, with the tongue between them, the penny on the upper side of the tongue has a sharp metallic taste. The copper coin excites the sensation of taste (like an ordinary steel knife) because it is being dissolved and it dissolves more rapidly in contact with the silver in conformity with the general law that when dissimilar metals are in contact, in the presence of an electrolyte, one of them is apt to be selectively dissolved or corroded.

Cause of Rust.—From these experimental observations the rusting of iron appears to depend on the fact that iron is soluble in water. The rusting of steel at a greater rate than iron appears to depend on its solubility in water plus a degree of selective solubility due to the dissimilar nature of its constituent grains. If, therefore, iron is to become rustless under ordinary atmospheric conditions it must first be made insoluble in water. And further, in order to guard against selective corrosion, its composite grains should be made as similar as possible.

Use of Chromium.—The simplest and cheapest forms of rustless steels, but not the first in chronological order, are ordinary mild steels containing chromium. The resistance of the steel to rusting depends on the amount of chromium it contains. The addition of 10% of chromium to pure iron would suppress its solubility in water, and as the resulting pure chromium-iron would consist of similar crystals it might be regarded in itself as a satisfactory rust-resisting metal. But such pure chromium irons cannot be produced commercially. The commercial rustless steels always contain carbon which even in small amounts causes the formation of dissimilar crystals. Between 1912–4, a series of steels containing between 9 and 16% of chromium was investigated by Brearley (see U.S.A. patent 1197256/16), who concluded that with the stipulated amounts of chromium and not more than ·70% of carbon, rustless steel articles could be produced providing they were submitted to suitable hardening operations with the object of suppressing differences in grain constitution due to the carbon in the steel. From this series of rustless steels developed by Brearley the familiar "stainless" cutlery is made.

The resistance of chromium steels to rusting is increased by adding chromium and decreased by adding carbon. Small amounts of carbon are always unavoidably present but definite amounts are also added with the object of producing required degrees of hardness, resistance to wear or ability to cut. The useful extent to which chromium alone can be added to iron is limited because ultimately such comparatively pure chromium irons are brittle and on that account are not in great demand for industrial purposes.

Steels containing more than 9% chromium were made as early as 1892. Their rust-resisting properties were not realised because at that time the resistance of steel to general corrosion was estimated by its measured resistance to solubility in dilute sulphuric acid. Since the solubility of high chromium steels in dilute sulphuric acid is greater than that of ordinary steel, the quest for non-rusting steels, depending on conventional tests, was directed away from and not towards the undoubted merits of chromium.

Nickel Steels.—Prior to 1912 the least corrodible steels in general use were nickel steels. The more nickel they contained the less they were supposed to corrode. Steels containing 25% nickel were held in high regard, as they were notably resistant to dilute sulphuric acid, an active corrosive agent in industrial towns or under special conditions as in chemical works or mines.

The addition of nickel to steels which already contain enough chromium to make them resistant to ordinary atmospheric corrosion produces useful results: (1) conferring a certain degree of resistance to the corroding effect of cold sulphuric acids, whether in the liquid or vapour form, (2) making those higher chromium alloys tough which, without the nickel, would be brittle, and (3) making it comparatively easy to secure homogeneous grain constituents with or without the necessity of submitting the alloy to special forms of heat treatment. Materials of this class were investigated by Strauss in Germany 1912–4 (English patents, 13414/13 and 13415/13). Strauss appears to regard the presence of nickel as an indispensable constituent of rustless steels, and Krupps, with whom he is associated, have devoted most attention to a steel containing about 20% chromium and 6% nickel. Steels of this composition are austenitic or can readily be made austenitic by quenching from temperatures of about 1,000° Centigrade. Such steel cannot be hardened by the usual heat-treatment processes. They are hardened by cold-working, as are all metals and alloys (*see* METALLURGY).

Faraday's Work.—The commercially more important rustless steels owe their properties to the presence of 10 to 20% chromium with or without the addition of nickel in amounts generally less than 10%. But attempts to preserve brightened and polished surfaces were made 100 years ago when both nickel and chromium were rare metals. Michael Faraday, amongst others, studied the subject in 1822. He produced an alloy which "after lying many months had not a spot on its surface." This alloy was a combination of steel with a considerable proportion of platinum. Faraday appears to have made 3% nickel and 5% chromium steels but produced nothing which resisted tarnishing except rare metal alloys which are much too costly for industrial use.

Marsh's Work.—If scalding at high temperatures be regarded as a form of corrosion, then the work of Marsh must be noticed. Looking for some substitute for platinum wire or strip to wind resistance coils, Marsh found what he required in an alloy of nickel and chromium. This material, alloyed with more or less iron, is familiar as the coiled filament of heated metal in office and bedroom radiators. Its value for that purpose, apart from its electrical properties, is that it does not scale when it becomes red hot. Marsh's nichrome alloy having satisfied all the requirements of a good radiator, neither Marsh nor anyone else appears to have connected its resistance to scaling at red heat with its possible value as a rustless alloy.

Haynes' Cobalt Chromium Alloys.—After Marsh, the American Haynes, who is reputed to have made the first motor-car in America, was busy with cobalt-chromium alloys. From his observations and experiments arose the well-known cutting tool material called "stellite" and a similar material in a malleable form from which Haynes made pocket-knife blades.

Development.—The development of rustless steels appears to follow closely the lines on which ordinary steels have developed. The rustless chromium steels were first used for table cutlery and aero-engine exhaust valves. When the valves were required to offer great resistance to scaling, silicon was added with good effect. When valves were required to be as hard at red heat as ordinary structural steel is at ordinary temperatures, 12 to 30% of nickel was added with good effect. To resist other specific conditions, other metals such as molybdenum, tungsten, manganese and copper have been added. In this way chromium irons are becoming the base of a series of rustless, scaleless and non-corroding alloys, whose possibilities are not likely to be completely explored for many years.

Special Difficulties.—The development of rustless steel is hampered by two difficulties. The first relates to its adaptability to existing manufacturing processes. This difficulty starts with the actual making of the steel and is met in every hot-working

and cold-working process. Apart from its rustlessness the most diverse and often antagonistic properties are required. The second difficulty relates to the smelting of the ore. The ferro-chromium alloy can be produced cheaply by smelting chrome-iron ore in the blast furnace but it contains unfortunately some 8 or 10% of carbon. This alloy is useless for making rustless steel because it contains too much carbon. For soft varieties of rustless steel the steel maker requires ferro-chromium alloys containing practically no carbon. To take the carbon out of the blast furnace ferro-chromium, costing about £20 per ton, involves an additional cost of £100 per ton. This is the price of ignorance; and it is still not known how to adapt cheap smelting operations to chromium ore without contaminating the product with carbon. Even if suitable chromium alloys were obtainable for nothing, rustless steels would still be more expensive than ordinary steels on account of steel manufacturing defects, which it is costly to avoid or remove.

Chromium Plating.—Closely bound up with the future of rustless steel is the possible development of chromium plating, which is arrested by unforeseen difficulties. Those interested in the production of chromium-plated articles assumed the possibility of covering mild steel with a coating which should exhibit *ne plus ultra* resistance to corrosion. The process appears to have failed for the same reason that nickel-plating fails when applied to steel articles exposed to weather conditions, since it is porous, and against a strong light is seen to be perforated. The same is true of chromium plating when peeled off, so that sooner or later moisture would find its way through the perforations and rust the unplated steel surface. Until this trifling defect has been overcome visions of chromium-plated steel castings and plated goods made from pressed mild steel, which would last for ever, are just visions. The unquestioned acceptance of rusting as a characteristic of ordinary steel has concealed the various causes which promote rusting. Since the introduction of rustless steels individual causes of general corrosion have been more sharply separated and defined. The most notable causes of corrosion, apart from direct solubility, are due to distortion and contact.

Effects of Distortion and Contact.—A piece of rustless steel used for stainless knives and containing, say 13% chromium, will remain bright if exposed in a country garden providing it has been suitably heat-treated. If, however, a piece of the same material be machined in a lathe the machined surface and the turnings themselves will rust, because they are distorted and probably to some extent because adjacent parts of them are distorted unequally. The more smoothly and less violently the surface is machined the less it is likely to rust. If ultimately the surface be smoothly ground and polished it will not rust. The polished surface does not offer easy lodgment for casual dirt but otherwise polishing in itself does not appear to exert a great restraint to rusting. A piece of the same 13% chromium steel, for example, in the form of cold-drawn wire which has simply been highly polished after cold drawing rusts with surprising readiness.

The corrosive effects of distortion can generally be avoided or eliminated. In many cases the direct effects are negligible, but the secondary effects of roughly machined surfaces may be serious. Foreign substances which readily adhere to rough surfaces produce contact corrosion. Almost any wet substance will cause corrosion of the lower chromium rustless steels, to start at the point of contact. A piece of string, glass, wood, paper or even the contact in still water of two pieces of the same low grade rustless steel promotes corrosion. In running water, contact corrosion is less noticeable and may even be entirely absent.

When the substance in contact with rustless steel is some other metal of a more electro-negative character the attack is greater and occurs more quickly. The effects of contact corrosion are also quickened and greater when the contact surfaces are wetted by sea water instead of ordinary water. Contact corrosion of the simpler kinds can be avoided by using higher-chromium rustless steels with or without the addition of nickel. For a few instances —notably in machines pumping hot sea water—the problems are difficult to deal with because the effects appear to contradict general rules and tendencies. This may be taken as a sure indication that the subject of contact corrosion, a most extended and energetic destroyer, has not been completely explored. (*See* also IRON AND STEEL.)

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RUTHERFORD, SIR ERNEST (1871–), British physicist, was born at Nelson, New Zealand, Aug. 30 1871 and studied at the University of New Zealand, where he took the B.Sc. degree in 1894. After a period of research at the Cavendish Laboratory, Cambridge, he became in 1898 Macdonald professor of physics in McGill University, Montreal; in 1907, Langworthy professor of physics at Manchester University; and in 1919 Cavendish professor of experimental physics in the University of Cambridge, accepting, in addition, in 1920, the professorship of physics at the Royal Institution, London. In a brilliant series of researches he established the existence and nature of radio-active transformations, the electrical structure of matter, and the nuclear nature of the atom. He was elected F.R.S. in 1903, and was knighted in 1914. Many British and foreign degrees and honours were bestowed upon him, including the Rumford Medal of the Royal Society, 1905, the Barnard Medal 1910, the Bressa Prize 1908, the Copley Medal 1922, and the Franklin Medal 1924. He was awarded the Nobel Prize for chemistry in 1908, and the O.M. in 1925 and was President of the British Association in 1923, and of the Royal Society in 1925.

His works include *Radio-activity* (1904), *Radioactive Transformations* (1906); *Radioactive Substances and their Radiations* (1912), and numerous papers in *The Transactions of the Royal Society*, *The Philosophical Magazine*, etc.

RUTHERFORD, MARK (c. 1830–1913), British author (*see* 23.940), died at Groombridge, Sussex, March 14 1913.

RYAN, JOHN DENIS (1864–), American capitalist, was born at Hancock, Mich., Oct. 10 1864. In 1889 he went to Denver, where he was employed as a salesman of lubricating oils. In 1901 he secured an interest in a bank at Butte. In 1904 he was made manager of the Amalgamated Copper Co. in Montana, becoming president in 1908. He had been elected president of the Anaconda Copper Mining Co. in 1905, and after the merging of the Amalgamated interests in the Anaconda in 1910 he continued as president of the latter until 1918. He developed large water powers in Montana and in 1913 electrified the railway between Butte and Anaconda (100 m.), the success of which led to a wide expansion of railway electrification. During 1917–8 Ryan was on the executive of the American Red Cross. He was appointed in April 1918, head of the aircraft board of the Committee of National Defence, and in Aug. was appointed second assistant-secretary of war and director of air service of the U. S. Army, which position he resigned in November. In 1919 he was elected chairman of the board of directors of the Anaconda Copper Mining Company.

RYDER, ALBERT PINKHAM (1847–1917), American painter (*see* 23.949), died at Elmhurst, L. I., March 28 1917.

RYKOV, ALEXEI IVANOVICH (1881–), Russian politician, was born in Saratov, the son of a peasant. Saratov was a place of banishment for revolutionaries, and Rykov came under their influence. When he went to Kazan he was already taking part in social democratic organisations. He was imprisoned and sent back to Saratov to remain under police supervision. Continuing his revolutionary work, he was rearrested, but escaped abroad before his trial. He visited Lenin at Geneva and returned to Russia as a propagandist in various industrial districts. In 1904 he was in Moscow, and in 1905 attended a congress of the Communist party which elected him a member of the party's central committee. On returning from the Congress he was arrested in St. Petersburg (Leningrad). He was

freed by the revolution of 1905, was a representative of the Bolsheviks in the St. Petersburg Workmen's Soviet and escaped from the capital when the Soviet was arrested. He took part in the Dec. revolt and the fighting on the barricades in Moscow, escaped to Odessa after the failure of that revolt, but presently was again working in Moscow, where he was arrested but once more succeeded in escaping.

In 1907 he was arrested and banished to Samara, but went abroad to visit Lenin. He was arrested on returning and exiled to the province of Archangel for three years. He escaped shortly before the end of his term of exile and went to Paris. He returned to Russia to organise a congress, was arrested in 1911 and remained in prison till 1913, when in Oct. he was sentenced to exile to the Narym district for four years. In 1914 he escaped, went to Samara, was recaptured and sent back to the Narym district, where he remained until the March revolution of 1917, after which he worked in the Moscow organisation of the Bolsheviks. He took an active part in the Nov. revolution, was for some time president of the supreme economic council, and, after the death of Lenin, became president of the council of people's commissars. He was still occupying this position in 1926.

SAAR (SARRE) TERRITORY, (*see* SAAR, 23.953), an industrial and mining district situated on the Franco-German frontier, north of Lorraine and near the iron ore deposits of Briey. Its area is 741 sq. m., its population 770,000. The 31 coal mines employ 72,000 men; the 5 iron and steel plants and subsidiary industries a further 32,000. The larger part of this most important district is Prussian, the smaller Bavarian. From Nov. 1918 to Jan. 1920 it was occupied by French troops and administered by a French general.

Administration under the League of Nations.—By Section IV. of the Treaty of Versailles (Jan. 10 1920) Germany ceded to France the full and absolute possession of the coal-mines in the Saar basin as compensation for the destruction of the coal-mines in the north of France and as part payment towards the total reparation due from Germany for the damage caused by the War. The district containing the mines was formed into the Saar Territory, of which the frontiers were roughly defined in the Treaty and afterwards to be exactly traced by a commission. This territory, which is not a state, possesses no sovereign rights and has no permanent existence; it is administered by the League of Nations, acting as trustee, for the period 1920–35.

During this period all powers of government formerly possessed by the German Empire, Prussia and Bavaria are ceded by Germany to the League of Nations and exercised by a governing commission of five, to be nominated by and responsible individually and collectively to the League of Nations. One of these five persons must always be a Frenchman, a second always a Saar inhabitant of German nationality; the remaining three members belonging to three countries other than France or Germany. The five are appointed for one year by the Council of the League of Nations, which designates one of them as President. Each member may be reappointed or revoked by the same authority. In view of the dominant French interests, M. Rault, the French member, has held the presidency of the commission from 1920 up to March 31 1926. A consultative council, consisting of 30 members, elected every three years by popular vote of the inhabitants, usually from the local political parties, has been established in an advisory capacity without power of initiative. All new laws and modifications of old ones are submitted to it before being promulgated by the governing commission.

A commission of 9 is nominated by the governing commission and tenders its advice on all problems submitted to it by the commission.

The power of the commission is not sovereign. France owns the mines[1] and the territory is subjected to the French customs régime. France, under the Treaty terms had also the right to use French money in all matters connected with the exploitation of the mines. In fact, the French franc became the only legal currency after June 1 1923. In many other respects, however, the *status quo* under German rule at the time of the Armistice is maintained. The inhabitants retain their local Assemblies, religious liberties, schools, language and nationality. The governing commission administers the following departments: public works, railways, ports, telegraphs, agriculture, social insurance, forests, public instruction, trade and commerce, foreign relations, finance, public welfare and decides all questions arising from the interpretation of the Treaty stipulations which concern the government of the Territory. In 1935 a plebiscite will be held, on the result of which the League of Nations will decide whether the Territory or certain portions of it shall continue to be governed autonomously under the League, be united with France or again be governed by Germany. After 1935 the coal mines may under certain conditions be repurchased by Germany.

[1] The mines now belong to the French State and are under the direct control of the French Minister of Public Works in Paris through an administrative head in Saarbrücken.

Work of the Commission.—The work of the governing commission has been exceedingly difficult, and was not accomplished without friction, especially during its opening stages. The first acute problem to arise was that of the status of the local officials. It was decided that they should retain their position as German officials, but pledge fidelity to the new government. Certain disagreements led, however, in July 1920 to an eight days' strike of all officials, which threatened to spread to the coal-mines. It was suppressed by the French military, by courts martial and expulsions. That again raised the question whether the presence of a French garrison was desirable in a plebiscite territory. In fact, the French garrison was subsequently reduced and a local gendarmerie raised. The establishment of a Court of Appeal of mainly neutral composition in June 1920 went some way to quieting apprehensions; another step in this direction was the appointment in Sept. 1922 of a Swiss Commissioner to inquire into and provide for the preservation of the records necessary for drawing up the voting test to be used in the plebiscite of 1935.

In the spring of 1923, when tension between France and Germany was high owing to the occupation of the Ruhr, 75,000 miners struck from Feb. 5 to May 15. A second grave political crisis now arose, especially after the Governing Commission had increased the French garrison and promulgated certain repressive measures (decree of March 7). This decree was severely criticised, both in the meeting of the League of Nations on April 23 and in the British House of Commons in May. The British Govt. declared itself in favour of "an impartial inquiry conducted by the machinery of the League into the question of the general administration of the Saar territory." On Jan. 1 1923 the franc was substituted for the mark as the legal currency.

A public inquiry was conducted by the Council of the League on July 6. The Council found it unnecessary to discuss the Provisional Decree of March 7, as this had already been withdrawn (June 18). It "appreciated the economic considerations" which had led to the change of currency; and declared it desirable that "the support of a foreign garrison should be withdrawn so soon as the development of the local gendarmerie permits." It expressed its "great appreciation of the administrative work achieved by the Governing Commission." The present régime in the Saar Territory is inevitably and *ipso facto* unpopular among the local population. Causes of friction have, however, now been eliminated as far as humanly possible.

Economically, on the other hand, the Saar Territory enjoys considerable advantages. It has no army to support, no reparations to pay, no foreign debt and no war debt. It has always been able to balance its budget out of normal current revenue and the *per capita* taxation on the inhabitants has been low. Unemployment has rarely exceeded 1·5% of the total working population. Exports in 1924 amounted to 1,123,441,499 francs, imports to 874,642,000 francs. In 1913 the annual production of coal was 13,000,000 tons, the coal reserves about 16,000,000,000. Coal production sank in Feb. 1920 to 743,000 tons but rose by Oct. 1923 to 1,223,000 tons. It is thus over the pre-War average. The monthly average production of pig iron (115,000 tons) and steel (120,000 tons) is also above pre-War figures.

Since Jan. 10 1925, under the Treaty terms, a customs barrier has been imposed between Germany and the Saar, which thereby becomes incorporated within the French Customs régime. This has necessitated finding and developing new markets throughout the world. Future prosperity will be influenced by the terms of an ultimate Trade Agreement between France and Germany.

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SACHAU, CARL EDUARD (1845–), German scholar, was born July 20 1845 at Neumünster in Holstein. In 1869 he was

appointed Professor of Semitic languages at the University of Vienna, and in 1876 professor of Oriental languages at Berlin, where he became director of the school of Oriental languages. In 1879–80 he travelled extensively in Syria and Mesopotamia, and in 1897–8 in Babylonia and Assyria, for the purposes of study. Sachau was a member of the academies of sciences of Berlin, Vienna, London, Leningrad and Helsingfors.

His chief works are: *Gāwâlîkî's Almurrab* (1867); *Syriaca Inedita* (1870); *Syrisch-römisches Rechtsbuch aus dem 5. Jahrhundert* (1890); *Reise in Syrien und Mesopotamien* (1883); *Neuarabische Volkslieder aus Mesopotamien* (1889); *Katalog persischer Handschriften* (1889); *Muhammedanisches Erbrecht von Zansibar und Ost-Afrika* (1894); *Am Euphrat und Tigris* (1900); *Syrische Rechtsbücher* (1907–14); *Vom Asiatischen Reich der Türkei* (1915). For a complete bibliography of the works of Sachau, see S. Weil, *Die Festschrift zu Ehren Ed. Sachaus, 1915*.

SAFEGUARDING OF INDUSTRY.—This is a term which has come into use to designate a policy, entered upon by Great Britain after the World War, of tariff protection to particular industries under certain definitely prescribed conditions. The idea took shape at the Economic Conference of the Allies in Paris in 1916. The first of the resolutions concerning permanent measures, as distinct from war and reconstruction measures, was as follows:—

The Allies decide to take the necessary steps to render themselves independent of the enemy countries in so far as regards the raw materials and manufactured articles essential to the normal development of their economic activities.

The signatories—including, of course, Great Britain—retained complete freedom as to the nature of the measures to be adopted, and expressly added that, in deciding upon them, they would "have regard to the principles which govern their economic policy."

The Balfour Committee.—The further consideration of the matter was at once referred by Mr. Asquith, the Prime Minister, to the Committee on Commercial and Industrial Policy after the War, presided over by Lord Balfour of Burleigh. In an interim report in March 1917 it drew a distinction between the great staple industries of the country and those producing "certain special commodities essential to national safety as being absolutely indispensable to important British industries, which were supplied before the War entirely or mainly from present enemy sources or from sources under present enemy control." The report also set forth the position with respect to synthetic dyes, spelter, tungsten, magnetos, optical and chemical glass, hosiery needles, thorium nitrate, gauges and drugs, as pivotal or "key" industries.

The committee presented its final report on Dec. 3 1917, definitely recommending that "some Governmental action should be taken to promote and safeguard the development in the United Kingdom of industries of a special or pivotal character"; and also expressing the opinion that "the producers of this country are entitled to require from the Government that they should be protected in their home market against dumping." Dumping was defined as "the sale of goods at prices lower than those at which the goods are currently offered in the country of manufacture."

No action was taken on these recommendations until Aug. 1921, when the Coalition Govt. secured the passage of the Safeguarding of Industries Act, 1921. This dealt, in Part I., with the safeguarding of key industries, and in Part II. with the prevention of dumping, authorising, in each case, a duty of one-third of the value.

Key industries were specified in a schedule to the Act; the Board of Trade was authorised to issue lists in accordance therewith; and complaints as to improper inclusion in, or exclusion from, the lists were to be considered by a referee appointed by the Lord Chancellor. The duration of this part of the Act was for five years. The enactment as to dumping in Part II. was restricted to goods other than articles of food or drink; and dumping was defined by implication as sale "at prices below the cost of production," which was itself defined as "95% of the wholesale price at the works." But under Part II. were now included conditions beyond those contemplated in 1917. The depreciation of the exchanges of continental countries, especially of Germany, had been accompanied by a "lag" between the internal and external value of their currencies, which, so long as it continued, gave their exports an advantage in foreign markets, thus exposing the home manufactures of those markets to an exceptional but, it might be, ruinous competition.

Accordingly the Act added to the goods with respect to which action could be taken those sold "at prices which, by reason of depreciation in the value in relation to sterling of the currency of the country in which the goods are manufactured (not being a country within His Majesty's dominions) are below the prices at which similar goods can be profitably manufactured in the United Kingdom." On complaint being made to the Board of Trade, the Board must satisfy itself that the value of the currency of the country in question had fallen by at least one-third in relation to sterling. Whether it was alleged that the imports were being "dumped" in the usual sense, or sold cheaply on account of the rate of exchange, the Board was required to satisfy itself that there was a *prima facie* case for maintaining that such imports were seriously affecting employment. It might then refer the complaint to a special committee, selected from a permanent panel mainly of persons of commercial or industrial experience, which was directed to report as to whether the conditions were satisfied; into the effect which the imposition of a duty would exert on any other industry using the goods as materials; and also as to whether the threatened industry in the United Kingdom was being carried on with reasonable economy and efficiency.

If the report was satisfactory, the Board of Trade was given power, but not required, to make an order applying the Act, so long as it was not at variance with any engagement with any foreign state. The draft of the order must, however, be approved by the House of Commons before it became operative. Such an order, unless renewed, would not be valid for more than three years, and if made on the ground of depreciation of currency for more than three years after the passing of the Act.

Four Classes of Goods Safeguarded.—Most of the applications received were adversely reported upon; but four having been adjudged to fulfill all the conditions, formed the subjects of a draft order laid before the House of Commons in June 1922, and approved by Resolution of the House at the end of July. In each instance the complaint had been made on the ground of depreciated exchanges. The order applied to four descriptions of goods manufactured in Germany: fabric gloves and glove fabric, domestic glassware, illuminating glassware and domestic hollowware. The case of fabric gloves had previously been referred back to the committee that it might consider the assertion that the Lancashire cotton trade would be injured by the effect which the duty would have on the export of yarn from England, and it had reported, repeating its former recommendation. In the case of glassware, though the report of the committee had included imports from Czechoslovakia, that country had been so successful in stabilising its currency before the order was actually prepared, that the President of the Board of Trade, in the exercise of his discretion under the Act, determined to limit the imposition of duties to imports from Germany. In Oct. 1922 a further order was made with respect to gas mantles from Germany, the complainants having satisfied a committee that the conditions of the Act were in fact satisfied.

The time required by so elaborate a procedure and the limited duration of the promised safeguarding prevented any further action being taken before the fall of the first Baldwin administration at the end of 1923. As to the effect of the orders it is difficult to form any confident opinion, in view of the continuance, outside the particular trades under the Act, of the severe general depression of trade. But there seems reason to believe that in the case of domestic hollow-ware some improvement was discernible, and that in the other cases the trades were enabled to keep alive, and were saved from the still greater decline they would otherwise have experienced.

A Change in Procedure.—On the formation of the second Baldwin administration a new procedure was adopted. The general conditions on which safeguarding duties would be granted were announced on Feb. 3 1925, in a White Paper (Cmd. 2327, 1925), together with the intention of the Government, when a *prima facie* case had been made out and reported on favourably by a special committee, and the imposition of a duty had been concurred in by the Board of Trade and the Treasury, to proceed by the ordinary methods of financial legislation, with all their customary safeguards. To the conditions imposed by the earlier Act were now added (1) that the applicant industry should be "of substantial importance, on account of the volume of

employment or the nature of the goods," and (2) that the competing imports should be "abnormal." The term "dumping" disappeared; and it was now made necessary to prove that the competition came "largely from countries where the conditions are so different . . . as to render it unfair." "Unfairness" was limited to one or more of the following causes:—

(*a*) Depreciation of currency, operating so as to create an export bounty.

(*b*) Subsidies, bounties and other artificial advantages.

(*c*) Inferior conditions of employment of labour.

The special committee in each case might "call attention to any special circumstances by reason of which the industry in the United Kingdom was placed at a serious relative disadvantage." Finally, the committee was called upon, in the event of the claim to a duty being made out, to express its opinion as to the rate of duty which "would be reasonably sufficient to counteract the unfair competition."

The operation of the previous Act had been restricted by existing treaty obligations, and a commercial treaty had recently been made with Germany extending to that country most favoured nation rights. The Government therefore now determined that any safeguarding duties imposed under the new Act should be general in their application and not limited to imports from particular countries.

Four Further Applications Granted.—Out of more than a score of applications in the course of the next few months, four succeeded in satisfying the conditions of the Act. The first of these reports, that on lace and embroidery, was in time to be given effect to in the Finance Act 1925, which imposed an import duty of one-third of the value. The other three were given effect to in the Safeguarding of Industries (Customs Duties) Act 1925, which, after long debates, became law on Dec. 22. This imposed for five years a duty of one-third of the value on imports of certain classes of cutlery and on both leather and fabric gloves, and also a specific duty on incandescent mantles. The lace, cutlery and glove trades were deemed important by reason of the volume of employment they provided. The gas mantle industry was considered important in view of its character. During the War it had been discovered that there was vital need in every branch of gunnery of the rare metals thorium and cerium for the manufacture of searchlights, and it was held that the only chance of maintaining the production of these metals was to give those engaged in their extraction the one commercial market furnished by the gas mantle trade.

The report of the committee appointed by the Board of Trade upon:—

(*a*) The effect of Part I. of the Safeguarding of Industries Act 1921, on the Development of the industries manufacturing the goods covered by the Schedule to that Act.

(*b*) The question of the Desirability or otherwise of an extension of Part I. of the Act after its expiry on Aug. 19 1926.

(*c*) The question of the desirability of inclusion within the ambit of the Schedule of any articles or substances not now covered.

was published on April 22 1926 (Cmd. 2631 of 1926). The committee recommended the continuation, and in certain cases, the increase or extension of rates of duty, and the continuation of the safeguarding Duties for a minimum of five years, and preferably ten years.

BIBLIOGRAPHY.—*Final Report of the Committee on Commercial and Industrial Policy after the War* (Cd. 9035, 1918); and *Official Reports of Parliamentary Debates* (Hansard's), especially those in the House of Commons (Aug. 11 1921, July 31 1922; and Dec. 9 1925). (WM. A.)

SAFETY FIRST.—The origin of the safety movement or, as it is more popularly called, the Safety First movement, is often disputed. The United States first developed the idea on an organised national basis, but the principles were in practice much earlier in Great Britain and elsewhere. In the middle of the 19th century an association was formed in Manchester to prevent the disasters due to boiler explosions; early in the 20th century certain undertakings, notably Lever Bros., Cadbury Bros. and the Great Western Railway Co., were developing the principle of educating their employees in the necessity of being on their guard against the risks of modern machinery and high speed transport.

The slogan "safety first" was certainly used on a large scale in America first of all. Its origin lies in an old railway rule "The SAFETY of the *public* shall be the *first* consideration of the staff." The slogan caught on, and, though often misinterpreted as implying that all other considerations are of secondary importance, no better substitute has yet been evolved. It is the motto for a movement which aims at educating the community in the common sense principles necessary to cope with the ever-increasing and inevitable risks inseparable from modern conditions. The majority of all accidents should not, and need not, occur.

Campaign in Great Britain.—The beginning of the British national campaign was in London in 1916. At an important conference it was decided to form the London Safety First Council to deal with London's street dangers, and this body has been in active existence ever since. Composed of representatives from the various London local authorities, transport and business undertakings, together with experts on traffic matters, it has waged a continuous educative campaign in the London area, particularly in the schools. Nearly 200,000 school children participate annually in its essay competition; over 15,000 motor drivers enter annually for its "freedom from accidents" competition. Over 1,000,000 posters and warnings have been displayed in schools and elsewhere, whilst the chief transport undertakings have supplemented the campaign by additional efforts. It is claimed that, owing to these activities, there are fewer children killed on the London streets than was the case previously; that the rate of increase in London's accidents is less than in the provinces; and that the standard of both drivers' and pedestrians' watchfulness is higher in the metropolis than elsewhere.

Safety Work in Industry.—In 1918 attention was directed to the value of accident prevention work in industry, and the British Industrial Safety First Association was formed to deal with this side of the problem. Its gravity is best indicated by the fact that 200,000 more persons were compensated for industrial accidents in the five years following the War than were wounded in the previous five years of War. Members of this Association, who took up organised accident prevention work, found that they were able very materially to reduce the number of their accidents, in some cases by as much as 70 to 80%. These results were achieved by co-operation between employer and employed, and by impressing the necessary common-sense precautions by means of posters and allied measures for interesting and educating the workers.

A National Campaign.—The growth of motor traffic, and so the toll of street accidents, which rose from 36,000 in 1918 to well over 100,000 in 1925, directed attention to the need of a general national campaign. In 1924 the British Industrial Safety First Association and the London Safety First Council were merged in a National Safety First Association, and in that year and in 1925, with the support of the great motoring and other organisations, a national campaign was inaugurated. With the co-operation of many local authorities, education committees and chief constables, safety instruction was given in schools; the public were instructed through the medium of the Press, of posters and of the association's journal, *Safety First*, and arrangements were made whereby a pamphlet on safe motoring was issued with every motor driving licence. In eight of the chief provincial centres, branches of the association were formed for the purpose of initiating work on the lines successfully carried out by the London Safety First Council.

Other Countries.—Corresponding accident prevention bodies exist, or are in process of formation, in practically all countries. The oldest and most influential is the National Safety Council of America, with a very large membership and field of activity. Other bodies are the Canadian National Safety League, the Industrial Accident Prevention Association of Canada, the Association des Industriels (Accident Prevention) of France, the Association des Industriels (Accident Prevention) of Belgium,

the Associazione degli Industriali (Accident Prevention) of Italy and the National Insurance Institute, Trieste. The International Labour Office at Geneva has a special department dealing with accident prevention. (*See* INDUSTRIAL WELFARE.)

(J. A. A. P.)

SAGE, MARGARET OLIVIA SLOCUM (1828–1918), American philanthropist, was born at Syracuse, N.Y., Sept. 8 1828. After graduating in 1847 from the Troy (N.Y.) Female Seminary, afterwards known as the Emma Willard School, she taught in various schools until 1869, when she became the second wife of Russell Sage (*see* 23.1002). She proved herself a shrewd business woman and for several years before his death had full control of his affairs. She had long been interested in charities, and he left to her without restriction his entire fortune, over $64,000,000, doubtless foreseeing its probable final distribution to charity. In 1907 the Russell Sage Foundation was incorporated for the "improvement of social and living conditions of the United States of America," and to it she gave $10,000,000. In 1912 Mrs. Sage bought Marsh I., off the Louisiana coast, containing about 79,000 ac., later turned over to the state as a permanent refuge for birds. She died in New York City Nov. 4 1918. Her will provided that after bequests to relatives and friends amounting to about $12,000,000, the residue, some $36,000,000, should be divided into 52 parts and variously distributed to many colleges, museums, hospitals, charitable institutions, Bible societies and missions. To most of these she had made gifts during her lifetime. The largest portion, seven parts, was left to the Russell Sage Foundation. It was estimated that during her life she had made public gifts of some $40,000,000.

SAID HALIM, PRINCE (1863–1921), Turkish statesman, the son of Halim Pasha and the grandson of Mohammed Ali, the founder of the present Egyptian Dynasty, was born in Cairo and was educated in Turkey, completing his studies in Geneva. Exiled because of his sympathy with the Young Turkish movement, he affiliated himself to the Committee of Union and Progress in Paris. After the revolution of July 1908 he returned to Constantinople and was nominated Senator. At various times from 1908 to 1918 he was President of the Council of State, Minister for Foreign Affairs and general secretary to the Union and Progress party. On June 17 1913 he became Grand Vizier, in which capacity he endeavoured to settle the questions of Armenian reforms, Mosul oil, and the participation of English, French and Russian capital in the Baghdad railway. He also endeavoured to establish close relations with Greece. Prince Said Halim favoured a Turco-German alliance, but sought to keep Turkey neutral in the World War. On her entry into the War he tendered his resignation, which was refused, and he remained in office until Feb. 1917. After the Armistice of Moudros, Oct. 31 1918, Prince Said Halim was imprisoned by the British in Malta. Released in 1921, he was assassinated in Rome on Dec. 6 1921. One of the last representatives of old Turkish Grands Seigneurs, Prince Said Halim was a connoisseur of Oriental as well as Occidental fine arts. He founded the Evkaf for Muslim Arts in Constantinople, and the school for Turkish decorative writing and miniature.

SAID PASHA, MEHMED (1838–1914), Turkish statesman, was born at Erzerum, the son of Ali Namik Effendi, formerly chargé d'affaires at Tehran. In 1876 he became first secretary to the Sultan Abdul Hamid II. and afterwards senator. After the Russo-Turkish Peace in 1878, he became minister of justice, and showed energy and initiative in carrying through important legal reforms. In 1879 he was appointed grand vizier, a post which he held nine times in all. In 1881 he established the administration of the public debt, and the tobacco monopoly. In 1885, owing to his having advocated armed intervention to restore the *status quo* in Bulgaria, he was replaced by Kiamil Pasha. At the time of the Armenian massacres he was again in power, but was dismissed in 1895, and was forced to take refuge at the British Embassy. During the revolt of the Young Turks in 1908 he was called on by Abdul Hamid to form a Cabinet, but was unsuccessful in his attempts to defend the old régime. After the revolution he was for some time president of the Senate, and in 1911 succeeded Hakki Pasha as grand vizier. In 1913 he again became president of the Senate, and died in Constantinople March 1 1914. Said Pasha was a remarkable speaker; and, combining as he did the culture of both East and West, may be considered as one of the most experienced and far-seeing Turkish Ministers of the 19th century. His *Memoirs* in three volumes are a justification of his policy; and an account of his legal reforms will be found in the blue book, *Turkey* (1881, No. 8).

ST. ALDWYN, MICHAEL EDWARD HICKS-BEACH, 1ST EARL (1837–1916), British statesman (*see* 23.1013), was created an earl in 1915. He died in London April 30 1916.

ST. ANDREWS, UNIVERSITY OF (*see* 23.1015).—In St. Andrews, the Chandos chair of medicine has been converted into the chair of physiology and new chairs have been instituted in anatomy and English. In the scientific departments lectureships in various branches have been instituted. The gift, by Prof. Thomas Purdie, of a chemical research laboratory gave a great impetus to research work in chemistry, and Prof. Purdie's widow bequeathed an endowment fund for the fostering of research. The laboratory has played an important part in the development of research. Among the modern additions to the university may be mentioned the establishment of a botanical garden and of the Gatty marine laboratory.

The original scheme of the colleges involved the residence of the students in the college buildings and that system continued till about the beginning of the 19th century. Towards the middle of that century an effort was made to revive this system, which, however, was not maintained. In 1921 a residence for men students was established, and in 1926 a beginning was made with the erection of a residence hall on a more extensive scale. Dr. and Mrs. Younger, of Mount Melville, gave to the university the site and building of a large graduation hall adjoining the united college buildings.

By Mr. Andrew Carnegie gifts were made to the university of a large recreation park with pavilion adjoining, a gymnasium and a very considerable addition to the university library buildings. Mrs. Carnegie gave to the university a building for a women students' union or club house. The men students' union (originated in 1898) has been extended and improved under a gift to the university by Dr. William Low of Blebo. A number of bursaries, scholarships and prizes have been established by the donation of funds to the university, and among other funds is the Lady Donaldson fund for the benefit of students who fall ill during their college course. At University College, Dundee, a chair of bacteriology and a large number of lectureships in various branches of medical science and practice have been established.

To the original buildings of University College, Dundee, have been added a block of medical buildings, an electrical engineering laboratory, a mechanical engineering laboratory, library, fives court and students' union. A hostel for women students has been established in Dundee.

ST. GERMAIN, TREATY OF (*see* also VERSAILLES, TRIANON AND NEUILLY, TREATIES OF).—Austria and Hungary had up to 1918 formed a diplomatic unit; but in Oct. 1918 they were virtually two separate States. The Armistice of Nov. 3 still recognised Austria-Hungary as a diplomatic unit, but Austria was proclaimed a Republic Nov. 12, as was Hungary Nov. 16. The Armistice concluded by the Powers direct with Hungary (Nov. 13) recognised Hungary's *de facto* independence of Austria.

All the Powers, except the United States, early asserted that the "Fourteen Points," etc., did not apply to the settlements with Austria and Hungary. In Jan. 1919 it was known that even Wilson favoured including in Italy part of the Slovene population of Istria and Carniola, and would make Italy further concessions. On April 14 he agreed to grant Italy the Tirol south of the Brenner Pass, with over 250,000 Germans, as well as the Trentino, as already agreed by France and Great Britain. It was known also that the Czechoslovak State would include over 3,000,000 Germans. Austria was to be reduced to some two-thirds of her German-speaking territories. In mid-April

M. Clemenceau obtained from his Allies the further important decision to prohibit union between Austria and Germany without the unanimous consent of the Council of the League. This was embodied in the draft treaty with Germany of May 6, and formed article 80 of the Treaty of Versailles of June 28, appearing as article 88 of the Treaty of Saint-Germain, and Article 72 of the Treaty of Neuilly.

On May 2 the Austrian delegation was invited to Paris. On June 2 they were presented with a very imperfect draft treaty, followed by a more detailed one on July 20. Austria made great protests, turning mainly on two points. She asserted the applicability of the "Fourteen Points" to her case, and her right therefore to retain all her German subjects. President Wilson alone was willing to extend the application of the "Fourteen Points" to Austria; the Treaty assigned 3,500,000 Germans to Czechoslovakia, 230,000 to Italy. The other main point of dispute was how far Austria must accept the responsibilities of old Austria-Hungary. The Allies finally decided that the Austrian Republic was not a new State but an old one lopped of certain outlying provinces and endowed with a new Government. The Allies recognised this Government *de facto* by accepting their credentials on May 22 and *de jure* on Sept. 10, by signing the treaty with them at St. Germain-en-Laye. It came into force on July 16 1920.

Part I. The Covenant, and Part XIII. Labour, are as in the Treaty of Versailles.

Part II. of the Austrian Treaty details the borders of the new Austrian State.

Part III. Political clauses for Europe.—This deals with technical details such as the financial obligations of the former Austrian Empire, as affecting Italy, Yugoslavia, Czechoslovakia and Rumania. Articles 49–50 arranged for a plebiscite in two areas of the Klagenfurt basin. This plebiscite, taken in 1920, went in Austria's favour. West Hungary, with about 333,000 souls, was transferred from Hungary to Austria but ultimately, in 1921, without its chief town (*see* BURGENLAND). Further clauses in Part III. dealt with the protection of racial and religious minorities. Article No. 88 prohibits Austria from alienating her independence (*i.e.*, joining Germany) otherwise than with the consent of the Council of the League of Nations.

Part IV. Austrian Interests Outside Europe.—As in the Treaty of Versailles this part provides for a total renunciation of State properties immovable and movable outside Europe, and also of treaties, capitulations, concessions, etc., in the following countries: Morocco, Egypt, Siam and China.

Part V. Military, Naval and Air Clauses followed the general lines of the similar clauses in the Treaty of Versailles but showed somewhat more consideration to Austria. A long-service voluntary force not exceeding 30,000 was allowed. The manufacture of arms, etc., was confined to a single factory (article 132). The naval clauses were very drastic; the whole Austro-Hungarian Navy was broken up or distributed among the Allies, Austria only retaining four patrol boats on her inland waters. The air clauses were as in the German Treaty.

Part VI. Prisoners of War and Graves; *Part XI.* Aerial Navigation, were as in the German Treaty, with a few very small alterations.

Part VII. Penalties provided for the trial before Allied military Tribunals of Austrian offenders against the laws and customs of war. This provision was not executed.

Part VIII. Reparations; *Part IX.* Financial Clauses; *Part X.* Economic Clauses.—By article 177 Austria accepted responsibility for herself and her Allies for causing loss and damage to the Allied (Entente) Governments by the War. The rest of the "Reparation Chapter" followed the corresponding section in the German Treaty. No lump sum was fixed, but discretion was, in effect, given to the Reparation Commission to fix it. Austria handed over her whole commercial fleet and much livestock to the Allies. Czechoslovakia, Yugoslavia, Poland and Rumania had, however, to contribute to the expenses incurred by the Allies in liberating their territory from Austria. The financial clauses involved many complex questions as to the allocation of pre-War debt and the distribution of war debts. All these provisions were somewhat relaxed by the Supreme Council on March 17 1921, and the process was completed by Austria placing her finances under control of the League in Sept. 1922 (*see* Austria).

Part XII. Ports, waterways and railways, merely stressed some points in the corresponding section of the German Treaty.

See *Treaty Series*, No. 11 (Cmd. 400 of 1919); also H. W. V. Temperley (ed.), *A History of the Peace Conference of Paris*, vol. iv. and v. (Institute of International Affairs, London, 1921).

(H. W. V. T.)

ST. LAWRENCE: *see* GREAT LAKES AND ST. LAWRENCE; also 24.21.

ST. LOUIS (*see* 24.24).—The population of St. Louis July 1 1925 was 821,543 (census bureau estimate), an increase of 48,545 since 1920. The increase from 1910 to 1920 was 85,868, or 12%. The population figures are for limits fixed in 1876, when St. Louis city and St. Louis county were separated. An amendment (adopted in 1924) to the constitution of Missouri authorises the extension of the city limits into the county if the plan is approved by the voters of both city and county. The city, the counties of St. Louis and St. Charles in Missouri and the counties of St. Clair and Madison in Illinois form the St. Louis industrial district of the U.S. census.

The city charter of 1914 reduced elective officers to mayor, comptroller, president and board of aldermen, collector, treasurer, recorder of deeds, sheriff and coroner with four-year terms. Each of 28 wards has a resident alderman elected by citywide vote. The mayor, the comptroller and the president of the board of aldermen form a board of estimate and apportionment with control of appropriations. The board of public service (appointive) consists of a president and four directors of divisions—public welfare, public safety, public utilities, and streets and sewers, with departments and bureaus under them. The tax rate of 1925 was $2.57 per $100 assessment. Assessed valuation of realty, personalty and utilities increased from $775,500,000 in 1921 to $1,075,099,930 for the taxes of 1925.

City Improvement Plan.—In 1923 St. Louis voted $87,000,000 in bonds for a great scheme of city improvement. The bonds provided $8,500,000 for widening and $5,800,000 for improving 69 m. of streets; $12,000,000 for waterworks on the Missouri river, doubling the present supply of water taken from the Mississippi; $11,000,000 to put underground the River des Pères in the western suburbs; $2,600,000 for a plaza and park fronting Union station; $2,500,000 for new parks and playgrounds, with $1,300,000 for improving old ones; $8,000,000 for city-wide electric lighting; $8,000,000 for reconstruction of sewers; $400,000 for an aquarium; $4,000,000 for eleemosynary institutions; and $1,250,000 for city markets. The bonds voted provide also $5,000,000 for a memorial plaza occupying 9 city blocks (27 ac.) between Market and Olive streets, west of Twelfth street boulevard. The new buildings on the plaza will be a courthouse, $4,000,000; and auditorium and convention hall, $5,000,000; and a World War memorial, $1,000,000. Existing public buildings in the plaza group include the municipal courts, the city hall and the public library.

Municipal improvements accomplished since 1910 include a permanent open-air theatre in Forest Park with seats for 9,275; a free steel bridge costing $7,500,000; viaducts over railways, $700,000; and new school buildings, $5,000,000. Additions to Washington University were endowment gifts ($1,500,000) and new buildings for the medical, art, biological and other departments, costing $3,000,000. To St. Louis University James Campbell left an estate of $10,000,000 for a hospital and the advancement of medicine and surgery. Three new hospitals—Barnes, the Jewish and the Children's—represent, with endowments, $5,000,000. From the surplus of the Louisiana purchase exposition the Jefferson memorial was built, costing $500,000, for the Missouri Historical Society.

Trade and Industry.—The total resources of banks and trust companies in 1925 were $523,114,561; deposits, $536,701,672; capital stock $42,950,000. Clearings for 1924 were $7,174,034,000. In 1925 St. Louis industries included the largest plants in the United States for the manufacture of shoes, street cars, stamped ware, stoves and ranges, drugs, tobacco, lead and brick. Operating 11 tanneries and 40 factories, the leading shoe company reached a production of 150,000 pairs daily in 1925. Recent development in metals has been marked, giving St. Louis the largest steel-casting plant in the world. An industrial district employing 55,000 has developed in northwest St. Louis since 1915. Rail freight tonnage received increased from 43,000,000 in 1920 to 52,000,000 in 1923; shipments out increased from 29,000,000 to 35,000,000 in the same years. Receipts of grain in 1924 were 113,974,000 bushels. Receipts of hogs in 1923 were 4,800,000.

(W. B. St.)

ST. MIHIEL, BATTLE OF.—For four years the St. Mihiel salient had projected 28 km. deep into the French lines. Its original purpose, to serve as one of the jaws of a nutcracker attack on Verdun having failed, it was used in 1916 as the anvil against which Von Falkenhayn sought in vain to drive home his hammer blows against Verdun from the north. In the spring of 1918 Ludendorff again hoped through its possession to gain Verdun, and much more by the wider encircling attack in Champagne of July 15, but again the attack failed. During all these years the salient had been not only a threat of further German aggression but a serious interruption of French railway communication with both the Verdun and Lorraine front. In 1915 the French Army had twice attacked to compel evacuation of the salient, but both attacks had failed, the first, made in April at Les Eparges, with serious losses. Tactically the salient afforded the Germans a strong defensive position. The Côte de Meuse, a range of hills rising abruptly 1,600 ft. above the Meuse valley, afforded strong supporting points on the western face of the salient, while Mont Sec and the lower-lying hills south of the Rupt de Mad were well adapted to a strong defensive organisation (*see* WESTERN FRONT CAMPAIGNS).

The Attack Assigned to the A.E.F.—To the General Staff of the American Expeditionary Forces, even before its arrival in France, the reduction of the St. Mihiel salient had appealed strongly as a favourable initial operation for the American Army as soon as sufficient forces should have arrived to undertake it. The reason for this selection was in part that the nature of the salient enabled an offensive to be undertaken there with relatively small forces such as the A.E.F. might hope to have by the following spring, but mainly because at this point the eventually preponderant American forces could strike a most serious blow by the capture of Metz, which was not only important as a railway centre, but the heart of a vital industrial region. The staff further deemed it important to begin at once the installations and lines of communication necessary for both the reduction of the salient and the subsequent operations.

Gen. Pershing discussed this view with Gen. Pétain in June 1917, and, after a further study of the front, port facilities and railway lines, it had been adopted as a working plan. However, the success of the German offensive operations in the spring of 1918 caused the plan temporarily to be laid aside, and during both the spring and summer of that year American troops in France were scattered along the Western Front to meet needs of the moment. By the end of July the situation had stabilised sufficiently in favour of the Allies to enable the question of reuniting the troops of the American Army to be again discussed. On July 24 Foch confirmed the understanding arrived at the previous year that the first independent American operation should be the reduction of the St. Mihiel salient. A few weeks later he authorised the transfer to the American I. Army of the sector of the Allied front facing the salient. This transfer was made on Aug. 30.

The Allied Plan.—By this time the American Army consisted of forces far beyond the number required for the mere reduction of the salient, and the question of their subsequent employment had to be considered. Pershing had naturally desired to exploit the St. Mihiel attack to the utmost. Foch, with other plans in mind, limited the attack strictly to the reduction of the salient.

By Foch's direction, Pétain on Sept. 2 issued the directive for the operation, which called for a main attack on the south to debouch from the plateau Seicheprey-Limey toward the objective Vigneulles-Thiaucourt, and a secondary attack, to debouch from the vicinity of Eparges-Mouilly toward the southeast and, in connection with the main attack, to effect the cutting off of the German forces in the salient. To the main attack there were assigned eight American divisions; to the secondary, one American and one French; the French troops occupying the intermediate sector were to exercise pressure against the enemy forces in the apex. The wording and date of this directive and the disproportionate number of American divisions assigned to the main attack, which alone could hope speedily to reach the *Michel Stellung*, across the mouth of the salient, suggest that it was originally drafted with a view to at least a partial exploitation of the attack, to include the seizure of the *Michel Stellung*, but that in a subsequent alteration, to conform to Foch's insistence on a more limited scope to the attack, only the names of the objectives were changed.

Dispositions of the Opposing Forces.—Gen. Pershing's order for the attack assigned the main attack to the I. and IV. Corps, each of which were given four divisions, including two regular divisions, and the secondary attack on the Côte de Meuse, to the V. Corps, the attacking troops of which consisted of one American National Guard Div. and one French division; the French II. Colonial Corps in the centre was to guard the adjacent flanks of the main and secondary attacks, to execute deep raids, and to be prepared to follow up a withdrawal. At the disposal of the American I. Army for the operation were 2,971 guns, mostly French artillery. The I. Army also had a marked superiority in aviation, thanks to French co-operation and the assistance of the British Independent Air Force.

On the German side the salient was held by Army Detachment C, under Gen. Fuchs, comprising eight divisions on the line, organised into three corps groups, and three divisions in reserve. As early as Sept. 1 a deserter had given the Germans warning of the impending attack, and Ludendorff had at the time seriously considered ordering a withdrawal from the salient, but was deterred by the representations of the army detachment and army group commanders, who were confident of their ability to hold. By Sept. 8, however, the evidences of the coming attack on the salient had become unmistakable, and Army Detachment C was ordered to withdraw to the *Michel Stellung*. No need for haste was felt and the preparations were deliberate and methodical. The night preceding the attack the dismounted batteries were being withdrawn, and consequently could not be used in the battle.

Launching of the Attack.—Preceded by a four-hour bombardment the main attack was launched at 5 A.M. on Sept. 12; the secondary attack at 8 A.M. Deprived of most of its artillery support the German infantry, although ordered to hold, made virtually no resistance. The American I. Army on the right made its objectives in a few hours and, in spite of German counter-attacks brought by two of the divisions in reserve, begged permission to continue its advance; but, because of the precise instructions by which Pershing felt himself bound, this permission was refused. The IV. and V. Corps also made at an early hour their first-day objectives and halted awaiting further orders. Instructions were at once dispatched for the two corps to join hands at Vigneulles to cut off the apex of the salient. These instructions did not reach the troops until after dark on the 12th, so that the connection, though unopposed, was not effected until the morning of the 13th. Meanwhile the German commander had ordered the complete evacuation of the salient, which had not been attacked from the front, and the movement was successfully carried out during the night.

In the course of Sept. 13 and 14 troops of the American IV. and V. Corps and French II. Colonial Corps moved forward without opposition to the line designated by Foch, facing the *Michel Stellung*, which the I. Corps had already reached on the 12th. Of the troops engaged on the Allied side 555,000 were American, and 110,000 were French. American losses were 7,511, of which considerably more than half were borne by the I. Corps, which received the brunt of the counter-attack; French losses were 597. The captures included over 15,000 prisoners and 443 guns.

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(A. L. C.)

ST. PAUL, Minnesota, U.S.A. (*see* 24.35), had in 1920 a population of 234,698, of whom 51,722 were foreign-born (Swedes and Germans predominating) and 3,376 were negroes. The census bureau estimate for 1925 was 246,001. Bank clearings increased from $538,600,000 in 1910 to $1,659,900,000 in 1924!

The factory output was valued at $58,990,000 in 1909; $149,638,000 in 1919; and about the same in 1923 ($150,355,075), representing recovery after the depression of 1920–1. Building permits in the five years 1920–4 represented new construction valued at $96,691,000.

A new charter establishing a commission form of government was adopted in 1912 (in effect Jan. 1 1914). In 1921 a proposal to change back to the federal form was defeated at the polls. The City Planning Board (created by an ordinance of 1918) submitted in 1922 a city plan with many interesting features, including suitable approaches to the state capitol (based on the suggestions made by the architect of the building, Cass Gilbert, in 1905, when it was completed) and to the new union depôt, and designs for a city and county administration building. A zoning ordinance was adopted in 1924. The desirability of a metropolitan planning commission for the Twin Cities and their environs was under discussion. The Amherst H. Wilder Charity (incorporated 1910, with an endowment of $2,778,018) erected an administration building (1913) which became a central "charities building" for the city, where other agencies are housed without charge for rent; it made surveys of housing conditions (1917) and of health (1919) besides establishing a day nursery, public baths, etc. St. Paul, like Minneapolis, has a low general death rate, a low infant mortality and relatively little child labour and illiteracy; its percentage of home ownership is appreciably higher.

ST. PETERSBURG: *see* PETROGRAD.

ST. QUENTIN, BATTLE OF: *see* GERMAN OFFENSIVE.

SAINT-SAËNS, CHARLES CAMILLE (1835–1921), French musical composer (*see* 24.44), died in Algiers Dec. 16 1921.

SAIONZI, KIMMOCHI, PRINCE (1849–), Japanese statesman, was born in Oct. 1849 at Kyoto. When less than 20 years of age, he took part in the councils which led to the Restoration, and at 19 was commander-in-chief of an imperial army. In 1881 he commenced his official career, and in the following year accompanied Mr. (afterwards Prince) Ito to Europe and the United States to investigate the parliamentary system. In 1885 he was appointed minister to Austria; three years later he became vice-president of the house of peers and was raised to the privy council in 1894. In the same year he received the portfolio of education in the second Ito Cabinet. In July 1903 he became the leader of the Seiyu-Kai and in 1906 formed his first Cabinet as prime minister; he was again premier in 1911 to 1912. In 1919 he represented Japan as chief envoy at the Peace Conference and was invested with the Grand Order of Merit. He was made Prince in 1920 in recognition of his services in connection with the World War and the Peace Conference.

SAITO, MINORU, VISCOUNT (1858–), Japanese sailor and administrator, was born a commoner, at Iwata Ken. He joined the navy in 1873, and proceeded steadily towards the highest advancement, being gazetted commander in 1897. The discipline of the Japanese navy, strict as it was, still left something to be desired, and when he became captain in 1898, Saito declared his intention of revising some of the existing regulations and enforcing a stricter observance of others. In the same year he was appointed vice-minister of the navy under Adml. Count Yamamoto. Two years later he was gazetted rear-admiral in recognition of his valuable services in the development of the navy along Western lines. He was promoted to vice-adml. in 1904 and became adml. in 1912. He received several decorations for his services in the Russo-Japanese war, where he profited by his experience as naval aide-de-camp to the Emperor in the Chino-Japanese conflict. He was Minister for the Navy in 1913 and 1914. After the upheaval of Koreans in 1919 under the rule of Marshal Hasegawa, Baron Saito was appointed governor-general of Korea. His chief concern was education; there were only 250 schools in the peninsula at the time of his appointment, but by 1926, there were nearly five times that number. He was created Baron in 1907, and was raised to the rank of Viscount in 1925.

SAKHALIN or SAGHALIEN (*see* 24.54), a Pacific island, area 24,560 square miles. In Oct. 1905 Russia ceded to Japan that portion of the island lying south of the parallel of 50° N. lat., known officially as Karafuto, with an area of 13,158 sq. m. and population (1920) 105,899. Sakhalin contains important coal-fields, the three exploited in 1925 producing about 114,000 tons annually; iron pyrites in the Notoro peninsula; alluvial gold in the river beds; and oil-bearing strata which were first discovered in large areas in Anshi and Notosanu in 1913.

Natural Resources of Karafuto.—In Karafuto the chief industry is that of the fisheries. About 43,000 ac. of land were under cultivation in 1922, the main crops being barley and wheat. About 900,000 ac. suitable for cultivation and pasturage were still available. There were over 8,000,000 ac. of practically untouched forest. The wood-pulp manufacturing industry was growing. The Japanese treasury makes a fixed annual grant to supplement taxes and sources of revenue. The budget for 1924–5 balanced at 19,948,463 yen.

SALANDRA, ANTONIO (1853–), Italian statesman, was born at Troia, Puglia, in 1853. He first entered parliament as member for Lucera, and from the beginning of his political career was a Liberal of the Right wing. When Baron Sonnino became Treasury Minister in the Crispi Cabinet of 1893, Salandra was chosen under-secretary in that department. He was Minister of Finance in the first Sonnino Cabinet of 1906 and Treasury Minister in the second (1909–10). When in March 1914 Sig. Giolitti resigned, Sig. Salandra was called upon to form the new Cabinet, and he was premier on the outbreak of the World War. It was the Salandra Cabinet which took the momentous decision of bringing Italy into the World War on the side of the Allies. On resigning office in June 1916, he continued to support both the Boselli and the Orlando Cabinets. During the disturbed period from 1919 to 1922 Salandra upheld the principles of orthodox Liberalism, and opposed the policy of the various cabinets who truckled to the extremists. He succeeded Senator Tittoni as Italian delegate on the League of Nations Council and Assembly, and represented the Italian thesis in the Italo-Greek conflict arising from the massacre of the Tellini mission in Epirus in Aug. 1923. The Fascist movement was supported from the first by Sig. Salandra, but he did not join the Fascist party, and when he felt that Fascism was incompatible with the old Liberal tradition, especially after Mussolini's speech of Jan. 3 1925, he withdrew his support, without, however, abandoning the Chamber.

SALFORD, England (*see* 24.67), with an area of 5,202 ac., including Pendleton and Broughton, incorporated in 1919, had a population in 1921 of 234,045. Suggestions for its amalgamation with Manchester, or for the inclusion of Eccles, Swinton and Pendlebury in Salford have not come to fruition. Large clearances of insanitary and overcrowded areas have been made, and the death-rate has fallen to about 13 per 1,000. A wide new road was opened at Pendleton in 1925, and further road improvements were under consideration in 1926. There are 297 ac. of parks and recreation grounds in the borough; these include 46 ac. at Pendleton, bought before the War and laid out after it; Langworthy Park, Pendleton (6 ac.); Wallnes Lane, Salford (12 ac.); an extension of Peel Park; and the Light Oaks Estate, Pendleton. The power station at Agecroft, one of the largest in the country, was finished in 1925. The Salford War memorial ward at the royal hospital was opened in 1922.

SALISBURY, JAMES EDWARD HUBERT GASCOYNE-CECIL, 4TH MARQUESS OF (1861–), British politician, eldest son of the 3rd marquess, the Prime Minister (*see* 24.76), was educated at Eton and University College, Oxford. He was a member of Parliament from 1885, with the exception of one year, till he succeeded his father in 1903. He fought in the South African War with the 4th battalion of the Bedfordshire regiment, and was mentioned in dispatches. On his return to England in 1900 he became under-secretary for foreign affairs, a post which, on succeeding to the peerage, he quitted for that of Privy Seal in the Cabinet of his cousin, Mr. Balfour; and he held, for some months in 1905, the Presidency of the Board of Trade.

Lord Salisbury, who had not made his mark in the Commons, gradually came to occupy a position of considerable authority in

the Lords. In the crisis over the Parliament Bill he threw in his lot with the "Die-hards." During the early years of the World War he was energetic in the discharge of his military duties as lieutenant-colonel of his yeomanry regiment. He did not join either Coalition government, but was critical of both, taking an independent line. In the last months of the War and during the early years of peace he gradually came to assume the informal leadership of the Conservative Opposition first in the House of Lords, and afterwards in the party generally. As the reluctance of the Conservatives to support the Coalition grew, the discontented rallied round him; and, in a speech on Oct. 16 1922, he categorically demanded the freedom of the party. Three days later the policy was accepted at the Carlton Club meeting. He became Lord President of the Council in Mr. Law's Cabinet and continued in the same post in Mr. Baldwin's first Cabinet. In Mr. Baldwin's second Cabinet he was Lord Privy Seal, and on Lord Curzon's death in 1925 he succeeded to the leadership of the House of Lords. He married in 1887 Lady Cicely Alice Gore, daughter of the 5th Earl of Arran, and had two sons and two daughters. He was created K.G. in 1917.

SALISBURY, Rhodesia, the capital of Southern Rhodesia (*see* 23.260), lies 374 m. northwest of Beira and 301 m. northeast of Bulawayo. In 1921 the white population was 6,462. Situated at an altitude of 4,700 ft. above sea level and at the foot of a kopje, the town is well laid out, has many handsome public buildings and possesses nearly all the amenities of a European town. There is an excellent water supply. Government House, at the northeast end of the town, a large single-storey building, dates from 1910. The churches include an Anglican Cathedral (not completed in 1926). The private residences are mostly of the bungalow type set in large gardens. Salisbury is the centre for a large mining and agricultural district. The Jesuit Industrial Mission Farm at Chishawasha, 16 m. distant, is noted. The first parliament of Southern Rhodesia met here in 1923.

SALMON FISHING: *see* ANGLING.

SALONIKA (*see* 24.85), a seaport of southeastern Europe. When the first Balkan War broke out in 1912, Salonika surrendered to the Greeks on the festival of its patron, St. Demetrios, Nov. 8, after 482 years of Turkish occupation. King George I. proceeded to what was now the second largest city of his kingdom, but was assassinated there on March 18 1913, by a Greek, named Schinâs, to whom he had once refused money.

The Treaty of London of May 30 1913 assigned Salonika to Greece, and the battle of Kilkis in the second Balkan War of that year prevented the Bulgarians from approaching it. Salonika was becoming more and more hellenised when the World War brought it into prominence as the base of the Allied operations in the Near East. On Oct. 5 1915, despite a merely formal protest from M. Veniselos, then premier, allied troops landed there and a few days later Gen. Sarrail arrived and subsequently took over the duties of commander-in-chief. The War Council of the Allies decided to hold it, and held it was, despite several air raids. The Allies arrested and deported the four enemy consuls, occupied all official buildings and proclaimed martial law.

In 1916 a Veniselist revolution against King Constantine broke out there, and on Oct. 9 M. Veniselos arrived and formed a Provisional Govt., which the Allies recognised, and to which Lord Granville was accredited as British representative. From Salonika this National Govt. declared war on Nov. 23 against Bulgaria and Germany. On Aug. 18 1917 a great fire destroyed a large part of the city, including the ancient church of St. Demetrios. After the War an arrangement was made, by which Yugoslavia, now only three hours distant by rail, should have a so-called "Serbian Zone" in the harbour. But the question of the railway from Salonika to the frontier at Gjevgjelija was one of the obstacles to the renewal of the Greco-Yugoslav Alliance. After the proclamation of the Greek Republic, Salonika, as an important military centre, often had a decisive voice in politics, and the large immigration of Greek refugees from Asia Minor has further hellenised the country round it, now 90% Greek. Salonika is rapidly becoming a great modern city, and it is proposed to endow it with a university. The population at the last census was 174,390, but it is now much larger.

See General Sarrail, *Mon Commandement en Orient, 1916–8* (Paris, 1920); P. Risal, *La Ville Convoitée, Salonique* (Paris, 1914).

(W. Mi.)

SALONIKA CAMPAIGNS 1915–8.—Under the heading of SERBIAN CAMPAIGNS the collapse and subjugation of Serbia in 1915 is related in this work. The present article describes the campaigns in Salonika which formed the sequel to this Allied disaster. The narrative is presented in four sections, under the headings: I. Objects of the expedition; II. The retreat to Salonika; III. The first and second Allied offensives; IV. The defeat of Bulgaria.

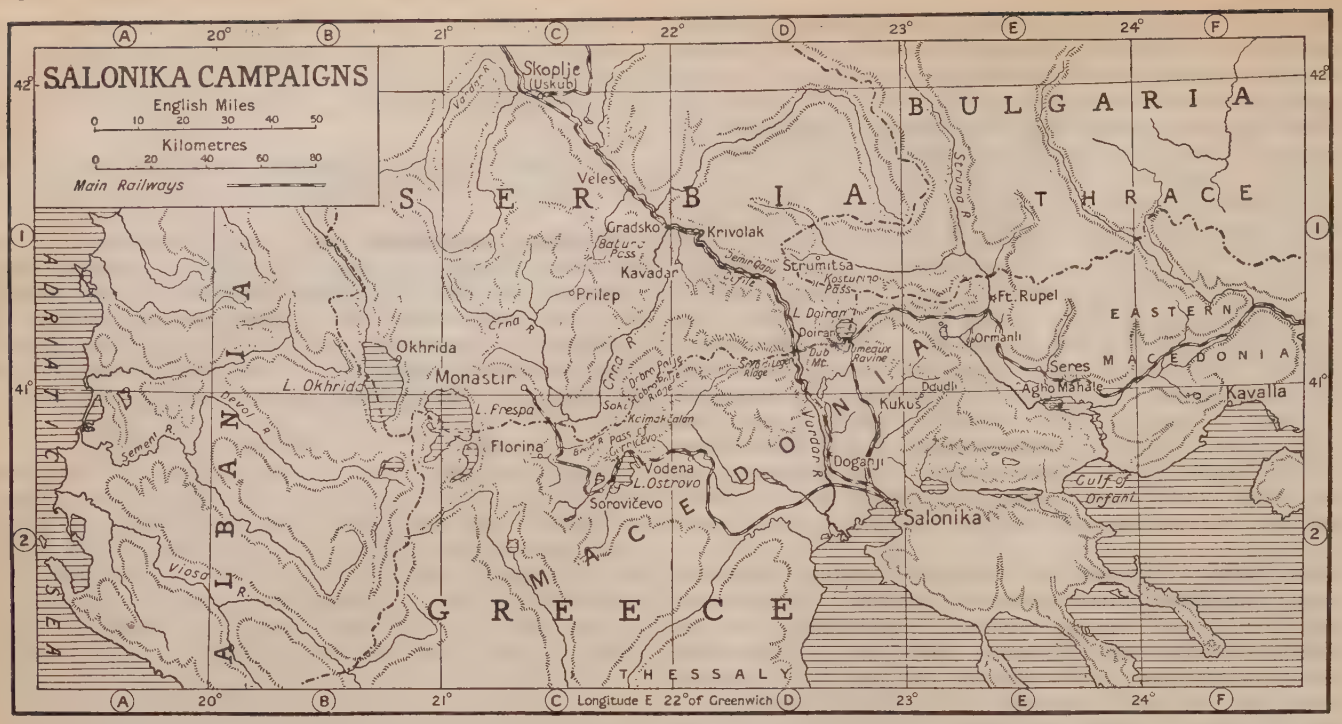
I. OBJECTS OF THE EXPEDITION

Although undertaken for political objects—to bring relief to a hard-pressed ally and to check the influence of Germany in the Balkans—the Salonika campaigns were ultimately crowned by the first decisive military success of the World War. For on the Macedonian front the continent-wide trench barriers of the Central Powers were first breached beyond repair, and there too was knocked away the first national prop—Bulgaria—of the Germanic alliance. To disentangle cause from effect is difficult where moral, military and economic threads are so closely interwoven as in the years 1914–8, yet the fact at least stands out that the overthrow of Bulgaria began the series of national capitulations which ended with that of Germany on Nov. 11 1918.

If Salonika was for several years an unproductive field of military effort, an infringement of the law of economy of force, which in some measure justified the German gibe that it was their largest concentration camp—"an enemy army, prisoner of itself"—the historian, when weighing his verdict, must throw the counterpoise of 1918 into the scales. And not this only, for it must be remembered that the Allied occupation of the Salonika front made possible the rebuilding of the Serbian Army—from the ragged and disorganised survivors of the 1915 winter retreat through Albania to the well-equipped and irresistible force which broke through the Vardar front in Sept. 1918. On the credit side also must be set the fact that the Salonika expedition prevented the danger that Greece might become a submarine base for the Central Powers, one which would have lain in deadly proximity to the British artery of communication with the East via the Suez Canal. And again, that the Allied force contained the bulk of the Bulgarian Army—although it is perhaps doubtful whether these would have placed their services at Germany's disposal for any front more remote from their homeland.

Origins.—If the Salonika expedition was the direct outcome of the Serbian débâcle of Sept.–Oct. 1915, the idea had an earlier origin. For Salonika was not only the one feasible channel of Allied communication with and supply to Serbia, but that front offered a possible strategic flank for attack once the trench line on the western front had been welded into a seemingly impenetrable barrier. As far back as 1914, British and French naval missions, with guns, had been sent to support the Serbians, and they had also been supplied with munitions by the Salonika route. The question, too, had been mooted of a larger employment of military force in that theatre, but British commitments at Gallipoli led to this project being shelved—until the Bulgarian mobilisation for war on the side of the Central Powers.

Bulgarian Intervention.—Throughout the summer of 1915 the two warring coalitions had been bidding for Bulgaria's support, and in this diplomatic bargaining the Entente suffered a moral and a material handicap—the first, their obvious failure at the Dardanelles; the second, Serbia's reluctance to concede any part of Bulgarian Macedonia, which she had seized as her share of the spoils of the second Balkan war of 1913. As this was the one prize on which the Bulgarians had set their heart, and as Austria had nothing to deter her from offering territory that belonged to her enemy—Serbia—the Entente offers failed to attract Bulgaria. Her intervention on the opposite side meant that free communi-



cation could be easily established between Germany and Turkey, and as a consequence that the Entente forces on the Gallipoli peninsula were imminently menaced.

II. THE RETREAT TO SALONIKA

Faced with this critical situation, the French and British Govts. decided, albeit tardily, to succour Serbia with an expeditionary force.

Allied Expeditionary Force.—The French took the lead, nominating as commander Gen. Sarrail, the former chief of the III. Army in the Verdun sector. Sarrail's political activities had earned him the distrust of the military authorities; but the same factor, through his influence with the parties of the Left, made it difficult to ignore him completely. His removal by Joffre from the III. Army command placed the Government in a temporary dilemma, and they eagerly seized the opportunity of placating Sarrail and his political supporters by appointing him to a conveniently distant theatre of war.

While the constitution of Sarrail's force was still under discussion, the Bulgarian mobilisation on Sept. 22 forced the hands of the Entente Governments. A hurried order was sent for the dispatch to Salonika of contingents from Gallipoli, preliminary to the arrival of reinforcements from France. Preceded by staff officers, the British 10th and French 156th Divs. began to disembark at Salonika on Oct. 5, and they were followed by the French 57th Division. On the same day, however, the Greek promise of aid to Serbia, made by M. Veniselos, was repudiated by King Constantine, and the Veniselist Govt. fell—to be replaced by that of M. Zaimis, which took neutrality as its keynote. This reacted at once not only on the Franco-British plan but on their operations. The Greek officials, civil and military, at Salonika did their best, or worst, to obstruct the disembarkation of the Allied contingents.

To increase the confusion, the intended concentration point was several times changed by successive orders from Paris until, on Sarrail's arrival on Oct. 12, he decided, in view of his slender resources and the doubtful attitude of the Greek Army in his rear, to concentrate no further forward than the Demir Qapu (Demir Kapija) defile. The limited object was to protect the railway and to ease the pressure on the Serbian forces to the north by repelling a Bulgarian advance from Strumitsa (Strumica)—which would sever that line and so the Serbian line of retreat. Meanwhile, the British troops under Gen. Mahon began moving up to Doiran, in echelon behind the right of the French.

The Retreat.—On Oct. 14 the leading French troops came into action at Strumitsa station (in Serbia), driving back a Bulgarian reconnaissance, and on Oct. 17, in response to Serbian urgings, a brigade was sent forward beyond the Demir Qapu defile as far as Krivolak. Reinforced by the arrival of the French 122nd Div. Sarrail began, on Nov. 3, an offensive northward to facilitate the Serbian retreat. But the seizure of the Babuna pass by the Bulgarians closed the channel of southward retreat for the main Serbian Army, and finally shattered the hope that the Serbians might fall back on the relieving force, as was the advice of their allies.

Sarrail was thus faced with a difficult problem. On the one hand the gallant French efforts to break through towards the Babuna had failed and they were forced on the defensive, and, on the other, he received news of the Serbian decision to retreat westward through Albania towards the Adriatic. With his small force thus isolated he took the only possible decision—to fall back towards Salonika. This decision raised further problems. Were they to hold on there, or evacuate Greek soil altogether? With the disappearance of Serbia beneath the enemy flood, the Entente Powers could no longer claim that they were at Salonika merely to use a line of communication to which Serbia was by treaty entitled. The other justification, that they had come at the request of the Greek Govt. was now nullified by the downfall of Veniselos. Considerations of prestige and their desire to use Salonika as a base for diplomatic operations in the Balkans led the Entente Govts. to remain, but without any clear policy as to the future.

Even with the decision to retreat taken, the Franco-British forces were not "out of the wood." The withdrawal had to be made down a single-track railway, through a country without roads—converted by the autumn rains into a swamp—and in face of a pursuing enemy. The retreat was made by echelons, in four stages, and only by a narrow margin did the French frustrate Bulgarian efforts to outflank and cut their retreat, first at the Demir Qapu defile, and again at Strumitsa station. The British, too, on the right were heavily attacked, and any weakening might have been fatal to the extrication of the Allied forces from the noose into which they had been pushed.

Fortunately, once the Greek frontier was regained the pursuit halted—mainly because the Germans were reluctant to undertake further commitments in the Balkans to the detriment of their strength in other theatres. Falkenhayn held that the Macedonian operations should be left to the Bulgarians, but this policy

overlooked the fact that the Greeks, however friendly to the Germans, would have resented any invasion of their territory by the Bulgarians. Thus by Dec. 12 the retreating forces were safely out of reach of their pursuers, facing them across the frontier. After pausing for a few days on a line stretching roughly from Sorovičevo to Lake Doiran, the withdrawal was resumed, and by Dec. 18 the forces of Sarrail and Mahon were back in the vicinity of Salonika. Covering this base an entrenched line was constructed, on an 80 m. arc stretching from the mouth of the Vardar through Doganji to the Gulf of Orfano, and occupied early in the new year.

Allied Reinforcements Arrive.—The delay in the expected enemy offensive enabled the Entente force to receive reinforcements, not only French and British but Serbian, for the remnant of their army, after resting and being re-equipped at Corfu, was brought round to Salonika. From April onwards the stream steadily swelled until by July their strength on the Salonika front reached a total of 152,000, divided into three armies of two divisions each. The French had four divisions. The British had been raised to five divisions (10th, 22nd, 26th, 27th, 28th), and later a sixth (60th), organised in two army corps; in May Lt.-Gen. G. F. (later Sir George) Milne took over command as general officer commanding British Salonika Force. The total allied force was thus a little over 300,000 men. Opposing it early in 1916 were the Bulgarian I. and II. Armies and the German XI. Army—a total of some 280,000 men—aligned on a front from Lake Okhrida on the west to the point where the Struma enters Bulgaria on the east. But from March onwards the drain on the German forces at Verdun led Falkenhayn to withdraw the German troops, all but one division; by 1918 the XI. Army, though German in name and in staff, contained only one complete German battalion.

On the Entente side the reaction of Verdun took the form of orders from Joffre to Sarrail to pin down the enemy on his front, in order if possible to prevent Falkenhayn drawing upon the forces there. Accordingly the French moved out west of the Vardar towards Vodena and the British advanced north to Kukus. This advance although it lengthened the front to be defended and the lines of communication was of essential value for the security of the Allied force, for the entrenched position at Salonika itself was dominated from the mountains east of the town, and might become untenable if these heights were occupied by the enemy. But in how small degree the Allied advance fixed the Germans can be gauged from the previous paragraph, and Sarrail, who had been placed under Joffre's supreme command in Dec., received instructions to act more vigorously and prepare a definite offensive in conjunction with the anticipated entry into the war of Rumania.

Effect of the Action of Greece.—Meantime, however, the situation was complicated by a Greek incident; from now on until 1918 politics were to play a larger part in the Macedonian theatre than warfare. The neutral Greek forces, five corps, were distributed throughout the region, in theory to guard the frontier; and such a situation, while Gilbertian in its absurdity to the distant observer, was a source of serious anxiety to the Franco-British forces on the spot. Feeling that they would be safer without such dubious protection, they brought diplomatic pressure to bear on the Greek Govt. for the withdrawal of the Greek forces from Macedonia and their dèmobilisation. Reluctantly the Greeks complied, but while the Allies occupied certain of their forts the Bulgarians seized the opportunity to cross the frontier, and appeared before Fort Rupel, which commanded the Struma gate into the Macedonian plain. The Greek commander thereupon handed over the fort to them (May 26).

This unfriendly act bared the eastern flank of the Entente Army, and gave the whole of Eastern Macedonia into the hands of the enemy. To meet the danger the British occupied the Struma line in force. Further, the Entente Govts. instituted an economic blockade of the Greek coast, sent a brigade to Athens, and by the ultimatum of June 21 enforced the demobilisation of the Greek Army and the resignation of the Government. As it proved, however, the seizure of Rupel and Eastern Macedonia did not develop into a general offensive by the German-Bulgarian forces.

Problems Facing the Expeditionary Force.—While these external troubles with Greece beset the Entente Powers, they were far from the sum of the handicaps which hindered effective action by the Salonika force. The idea of an offensive was constantly discussed between the French and British Govts., as also between Joffre and Sarrail; but, apart from reluctance to provide adequate forces, it depended on too many contingencies, in particular the uncertain and often postponed intervention of Rumania. Furthermore the internal troubles of the Salonika force were notorious. Sarrail had the title of "Commander-in-chief of the Allied Armies in the Orient," and with him Cordonnier commanded the French forces; but his status was a nebulous one. Not only was the British commander to all intents independent, but also the Italian—a detachment arrived from Italy in Aug. 1916.

Apart from the defect that Sarrail's orders were issued from French headquarters without consultation with the other Allied Powers, Sarrail's own personality was not such as to weld this loose understanding into an effective co-operation. In a heterogeneous force, composed of French, British, Italians, Serbians and Russians, it was hardly a recommendation that the chief commander should be known not to have the confidence of his own supreme command, and that even the suspicion should exist that he was conducting operations with one eye on the political game at home. The British, by polite but firm insistence on their independence, maintained tranquil relations; wrangles and disputes between the other Allied commands were continual, and the majority were unfortunately attributable to the policy or tactlessness of Sarrail.

The Bulgarian Attack.—While the Allies were still debating, the opposing armies moved, on Aug. 17, to forestall and dislocate the Allied offensive, which they judged would synchronise with Rumania's intervention. The Bulgarians made their effort on the two wings. The eastern wing from Rupel drove back the French cavalry on the east of the Struma and pressed down towards its mouth. But they dissipated their force by detaching part to seize the coastal strip of Kavalla, and the stout resistance of the British prevented them forcing the river line. On the western wing the position was more critical, for the Bulgarian advance from the Monastir area drove the Serbs out of Florina and reached Lake Ostrovo before they were ultimately held.

III. THE FIRST AND SECOND ALLIED OFFENSIVES

These reverses caused a further change in Sarrail's plan for the Allied offensive; the forces east of the Vardar were merely to contain the enemy, while those west of the Vardar carried out the offensive. Thus to all intents it became no more than a counter-offensive to restore the impaired situation in this sector. To release additional French troops the British extended their line west from Doiran to the Vardar; Sarrail was thus enabled to form an offensive group (of $2\frac{1}{2}$ French divisions, one Serbian division and a Russian brigade) under Cordonnier, in addition to the Serbian striking force of four divisions.

Sarrail's Tactical Errors.—On Sept. 10 the British detachments crossed the Struma in raids at six points to divert the enemy's attention, and on Sept. 11 the real attack developed west of the Vardar. The Serbs, skilled mountain fighters and inspired by the closeness of their native soil, made good progress, and on Sept. 14 gained the pass of Gorničeyo, breaking through the hostile front. But the Cordonnier group was slower, partly because of transport difficulties and Cordonnier's own inclination for the secure methodical advances he had practised successfully in France. As a result, however, the Bulgarians, broken by the Serbs at Gorničeyo, were able to fall back across Cordonnier's front and re-establish their lines on the Brod. Sarrail, incensed, ordered fresh attacks by both groups, which were repulsed by heavy loss—as Cordonnier, protesting, had prophesied.

Between Sept. 30 and Oct. 8 the British XVI. Corps (Briggs) advanced its front to the line Agho Mahale-Ormanli, as a fixing move, coincidently with a fresh attack on the main front by the French

and Serbs from Kaimakčalan westward. The pressure of the Serbs turned the Bulgar left and forced a further slight withdrawal, but a Franco-Russian attack on Oct. 6 failed. Cordonnier urged the idea of a wider turning manoeuvre, but Sarrail, in the mistaken belief that a Bulgarian collapse was imminent, ordered a fresh blow on Oct. 14. This was a costly failure and led to a violent scene between Sarrail and his subordinate. Cordonnier left for home a few days later. This internal friction caused a temporary breakdown of action, and the Serbs were left to fight unsupported, until Sarrail took the step of putting the whole attacking force under the Serbian Gen. Michich—a man of real military genius and with the knack of inspiring not only Serbian but other national forces.

Michich attacked in the Crna bend on Nov. 12 while, to aid this offensive, Milne's troops made local attacks and raids as a diversion on the Struma. Despite rain and snow the Serbs pressed on, turning successive positions, with the French, Russians and an Italian brigade on their left. Monastir was outflanked and on Nov. 19 was found evacuated—the first important Serbian town to be regained. For a moment there was a real opportunity of exploitation, as the Bulgarians were in full retreat towards Prilep; but the immediate attacking forces were tired and hungry, and Sarrail suspended the advance—to the annoyance of the Serbs, who, in default of receiving fresh reserves, tried to press on unsupported until exhaustion stopped them.

By this time the Rumanian collapse, under pressure of the convergent German and Bulgarian attacks, was clear, and on Dec. 11 Sarrail received instructions to consolidate a defensive line embracing as much of the regained territory as possible. This line stretched from Lake Prespa—just north of Monastir—north slopes of Kaimakčalan—to the Vardar, and thence by Doiran to the Struma and down to the sea. Its worst feature was that the commanding heights were held almost everywhere by the enemy. This front was to remain practically unchanged until Sept. 1918.

Preparations for 1917.—Apart from the incident of a threatening Greek concentration in Thessaly—settled by a fresh ultimatum—the winter months of 1916–7 passed quickly, and the opportunity was taken to reorganise and regroup the forces. From the Gulf of Orfani to the Vardar the front was held solidly by the British, owing to Milne's insistence, but on the rest of the front Sarrail followed his usual plan of interspersing detachments of the various nationalities—presumably on the principle "*divide et impera.*" Whatever its personal advantages it was hardly conducive to prompt and effective action. Reinforcements had now brought the French up to a strength of eight divisions, while there were six Serbian and 1½ Italian divisions—making with the British 21½ divisions, plus two Russian brigades. The total Allied strength was approximately 600,000, while the Greek National Defence, or Veniselist Army, was in process of formation. This concentration afforded adequate reserves for a resolute offensive in the spring.

Confronting the Allies were still the nominal German XI. Army, and Bulgarian I. and II. Armies, comprising the equivalent of one German and 13 Bulgarian divisions,[1] of which practically half faced the British. Apart from the II. Army, these forces were under a German Commander-in-chief, Gen. Von Scholtz. On their side no large move was considered, partly because the Bulgarians had already achieved their principal territorial aims, and merely desired to hold tight, while the Germans were satisfied with immobilising so large an Allied force at no expenditure to themselves.

Allied Attacks Renewed.—Sarrail's plan was for a preliminary flanking move on the extreme west, between Lakes Okhrida and Prespa, to shake the enemy's hold in the Monastir area; following this was to be the main fixing attack by the British on the Doiran front; then the French, Russians and Italians in the southwest of the Crna bend were to advance; and finally the Serbs were to strike the decisive blow to the west again.

[1] A Bulgarian division had almost twice the infantry strength of a French or German division.

The preliminary move began on March 12 and was soon suspended, achieving little apart from a creditable French local success on a spur west of Monastir. Then came the British turn—to attack the key position formed by the Dub and lesser ridges which commanded the passage between Lake Doiran and the Vardar. Milne had rejected an alternative proposal of Sarrail's that he should attack to gain Seres, which while attractive as a political advertisement had no military value, and being dominated by the hills behind would have been difficult to hold. After a two days' artillery preparation, in vile weather, the British infantry advanced to the assault, on a two-division front (22nd and 26th), at 9:45 P.M. on April 24, the late hour being to gain surprise and protection. On the left the enemy's first position was gained and held, but in the centre and right the difficulties of the Jumeaux ravine and the strength of the resistance foiled the attackers.

Worst of all, their sacrifice was in vain and their "fixing" rôle rendered abortive because the attack west of the Vardar was postponed by Sarrail, ostensibly for climatic reasons. Not until May 9 did the other attacks develop. Sarrail had rejected the Italian proposal for a flanking manoeuvre, in preference for a frontal blow, and this, made by the French and Italians, was a costly failure. The Serbian attack was even less effectual, in fact hardly developed, partly owing to internal political troubles then rife and partly to their want of confidence in the higher direction and in the genuineness of its intention to support their efforts. Once more the British, on the night of May 8, had delivered a fixing attack, and once more their heavy sacrifice had been purposeless. The offensive was definitely closed down by Sarrail on May 24.

The Bulgarians, content with the prestige of this successful repulse, attempted no counter-stroke, and as the Allied forces were neither in the mood nor the condition for further efforts, the front relapsed into stagnation for the rest of the year. The only minor incidents were a successful local advance in Sept. by the French on the extreme left, west of Lake Okhrida, and Milne's withdrawal of his right from the marshy valley to the foot-hills west of the Struma, a precaution to lessen the danger of malaria and dysentery. The focus of interest again became political—common action was taken to settle the simmering menace and intrigues of Greece. In June, Allied troops invaded Thessaly, but the abdication of King Constantine was forced without fighting, and the Veniselist Govt. returned to power. The consequent reinforcement of the Allies by the Greek Army came as a prospective counterpoise to the contemplated withdrawal of two British divisions in Sept. for the projected offensive in Palestine.

Sarrail Superseded.—At the end of the year the new Clemenceau ministry recalled Sarrail, in response to the renewed requests of the British and Italian Govts., which were supported by Foch. His successor was Gen. Guillaumat, who had distinguished himself as an army commander on the Verdun front. His first aim was to restore confidence and cohesion in the Allied forces at Salonika, while hastening the reorganisation and training of the Greek Army. His second, to think out and prepare the plan for a fresh offensive, adopting in its main outlines one which Gen. Michich had suggested in 1916. But to obtain the sanction of the Allied Govts. was more difficult, obsessed as they were with the threatened German offensive in France, and in any case dubious of the effectiveness of any major operation in Macedonia. While biding his time, however, Guillaumat seized the opportunity to "blood" his new Greek troops in an ably planned *coup de main* against the Srka di Legen ridge. Supported by a powerful concentration of French artillery it was completely successful, and Guillaumat withdrew the attackers into reserve before any possible counter-stroke might dilute the moral tonic. On the main front there were no other incidents of note between Jan. and Sept. 1918; but away on the Adriatic coast, in Albania, Ferrero's Italian XVI. Corps, aided by a French division, advanced in July from the Viosa to the line of the Semeni and Devol rivers; an Austrian counter-offensive late in Aug. regained most of the lost ground.

In July also, Gen. Guillaumat, his task of reorganisation completed, was summoned back to France, to be entrusted with the defence of the capital in view of the critical situation caused by the German offensives. A man who put first not his own interests, nor even those of France, but his duty to the Allied forces as a whole, his military ability had won the respect, as his character had won the esteem, of the multifarious contingents. He was succeeded by Gen. Franchet d'Esperey, who if, perhaps not possessing the exceptional tact and supra-national outlook of Guillaumat, was yet an able strategist, and well able to maintain allied cooperation. He adopted and put the finishing touches to Guillaumat's offensive plan, while the latter utilised his position at the centre of policy to gain sanction for its execution. Winning over M. Clemenceau, he then went to London and Rome on the same mission, and at last on Sept. 11 Franchet d'Esperey was authorised to attack—if there was still little confidence in its success.

IV. THE DEFEAT OF BULGARIA

The military situation on the eve of the offensive was numerically little changed. The Bulgarians had a ration strength of some 700,000 and a rifle strength of 200,000—divided into the same three armies. The Allies had a ration strength of about 574,000 and a rifle strength of 157,000, although against the inferiority of numbers they could put a slight preponderance in artillery and a heavy one in aircraft. But the real defect on the enemy's side was the first underlying war-weariness of the Bulgarians and their dissatisfaction with their German directors; and secondly the divided command by which the so-called German XI. Army and the Bulgarian I. Army—from Doiran westwards—were under Von Scholtz, while the Bulgarian II. Army and the coastal detachments were under the Bulgarian commander-in-chief, Gen. Gekoff.

Allied Offensive Plan.—Franchet d'Esperey's plan was first to strike a concentrated blow with a Franco-Serb group under Michich on a narrow front of seven miles along the Sokol-Dobro Polje range, aiming at a tactical break-through and a subsequent expansion of the breach to gain and clear the triangle formed by the Crna and the Vardar. This would menace the enemy's communications on both flanks, and the offensive would then be taken up in turn by the other forces along the front. The initial objectives were relatively modest, for the possibility of a strategic break-through, ending in the overthrow of the enemy armies, was no more than an idea in the commander's mind.

The immense difficulties of the terrain and the scantiness of reserves made even this limited aim far from certain of success. But Franchet d'Esperey's plan, made possible by the wholehearted co-operation of the other Allied commanders, was an admirable fulfilment of the principle of concentration. On the vital sector six Serbian and two French divisions with 600 guns—more than a third of the total artillery strength in Macedonia—were concentrated against one Bulgarian division, and to do this the other sectors were almost stripped of their artillery.

Opening of the Attack.—On Sept. 1 the British 27th Div. made a feint attack in the Vardar valley to divert the enemy's attention, and on the night of Sept. 14 a heavy bombardment was begun on the real front of attack. Next morning at 5:30 A.M. the French divisions assaulted and after hard fighting gained the Dobro Polje ridge, the Sokol also falling by the evening—opening a path for the Serbian divisions of the I. Army, hitherto in reserve, to be pushed through. At the same time the Serbian II. Army advanced to the attack. By nightfall on Sept. 16 a penetration of five m. had been made.

British and Serbian Successes.—The Serbs, now inspired by success and the sight of their homeland, swept forward with such *élan* that by the night of Sept. 17 they were 20 m. forward, and the breach had been expanded to 25 m. by Greek and French divisions on the flank. After the initial clash resistance was feeble, partly because the mountains hampered the lateral movement of reserves. By Sept. 19 the left wing of the attackers had reached across the Crna, while the right wing was rolling up the front eastwards towards the Vardar, and between the two wings the Serbian cavalry had penetrated to Kavadarci in the apex of the Crna-Vardar triangle. Meanwhile on Sept. 18 Milne's troops attacked on the whole front from the Vardar to Lake Doiran in order to prevent the Bulgarians withdrawing troops to dam the breach west of the Vardar. Facing the British were the pick of the Bulgarian troops and also the strongest fortified positions, so that although they penetrated the enemy's lines along most of the front, it was little wonder that lack of reserves and artillery compelled them to yield up the larger part of their gains. But they had fulfilled their mission of pinning down the enemy including the reserves during these critical days, Sept. 18 and 19, and by Sept. 21 the whole of the enemy's front west of the Vardar had collapsed under the convergent pressure of the exploiting Serbs and of the French on their flanks.

Collapse of the Bulgarians.—By the afternoon of the same day the collapse spread to the Doiran—Vardar front, and the British aircraft spread havoc among the troops of the Bulgarian VI. Army falling back through the narrow Kosturino pass. Similarly, on the extreme west, facing Prilep, the Italians joined in the advance. From now on the advance became a strategic pursuit, now fast, now slow, in which successive rearguard resistances of the enemy were outflanked. On Sept. 23 the Serbian spearhead reached Gradsko, and Veles three days later. Seizing their opportunity, a French cavalry brigade under Gen. Jouinnot-Gambetta made a dash for Skoplje (Üsküb), and seized this vital centre of communications, the key to the whole front, on Sept. 29. This definitely separated the XI. Army from the remainder of the Bulgarian forces, forcing them on divergent lines of retreat. To the southeast the British had already invaded Bulgaria itself, taking Strumica on Sept. 26. That night a Bulgarian staff officer arrived at British headquarters to ask for an armistice, and three days later the Bulgarians capitulated, accepting the Allied terms unreservedly. The first national prop of the Central Alliance had fallen. While the reoccupation of Serbia proceeded rapidly, a mixed striking force was rapidly organised under Milne's command to advance through Thrace on Constantinople, and had pressed as far as the Maritsa, seizing the bridgeheads, when Turkey—her force in Syria already annihilated by Allenby—surrendered on Oct. 30.

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(B. H. L. H.)

ŠALOUN, LADISLAV (1870–), Czech sculptor, was born at Prague, and was a pupil of the sculptor B. Schnirch. He first became known in 1901 when he won the competition for a monument of Jan Hus. This group of statuary which dominates the Old Town Square of Prague forms an example of that plastic impressionism which Šaloun represented. He also produced a number of portraits which are distinguished by an acute sense of reality.

SALT LAKE CITY, Utah, U.S.A. (*see* 24.92), the manufacturing and trading centre of the western inter-mountain territory, increased in population to 118,110 in 1920, of whom 19,897 were foreign born; and to 130,948 in 1925 (census bureau estimate). Products manufactured within the city had a value of $13,351,000 in 1909, $33,357,000 in 1919, $31,130,287 in 1921, $47,572,228 in 1923 and $106,000,000 in 1924. Many important plants were established after the World War, increasing the aggregate factory pay-roll by about $4,000,000 per annum. Electric light and power were supplied by an interconnected hydroelectric system with an installed capacity of 250,000 H.P., supplemented by a steam emergency plant of 50,000 horse-power. An additional generating station, to add 45,000 H.P., was under construction in 1925.

The retail trade for 1924 was estimated at $52,312,000; the wholesale and distributing business at $148,116,000. A branch of the Federal Reserve Bank of San Francisco was established here in 1918. The parks and playgrounds of the city itself by 1925

contained 1,035 ac., and expert supervision was provided for organised play. There were 58 public schools, including two high and seven junior high schools, with an enrolment of 30,218 pupils. The University of Utah had a registration of 2,692, exclusive of the summer school. A state capitol, built of marble and Utah granite, well placed on an eminence, was completed in 1916. In 1911 the city adopted the commission form of government.

SALVADOR (*see* 24.96), the smallest of the Central American republics. Salvador became a member of the League of Nations in 1920. During the World War the republic maintained an attitude of benevolent neutrality towards the United States and the Allies; but in a note of Aug. 24 1917 the Foreign Minister stated that the Govt. of Salvador would permit the vessels of the United States to enter or remain in Salvadorean ports irrespective of their condition of armaments. Area, officially estimated, 13,176 square miles. The population in 1923 was 1,506,176, indicating a population denser than that of any American republic except Haiti. The estimated population of the chief cities in 1924 was: San Salvador, 82,000; Santa Ana, 71,000; San Miguel, 35,000; San Vicente, 31,000; La Paz, 30,000. In 1923 the births numbered 56,184; deaths, 25,296; nearly 60% of the births were illegitimate. Half-castes or Lavinos and Indians constitute the bulk of the population; but most of the educated classes are of European descent and reflect European influences.

Political History.—The presidential succession after 1909, when Gen. Fernando Figueroa held the presidency was mainly peaceful. Figueroa was succeeded in 1911 by Dr. Manuel Enrique Araujo, who was murdered in Feb. 1913. The vacant presidency was filled by the vice-president, Carlos Meléndez, who resigned in Aug. 1914. Alfonso Quiñones Molina governed as temporary president until 1915, when Carlos Meléndez was elected to office. In March 1919 Jorge Meléndez was inaugurated for the term 1919–23, and was succeeded for the term 1923–7 by Alfonso Quiñones Molina, the vice-president.

Salvador alone of the Central American Republics declined to declare war on Germany, though she allowed U.S. war vessels the use of her ports. The inclusion, without definition, of the Monroe Doctrine in the Covenant of the League of Nations, led Salvador to interrogate the United States Govt. as to the interpretation of the doctrine. In 1920 Salvador attempted to renew the Central American Court of Justice established by the treaty of 1907. This movement gave place to that of the Central American Union (*q.v.*). Salvador signed the "Tacoma" agreement of Aug. 20 1922, but did not approve all the resolutions of the Washington Conference on Central American affairs of 1922–3. In the General Treaty of Peace and Amity she failed to approve the International Central American Tribunal and the international commissions of inquiry. She also rejected the agreement not to recognise the election to the presidency of leaders of revolts or high government officials involved in them, and she declined to set a constitutional limit to re-election. She also rejected the convention relative to the preparation of electoral legislation and convention for establishment of free trade. Approval was given to limitation of armaments, the establishment of permanent Central American Commissions, the extradition agreement, the convention establishing agricultural experimental stations and that regulating the practice of the liberal professions. Several of the conventions still awaited approval in Aug. 1925.

A loan of $6,000,000 was effected in Oct. 1923, through a New York banking firm. It was secured by a first lien on 70% of the total customs. The contract provided for underwriting the loan by the United States; differences concerning interpretation of the terms were to be submitted for ruling to the Chief Justice of the U.S. Supreme Court. The proceeds were used in consolidating and paying the outstanding loans.

Education has long been nominally free and compulsory, but until 1919 received little attention from the Government. In 1911 there were 486 schools with 21,569 pupils, out of a total of 173,495 children of school age. In 1919, a law for eradicating illiteracy was enacted, and a campaign begun to reduce the proportion of illiterates, then 70% of the population. In 1924 there were 733 primary public schools with 1,110 teachers, the registered pupils numbering 44,791 with an average attendance of 30,070. There were 37 private primary schools and 38 municipal schools, in addition to normal, technical and continuation schools. The National University at San Salvador has faculties of medicine, chemistry and pharmacy, law and social sciences, engineering and industry. In addition the Popular University for working men offers lectures on personal and shop hygiene and the duties and rights of citizens.

Finance.—In 1919 the colon was fixed at the value of $0.50 American, and by the law of July 16 1920 was made the monetary unit, and given a fineness of 900 milesimos and a content of 836 milligrammes. It is issued in denominations of 5, 10, 20 and 40 colones, with auxiliary silver and nickel coins. United States gold and silver coin is legal tender up to 10% of payments. The national revenue and expenditure for the three years 1920–1, 1924–5 and 1925–6 was:—

	1925–6	1924–5	1920–1
Revenue	18,205,860[1]	16,464,034[1]	£2,945,234
Expenditure	18,166,715[1]	16,414,034[1]	£3,245,516

[1] Estimated in colones.

The total debt Dec. 31 1922 was 34,259,059 colones. The foreign debt on Dec. 31 1925 was as follows: Bonds in the hands of English creditors to the amount of £1,008,314; other foreign debts $13,683,900. Customs receipts from Jan. 1 1923 were $3,776,819. Interest and sinking fund on the loan above-mentioned required $682,000. For the first six months of 1924 customs receipts were $3,180,008, and loan requirements $411,599.

Agriculture and Commerce.—Agricultural production for 1923 was valued at $36,699,000. Coffee, the principal crop, totalling 60,000 metric tons, was valued at $16,800,000; corn, totalling 250,000 metric tons, was worth $12,500,000; cattle were valued at $2,500,000. Cotton production has been encouraged for several years; the crop in 1923 was 55 metric tons, worth $33,000. Sugar production reached 20,000 tons, valued at $2,000,000. Other agricultural exports are tobacco, henequin and rice. Lumber, balsam and hides are also exported.

Foreign trade was chiefly with Great Britain, the United States and France. The movement of trade in the period 1912–24 was:—

Year	Imports	Exports
1912	$6,744,859	$9,942,184
1916	5,668,000	9,970,000
1921	8,486,453	8,479,548
1924	10,958,500	24,367,674

Communications.—With the opening of the third section in 1922 of the line from San Vicente to Cojutepeque, the International Railways line from east to west was completed. There were 253 m. of narrow gauge railways and 1,476 m. of national roads in the republic in 1925, also 2,401 m. of telegraph lines and a little greater extension of telephone lines. There were 20 wireless receiving stations. Material for 200 m. of railway to Guatemala had been ordered before June 1925. The lines from Santa Lucía, Santa Ana province, to Ahuachapán and from Santa Lucía to Metapán were soon to be completed.

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(H. I. P.)

SALVAGING (*see* 24.97).—Salvage work, or the raising and recovery of sunken ships and cargoes, has always had a fascination, first for the reason that very little is known of the subject by the outside public, and secondly the spirit of adventure appeals to us to-day, although possibly in a modified degree compared with that which sent our forefathers out to search for hidden treasures in far-off lands. It is still one of the professions which retains a spice of romance in this commonplace world.

Salvage engineering has always been confined to a small number of the engineering profession, although it is a highly technical business, where skill, experience and determination are pitted against wind and sea. It necessitates trained men and special appliances and is a work that must be carried on night and day whenever the elements permit.

Divisions of the Subject.—Marine salvage may be divided up under a few principal headings:—

(1) The raising of vessels sunk in deep water by means of pontoons, etc.

(2) Raising by the application of compressed air to expel the water.

(3) Refloating of ships stranded on rocks or sand where the bottom is damaged and temporary repairs have to be made by divers, and where pumping plant of different descriptions is used to free the vessel of water.

(4) Uprighting of capsized vessels, etc.

The Salvage Ship.—The salvage ship is one of the most important factors in salvage operations, and, although generally a small vessel, carries a very complicated equipment of appliances for use in the work with a view to rendering her as independent as possible of assistance from ashore, and enable her to make repairs, etc., in out-of-the-way places where it would be difficult to obtain other assistance.

As an example, one of the most modern type is composite built and her dimensions are 170 ft. long by 30 ft. wide, fitted with triple expansion engines, and has a speed of 14 knots. She accommodates about 80 officers and men, consisting of engineers, artisans, divers, motor engineers, electrical engineers and others.

Her equipment consists of portable pumping plant of 5,000 tons per hour which can be transferred to the wrecked vessel, portable oil driven air compressors, portable electric lighting plant and electric submersible pumps which work under water.

The vessel has powerful electric arc lamps at the mastheads of 5,000 c.p., with sufficient length of water-tight cables to allow of them being placed on the wrecked ship and operated by the salvage ship's dynamos; also searchlights, submarine arc and incandescent lamps for the divers, submarine oxyacetylene burning plant for cutting plates under water, also a complete equipment of submarine pneumatic drilling machines up to 3 in. in diameter, pneumatic hammers, rock-boring drills and submarine photographic apparatus. She is fitted with long-range wireless telegraphy, and has a fully equipped workshop with electrically driven lathes, drilling machines, etc. In the store-room are all descriptions of blocks, shackles, ropes and other appliances necessary for discharging cargoes and other work in connection with the salvage of a wrecked vessel; she is also fitted as a first class and powerful tug boat, and carries line-throwing guns. Being constructed of wood she is able to remain alongside a damaged ship in weather when the vessel of ordinary construction would have to leave.

Salvage Pumps.—At one time steam pumps were entirely used in salvage operations, and were supplied with portable boilers so that they might be placed on board a wreck. They performed very excellent service, generally under most difficult conditions. To place such heavy gear on board a wrecked ship from a salvage craft rolling alongside on a winter night required a large amount of skill and care. When placed in position they had to be connected up to the portable boilers and steam raised before they were available for pumping. It was also necessary to place a supply of coal on board if the ship's bunkers were not available, and this supply was often washed away. Steam pumps are still retained on board the salvage ship, as they are able to perform work that the present type of pumping plant cannot do; for instance, sand, coal, grain and even copper and iron ore can be discharged by them from under water.

The internal combustion engine (*q.v.*) went a great way to revolutionise salvage pumping plant. It was much lighter than the steam pump, required no boiler, and the fuel could be carried to the wreck in barrels or drums in an ordinary ship's lifeboat. Further, when not required for work it can be stopped and started again in a few minutes, while steam has always to be kept on the portable boilers of the steam pumps. The advantages of the oil motor driven centrifugal pump will be obvious; it is just as efficient for pumping water as the steam pump, saves in cost of running, takes up less stowage space and uses paraffin as fuel, which can generally be obtained without difficulty. The sizes in general use are 12 in. and 6 inch.

The latest type of pumping machinery is the electrically driven submersible. It has been well tried under all conditions and found more efficient than any of the older types. It can be placed aboard in boats and driven from the dynamos of the salvage ship lying off the wreck. There is no necessity to secure it, as it works practically without vibration and can be used from the derricks and lowered down into the water. Its great advantage is that while the ordinary salvage pump has only a lifting capacity of 30 ft. the submersible is able to raise the water to a height of 80 ft.; no priming is necessary, and no particular attention need be paid to the discharge hose as far as making it air and watertight. Former electric salvage pumps that were tried were fitted with watertight cases, and proved entirely unsuccessful for this particular kind of work. In the submersible pump water is allowed free access to the electrical parts.

Lifting Operations From Deep Water

With this somewhat brief description of salvage plant used particulars of actual salvage operations will be explained, commencing with the raising of sunken vessels from deep water by means of lifting barges dependent on the rise and fall of tide.

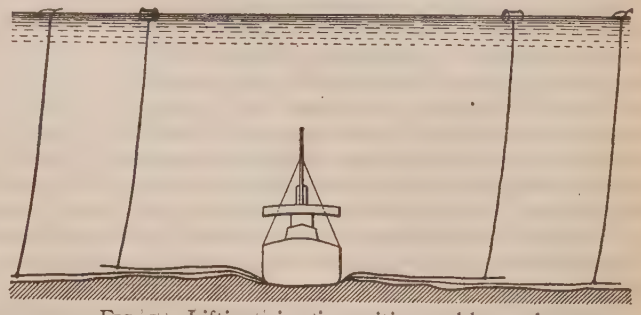

Fig. 1.—Lifting wires in position and buoyed.

The method of procedure is to place lifting vessels of sufficient buoyancy over the wreck and pass a number of 9 in. steel wire ropes under the vessel, bringing the ends of the wires up and making them fast to the lifting ships at low water; then as the tide rises, if the calculations have been correct, the vessel is raised from the bottom the height of the rise of tide, and carried into shallower water where the wreck is grounded, and the operations are continued each tide until her decks are above water (see figs. 1, 2 and 3). The fractures are then patched by the divers, salvage pumps installed and the vessel pumped out and floated. The dimensions of lifting vessels

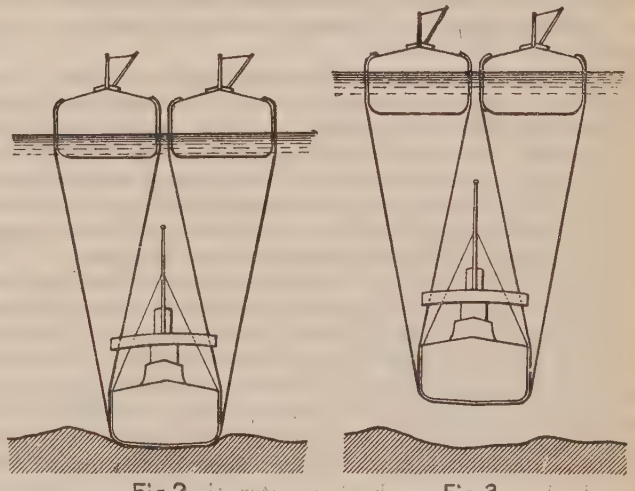

Fig. 2.—Lifting lighters in position. Wires secured, and pinned at low tide. Fig. 3.—Wreck lifted.

that have been employed in a large number of cases are: length 165 ft.; breadth 36 ft., and each with a lifting capacity of 1,500 tons maximum.

One of the principal difficulties with this method is the placing of the heavy wire cables under the bottom of the wreck, especially if she has sunk in the sand, mud or clay. If not too deeply embedded this is generally accomplished by towing them under with two vessels, one on each side, and the ends of the cables attached to them. Where this is not found to be possible owing to the wreck having become too deeply embedded a system of hydraulic boring at nigh pressure is resorted to, by which method the wires are rove under the wreck in the required positions for lifting.

In cases where there is little or no rise of tide submersible pontoons are used. These are really steel cylinders with a lifting capacity ranging from 50 tons each to 250 tons or more. They are divided into three watertight compartments and fitted with

low pressure air connections for expelling the water, and with high pressure air for opening the valves. The ends of the cylinders used at the lifting of H.M.S. " Gladiator " were dome-shaped, and covered with collision mats to protect them against chafing. Strong channel bars were riveted around the pontoons at intervals to carry the wire cables, and the whole of the cylinders between the channel bars were covered with 3-in. fir planking for protection against obstructions when lifting. Double 6 in. strops of special extra flexible wire ropes were fitted in the required position around the pontoons, and to these were attached plate shackles to which the 9-in. lifting wires were fastened. In this case the pontoons were used to uprighten the vessel, which lay over on her beam ends at an angle of 113 degrees.

The 9-in. wire cables were swept under the wreck and the outside ends attached to the pontoons. These were filled with water and sunk alongside the ship; the other ends of the wires were then hove in as tightly as possible and made fast to massive steel bollards fastened to the upper side of the ship. The cylinders or pontoons were then emptied of water by means of compressed air and the vessel uprighted, assistance being also given by compressed air and pumping from some of the sound compartments. In this case pontoons were only used on one side, but in order to raise a vessel that is sunk and lying upright on the bottom two sets of cylinders are necessary, and the plan of lifting is as follows:—

A sufficient number of 9-in. wire cables are placed under the ship, the pontoons are attached to the ends of the wires on one side of the ship and filled with water, and by heaving in on the opposite cables they are hauled down into the required positions alongside the wreck. A special form of hydraulic gripping machines is attached to the pontoons on the other side of the wreck and the wire cables rove through these hydraulic grips. When everything is ready the pontoons are filled and allowed to slide down the wire cables to the bottom. The grips are then closed from the surface vessel and compressed air pumped down to all the pontoons, which expels the water, and if sufficient buoyancy has been given by the pontoons the vessel is brought to the surface.

Lifting by Compressed Air.—All openings are closed by the divers, and compressed air pumped down to connections made to all the different compartments from air compressors of the salvage ships. The water is then expelled through the fractures and the vessel rises to the surface. This method entails a very large amount of diving work, as funnels, etc., have to be cut away and the openings closed and made airtight. Decks under air pressure have to be strongly shored up and supported.

Refloating Stranded Ships.—The conditions of stranding are very varied. Assuming a large vessel stranded on a rocky bottom on an exposed coast and sustaining such damage that all compartments are filled with water and the vessel appears at first sight to be a hopeless wreck. A diver's survey of the position is made as soon as possible, and at the same time a careful survey is made of all compartments to ascertain whether the water falls in each at the same rate as the tide. Some compartments will generally be found to be holding water, that is to say the tide does not ebb and flow in them as it does outside. The amount of pumping plant required can thus be easily gauged for compartments under these conditions. When the tide ebbs and flows as it does outside it shows considerable damage to the outer bottom, which necessitates extra pumping plant and the patching of the fractures by divers. Should the vessel have cargo on board a portion of it will probably have to be discharged to lighten the ship. After all this work has been done the vessel is pumped out and refloated.

The patches used by divers to close up fractures are generally made of wood and secured into position by bolts drilled through the patches and through the plating of the ship. Jagged or outstanding plating is cut away by explosives or by submarine oxyacetylene cutting plant to make a fair surface for the patches. If any rocks are in the way or have entered the hull of the wreck they are removed by drilling holes with submarine pneumatic rock drills and dispersing them by explosives. (F. Y.)

SALVATION ARMY (*see* 24.100d).—The Salvation Army is a religious organisation of international scope, founded in 1865 under the title of the " Christian Mission " in the east of London. Its founder, William Booth, formerly a Methodist minister, died in 1912.

The announcement of the founder's death was accompanied by the intimation that his eldest son, William Bramwell Booth (*q.v.*), formerly his chief of staff, had become the new general. Under a deed-poll of the Salvation Army, dated 1878, each general appoints his successor under seal, but the name of the person so chosen is not divulged until the proper time. At an International Staff Council in 1904 a supplementary deed-poll was adopted, the principal object of which was to set up machinery for removing from the position any general who proved to be unworthy of confidence, and also for the selection of a general by a high council of the Army called into being for this purpose, in the event of the position becoming vacant through failure to appoint or other cause.

Extension.—In many quarters it was feared that after the withdrawal of the forceful and picturesque personality who had dominated Salvation Army affairs for a generation, and had raised up a worldwide following from what was originally a despised and derided local effort in the slums of London, the Army would decline. The World War also was a menace to all international organisations. These fears, however, proved to be groundless. The number of adherents has steadily increased, and the " field " occupied has grown greatly in extent. At the time of the founder's death the Army was operating in 59 countries. At the end of 1925 its flag was planted in 81 countries and colonies.

Extension has taken place on every continent. In Europe new spheres of activity have been found in Czechoslovakia, Latvia and Hungary. In Asia, where the Army had its oldest mission field (India 1882), it has opened in China and Burma. Africa has become an important sphere for its missionary operations, and, in addition to what is known as South Africa, regular work is carried on in Nigeria, the Gold Coast, in Kenya and the Portuguese territories in the East. In the Western Hemisphere the accessions to the Army's field include Cuba, Honduras, Chile, Bolivia and Brazil. In the earliest countries to be occupied outside Great Britain important consolidation has taken place. Canada has been divided into two " territories " (a " territory " being usually a country or large part of a country under one command), one east and the other west, with Toronto and Winnipeg as the respective headquarters; Australia has been organised also into two " territories," with headquarters at Melbourne and Sydney; and the United States into three, with headquarters at New York, Chicago and San Francisco. In Great Britain sub-territories have been set up in Scotland and Wales.

The Corps.—The Army has more than 14,000 corps or societies, each of which serves not only for the establishment of its own members in the faith, but as a centre of aggressive evangelistic effort. It has also 1,400 social institutions for the friendless, unfortunate and wayward. In the British Is. the centres number 1,500, and reach a similar figure in the United States; in Canada there are between 600 and 700, and in Australia and New Zealand nearly 1,900. India, with Ceylon, has nearly 5,000 such centres, and the Far East 450. The number of officers and cadets engaged in field and social work is about 22,360. The Army's mission field has greatly extended, and many of its officers who work devotedly in their own dark lands were, but a few years previously, themselves in the bondage of superstition. The right method of evangelising the people is found in the employment of converted officers of their own race and speech. In Japan, for instance, 98% of the officers are Japanese.

New Organisations.—The progress which continued under the second general is not to be measured merely by an extended front. New organisations have been called into existence, especially for influencing and instructing the young of both sexes. Careful provision has been made to insure a constant replenishment of officers by means of institutes for the training of cadets. In each year upwards of 1,800 young men and women are trained for Army work, to which they have to devote the whole of their time. Congresses on national and international lines are held frequently for the instruction and encouragement of officers. Constantly increasing use is made of the printing-press. The

various *War Crys*, as the principal periodical publication of the Army is called, are issued in between 30 and 40 languages.

Finance.—Greatly increased sums of money have been raised as the movement progressed. The financial system of the Army is of a very carefully organised character. Roughly it may be said to be divided into two parts, local and central, the one concerned with the local unit or corps, financing itself by its own efforts; and the other concerned with the provision of funds (1) for properties, the training of officers, missionary enterprise, and (2) for social work in Great Britain. In the year ending in Sept. 1925, the total income received at International Head Quarters for (1) was £599,768, and for (2) £71,174.

Social Work.—The social work, which received its first great impetus in 1890 with the publication of *In Darkest England and the Way Out*, by William Booth, has become not only more extensive but more varied in character. This work from the first has been regarded by the Army leaders as an organised warfare against social evils in order to clear the way for evangelisation. It was realised that the physical and environmental condition of many of the people, especially in great cities, made it extremely difficult for them to apprehend the spiritual message which the Army had to deliver. Therefore various social activities arose, diverse in character but all actuated by the same purpose, from the provision of free breakfasts and night shelters to the settlement of people in overseas dominions. This last is a department of work characterised by careful selection of the emigrants, and is coupled, particularly in the case of the young, with training beforehand and effective provision for future care, while work is assured upon arrival. The efforts of the Army in getting men to work on the land, both in England and overseas, have called forth many commendations from statesmen and others.

Rescue work among women was one of the earliest social tasks to which the Army set its hand. In this work Mrs. Florence Booth, wife of Gen. Bramwell Booth, was the responsible leader from its inception until 1912. Maternity work has been carried out by the Army's ministering women, and for this in 1918 the Army received a grant from the British Govt.—the first state subsidy ever made to the Army in the country of its origin. In other lands also social work has proceeded, adapted to the different national conditions and needs, and often commended and assisted by the governments concerned. This is true also of eastern lands: thus settlements for criminals have been established in India, and leper colonies in the Dutch Indies; and these are but instances of many such works.

Spiritual Character of the Work.—With this development of organisation the Army has maintained its original character as a body of spiritual witness and aggressive evangelism. In theory and creed it is at one in almost every respect with orthodox evangelical belief, but its methods—its realistic presentation of religion, and its use of various constraining means to bring people to salvation—distinguish it from other religious bodies. It continues to lay the greatest emphasis upon the need for conversion, preceded by penitence, and followed by growth in holiness. The people gathered into its ranks are cared for by its officers and trained in a real separation from the world and devotion to Christ. They are set to work immediately with a definite objective, their zeal is employed in the winning of others, and public testimony is required from them, however unlearned or backward in religious experience they may be.

A large place in the Army's endeavours is given to music and song. In every country the band—usually a brass band—is a feature of Army work. The strains of such a band, reaching farther than the human voice, draw numbers within earshot of the Army's message who would otherwise not be attracted. The Army has also made use of improvisations of various kinds, not only because in this way public attention is more likely to be caught, but because these methods prevent the officers from falling into the conventional and the ordinary. Those who conduct Army meetings are instructed to talk in a colloquial fashion, and, speaking generally, formal sermons are discouraged.

Ideals of Conduct.—The Army exacts a high standard of behaviour from its adherents. In the series of *Orders and Regulations* for officers and for the rank and file definite guidance is given even in the smaller matters of everyday conduct. Officers accept a relative poverty, being content to receive sufficient for their simple needs. There are contributory funds from which they receive allowances on retirement, and from which provision is made for widows and orphans. Marriages are solemnised "under the flag," and children of members are dedicated to become soldiers or officers in the "war." Officers wear a regulation uniform, which it is not permissible for the individual to vary. The uniform is regarded as a means of confessing to the world the fact of separation and consecration, as opening the way to many opportunities of usefulness which would not otherwise appear, and as making possible instant recognition and fellowship amongst Salvationists themselves. One of the great principles of the Army, firmly adhered to, is that women have absolute parity of privilege, position and dignity.

An order of the founder has been instituted to mark distinguished and memorable services, revealing the spirit and purpose of the Salvation Army, such as would have especially commended themselves to William Booth. Some 30 officers have been admitted to this order. A memorial to the founder was projected in the shape of an International Training Institution in London, at a total estimated cost of £350,000, towards which about £250,000 sterling had been raised up to Dec. 1925.

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SALVEMINI, GAETANO (1873–), Italian historian, was born in Molfetta in Sept. 1873. In 1902 he became professor of mediaeval and modern history at Messina University. He then went to Pisa University, and in 1917 was appointed to the chair of history at Florence University. His best known works as a historian are *Magnati e Popolani in Firenze dal 1280 al 1295* (1899); *La Rivoluzione francese 1789–92* (1905); *Mazzini* (1915) and *L'Italia e gl'Imperi Centrale dal 1871 al 1915*. He became known to the British public through his lectures delivered in London University in 1923 and 1926. In politics he showed views of a liberal trend which brought him into conflict with the Fascist Government. He edited the liberal newspaper *L'Unità* (1911–21). Before the World War he vigorously criticised the Socialists for their half-hearted social work, and attacked Giolitti's electoral methods. During the War he was a leading advocate of Italian diplomatic moderation. He was a member of the Italian Parliament from 1919–21. After the Fascists captured power, however, his political activity was made impossible, and, being suspect, he was in constant personal danger. In June 1925, while in Rome, he was arrested and taken to Florence, where he was charged on the hearsay evidence of a printer with complicity in the production of an anti-Fascist newspaper *Non-Mollare*. He was imprisoned for 35 days before being tried. No evidence but that of the printer was cited, and his case was postponed till July 1925 when he was provisionally released. Professor Salvemini was compelled to leave Florence and was kept under police surveillance until Oct. 1925, when he took the occasion of the government amnesty, proclaimed for the Matteotti murderers, to leave the country. He resigned his post at Florence University on Nov. 5 1925 and was "dismissed" from it on Dec. 1. Afterwards he resided in London.

SALVINI, TOMMASO (1829–1915), Italian actor (*see* 24.103), died at Florence Dec. 31 1915.

SAMOA (*see* 24.115), a group of islands in the South Pacific, which were before the World War divided between Germany and the United States under an agreement made between these Powers and Great Britain in 1900.

West Samoa.—The former German islands of West Samoa were occupied by a New Zealand expeditionary force on Aug. 30 1914, and on May 7 1919 a mandate for these islands was conferred by the Supreme Council in Paris on New Zealand. The Govt. of New Zealand asked the British Govt. for legal authority to act under the mandate, having no special desire to exercise independent action in the matter. The German holdings

of land, amounting to over 8,000 ac., were taken over by the New Zealand Government. The constitution was settled by the Samoa Act of 1921, and an Amending Act of 1923. It is administered by an Administrator appointed by the Govt. of New Zealand; he has the assistance of a legislative council, and a consultative native council. The principal islands are Savai, with an area of 725,000 ac. and Upholu, and the total population of the islands was estimated in 1925 at 38,829. Cocoanut, cacao and bananas are the principal products and copra is the principal article of export. The total exports in 1924 were valued at £361,418, and imports at £274,803. The revenue in 1925 was £130,914 and the expenditure £135,523. The revenue is augmented by an annual subsidy from New Zealand based on the additional costs of the education and medical services since the acceptance of the mandate by New Zealand, and on the cost of the wireless station in excess of revenue. (*See* MANDATES.)

Eastern (*American*) *Samoa* is administered by a commandant who also holds the governorship by commission from the President of the United States. Almost the whole of the land is owned by the natives, the principal article produced for export being copra. The total area is about 58 sq. m. and the population 6,125, the largest islands being Tutuila and Tau. The harbour of Pago Pago is a United States naval station. Tutuila has a high power naval radio station, which is also used for ordinary commercial traffic.

See the annual *Reports* of the commandant at Tutuila, Pago Pago, Samoa (Washington, D.C.), and the *New Zealand Official Year Book* (annual, Wellington, N.Z.)

SAMUEL, SIR HERBERT LOUIS (1870–), British politician, was born at Liverpool Nov. 6 1870. He was educated at University College School, London, and at Balliol College, Oxford, where he graduated in 1893. In 1895 and 1900 he unsuccessfully contested South Oxfordshire as a Liberal, and in 1902 was elected for the Cleveland division of Yorkshire. He entered Sir Henry Campbell-Bannerman's Government in 1905 as parliamentary under-Secretary to the Home Office. In 1908 he was sworn in the privy council. From 1909 to 1910 he was chancellor of the Duchy of Lancaster, with a seat in the Cabinet, and in 1910 became postmaster-general. He held this office until 1914, and then became for a year President of the Local Government Board. From 1915 to 1916 he was again postmaster-general and chancellor of the Duchy of Lancaster, and in 1916 became Home Secretary. He acted as chairman of the select committee on national expenditure (1917–8), and in 1919 was special commissioner to Belgium. In 1920 he was appointed high commissioner to Palestine and was created G.B.E. This post he retained until Aug. 1925, when he returned to England and was made chairman of the royal commission appointed to inquire into conditions in the coal industry, as a result of the dispute between the coal-owners and the miners in the summer of that year. The report issued by the commission is often referred to as the Samuel Report. (*See* COAL.)

SAN, BATTLES OF THE: *see* DUNAJEC-SAN, BATTLES OF THE; VISTULA-SAN, BATTLES OF THE.

SAN ANTONIO, Tex., U.S.A. (*see* 24.126), continued its rapid growth after 1910. In the following decade the population increased 67%, reaching 161,379 in 1920, of whom 14,341 were negroes and 36,824 foreign born (including 28,477 Mexicans). The census bureau estimate for 1925 was 198,069.

San Antonio is the centre of a rich oil-producing area which developed rapidly after the opening of the first field at Somerset in 1919. Two direct railway lines connect it with the new deep-water port at Corpus Christi. Five irrigation projects (under construction in 1925) will bring under cultivation about 500,000 ac. of new land. The large and varied establishment of the U.S. Army (with about 12,000 troops) included three flying grounds, a great motor-transport camp, an artillery camp, and an artillery and rifle range, in addition to the arsenal and Fort Sam Houston, which is a cavalry post and headquarters of the VIII. Corps area. The output of the factories was valued at $13,435,000 in 1909, $35,456,000 in 1919 and $34,756,016 in 1923, when there were 297 establishments, employing 5,581 wage-earners. The leading industries were iron and steel, candy, textiles, cigars, leather goods, clothing and soap. Gas and electric current for industrial and domestic consumption were supplied by the San Antonio Public Service Co., which was constructing a high-power hydroelectric station on the Guadalupe river in 1925.

The commission form of government was adopted in 1914. Among the public improvements under way in 1925 were flood-prevention works and a municipal auditorium. The water supply (derived from 17 artesian wells and sufficient for a city of over 500,000) was purchased by the city for $7,000,000 from a private corporation. In respect of school attendance, San Antonio in 1920 ranked last but one among the cities of 100,000 population and over; and in "illiteracy" third.

SANCTIONS AND GUARANTEES (*see* 14.695) in international law correspond to the means adopted in national law to enforce legal decisions, but the decisions to be enforced are international decisions. During the years which followed the World War it became increasingly apparent that the most important and the most enduring of European political problems was that known as the problem of security (*q.v.*).

Terminology.—As a deduction from the new conception of security the word "sanctions" began to replace in the language of diplomacy the word "alliance." Security was now to be sought not in limited agreements between small groups of states to fight together whenever any of them should, for whatever cause, be involved in international conflict, but in common agreements among a greater or smaller number of states to act together when—and only when—the established rights of one of them had been violated by force. Security, therefore, must be found in "sanctions" against the wrongdoer. For some time indeed, the word "guarantees" was used instead of, or on an equal footing with, the word "sanctions." The first security scheme prepared by a commission of the League of Nations was, for example, originally called a "treaty of mutual guarantee," but gradually the use of the word "guarantee" disappeared and the word "sanctions" took its place.

This change in phraseology was right, for the security arrangements which European politicians after the War endeavoured to set up constituted nothing more nor less than an attempt to create a rudimentary international police. They constituted an attempt in international affairs to limit and control the use of force as it is limited and controlled in national affairs; an attempt, that is to say, to put force within the law instead of leaving it without the law to cause the international disorders which have resulted from its use in the past, and to this end to create a system of sanctions closely analogous in principle, though not of course in form, to the sanctions which support the legal system of every civilised state.

The discussions which occurred during the years immediately after the War soon showed that there were two ways of achieving the result in view; the first was by the creation of a general system embracing all the States throughout the world; the second was by the creation of limited arrangements applying to a certain number of States situated in geographical proximity to each other and bound together by common bonds of material interest. The first corresponded broadly to the application in international affairs of the principle of the sheriff's posse; the second was an elaboration, with of course essential changes, of the method of the pre-War military alliance.

Article 16 of the Covenant.—It was by the application of the general method that the first step was made towards the organisation of a true system of international sanctions. This first step consisted in the adoption of the Covenant of the League of Nations, Article 16 of which imposes obligations upon every member of the League to adopt common coercive measures, including especially a financial and economic boycott against states which, in violation of the undertakings of the Covenant, resort to war. It was believed by the authors of the Covenant that the system of Article 16 would, if loyally applied by the members of the League, act as a very powerful deterrent against aggression. But Article 16 unfortunately contained ambiguities the effect of which was to create in the minds of many govern-

ments doubt as to the kind and the amount of help which the members of the League would in practice give to any state that might be wrongfully attacked. It was not, therefore, generally regarded as by itself creating a sufficiently sound system of sanctions to solve the problem of security. For that reason the temporary mixed commission set up by the Council of the League of Nations prepared in 1923 the draft treaty of mutual guarantee (or assistance), on the basis of which was prepared the Geneva Protocol of 1924. Both instruments were founded on the clear acceptance by all signatory states of obligations to co-operate by military or other necessary means against an aggressor, and if they had been ratified they would have been regarded by the governments which drew them up as a substantial progress towards providing the common action required for the protection of loyal members of international society against disloyal attack.

Regional Guarantees.—The second method, which in the early stages of the security discussions had great prominence, received its first application in the Anglo-American-French guarantee treaties drawn up in 1919 at Paris. These treaties failed to secure ratification, and were replaced by the Franco-Belgian, Franco-Polish and other similar treaties of alliance. The Little Entente was another example of the same method. But it was recognised even by the authors of these treaties that although they were subject to the Covenant of the League they were nevertheless, liable to degenerate into alliances of the old sort, and that therefore they would be dangerous unless they were effectively controlled by the League. It was the temporary mixed commission above mentioned which first established the principles of the League control which would make such partial treaties consistent with a general system of sanctions. The Commission recognised that in cases where for whatever reason there was great danger of war, special reinforcement for general obligations might be required, and in the draft treaty of mutual assistance the two methods were for the first time combined into one coherent system. The Protocol similarly recognised the utility of special treaties in support of general sanctions, but on condition that such special treaties could only be applied after it had been recognised by some impartial arbitrator that aggression had taken place.

After the first failure of the combination method of the Geneva Protocol, a return was made in the Locarno Agreements and the Rhineland Pact to the method of partial treaties. These agreements, however, in no way resembled an old-time alliance; the concern of their authors was plainly to create one more stable element in a new system of international sanctions against aggression.

Whatever developments may follow the Locarno Agreements, it is certain that the problem of security throughout the world will only be solved when satisfactory arrangements have been made for the provision of effective sanctions in support of international law, and that such sanctions can only be effective if they are founded on a combination of the two principles of general and partial guarantees. (*See* LEAGUE OF NATIONS and bibliography thereto.) (P. J. B.)

SANDBURG, CARL (1878–), American author, was born at Galesburg, Ill., Jan. 6 1878. In 1898–1902 he studied at Lombard College, Galesburg, and in 1910–2 was secretary to the mayor of Milwaukee, Wisconsin. He became associate editor of *System*, Chicago, in 1913, and was also editorial writer on *The Chicago Daily News*. He served in the 6th Illinois Volunteers in the Spanish-American War, seeing active service in Porto Rico. In 1918 he was a member of the editorial board of the National Labour Defence Council. His poetry is distinguished by an intense realism, set off by an abrupt irregularity of line which intensifies its effect. His choice of words is always significant and adds greatly to the force of his verse. He has been termed the laureate of industrial America.

Among his published works are *Chicago Poems* (1915); *Corn Huskers* (1915); *The Chicago Race Riots* (1919); *Smoke and Steel* (1920); *Slabs of the Sunburnt West* (1922); *Rootabaga Pidgeons* (1923); *Abraham Lincoln—the Prairie Phase* (1926).

SANDFLY FEVER.—"Sandfly" or "phlebotomous fever" is an acute specific fever, common in tropical and sub-tropical countries. It is caused by a virus, possibly a leptospira, conveyed to man by the bite of a small midge of the dipterous family, Psychodidae. The incubation period is about five days.

Symptoms.—The fever is sudden in onset, and of short duration, accompanied by severe headache and pains in the limbs. The attack starts with a general feeling of depression and loss of appetite, soon followed by weakness of the legs, and pains and tenderness in the muscles, especially those of calves and back of neck. The temperature rises rapidly to 102 to 104° Fahrenheit. There is flushing and fulness of face and eyes as though some constriction were being applied around the neck. The bloodshot eye is typical and in some countries has led to the disease being called "dog disease" (Hundfieber). Frontal headache and pains in the eyes and leg muscles are usually severe. The pulse is relatively slow throughout. There may be vomiting and diarrhoea. Rashes are uncommon and are not to be confused with insect bites. A blood examination shows a marked decrease in the number of white blood corpuscles. The temperature usually falls to the normal level within four days, although one- to seven-day types of fever are to be seen. Recovery is slow, depression and other nervous symptoms may persist for weeks or months.

Treatment.—The sooner the patient takes to bed the less severe are the pains likely to be. The bowels should be moved by means of calomel, followed by salts. Then the aches and pains may be relieved by the administration of 10 grains of aspirin every four hours, or by half a teaspoonful of liquid extract of opium. Quinine is useless. Hot tea is very soothing for the pains, especially during the night. It is advisable to surround fever cases with a sandfly net to lessen the chance of the infection spreading. Tonics and a change of climate may be necessary during convalescence.

Etiology.—While the nature of the causal organism is uncertain, *Phlebotomus papatasii* is the proven carrier of the disease.

Sandfly fever is liable to occur wherever the P. papatasii can breed, *i.e.*, where for eight consecutive weeks the mean daily temperature lies between 65° and 90° Fahrenheit.

Epidemics of the fever depend on the number of infected *Phlebotomus*, and the number of susceptible people. Other conditions, such as temperature, humidity, winds and reaction of soil, may modify the prime factors.

The Virus.—Doerr in 1909 and Birt in 1910 showed that, in sandfly fever, the blood of man is infective by direct transmission to other men only in the first day of disease. Kilroy in 1909 infected himself by Phlebotomus bites, and, by inoculation of his blood transmitted the disease to a non-immune subject. Birt in 1910 showed that the virus could pass through a very fine filter. In 1921 Couvy reported that spirochaetes had been seen in cases of dengue in Beirut. In the same year the Royal Air Force Sandfly Commission isolated a leptospira in six cases of so-called sandfly fever in Malta, while in 1922, Vervoort and Van de Velde, working in the Dutch East Indies, found leptospira in cases of fever resembling phlebotomous fever. However, the correct diagnosis of some of these cases was doubtful, and until further transmission experiments have been carried out this organism cannot be accepted as the causal virus.

The Vector.—Doerr and Birt in 1910 claimed that *P. papatasii* which had fed on cases of sandfly fever were capable of transmitting the disease, but only seven to ten days after sucking virulent blood. Doerr suggested that the adult female Phlebotomus transmits infection to her offspring.

During the years 1907 to 1922, parts of the bionomics of the sandfly had been worked out, but its life history was not fully elucidated.

The R.A.F. Sandfly Commission, working in Malta and London during 1921, 1922 and 1923, bred the sandfly in captivity and extensively studied the bionomics of this insect. The fever was transmitted to man by the bites of *Phlebotomus* bred in captivity in London, showing that these flies were the true carriers of the disease. Further experiments showed that the infection was handed on from generation to generation of sandfly in its breeding grounds, by the grub feeding on the excreta and dead remains of the parent flies.

Phlebotomus papatasii is a small midge measuring about 3 mm. in length; of a very delicate build and thickly covered with fine, long hairs. The body is of a pale lemon tint and shows the morphological characters common to its genus. Eyes are relatively large, black and conspicuous. The antennae are long and filamentous. The proboscis is long and prominent. The fine wings are lancet-shaped, covered with hairs and held erect, except when newly hatched and shortly before death. The female fly has a spindle-shaped abdomen.

The life-history of this fly covers a period of about eight weeks, the exact time depending on food supply, temperature and humidity. The egg stage occupies about nine days; the grub stage about 28 days; and the chrysalis stage about 10 days, ending in the emergence of the adult fly. The wings of the newly hatched fly are crumpled and moist. Until these are dry the young fly can only crawl. The recognition of this stage is most helpful in detecting breeding spots of the insect. During the night, when the atmospheric humidity is usually great, the wings cannot dry. The process of drying is usually completed within three hours after dawn, and the mouth parts are sufficiently hardened to allow of the sucking of blood during the first 24 hours of adult life. Copulation can take place within the next 24 hours, and eggs to the number of 40 are laid 6 to 10 days later. The length of life of the adult female fly in nature is about two weeks, though in the laboratory life may be prolonged for 30 days.

Only the female *Phlebotomus* bites. A feed of blood is essential for the eggs to become fertilised. The insect usually bites after sunset. Man is bitten wherever the skin is exposed. The sandfly progresses by a short hopping flight usually to one side. The distance of a single flight is never more than four yd., and it does not travel more than 50 yd. from its breeding haunts. It is attracted by the odours of man and other animals, and enters buildings by apertures in the walls, windows, doorways, ventilators or cracks. The flight of the *Phlebotomus* is so feeble that it avoids all currents of air, natural or artificial. Upstair rooms, which are more exposed to air currents, are less infected than those on the ground-floor. In nature the grub and chrysalis forms are found in the cracks in embankments, in the loose earth at the base of walls and buildings, in cultivated soil and in other places where suitable conditions of food, moisture and temperature exist. The grubs are found even to a depth of a foot or more in loose soil, and can migrate to the level of optimum environment. Hibernation takes place in the last grub stage, a very resistant stage. When ready to pass into the chrysalis form, they seek a drier spot, usually within a few inches of the surface of the ground. Excess of moisture is injurious to all stages of the life of this insect.

The Recipient.—About 80% of newcomers to sandfly regions suffer from the fever during their first summer of residence, and about 15% develop a second attack within three years. Such factors as atmospheric temperature and humidity affect the development of the virus in man.

Prevention.—It is necessary to eliminate the hiding and breeding places of the fly. Cracks in the ground or in masonry must be got rid of by levelling, pointing, etc. Premises must be thoroughly cleansed, and dust and cobwebs removed. Good refuse disposal is essential. The sandfly must be kept away by sandfly proof nets (45 meshes to the square inch), electric fans or repellants, such as paraffin or camphor; whilst insects living in corners of rooms must be destroyed by swatting with a damp cloth or spraying with 1% cresol. There must be a daily war against this pest. All the necessary repairs, tarring, painting and lime-washing must be carried out immediately before the warm weather sets in. Each year the interior of all rooms should be washed down and painted or lime-washed.

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SAN FRANCISCO, Cal., U.S.A. (*see* 24.144).—The population increased 21·5% in the decade 1910–20, reaching 506,676 in 1920, when it ranked 12th among the cities of the United States, and was outranked in California for the first time by Los Angeles. The population of the San Francisco-Oakland metropolitan district, however, was still (1920) somewhat greater than that of the Los Angeles metropolitan district (900,921 and 880,653 respectively). For 1925 the census bureau's estimate for the city proper was 557,530; local estimates were considerably higher, over 700,000. The population still had (1920) the frontier characteristic of a preponderance of males (116·6 males to 100 females). The leading nationalities among the 149,195 foreign-born were Italians, Germans, Irish and English; there were 4,497 Chinese, 4,198 Japanese and 3,810 Mexicans. The amount of illiteracy and of child labour was relatively small; the percentage of men employed relatively high; the general death-rate slightly above the average (probably because of invalids from the east); the infant mortality far below the average. San Francisco is the seat of the federal reserve bank for the twelfth district.

Communications and Commerce.—Between 1910 and 1925 the Western Pacific Railroad was greatly developed, and important improvements were made by the Southern Pacific and the Santa Fe companies. Traffic by sea greatly increased, especially after the opening of the Panama Canal; the total tonnage of cargoes received and shipped in 1924 (including foreign, coastwise and local commerce) was 11,395,012 short tons. Foreign commerce in 1924 amounted to 3,083,513 cargo tons (imports, 1,244,242 tons; exports, 1,839,271), giving San Francisco eighth place among the ports of the United States. Extensive improvements were made in port facilities: pier space was more than doubled; warehouses were built; and a tunnel was made connecting the government docks and the Presidio with the Belt railway. Passenger and motor traffic across the bay increased beyond the possibility of accommodating it by ferries, and in 1923 the war department gave permission for the construction of a cantilever bridge for vehicular traffic across Carquinez Straits in the upper bay, and of two vehicular bridges across the lower end of the bay. The Bay Shore Highway to San Jose, a boulevard 125 ft. wide, was under construction in 1925.

Industries.—Products manufactured in San Francisco were valued at $133,041,000 in 1909; $417,321,000 in 1919; $327,499,417 in 1921; and $416,317,535 in 1923, when the city stood 15th among the industrial centres of the country. During the World War shipbuilding was very important; in 1919 the output of the yards within the city limits was 11% of the total value of the factory products; in the yards of the metropolitan district 165 cargo ships of 1,553,433 tons were constructed in 1916–20, besides 110 naval craft, including three super-dreadnoughts.

Following a strike of the longshoremen in 1916, which completely tied up the port, the chamber of commerce, at a mass meeting of business men, declared for the principle of the "open shop" in labour relations, and appointed a "law and order" committee, for which an initial fund of $1,000,000 was subscribed. An ordinance making picketing illegal was secured in Nov. 1916. The organised effort thus begun to establish the open shop, in the city which had long been the greatest stronghold of organised labour, was continued after the War by the industrial association, an organisation of employers formed for the purpose.

Public Utilities and Building.—In 1910 a bond issue of $45,000,000 was voted for the municipal project of bringing water from the headwaters of the Tuolumne river in the Sierra Nevada mountains, 150 m. away; an additional $10,000,000 was voted in 1924, with $20,000,000 more still needed. The dam in the Hetch-Hetchy valley was completed in 1923. By 1925 an 18 m. tunnel through the mountains had been completed to Moccasin creek, where the first powerhouse of the system (100,000 H.P.) had been built; the western end of the project also had been completed, including conduits and tunnels across the bay to the Crystal Springs Lakes, in order to make immediately available an additional supply of water from the Mount Hamilton range. Condemnation proceedings were begun in 1913 to acquire the property of the Spring Valley Co., which owns the local distributing system and the reservoir on the peninsula; and in 1922 an agreement with the company gave the city the right to purchase at any time before 1934, at $38,000,000 *plus* expenditures for improvements. Up to 1925 the voters had refused to approve the necessary bond issue. On Aug. 14 1925 the Moccasin Power Plant was put into service, with the Pacific Gas and Electric Company as temporary distributor. The net revenue from the power and from the rental of the Bay Crossing aqueduct is sufficient to pay the interest on the outstanding bonds.

With the reconstruction of the Geary Street Railway in 1912, the city government entered the business of local transportation. By 1925 it owned 72 m. of track, and had met all expenses out of earnings while keeping a five-cent fare. An amendment to the city charter in 1920 authorised negotiations for the purchase of the privately owned street railways (286 m. of track) with provisos that the price must be paid out of earnings and that the agreement must be submitted to the electors for approval. A tunnel under the Twin Peaks (about 12,000 ft. long, completed 1917) brought within easy reach of the business sec-

tion a new territory, where several well-planned residence districts of great beauty were developed. The Stockton street tunnel (911 ft.) was completed about the same time. The Dubose tunnel (4,232 ft.), for which bids were received May 5 1926, will serve the Sunset district.

Land for a civic centre was acquired in 1912, and by 1925 it had been improved with a notable group of buildings: a large and well-designed city hall, the public library, the state building and the auditorium which was presented to the city by the administration of the Panama-Pacific exposition. A municipal opera house is to be added soon. A city-planning commission was authorised in 1912, and a zoning ordinance (regulating use of buildings) was adopted in 1921. The building permits issued in the five years 1920–4 represented new construction to the value of $198,832,000, but there was still a housing shortage. For the fiscal year 1925–6 the assessed valuation of property (on a 50% basis) was $734,000,000.

Education.—After a long and bitter struggle, the charter of the city was amended in 1920 to provide for a board of education appointed by the mayor (but subject to ratification by the electorate), serving with only nominal compensation, who should appoint a superintendent of schools responsible to the board. This superseded a system in which the superintendent was elected by popular vote. Upon the establishment of the new board a comprehensive building programme was mapped out, for which a bond issue of $12,000,000 was voted in 1923, and by 1925 most of the buildings were under construction.

The Panama-Pacific Exposition, celebrating the opening of the Panama Canal, was held in 1915 (Feb. 20 to Dec. 4). There were 80,000 exhibits, valued at $350,000,000, representing 39 foreign countries and 37 states and three territories of the United States; 800 congresses and conventions were held in connection with the exposition. The attendance aggregated 18,413,399; the average per day was 62,000. Architecture, colour scheme and effective illumination at night combined to make it an artistic success. Financially, there was a final net profit of about $1,000,000. It left to San Francisco as a permanent heritage not only the municipal auditorium at the civic centre, but the Marina Park lands, extending along the Bay for eight blocks between Fort Mason and the Presidio, and the Palace of Fine Arts with the surrounding park lands of 20 acres.

Government.—James Rolph, Jr., elected mayor in 1911 as a "reform" candidate, was still in office in 1925, with two more years of his fourth term to run.

SAN GIULIANO, ANTONINO PATERNO-CASTELLI, Marquis di (1852–1914), Italian statesman, was born at Catania Dec. 10 1852, a member of a noble Sicilian family. After graduating in law at the university of Catania he became, in 1879, Mayor of his native city, and in 1882 was elected to Parliament. When in 1892 Sig. Giolitti became premier, San Giuliano was selected as under secretary for agriculture, while in the second Pilloux Ministry (1899–1900) he held the portfolio of posts and telegraphs. Having been defeated at the election of 1904, he was nominated senator. When in Dec. 1905 Sig. Fortis became prime minister he was appointed minister for foreign affairs, and on the fall of the Cabinet early in 1906 he was appointed Ambassador in London, where he remained until 1910. From London he was transferred to Paris, but he soon returned to the Consulta as foreign minister in the Luzzati Cabinet (1910–1), and continued at the same post in Sig. Giolitti's administration. San Giuliano was an ardent believer in the Triple Alliance but having retained his portfolio under Salandra, after Giolitti's resignation in March 1914, he carried out with complete loyalty the policy of neutrality adopted by Italy on the outbreak of the World War. He died in Rome on Oct. 16 1914.

SAN MARINO (*see* 24.153) had, in 1920, a population of 12,069. The peaceful revolution of March 25 1906 had restored the original system of election to the council (which had become a close corporation, renewed by co-option) by the Arengo, or assembly of heads of families, one-third of the council being henceforth renewable every three years. But in Sept. 1920 the council resigned in a body and enlarged the Arengo into a single constituency, electing the 60 councillors under practically universal suffrage and proportional representation, illiterates not being disqualified.

The march of democracy at San Marino is shown by the figures of the general election of 1920, when 2,352 persons voted as compared with the 802 heads of families who polled in 1906. San Marinese public life takes its colour from Italy; thus, the Catholic Popular party there, as in Italy, was powerful in 1920, and Socialism, imported from abroad, was largely represented, while Fascism has appeared. Pending the election of their successors after the vote of 1920, the two half-yearly presidents of the republic, for the first time since 1787, remained in office after their six months' legal tenure had expired, and, for the first time since 1740, the new Capitani Reggenti came into power on Dec. 5 instead of Oct. 1 or April 1, the time-honoured dates, a return to which was effected at the ensuing election of presidents.

Effect of the War.—The World War affected even this neutral republic. The Germans accused it of espionage through the wireless station on Monte Titano, which stands 2,437 ft. above the sea. The republic refused, however, to receive the threatened commission of inquiry. When Italy entered the War, San Marino showed its sympathies by voting £1,500 for the Italian sufferers, and one of the regents publicly expressed his hope for an Italian victory. Some amusement was caused by the order of the council of the League of Nations in Rome in 1920 that its permanent military commission should inquire into the "military and naval forces" of this landlocked republic.

Relations with the Powers.—San Marino has been since 1862 in treaty relations with Italy, and the Italian ex-premier, Sig. Luzatti, acted as its adviser. In 1911 it had a separate pavilion at the Rome exhibition; in 1921 the flight of Bolsheviks into the republic, and the "punitive expedition" of the Fascisti in search of them, led San Marino to invoke the aid of the Italian Carabinieri, who were placed under the republic's authority. With Great Britain San Marino, which has a consul-general in London, signed an extradition treaty in 1899, and sent an envoy to Edward VII.'s coronation; correspondence passed between George V. and the regents on the death of Edward VII.; and in 1919 a celebration in honour of "our smallest ally" was held in London.

The republic no longer confers titles for a consideration, but finds a fruitful source of revenue in the frequent changes of its postage stamps (first issued in 1877 and divided into two series, one for foreign and the other for internal postage, in 1899). However, it has had to resort to a loan, and new taxes were imposed to provide higher salaries for officials, causing the peasant rising in 1910. But it has steadily refused the offer of a gaming-table. In recent years newspapers have been published. The only exports, besides postage stamps, are stone from Monte Titano—the legendary founder of San Marino was a Dalmatian stone cutter—and the strong wine grown on this volcanic soil. The museum contains among other curiosities the banner of Garibaldi's "Italic Legion," which sought refuge at San Marino in 1849. The archives were rearranged and described by Malagola. The present Government House, built from the designs of Azzurri, and inaugurated with an address by Carducci in 1894, is a handsome building, and a fine statue of the republic adorns the Pianello. The cold climate should make San Marino a good summer resort now that it is connected with Rimini by motors. Education is provided at the Belluzzi College, founded in 1691 and refounded in 1883, and the republic has produced two native historians.

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(W. Mi.)

SAN REMO, CONFERENCE OF (April 19 to 26 1920).—This conference was preceded by a meeting of the Supreme Allied

Council (Mr. Lloyd George, M. Millerand and Signor Nitti) from Feb. 12 to 23 in London, where the main lines of the future Treaty of Sèvres with Turkey were laid down, and the draft treaty with Hungary and the Fiume question were discussed. At San Remo itself, where the three statesmen above mentioned were joined by representatives of Greece, Belgium and Japan, the Turkish Treaty was the first and principal business dealt with, and the framework of the Sèvres Treaty was there constructed. The mandates for Syria, Palestine and 'Iraq were assigned to France and Great Britain respectively, and an Anglo-French Oil agreement was negotiated which covered Rumania and the French and British non-self-governing colonies as well as the Middle East. The most controversial question dealt with, as between the Allies, was that of the maximum strength of the German Army, both as to its total and as to the number of troops allowed in the neutral zone skirting the area under Allied occupation.

During the preceding month the reactionary *Putsch* organised by Herr Kapp had temporarily driven the Republican Government from Berlin; the swing of the pendulum had produced a Communist rising in the Ruhr, with which the Republican Government had come into armed collision; the Government had dispatched against the Communists (whose outbreak happened to have occurred in the neutral zone) more troops than were allowed in this zone under the Versailles Treaty; France had retaliated by occupying Frankfurt and Darmstadt without consulting her Allies; and Great Britain had protested against this sharply. In these circumstances the German Govt. asked the San Remo Conference to sanction the doubling of the maximum strength for the German army as fixed by the Versailles Treaty. In a joint declaration made at San Remo the Supreme Allied Council refused this request and charged Germany with default in respect not only of disarmament but of reparation. At the same time they announced their intention of inviting the heads of the German Government to a direct conference. (*See* SPA, CONFERENCE OF.) (A. J. T.)

SANTAYANA, GEORGE (1863–), American philosopher and writer, was born in Madrid, Spain, Dec. 16 1863. At the age of nine he went to America and was educated at Harvard (A.B. 1886; Ph.D. 1889), where he taught from 1889 to 1912 as instructor, assistant professor, and, after 1907, as professor of philosophy. He then retired to devote his time to literary work. In 1905 he was Hyde lecturer at the Sorbonne. As an essayist he attained a high position in American letters, being one of the acutest opponents of the pragmatic attitude in matters of conduct and education. To the most abstruse subjects he never failed to bring an acid wit and a romantic beauty of style. His chief work is *The Life of Reason: or the Phases of Human Progress* (1905–6), 5 vol., entitled respectively *Reason in Common Sense; Reason in Society; Reason in Religion; Reason in Art* and *Reason in Science.*

His other writings include: *Sonnets and other Verses* (1896); *Lucifer, a Theological Tragedy* (1899); *A hermit of Carmel* and other poems (1901); *Three Philosophical Poets* (1910); *Winds of Doctrine; Studies in Contemporary Opinion* (1913); *Egotism In German Philosophy* (1916); *Character and Opinion in the United States; with Reminiscences of William James and Josiah Royce, and Academic Life in America* (1920); *Soliloquies In England* (1922); *Poems* (1923); *Scepticism and Animal Faith* (1923); *The Unknowable* (Herbert Spencer lecture, Oxford, 1923); and *Dialogues in Limbo* (1925).

SANTIAGO, Chile, the capital of Chile (*see* 24.191), had a population of 507,296 at the census of Dec. 15 1920, an increase of 52·5% since 1907 (332,724), compared with an increase of only 21·2% in the same period for the province of Santiago outside the city, and 15·6% for the entire country. As the natural increase of the population is small (3·3 per 1,000 of the province of Santiago, 1923) and immigration had been inconsiderable, it is evident that the growth of the capital was due largely to migration from the smaller towns and rural districts. The city had 9·5% of the entire population of the country in 1895, 10·2% in 1907, 13·5% in 1920. Birth-rates and death-rates both are excessive (37·7 and 34·4 per 1,000 respectively for the province of Santiago in 1923); 38–40% of the births are illegitimate.

While Santiago remained primarily the political and cultural centre of the nation, its importance as a commercial and industrial metropolis increased. There were many wholesale firms, doing a large business in cattle, hides and other agricultural products. Chilean manufacturers received a stimulus from the dislocation of international trade during and after the World War, and by 1923 Santiago had over 1,300 industrial establishments, with a capitalisation of 163,000,000 pesos. Among the leading industries were breweries, flour-mills, foundries, machine-shops, woodworking plants, tanneries, knitting-mills, soap factories, factories for making shoes, hats, umbrellas and various articles of clothing. There was a rapid development in labour organisation, and the chronic shortage in the labour supply persisted.

By 1925 Santiago was described by travellers as one of the most beautiful cities of South America, with all the characteristics of a modern capital; fine public buildings and private residences, broad avenues, well paved and well lighted streets, and modern conveniences of every sort. Among the new buildings were the Palacio de Bellas Artes, in the Parque Forestal; the national library then under construction, for which a site was purchased in 1913; the Agronomical Institute and the School of Engineering; and two banks of steel construction. The electric tramway and lighting company, which before the War had been in German hands, was reorganised as a Chilean enterprise. It constructed hydroelectric projects at Santiago in 1921, and secured the contract for supplying power to the railway from Santiago to Valparaiso after its electrification, as well as for lighting the city and running its tramcars. In Oct. 1924 the Government granted a concession to a local firm for the construction of an underground way through the centre of the city (9 km. long, 10 metres below the surface). The water supply was increased by bringing water from Laguna Negra in the Andes, 53 km. away. The fifth international conference of American States was held in Santiago March 25 to May 3 1923.

SANTLEY, SIR CHARLES (1834–1922), British singer (*see* 24.194), published *The Art of Singing* (1908) and *Reminiscences of My Life* (1909). He died in London Sept. 22 1922.

SANTO DOMINGO (*see* 24.195), a West Indian republic on the eastern portion of the island of Haiti. Estimated area, 19,332 square miles. The first census of the republic ever taken was completed by the military government in 1921, when the population was declared to be 897,405. The estimated population in 1923 was 708,000. The inhabitants are mostly of mixed European, African and Indian blood, though there are some creoles of Spanish descent. Santo Domingo, the capital, had a population of 30,957 in 1923; Santiago de los Caballeros, 17,052.

I. POLITICAL HISTORY

The assassination of President Ramón Caceres on Nov. 19 1911 brought to an abrupt end the internal peace that was hoped to follow from the fiscal treaty of 1907. Gen. A. M. Victoria, the dominant military figure, secured the selection of his uncle Eladio Victoria as president. Revolutionary outbreaks followed, and the United States President appointed a special commission to help establish order. As a result Victoria was induced to resign, and Archbishop Nouel was chosen provisional president. Further political disturbances developed, and Archbishop Nouel resigned on March 31 1913, the national congress selecting Gen. José Bordas Baldez as provisional President. Once more revolutionary outbreaks prompted the United States to proffer its good offices, and on the advice of the American commission Baldez resigned and Dr. Ramón Baez was elected provisional president on Aug. 27 1914. In Oct. of the same year the former president, Juan Isidro Jiménez, was chosen constitutional president, and a period of peace and prosperity followed until April 1916, when Gen. Desiderio Arias precipitated a revolution by marching on the capital. He seized military control, swept aside the aged president Jiménez and proceeded to assume the executive power. His plans were thwarted by the United States Govt., which dispatched an army of occupation to Santo Domingo in May 1916. Jiménez resigned office and retired to Porto Rico, and the

American commander promptly suppressed Arias. The complete pacification of the interior was rapid, and was effected without any serious resistance.

On July 25 1916 the Dominican Congress selected Dr. Francisco Henríquez Carvajal as temporary president. The United States, refusing recognition until assured of the non-recurrence of civil disorder, proposed a new treaty based upon the convention adopted between the United States and Haiti (*q.v.*), which should provide for the collection of customs under American auspices, the appointment of an American financial adviser and the establishment of a constabulary force officered by Americans. On the refusal of President Henríquez to enter into this arrangement, the American authorities proceeded to withhold from the Government all the revenues collected by their officers. When Henríquez announced his intention not to retire from the presidency upon the expiration of his provisional term, but to present himself as a candidate for popular election, the deadlock threatened to continue indefinitely. On Nov. 29 1916 Santo Domingo was placed under the military administration of the United States. Executive departments were taken over by American naval officers, ex-president Henríquez left the country, order was quickly established and Santo Domingo entered upon four years of civil quiet and economic improvement.

On July 11 1922 the Department of State at Washington announced a plan for the termination of the military government in Santo Domingo. A special commissioner to the Dominican Republic was appointed to make the plan effective. On Oct. 21 1922 Juan Bautista Vicini Burgos was installed as provisional president to hold office during the period necessary to carry out the proposed plan of evacuation and to re-establish a Dominican constitutional government. The executive officers of the military government continued on duty in Santo Domingo to assist the provisional government during this time. On July 12 1924 General Horacio Vásquez was inaugurated constitutional president of the republic, having been chosen at the elections held on March 15 1924. Control of all fiscal and administrative affairs was again placed in Dominican hands, with the exception of the customs service, which continued to be administered by officials nominated by the President of the United States. The treaty with the United States for the withdrawal of the American forces was ratified by the Dominican Congress on June 26 1924, and on Sept. 17 the last of the American marine forces of occupation left the republic.

Education.—Primary education is compulsory and free. The Government educational scheme comprises primary and secondary schools, technical and training colleges. By a presidential decree of Nov. 29 1914 the professional institute was raised to the rank of a university. There were 972 public schools in 1920, with 105,000 pupils; in the same year the government expenditure on public instruction was $966,952. The period of American occupation was marked by the building of schools and the extension of educational facilities. In 1924 the Dominican Govt. made provision in the budget for the establishment of 300 schools in the republic, and legislation provided that the tax *impuesto de Patentes* should be used for educational purposes.

II. FINANCIAL AND ECONOMIC HISTORY

Finance.—Political disturbances delayed the course of financial extrication ensured by the convention of 1907, but after 1916 rapid progress was made. Of the $20,000,000 loan of 1907 there was on Dec. 31 1924 an outstanding liability of only $3,868,716, which was to be paid off before 1929. The total bonded debt of the republic on Dec. 31 1924 was $13,534,276.

One of the first acts of the new Government was to negotiate a convention with the United States to replace the convention of 1907. In effect, this proposed convention followed the lines of the convention of 1907, authorised the Dominican Govt. to issue $25,000,000 in bonds, and provided for the appointment by the President of the United States of a general receiver and the necessary assistants to collect the customs duties in the republic and to allocate to the interest and sinking fund of the bond issue the necessary amounts. This convention was signed in Washington on Dec. 27 1924. It was ratified by the United States Senate at that session, and its ratification by the Dominican Congress was approved by the president of the republic on May 25 1925.

During 1924 the customs receipts were $4,386,602 as against $3,596,166 in 1923. The internal revenue for 1924 was $2,998,686 as against $2,575,055 in 1923. Deposits in the savings banks during 1924 showed an increase on those for 1923. Estimated receipts for 1925, according to the budget promulgated Dec. 28 1925, were $11,968,110, leaving after certain deductions an available balance of $6,006,840.

Production and Industry.—Agriculture is the chief source of wealth in the republic, the cultivation of sugar taking first place amongst the industries. Cacao, tobacco and coffee are the other staple products. From 1912 to 1914 the increase in production was arrested, but in 1915 production went up. The military occupation and high prices caused by the World War maintained high export values through 1920, when record prices were reached, to be followed by an abrupt reaction. The 1924–5 sugar crop at 340,870 short tons exceeded the estimate by 21,722 short tons. Cocoa exported in 1924 was 23,142,478 kilos, as against 19,830,722 kilos in 1923. The value of the 1924 heavier exports at $2,793,502 was less than that of the 1923 exports, which were valued at $2,917,165. Exports of coffee increased in value from $427,588 in 1923 to $863,531 in 1924. Sugar and molasses exports in 1923 were $19,042,067, compared with $22,484,651 in 1924. Imports and exports for the years 1914 and 1924 were:—

	1924	1914
Imports	$21,580,571	$ 6,729,007
Exports	30,262,896	10,588,787

63·73% of the import and 30·68% of the export trade being with the United States in 1924, as compared with 59·29% and 52·31% respectively in 1911. The chief imports in 1924 were cotton goods, foodstuffs, manufactures of iron and steel and oils.

Communications.—During the American military occupation a number of much-needed highways were constructed, of which 405 m. of highways had been completed by 1924, 96 additional m. were under construction, with a further 452 m. projected.

A government owned telephone system operates over 1,034 m. of lines, with telephonic connection with the republic of Haiti. In 1924 there were wireless stations at Santo Domingo and at La Romana; the latter was opened to foreign traffic in 1912.

(J. H. Ho.)

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SANTOS (*see* 24.196), population 101,000, has made notable progress since 1910. An annual rainfall of about 77 in. and a mean temperature of 69° F., combined formerly to create unhealthy conditions, but the building of a series of drainage canals, extension of modern sanitation, paving of streets, construction of better business and dwelling houses, port improvements, all representing an outlay of millions of pounds, are largely responsible for the change to a healthful city. A suburban seaside resort, Guarujá, with new hotels, now draws many visitors from inland parts of Brazil.

Santos has passed Rio de Janeiro in the amount of its exports and is now the world's greatest coffee port, shipping annually from 8,000,000 to 13,000,000 bags. The annual imports have increased in 20 years from about 500,000 to 1,500,000 tons. About 1,500 ships visit the port yearly, the busiest season being from Aug. to January. New docks extend for three miles and can accommodate 50 steamers at one time; belt conveyors operated by steam load several thousand bags of coffee per hour. Many warehouses are splendidly equipped with machinery which replaces manual labour. The British-built railway to São Paulo ("Heart of Coffee Land"), 40 m. distant, transports the bulk of coffee of that region to Santos, making the line the best paying railway in South America. A congestion of rail traffic at times has been pronounced and plans are proposed for additional facilities. Motor trucks are gradually replacing horse-drawn carts. A good highway from São Paulo to Santos was completed by the state government in 1919.

(W. A. R.)

SÃO PAULO (*see* 24.200), capital of the State of the same name in Brazil, and its commercial and industrial centre, grew very rapidly between 1900 and 1925, especially after the close of the World War. In 30 years the population increased ninefold, reaching 579,033 according to the census of 1920, and was estimated at

about 625,000 in 1925. The high rate of natural increase (as indicated by a birth-rate of 40·8 and a death-rate of 20·5) was supplemented by a considerable immigration, Italians leading among the foreign population, followed by Germans, Portuguese, Spaniards, French and English. Manufactures (especially textiles and clothing, hats, boots and shoes, machinery and other articles for home consumption, and meat products for export) were greatly stimulated by the War and, in a few years, the annual output was valued at $20,000,000. In 1923 four large packing-plants were in operation near the city, with an output valued at 89,799,210 milreis (1 milreis = approx. 50 cents). With the increase in business the old and narrow streets in the business quarter of the city became seriously congested.

SÃO SALVADOR: *see* BAHIA.

SARGASSO SEA.—The portion of the Atlantic Ocean extending from Bermuda to the Azores, bounded approximately by 25° and 30° N. and by 38° and 60° W. is termed the Sargasso Sea, because of the prevalence throughout this area of the weed known as Sargassum bacciferum. This plant, floating on or near the surface, is about one foot in length and consists of a single layer of feathery branches of varying degrees of yellow in colour. Scattered among these branches are numerous globular air bladders or capsules, the size of a large pea. The term " Sargasso " is derived from two Portuguese words, signifying the sea of the little grapes—having reference to these air capsules. The weed is not matted, but is always found floating nearly free, only sufficiently entangled for the mass to keep together, with long lanes of open water between the masses. The weed-infested region, though it apparently expands and contracts at uncertain times through unknown causes, is approximately one-third the size of the United States, and within this area is found a highly specialised and unique series of pelagic animals. Though large in point of numbers, only 15 species have been met with, for the most part distinct from normal pelagic fauna.

The Sargasso Sea was discovered by Columbus on his first voyage and received from him the name of the Mer de Sargaco. Geographers, sailors and scientists have varied greatly in their estimates respecting the extent and density of the area of weed, and also as to its source and propagation. Some have stated that many of the branches show signs of having been attached to rock and that the individual plants have travelled a great distance, since in a large proportion of instances only a part of the weed is living. From these facts the suggestion is made that the weed is torn off from the Bahamas by the force of the waves and is then caught in the eddy of the great system of Atlantic currents. On the other hand it has been maintained that the weed propagates itself in the high seas. Again, the statement has been made that the weed is so dense at times as to be an obstruction to navigation, whereas others have affirmed that it offers no resistance to ships, and even its very existence has recently been denied. The widely credited possibility of ships becoming embedded in the weed, and being unable to escape, is disproved by the expedition of the " Michael Sars," under the direction of Sir John Murray and the Norwegian government in 1910, which found the surface covered with weed only in patches. It would appear that at times the weed sinks, remaining suspended 12 or 18 in. below the surfaces of the water, and this phenomenon may have given rise to the divergent opinions met with.

Other similar tracts exist covered with floating weed, *e.g.*, in the solitary part of the Pacific, north of the Hawaiian Islands, between 30° and 40° N. and between 150° and 180° W. There is a smaller tract southeast of New Zealand and along a belt of the southern ocean extending from the Falkland Is., south of Africa and southwest of Australia, similar floating banks of weed are discovered.

SARGENT, JOHN SINGER (1856–1925), Anglo-American painter (*see* 24.219). For 40 years before his death John Singer Sargent was too towering a personality for his contemporaries to judge either him or his work in true perspective. A tall and commanding presence, with a small head well set on broad shoulders, with large, somewhat prominent grey eyes, kindly in expression though nothing escaped them, with a close-cut beard at a time when nine men out of 10 were clean-shaven, he made an instant impression upon those who came into contact with him. During the last years of his life, especially, with his great size, his dark hair and beard turned silver-white, his complexion florid, and an air about him of singular freshness and calm, he had a look as of some serene and beneficent Jove.

That he was a great artist is universally acknowledged, but that he was a great man his life attested—in its austerity, its generous highmindedness, its breadth of vision, and above all in its independence of praise, fame or wealth. Essentially a cosmopolitan, he was of American descent. He appreciated with amusement the anomaly of his own situation, claimed as he was by two countries—the land of his immediate forefathers, the land of his adoption.

His record of extraordinary good fortune was based as much upon character as upon incidental circumstance. The simplicity of his aim was a citadel of strength. He knew what he wanted, and any distraction, however tempting, that interfered with his object he summarily brushed aside. Yet he was in no sense an ascetic. He had a vigorous relish for good plays, good music, good books, good company. His movements were deliberate, he never seemed to hurry; but it was always a question whether his self-control did not consist rather of the coolness of the born fighter than of the phlegm of a somewhat contemptuous philosopher.

He himself would have said that he was most fortunate in the choice of his parents. His father, Dr. Fitzwilliam Sargent, was born in Gloucester, Massachusetts, where his ancestors, emigrating from Gloucester, England, settled before 1650. For his medical training Fitzwilliam Sargent went to Philadelphia, practised there for a short period and married Miss Mary Newbold Singer, a member of an old Philadelphia family. In 1854 (Mrs. Sargent not having recovered from the death of her first child) the young couple, with Mrs. Sargent's mother, went for change of air and scene to Europe, with no premonition that this journey would result in their permanent establishment abroad. Two years later, on Jan. 12 1856, in Florence, at the Casa Arretini, on the Lungarno Guicciardini, their son, John Singer Sargent, was born. He showed his special aptitudes from his earliest childhood, which was spent at Nice, in Rome, in Dresden, with periodical returns to Florence. Whenever possible he took drawing lessons of a desultory kind, interrupted by the exigencies of schooling and a life of constant travel. His mother, who herself loved to sketch in water-colours, recognised and encouraged his unusual gifts.

His own awakening to the enchantment of being able to express his delight in the visual world came to him, he once mentioned, at Mürren, with his closer acquaintance with mountains, in the summers of 1868 to 1870. His early drawings were carefully painstaking efforts to show every variation in rock forms, or in the verdure that sprang from their crevices. This creative ardour, this eagerness to attack a difficult problem, were characteristic to the last day of his life. In 1873 he won a prize for drawing at the Accademia in Florence.

In 1876 he paid the first of many visits to America, but before the short interruption of this trip he had begun his artistic education in earnest, having entered the studio of Carolus Duran, in Paris, in 1874, at the age of eighteen. Rarely, if ever, was a student better equipped for his profession. Travel had enriched a naturally receptive and keenly observant mind. He had absorbed beauty in landscape, pictures, music or architecture as instinctively as he breathed, and extensive reading had made each place of sojourn live for him with all the intensity of the immediate as well as of the remote past.

A fellow student described him as a tall, slenderly built, rather silent youth, with a friendly, somewhat shy manner, who could, on occasions, in spite of his diffidence, express himself with startling decision. Mature for his years, he was never inclined to exuberance, and was more the amused observer than a participant in the riotous diversions that varied the routine of student life in Paris. His industry was no less remarkable

than his physical strength, his youthful powers of endurance not being unduly taxed by the strain of attending not only the class at Duran's studio, but the Beaux Arts and an evening life class as well.

Contrary to many published recollections, Sargent himself declared, perhaps with characteristic modesty, that he was by no means a brilliant pupil, that he was considered, at first, somewhat dull and slow, and that he only acquired his amazing technical skill by continued concentrated effort. What he did recognise, with instant appreciation and lifelong acknowledgment of his debt, was the scientific precision of the method taught by Carolus Duran, who had occupied himself deeply with questions of technique. Duran had based his own theories on a close study of Franz Hals and Velasquez. He believed that painting was a science necessary to acquire in order to make of it an art. Few painters have the stamina to remain faithful to principles at once so precise and so arbitrary, where a slip invites disaster, and an error in one particular the failure of the whole. John Sargent, not without struggle, made this technique his own, and it gave him, at the start, the assured mastery of his materials, enabling him to devote all his energies to more engrossing problems.

His first picture exhibited in the Salon of 1878 won an honourable mention. It was called " En Route Pour La Pêche," and is now in the Corcoran Gallery at Washington. In the next year's Salon he showed the portrait of his master, which he had painted in 1877, at the age of 21, and which was instantly acclaimed as of extraordinary promise. Shortly after, emancipated from schools, he made a pilgrimage to Spain, which he had already visited as a boy, and the studies done in the Prado Gallery, which, after his death, were sold at Christie's at such phenomenal prices, were painted on this occasion. Some were quite small, some of the size of the originals, and all were interpretations rather than copies.

Immediately after his return to Paris he painted the beautiful canvases " El Jaleo " (Salon 1882), now at Fenway Court, Boston and " The Children of E. D. Boit " (Salon 1883), now in the Boston Fine Arts Museum. Of " The Lady of the Rose " (Miss Burkhardt), which was shown in 1881 and gained a second class medal, Henry James wrote that it was the work of " a talent which on the very threshold of its career has nothing more to learn." This was a phrase, for to the end of his days Sargent remained the student, making ever briefer the span between brain and hand, between conception and achievement; yet these early canvases are remarkably mature, with a suave beauty of surface texture he rarely excelled, and with the added sense of atmospheric reality, the " quality " he had learned from Velasquez. He had the special readiness of genius to absorb great traditions, to take valuable hints from every source, and incorporate them into his own work with the freshness and vigour of a deeply original mind.

From the outset commissions came to him unsought. He had to knock at no doors; but it was not till the Salon of 1884, when he showed the portrait of Madame Gautreau (Metropolitan Museum of New York), that the painter awoke to find himself famous—or infamous. Madame Gautreau was the friend of Gambetta, acclaimed by the Republican party, and Sargent was accused of having purposely done a caricature. The journalists outdid each other in senseless abuse.

This experience, with its astounding unreason, its venomous personal bias, probably laid the foundation for his almost incredible independence of all critical comment. Irritated by adulation, detesting every form of publicity, he could never be induced, unless it was forced upon him, to read any criticism of his own work, appreciative or the reverse.

So furious and so prolonged was the outcry in the French Press that finally, in a fit of disgust, Sargent left Paris and moved to London. His first studio was in Kensington, but in 1885 he had already settled at 33 Tite Street, Chelsea. In 1901 he bought the adjacent house (No. 31), and a door was cut through between the two studios. Here he lived and worked till his death on April 15 1925.

Into these 40 years of his London domicile was crowded the experience of a dozen ordinary lifetimes. His first exhibited study of childhood: " Carnation, Lily, Lily, Rose," was bought in 1887, by the Chantrey bequest, for the Tate Gallery. A few years later the Luxemburg acquired the picture of the Spanish dancer " Carmencita," painted 1890, shown at the Royal Academy 1891. In spite of adverse criticism, it was not long before he was in great demand as a portrait painter, and the unflagging zeal of his industry kept pace with every triumph of public recognition. He numbered among his sitters princes and princesses, musicians, actors, teachers, writers, statesmen and diplomats. Many of his distinguished models he painted in their habit as they lived. The great groups of " The Duke of Marlborough and his Family " (1905), the " Ladies Acheson," (1902), the " Daughters of the Hon. Percy Wyndham " (1900), the " Misses Hunter " (1902), etc., and a noble series of single portraits, notably those of the Duke and Duchess of Connaught (1908), the Duke (1901) and Duchess of Portland (1902), Lord Russell of Killowen (1900); of Francis Penrose, Esq. (1898), and of innumerable beautiful women: The Duchess of Sutherland (1904), the Countess of Warwick (1904), Lady Agnew (1893), Lady (Ian) Hamilton (1896), Mrs. Hammersley (1893), increased his ever-growing prestige.

In 1894 he was elected an associate, in 1897 to full membership of the Royal Academy, and at the exhibitions at Burlington House his portraits were the centre of interest and of controversy. It became a high distinction to be painted by him, and hundreds clamoured for the honour in vain. Universities offered him degrees, he had as many medals as a war veteran. Quite unmoved by all this acclamation, he retained the serene simplicity of manner that made him so exceptional and so distinguished a figure. Yet people, even his friends, went in secret awe of him.

In the sense of being generally understood John Sargent was never a popular painter. Painting is the most outspoken of the arts, but its language is not easy to read. Its apparent simplicity and the directness of its appeal to the eyes are misleading, and in the case of pictures so incisive and brilliant, so uncompromising in their truth, so unerring and authoritative in their presentation of character, it was no wonder that they awakened as much resentment as admiration. Sargent chronicled his enjoyment in no uncertain tone; like music made visible, each brush stroke seemed to resound, like a note on the violin, ringing and clear. There are mysteries of light, as well as of darkness, and the secrets of this accomplishment were no less inscrutable, became actually more tantalising, because the method of expression was so frank, and looked so unexpectedly, amazingly easy to imitate. And he was imitated, inevitably, but in no single instance with any distinction. His own processes were individual. He made no concessions to popular prejudice. His inspiration was peremptory and knew few ingratiating moods. Referred to as a psychologist or a satirist, he was frequently accused of deliberately accentuating the less pleasing qualities in his sitters—a foolish legend he dismissed with a shrug of his shoulders. " I chronicle," he once said, " I do not judge." Though his outlook on life was essentially indulgent, his sense of humour was irrepressible, and the unerring rectitude of his realism struck at a deep-rooted human weakness—a preference to be seen not as we are but as we should like to be.

In that its conclusions are so little deliberate painting differs from literature. John Sargent did not sum up his characters, he painted what he saw; but he caught, subconsciously perhaps, each fugitive betrayal of a passing thought, a restless movement, a smile or a glance. This subtle power of definition has been, in all ages, the peculiar gift of great portrait painters.

In recalling the astonishing variety and scope of his work, it may be assumed that he was almost indifferent to the form in which he was called upon to portray the modern spirit. His only prayer must have been that that spirit should not be utterly commonplace. For dullness he had no talent, even his magic touch failed to enliven it. Before the strange, the unexpected, the bizarre, his resource and his freshness were unfailing.

No happy invention was permitted to degenerate into a formula. He never repeated himself. For the extremes of youth and of age he had undeniable tenderness; with incredible delicacy he portrayed the flower-like freshness of one, and if he did not disguise in the other the hint of decrepitude it was generally illumined by more than a suggestion of wisdom and dignity.

At the very height of his fame, in 1910, he decided to give up the painting of portraits. This decision, so typical of his artistic integrity, he lived up to. He was his own severest critic. He had grown tired of the tyranny of sitters, and had begun to lose interest in his work. He pulled himself up sharply. Only in exceptional instances was he afterwards induced to break his rule, and then never for considerations of money. Though he lived on a generous scale, he was never a wealthy man. Always ready to give a helping hand to a student, or to a brother artist, he was at once too busy and too impatient of all forms of implied superiority ever to want to teach. Deliberately then, perhaps, he set his face against the scattering of his energies over too wide a field. An omnivorous reader and a passionate musician, an excellent host and a most entertaining guest, his rare leisure was all too adequately filled.

In a holiday spirit he began to play with water-colour (in which medium he had made his earliest efforts at painting) and the result of his first summer of freedom may be seen in the sparkling brilliance, the irresistible gaiety of the 80 sketches bought *en bloc* by the Brooklyn Fine Arts Museum. His disciplined hand had acquired an almost miraculous lightness and certainty of touch.

But a heavier task had already for years been engaging his energies, and the last 20 years of his life were given more and more to the magnificent series of decorations which illustrate the range of his great gifts. It was said of his "History of Religion," begun in 1890 and not completed till 1916 (the subject for the great Hall in the Boston public library known as Sargent Hall), that his work here was not only a monument to the picturesque possibilities of his colossal subject, but to the sheer erudition of the painter. This task took him on several journeys to Egypt, Palestine, etc., as well as for a few months almost every year to America, where he had a studio in Boston, in the Columbus Avenue Building; and he had also another studio in London, for these huge decorations, at The Avenue, 75, Fulham Road.

In 1914, at the outset of the War, he was on holiday in Austria, and he witnessed with horror the disintegration of the Europe he had known. He gave without stint; and when the opportunity offered went to the front to record his impressions at first hand. In his famous war picture "Gassed" (London War Museum) he testified to his deep admiration for the invincible pluck of the British soldier. In the background, through the waning light of the late afternoon we see a football game going on; the ground is carpeted by writhing figures; while a tragic procession of wounded men, blinded by gas, staggers towards the dressing station.

The quieter life in London suited his temperament better than the more buoyant, distracting, lavish social exactions of Boston. In London finally he was to know an honour no living painter had hitherto experienced. The magnificent series of portraits, bequeathed to the nation by Asher Wertheimer, were hung in the National Gallery. A wing in the Tate Gallery, the gift of Sir Joseph Duveen, will one day house these, and such other works by Sargent as are already in national possession—the portraits of Lord Ribblesdale (1902), of Coventry Patmore (1895), of Henry James (1914), Octavia Hill (1899), of Ellen Terry as Lady Macbeth (1899), and many others. Sargent is represented in the principal galleries of the world, but the Metropolitan in New York, and the Boston Fine Arts Museum, are particularly rich in fine examples. The decorations for the Boston Library, for the Boston Fine Arts Museum, for the Harvard Memorial Chapel, absorbed him till, fortunate to the end, at 31 Tite Street, death overtook him in his sleep, in his 70th year, with no evident diminution of his forces, no weakening of his physical or mental energy.

Mr. Sargent had never married. He had been a devoted son and brother, and was survived by his two sisters, Miss Emily Sargent and Mrs. Francis Ormond. His body was interred at Brookwood Cemetery. Memorial services were held at Westminster Abbey, at the request of the Royal Academy and a replica in bronze of the Crucifixion in the Boston Library, with a memorial tablet, is to be placed in the Crypt of St. Paul's Cathedral.

In looking back over his immense achievement in so many different fields of art, his extraordinary vitality strikes one first. His slightest sketch pulsates with life. The beautiful suavity of his style he acquired through the iron discipline of years. He would paint a head 20 times over in order to give it the look of perfect ease and fluency he aimed at. He kept his palette and his brushes as carefully clean as a soldier keeps his weapons. At his easel he had the calmness of intense concentration. His brush would pause in mid-air and descend in a stroke calculated to a nicety. The knowledge of a lifetime was behind it. His insight into character was instinctive; character wherever it was exhibited—in the cut of a coat, in the detail of a building, in a dog, in the hands of a woman, in the head of a philosopher. This went far beyond ordinary perception; at its best it became a miracle of intuition, of skill in rendition. He knew no greater joy in life than this concentration on work provided him. What he lacked entirely may be called, for want of a better term, the feminine touch. Beauty and charm that were not in direct relation to his subject he could not entertain. This severity was his strength, as it was the weakness of so much of the art of the period that it perpetuated the worship of purely irrelevant sweetness. Idealisation, he felt, must come of itself with the enriching processes of time, when the years, helped by the imagination, give that nobility that is partly aloofness, partly an inherent quality in all great painting.

Taken as a whole, his portraits may come to be considered an epitome of the period in which he painted, not divested of those characteristics that make the human panorama so diverting, but bearing, with their unflinching realism, the very stamp of truth. Compared with these powerful representations, drawn from every class of modern society, the living people who pass before them seem shadowy and ill-defined. It is certainly to him above all that the age he lived in owes an appearance of stateliness and splendour, which was evidently as much a part of his own vision of life as the grace and elegance he could lend to the portraits of women—clothed with all the eccentricities peculiar to the late Victorian era—or the beauty that flamed for him wherever light played: on the rushing waters of a mountain stream, on heavily laden oxen, on a palace courtyard, or the interior of a stable. The exact measure of his greatness may safely be left to the future to determine.

(J. He.)

SARRAIL, MAURICE PAUL EMMANUEL (1856–), French soldier, was born at Carcassonne (Aude) April 6 1856. He passed out from the St. Cyr Military Academy in 1877, and after a series of promotions was appointed in 1907 director of infantry at the War Office. In 1911 he was promoted general of division and on Nov. 1 1913 was given command of the VIII. Army Corps, being later (April 24 1914) transferred to the VI. Corps which he commanded on the outbreak of the World War. On Sept. 2 1914 after leading the VI. Corps with credit at the battle of the Frontiers, he succeeded Ruffey as commander of the III. Army which played a brilliant part during the retreat to the Marne. During the trench-warfare operations of 1914–5 he was less successful, however, and he was transferred to the chief command of the French Army of the East. He later became commander-in-chief of the Allied forces on that front (*see* Salonika Campaigns). After the World War he devoted himself to politics and having stood unsuccessfully as Radical deputy for Paris, he was, in Jan. 1925 appointed high commissioner in Syria. In this capacity he showed undue favour towards certain of the native elements and a rebellion broke out among the Jebel Druses during which Sarrail bombarded the native quarter of Damascus. These events

caused a bad impression in France and a section of the press began to clamour for Sarrail's recall. In Oct. 1925 as a result of the report by General Dupont who had been deputed by the Government to inquire into the matter, he was relieved of his post.

SASKATCHEWAN (*see* 24.225), a province of the Dominion of Canada. Area 251,700 sq. m. of which 8,319 sq. m. are water. In 1921 the population numbered 757,510, an increase of 53·83% over 1911. The rural population amounted to 538,552; the urban to 218,958. The principal groups were English 206,472; Scotch, 104,678; Irish, 84,786; German, 68,202; Scandinavian, 58,382; Russian, 45,343; French, 42,152; Austrian, 39,738; Ukranian, 28,097; Dutch, 16,639; and Indians, 12,914. The capital city, Regina, had a population in 1921 of 34,432. Saskatoon is the seat of the provincial university. Moosejaw is an important railway and milling centre. Prince Albert is well-known for lumber and fur trading.

The province is governed by a legislative assembly, consisting of 63 members, with an executive council of seven members. It is represented in the federal parliament by 21 members in the House of Commons and 6 senators. The educational system has been carefully developed by the provincial Government, and includes elementary and high schools, two normal schools and a provincial university.

Production and Industry.—The province is essentially agricultural. Grain growing in the prairie sections and mixed farming in the prairie and woodland parts are carried on with conspicuous success. The transcontinental railway lines have a network of branches which serve the agricultural districts. The farmers are strongly organised co-operatively for the marketing of their products.

The following table gives the yield in thousands of bushels and value in thousands of dollars of the principal field crops for 1922–5:—

Crop	1922		1923		1924		1925	
	Yield	Value	Yield	Value	Yield	Value	Yield	Value
Spring Wheat	250,167	212,642	271,662	176,554	132,918	160,831	240,551	264,606
Oats	179,708	52,115	218,075	54,519	97,345	41,858	174,967	57,739
Barley	18,551	6,972	19,278	6,747	17,360	10,937	27,061	12,177
Rye	16,164	8,567	8,582	3,861	2,507	2,382	4,512	2,888
Flaxseed	4,079	6,975	5,494	9,614	6,119	11,932	7,439	14,580
Potatoes	4,021[1]	3,210	4,370[1]	3,632	2,137[1]	3,291	3,623[1]	3,949
Hay and Clover	360[2]	2,883	425[2]	3,423	405[2]	3,528	635[2]	5,080
Fodder Corn	187[2]	1,309	305[2]	1,600	277[2]	1,640	260[2]	1,560

[1] Cwts. [2] Tons.

Livestock in 1924 included 1,170,745 horses, 468,151 milch cows, 1,060,716 other cattle, 123,362 sheep and 872,819 swine. Poultry farming is increasing in importance. Rapid and substantial progress has been made in dairying, the province being well suited for milch cows and stock of all kinds. The values of dairy products increased from $6,051,000 in 1918 to $19,357,329 in 1924; the output of creamery butter increased from 1,548,696 lb. in 1910 to 13,583, 902 lb. in 1924; in the same year 19,250,000 lb. of farm-made butter was produced. The output of factory cheese increased from 26,730 lb. to 165,000 lb. in the same period. There were 64 creameries in operation in 1924, 28 of which were equipped with mechanical refrigeration.

Manufacturing industries are not important, the chief development being in flour milling and lumbering. The conditions are favourable to the production of non-metallic minerals. Lignites are mined in the southern part of the province. Ordinary brick clays are widely utilised and there are extensive beds of clays used in the manufacture of fire brick, stoneware, pottery and sewerage pipe. Water power resources are being actively developed: in 1924 the available 24-hour H.P. at 80% efficiency, at the ordinary six months flow, was 1,030,634. The railway interests are looked after by a provincial department of railways. In 1924 there were 6,956 m. of track in the province. Highways on March 31 1924 included 124,613 m. of unimproved earth, 10,387 m. of improved earth, 10 m. of gravel and 25 m. of bituminous concrete. The number of motor-cars is increasing, 70,561 being registered in 1924. (D. A. MacG.)

SAVAGE, MINOT JUDSON (1841–1918), American divine and author (*see* 24.239), died in Boston, Mass., May 22 1918.

SAVINGS MOVEMENT.—Professor Alfred Marshall in his *Principles of Economics* says that "man's character has been moulded by his every-day work, and the material resources which he thereby procures, more than by any other influence unless it be that of his religious ideals; and the two great forming agencies of the world's history have been the religious and the economic." The National Savings Movement is a definite and well thought out attempt to apply the economic forming agency to the improvement of the social conditions of the people of this country. The movement has two functions; the first is the education of all classes in the knowledge and practice of using wealth for the promotion of welfare. The second is to provide facilities for saving by the small investor on advantageous terms.

I. GREAT BRITAIN

Origin.—The movement in Great Britain was established in Feb. 1916 on the recommendation of the committee on War loans for the small investor, presided over by Mr. E. S. Montagu. It was recognised during the War that the fighting forces required all, and more than all, the available material and labour for the conduct of the War, and that non-combatants ought to restrict their demands to as great an extent as possible in order that everything required for war might be supplied. The economic doctrine of "goods and services" was developed and popularised, and many people came to realise more fully than before the great extent to which national well being depends upon the way in which individual citizens spend their money.

A more attractive motive for saving than has usually been presented, was put forward. Saving is a process which may be good or bad according to the purpose to which savings are applied. It is beneficial to the individual and to the community when saving results in more but wiser spending. That more spending can result from saving is obvious from the fact that if £10 a year is saved for 17½ years, and interest is accumulated at 4% per annum, the capital will be sufficient to yield at the same rate of interest £10 a year in perpetuity. While the money is being saved and interest earned by it, the money directly or indirectly finds its way into industry, helps to develop the business of the country and in particular to increase employment. Truths of this character were more readily appreciated during the War than in normal times, and this prepared the way for the better understanding of the economic doctrine of "goods and services" as applied to peace conditions.

Organisation.—Early in 1916, on the recommendation of the Montagu Committee, two committees were established, one to undertake organisation, and the other to advise about matters of finance. After a few months the two were merged into one under the title of the National War Savings Committee. This was concerned with England and Wales, and shortly afterwards a separate committee was appointed for Scotland. Corresponding work in Ireland was subsequently undertaken. The method of organisation is interesting and has proved effective. Local committees were established in most towns and country districts; their task was to educate public opinion and to establish savings associations which should receive subscriptions for savings certificates among groups of people who are associated for other purposes, such as children in schools, employees in business firms and members of clubs. The members of the local committees

and the officials of the Savings Associations are all voluntary and unpaid workers, but there is a small paid staff, the expenses of which are met by a Parliamentary grant. The organisation has been well described as a " voluntary movement that is also a government department." Every effort has been made to give the fullest expression to the views of the voluntary workers. The associations are represented on the local savings committees, and each savings committee nominates two members to attend an annual Regional Conference. Formerly there was a Conference for almost each county in England and Wales, but after a time the territory was divided into twelve regional areas, in each of which a large and important conference is held every year.

The original Savings Committee consisted only of nominated members who represented certain interests, or whose services were valuable on personal grounds. Among the interests now represented on the National Committee are the Post Office, the Board of Education, the National Union of Teachers, the joint stock banks, the trustee savings banks, the Ministry of Health and the Municipal treasurers. It was thought desirable that other members of the committee should be elected by the voluntary workers. To achieve this each annual conference elected representatives to serve on a national savings assembly, which normally meets annually, and which at its outset elected six representatives to serve on the National Committee. This representation was so successful that the number of elected representatives was increased to twelve, and on the division of the country into twelve regions, one representative is nominated at each of the twelve regional conferences. These elected representatives contribute to the management of the Movement the result of their personal experience in their respective areas, and to this is largely due the flexibility and initiative that is usually more characteristic of a voluntary movement than of a government department.

War Savings Certificates.—In order to make better provision than previously existed for saving by the small investor, the " War savings certificate " was introduced in Feb. 1916. It originally cost 15s. 6d. and accumulated to £1 by the end of five years. The life of the certificate was subsequently extended to ten years, when it became worth 26 shillings. So far as savings certificates are concerned, income tax does not exist, the interest upon them not being taxed, and not having to be included in returns for either income tax or super tax. The certificates can be cashed at a day or two's notice for their cost price, plus the accrued interest. The ingenious plan is adopted of allowing a rate of interest that, speaking generally, increases with the length of time which the certificate is allowed to remain before being cashed. The first series of certificates yielded just under 5¼% if cashed at the end of five years, and a trifle over this rate if allowed to remain for ten years. The second series of certificates was commenced in April 1922. The purchase price was raised to 16s., but the general conditions were almost identical with those of the first issue. With a further fall in the prevailing rates of interest a third issue was commenced in Oct. 1923; the purchase price remained at 16s. and the value at the end of ten years is 24 shillings.

Important characteristics of savings certificates are that they can be cashed at any time without loss of capital; that the interest accumulates instead of being paid in dividends; that they are entirely exempt from income tax and super tax; that the rate of interest, especially if held for the full ten years, is high; that they can be purchased by instalments, and that they are registered securities which can safely be kept by those who have no accommodation for the custody of valuables. These attractive features immediately won recognition. By April 1925 more than 764,000,000 certificates had been sold, representing a cash investment of nearly £600,000,000, of which, after deducting withdrawals, more than £372,000,000 remained invested, in addition to the accrued interest. In the financial year ending April 1926, the sales exceeded by about 10% those of the previous year, and the amount paid for withdrawals was substantially less though the total amount remaining invested had increased.

The Movement in Peace Time.—During the War the purchasers of certificates knew that they were lending their money to the Government to help pay for the War. When peace came, it was thought advisable that the money might still be earmarked for some national purpose. It was therefore decided that half the money paid for savings certificates in any area could be borrowed by the local authority of that area for capital expenditure on housing. The purposes to which loans could be applied was subsequently extended, and up to April 1926 loans had been made to nearly five hundred local authorities.

The use of savings certificate money for War purposes became so predominant that many people failed to realise, when peace came, the great advantages that would still accrue to individuals and to the community by the continuance of savings associations, and in consequence many of these came to an end. It took some years to make generally understood the great advantages of the movement to individuals and to the community. This is now being accomplished with increasing success, and in 1926 more than four hundred new savings associations are being formed every month. One contributing cause of this success is that extremely simple schemes for the purchase of savings certificates by instalments have been devised which involve practically no time or trouble for account keeping. Special savings stamps costing six pence each are used under one scheme, and six penny coupons under another. These stamps and coupons are stuck on cards which, when they contain thirty-two coupons or stamps, can be exchanged for a Certificate. There are other schemes admirably suited for different circumstances, which also reduce the work to a minimum.

Saving in the Schools.—From the outset the work has been most successfully and extensively undertaken by the schools. The Board of Education, the local education authorities, the National Union of Teachers, inspectors and directors of education and the schoolmasters and schoolmistresses throughout the country, have rendered a service to the country in this connection that cannot be valued too much or praised too highly. In April 1926 there were more than thirteen thousand school savings associations in existence.

The National Committee were confronted with the somewhat difficult problem of seeing that the work done in the schools and the habits there formed, were not lost when the children left school. For this and other reasons, it became important to establish savings associations in as many works, shops and offices as possible. The importance and social value of the work was at first inadequately recognised, but in 1926 savings associations among industrial groups are being formed at the rate of over two hundred a month. Employers can render no better service either to their employees, to the community or to the prosperity of the industry of the country than by encouraging the formation of savings associations among their employees.

In Feb. 1926 the earliest issued certificates reached maturity at the end of ten years from the date of issue, and a committee under the chairmanship of Mr. Cecil Lubbock was appointed to consider what steps should be taken in view of the approaching expiry of the term for which the certificates were issued. The committee recommended that an option should be given to all holders of first series certificates to continue to hold them until March 1932, receiving interest after the tenth year at the rate of one penny per certificate per month. This recommendation has already been adopted. The committee further recommended the issue, for the conversion of savings certificates of the first series, of a special savings bond designed to meet the needs of the small investor, and of the new 4½% conversion loan; the encouragement of early conversion of savings certificates of the first series by the grant of a small bonus on certificates converted before they have run ten years; and finally that conversion of certificates should be made possible without the necessity of encashment and reinvestment.

In order to avoid undue loss of income tax, the purchase of certificates by any one individual is limited to five hundred, and five hundred certificates of the first series have at the end of ten years a cash value of £650, whereas five hundred certificates of

the third series would cost only £400. Hence some fresh security was deemed advisable. Doubtless the holders of comparatively small numbers of maturing certificates will convert them into certificates of the current series, while other holders may decide to have the value of the maturing certificates placed to their credit in the Post Office Savings Bank. (R. M. K.)

The Publicity Campaign

Prior to the outbreak of War in 1914, Government loans in Great Britain were subscribed by a very limited circle of large investors, businesses and corporations. Publicity in connection with the floating of them began and ended with the issuing of a prospectus, its publication in the Press and its distribution by a limited number of bankers and stockbrokers.

Initial Operations.—The first attempts at the application of modern methods of publicity to the flotation of War Loans were on a limited scale, being hampered by official reluctance to depart from traditional procedure and a prejudice against any lapse from official " dignity." A slight expansion of newspaper advertising, at first not widely departing from mere " publication of prospectus " advertising, and the use of posters displayed in the streets and on hoardings, marked the beginning of a new state of things. The work of the War Savings Committee from 1916 onwards, together with news of the successful publicity work in the U.S., helped to reconcile British officialism to an increase of activity in this direction. By the time the so-called " Victory " Loan was floated, early in 1917, newspaper advertising had increased both in volume and effectiveness. Many more posters appeared on the hoardings. The services of local authorities were invoked, and public meetings were held, up and down the country, at which speakers drew attention to the country's pressing need of money and appealed openly for subscriptions. It was, however, in connection with the campaign for National War Bonds, which were first offered to the public in Sept. 1917, that organised publicity on behalf of British War Loan subscriptions displayed the fullest measure of its possibilities and achieved its greatest success. The National War Bonds were short-dated securities continuously on offer—in contrast to earlier loans the subscription lists for which had remained open only for some weeks. They were introduced by Mr. Bonar Law, the then Chancellor of the Exchequer, in order to inaugurate a period of " continuous borrowing "—to provide a method by which the public could subscribe each week the weekly cost, or more than the weekly cost, of the War. It was hoped by this means to avoid the dislocation of the money market and the inflation of currency.

Despite attractive terms the subscriptions for National War Bonds for the first two or three weeks were distinctly disappointing. Starting at an exceedingly low weekly total the receipts rapidly fell, and it says much for the extent to which publicity methods had already justified themselves that in Nov. 1917 the Chancellor of the Exchequer, faced with the prospect of the failure of the whole new scheme of continuous borrowing, saw fit to appoint Sir George (then Mr.) Sutton, the chairman of the Amalgamated Press Ltd., as Directory of Publicity for the War Bond Campaign—with a free hand as to methods employed, and, within very wide limits, a free hand as to expenditure.

Value of Advertising.—The backbone of the campaigns was undoubtedly newspaper and periodical advertising. This advertising was practically continuous, though very widely varied. The appeal of it was cast and recast in a hundred ways. It struck first the finance note, the self-interest note, the explanatory " see what you get and what security " note and then the loftier note of patriotism, of service, of exhortation to duty. The advertising was intensely human, written to appeal not merely to business men but to the people at large. It reached its highest pitch of emotional appeal during the terrible spring of 1918 when the Germans, pushing far into the Allied lines, threatened Amiens, and the whole British nation hung breathless upon the march of events. During those dark weeks the War Bond advertising told, almost day by day, the story of England in terms of Belgium; pointing out the inevitable and hideous consequences of defeat, and urging the duty of supporting with money the brave men then fighting. Appropriate " copy " was actually kept standing for immediate publication in the event of certain contingencies such as a great victory, or (on the other side of the picture) the air bombing of important British towns.

It was recognised that in order to sustain interest in War Bonds over a long period the steady appeal of the press advertising required reinforcing by periods of special activity. The necessary stimulus was obtained by the organisation throughout the country of special " weeks " such as " Tank Weeks "—" Business Men's Weeks "—" War Weapons Week "—" Feed the Guns Weeks." The main features of these were similar. They consisted essentially in the provision of some spectacular feature round which the appeal for subscriptions could centre. Tanks, for instance (then just newly invented), each with an officer and crew, took up their stand for a week at a time in the leading towns and cities. Officials of the Bank of England and of the Post Office accompanied the tanks, and many million pounds' worth of bonds were sold by them.

Forms of Appeal.—All these separate campaigns of special weeks were " led off " by spectacular displays in Trafalgar Square, London, which was transformed for each occasion into something resembling a huge circus. Tanks or guns, as the case might be, were " parked " and surrounded with skilfully built imitation trenches and entanglements; barriers and huts were erected, painted scenery was provided to form a background, giant posters almost hid the façades of the National Gallery and the buildings surrounding the Square, and hundreds of thousands of people were attracted of a class which could probably not have been reached by any other form of appeal. Carrier pigeons were also used, with great success from the point of view of publicity, to bring in applications from a distance to Trafalgar Square. Another important publicity aspect of these special weeks was the opportunity each provided for an important official opening. Thus " Business Men's Week " was preceded by a great public meeting in the Connaught Rooms, London, at which the Chancellor of the Exchequer was the chief speaker and to which all the leading bankers of the kingdom were invited. " Feed the Guns Weeks " were introduced by another great meeting at the Guildhall, addressed by the Chancellor of the Exchequer and the Rt.-Hon. A. J. Balfour. The extent of the response to these special weeks was enormous, as may be judged by one of them only, the " Business Men's Week," which brought in £160,000,000—nearly eight times as much as the average weekly total.

Apart, however, from greatly increased purchases, these special weeks, " booms " and " stunts " were very valuable as yielding a continuous " news " story. The problem before the publicity director was to maintain interest in War Bonds week after week and month after month; and had the campaign once been allowed to become a matter of routine, lacking new incidents, the " news " story of it would perforce have dropped out of the columns of the press. As it was, so great was the variety and so many the incidents that a full-size news agency had to be installed at headquarters, where a large staff was kept busily engaged in collecting news by telegram and telephone from all over the country and passing it on to the press. A successful publicity device was the inter-town War Bond race. The race, of course, was to secure the largest total of local holdings in War Bonds, and, promoted and fostered by the Publicity Director, it went gaily on for months—the varying position of the leading cities, now one leading, now another, forming for over a year an almost staple article of news.

Varied Devices.—Many other publicity devices were employed, among which the following may be noted:—

(1) Arranging with the Postmaster-General to adopt a cancellation mark carrying the words " Buy War Bonds," so that practically every citizen received a daily reminder of his duty on the envelope of every letter received. (2) A letter signed by the Chancellor of the Exchequer urging investment as a patriotic duty—sent out by the Bank of England with each dividend on a Government security. (3) A letter signed by the chairmen of banks to the individual depositors urging that deposits should

be reduced and the money invested in War Bonds. (4) A letter sent out by limited liability companies simultaneously with the dispatch of their dividend warrants, urging that the amount of the dividend should be at once invested in War Bonds.

After the Armistice a closing date for War Bonds was announced, and a very extensive final appeal was organised which brought the total of investment in them up to the magnificent figure of £1,600,000,000—subscribed in under 17 months. Publicity in connection with post-Armistice loans, notably the Thanksgiving Loan of 1919, was conducted on similar lines.

(G. A. S.)

II. THE UNITED STATES

In the United States the term Savings Movement was used in a somewhat wider sense than was the case in Great Britain. The publicity campaign carried on in Great Britain found its counterpart in the one conducted in the United States on behalf of the Liberty Loans (*see* LIBERTY LOANS).

Upon the declaration of War by the United States in April 1917 it became evident that the nation must practise strict economy if the huge War-time expenditures were to be successfully financed and material aid given to the Allies. President Wilson outlined a food control programme, after the U.S. declaration of War in April 1917, appointing Herbert Hoover Food Administrator. Congress passed the Lever Act (effective Aug. 10 1917) designed to encourage the production and conservation of supply and to control the distribution of food products and fuel. The administration of the Act was under the direction of a U.S. Food Administrator and a U.S. Fuel Administrator. The ends sought by the Food Administration were: (1) to save food and eliminate waste; (2) to distribute food equitably and cheaply; (3) to stimulate production; (4) to prevent hoarding; (5) to save transportation; (6) to provide for the needs of the U.S. Army and Navy; (7) to secure the largest possible amount of food for the Allies.

Sugar and Wheat.—The most vital early need both for America and for the Allies was the conservation of sugar and wheat. In Aug. 1917 an International Sugar Committee was appointed. It was faced by a scarcity of sugar that had sent the price of Cuban raw sugar to $9.15; this was fixed at $6.90 for the season's crop, the retail price being kept at 8½ to 10 cents per pound. From May 15 1918 the sale of sugar for manufacturing purposes was prohibited except through special permits (certificates) by which records of consumption could be kept. Retailers were restricted from selling sugar to consumers in quantities greater than 2 lb. for city residents and 5 lb. for those residing in the country, except for home canning, in which cases the dealer was required to secure certificates for the amount sold. By such means a saving of between 400,000 and 600,000 tons was effected in 1918.

The wheat shortage of the season 1917–8 left the United States with only enough of this grain to meet normal demands for home consumption. The total production of France and Great Britain was considerably less than one-third their normal consumption and it was essential that they should receive from the United States an additional 75,000,000 bushels. All manufacturers in the United States using wheat flour in the production of various foods were placed under licence and their supply was strictly limited. Wheatless days and other measures for wheat conservation were established. Mills were permitted to grind only a certain percentage of the amount of wheat milled during a corresponding period the previous year. Wholesale dealers were prohibited from purchasing wheat flour in excess of 70% of the amount they had purchased during a corresponding period the previous year. In sales to consumers the retailers were required to sell an equal quantity of substitutes to the purchaser at the time wheat flour was sold. Between 13,000,000 and 14,000,000 women pledged themselves to the conservation of wheat by the use of substitutes for wheat products. These various measures made it possible for the United States to send abroad in 1918 approximately 140,000,000 bu. of wheat.

Export of fats to neutrals was greatly restricted and the amount of fats used in bakery products limited. In 1918, 1,125,397 short tons of hog products were exported as against 839,000 in the fiscal year ending June 30 1899, the largest in any year prior to 1918. In 1918, 773,000,000 lb. of beef were exported, or over three and a half times the exports on the average of the three previous War years. These supplies were made available by the conservation of meats formerly wasted, by voluntary rationing and by the adoption in many localities of meatless days and meatless meals.

To remedy the congestion of rail terminals and keep open the transportation routes, a regulation was promulgated providing an average increase in the minimum car-loads of about 50% over those of the published tariffs of the carriers. Thus the number of cars required for the distribution of the commodities on the list of non-perishable groceries was reduced fully 25%. The Waste Reclamation Service was instrumental in reclaiming during 1918 waste material valued at approximately $1,500,000,000. The National Emergency Food Garden Corporation put 1,500,000 ac. of city and town land under cultivation in 3,000,000 gardens, resulting in an increase of the food supply to the value of over $350,000,000 in one year.

Fuel Administration.—The U.S. Fuel Administration began its work in Aug. 1917, with Dr. Harry A. Garfield as director. The Administration set out to accomplish: (1) increased production; (2) better distribution; (3) fair sale prices; (4) the elimination of waste. It succeeded largely, through agreements, in preventing strikes, with their resulting interruption of production. In April 1918 a nation-wide plan designed to insure equitable distribution of coal was put into effect. More than 5,000,000 tons formerly shipped from eastern mines to western territory adjacent to western mines were saved for the eastern states, where the demand of War industries was greatest. Rationing was put into effect, the supply of coal to non-essential industries being greatly reduced. It was estimated that this saved over 1,000,000 tons. All industries were held to their minimum needs. Stores and office buildings were encouraged to take their electric current from central plants. A "skip-stop" system was adopted on electric street railways by which no stops were made at unimportant crossings. Economy was also effected by "lightless nights," which affected window lighting, electric display and street illumination. Home instruction was given in the operation of heating systems and in the use of electricity. For several weeks heatless Mondays were observed in stores, office buildings and places of amusement. A saving of 12,700,000 tons of coal for the first half of the coal year was thus effected in addition to large economies made possible by "daylight saving" (*q.v.*). From so-called gasolene-less Sundays, involving a voluntary cessation of Sunday motoring, resulted an estimated saving of 1,000,000 bar. of gasolene.

The Conservation Division of the War Industries Board was established May 9 1918. Its purpose was to eliminate wasteful or unessential uses of labour, material, equipment and capital. Its specific aims were: (1) to secure the maximum reduction in the number of varieties of products of the various industries; (2) to eliminate accessories which used material for adornment or convenience, but which were not essential; (3) to substitute materials which were plentiful for those which were scarce; (4) standardisation; (5) reduction of waste; (6) economy in samples; (7) economy in containers and packing. By such means enormous savings were effected in textiles, paper and other materials, as well as in storage space and labour. Reductions in varieties of particular commodities held out such promise of permanent economies that this activity was later continued through a Division of Simplified Practice in the Dept. of Commerce (*see* STANDARDISATION).

The request that the people of the United States lend money to the Government to provide necessary funds for the prosecution of the World War met with an almost universal response. Over 22,000,000 people purchased Liberty Bonds and Victory Notes in various denominations from $50 to $10,000, and other millions invested in the smaller war savings securities.

War Savings Certificates and Thrift Stamps.—Section 6 of the Second Liberty Bond Act, approved Sept. 24 1917, authorised

the Secretary of the Treasury to issue war savings certificates, redeemable within a maximum term of five years from the date of issue, on which interest to maturity might be discounted in advance. A limitation of $2,000,000,000 (later $4,000,000,000) was placed by the Act upon the amount of war savings certificates which might be outstanding at any one time; a limit (later withdrawn) of $100 was placed on the amount of certificates which might be purchased by one person at one time; and no individual was permitted to hold more than $1,000 in such certificates (later $1,000 in a single issue). Four series of war savings certificates were issued—on Dec. 3 1917 (series of 1918); Jan. 1 1919; Jan. 1 1920; and Jan. 1 1921. Each certificate, in the form of a stamp, when affixed to a war savings certificate (a folder with spaces for 20 stamps) would have a fixed maturity value of $5, with the date of maturity not to exceed five years, the purchase price to vary one cent each month throughout the year of issue, beginning in Jan. at $4.12 and increasing to $4.23 in December. The stamps might be redeemed before maturity, their redemption value increasing one cent each month. There were also provided 25-cent "thrift stamps," bearing no interest and not redeemable for cash, but to be accumulated on a "thrift card" until there were 16, when they could be exchanged for a war savings certificate stamp by paying the additional odd cents necessary to cover the current price of the war savings certificate stamp.

In addition to the original securities there were offered in July 1919, Treasury savings certificates, one of $100 and the other of $1,000 maturity value. Treasury savings certificates were registered at the Treasury Dept. at the time of purchase and increased in redemption value monthly on the same interest basis as War savings certificate stamps. In Jan. 1921 there were offered for sale $1 non-interest-bearing Treasury savings stamps and $25 Treasury savings certificates, in addition to the other Treasury savings securities.

Organisation.—The sale of these securities was furthered by a National War Savings Committee, assisted by six Federal and 52 state directors. The ultimate goal was to offer every man, woman and child in the United States the privilege of aiding the Government by investing in government securities, and at the same time to develop habits of thrift. The war savings securities were put on sale at every post-office, at banks and in thousands of voluntary agencies. House-to-house canvass for their sale was made by postmen, boy scouts, representatives of insurance companies and members of women's organisations. Sales from Dec. 3 1917 to Jan. 1 1921 totalled $1,176,111,000. Redemptions in the same period amounted to $415,174,000.

Partly with a view to rendering permanent the habits of thrift imparted during the War, the War Loan organisation, through a savings division, took over, in the autumn of 1918, the work of the National War Savings Committee. It aimed to sell Treasury savings securities and to develop and protect all War issues of the Government. School Government savings systems were established and instruction in thrift, saving and the principles of sound finance was introduced into schools. (J. W. T.)

SAXONY (*see* 24.265).—A free state and territory (Freistaat Sachsen) of the German Reich. The area is 5,787 sq. m.; the population (1926) 4,970,300.

Conflict Over the Constitution.—In the years immediately preceding the World War political life in the German kingdom of Saxony was dominated by a conflict about the constitution. The Left had for years demanded a reform of the First Chamber, the Upper House, by which the predominance of the agrarians in that House should be broken, and commerce, industry and handicrafts should obtain greater influence. In Jan. 1910 the National Liberals, Liberals and Social Democrats once more introduced resolutions with this object in the Lower House, but these met with keen opposition from the Government. Notwithstanding the majority in the Lower House for the reform, it was thrown out by the Upper House. In Dec. 1917 the Government introduced a bill for the reform of the Upper House, which again led to fierce conflicts in Parliament, which only ended with the advent of the German Revolution. Simultaneously controversy concerning a new electoral law for the Lower House had been raging since 1910.

War Conditions.—Saxony, which is chiefly industrial, suffered more under War conditions than most other German States. The problems of supplying the population with food were extremely difficult. There was a widespread dearth of the most important foodstuffs, such as corn and potatoes, so that the population was frequently obliged to use substitutes.

The Revolution.—In 1917 the extreme Left in the Saxon Diet had begun an agitation, which never abated, for the early conclusion of peace. On Oct. 26 1918 the Cabinet gave place to a more liberal Government under Dr. Heinze. On Nov. 9 1918 the revolution broke out, on Nov. 10 the Republic was proclaimed, and King Frederick Augustus abdicated on Nov. 13. A Cabinet of Commissaries of the People (*Volksbeauftragte*), composed exclusively of Independent Socialists, was formed. Revolutionary conflicts in Jan. 1919, which entailed sanguinary street fighting in Leipzig, Dresden and elsewhere, led to the resignation of the Cabinet, which was succeeded by a Government of Majority Socialists. The extreme Left instituted demonstrations throughout the country, and there were serious excesses, especially in Plauen and Leipzig. In April 1919 a Soviet Republic was proclaimed in Leipzig, which was dissolved by troops of the Reichswehr under Gen. Märker on May 12. Serious disturbance followed in the Vogtland and in Chemnitz in June and August. On Oct. 2 1919 the Democratic party joined the Ministry, which kept in power till April 25 1920. It was replaced by a coalition of Majority and Independent Socialists, which was vigorously combated by the non-Socialist parties.

In the spring of 1920 formidable unrest recurred, especially in West Saxony. In Leipzig sanguinary fighting continued for several days. In the Vogtland the Communist Hölz formed a band of several hundred men, with which he conducted a reign of terror in the towns and villages. The Government long hesitated to take action against him; finally, however, Hölz's force was surrounded and dispersed by Reichswehr troops. Hölz fled to Czechoslovakia. In March 1921 he returned and took command of the Communist insurgents in Central Germany. After the collapse of the insurrection he fled to Berlin, where he was ultimately arrested, and condemned to penal servitude for life with the loss of civic rights (June 1921).

The New Constitution.—On Nov. 1 1920 the definitive new constitution was adopted unanimously by all parties. The supreme organ is the Diet (Landtag), consisting of one chamber. Its rights are only limited by those of the people, which can dissolve it, and themselves initiate legislation by means of a popular initiative (Volksbegehren) or give a referendum on measures passed by the Landtag. The Landtag elects the Minister President, who then nominates the rest of the Ministry, which, like himself, must enjoy the confidence of the Landtag. The Minister President also determines the general lines of the policy and the Ministry; his position entails real authority, but he is not the titular head of the State.

In 1923 the Zeigner Ministry, which was not able to control the Communist agitation, came into conflict with the Government of the Reich, which sent a Commission and troops to Saxony to restore order. Zeigner's Ministry was replaced by a Ministry composed of German People's Party Democrats and Social Democrats. Zeigner was prosecuted for corruption (*see* GERMANY). (W. v. B.)

SAZONOV, SERGHEI DMITRIEVICH (1866–), Russian statesman, was born in the province of Ryazan July 29 1866 the son of a landed proprietor, and educated at the Alexandrovsky Lyceum, St. Petersburg (Leningrad), a high school for the sons of noblemen destined mainly for the civil service. Having occupied various diplomatic posts in Rome and served six years in the Russian Embassy in London he was promoted, in 1906, to be Minister-Resident at the Vatican, where his engaging manners, frankness and taste for ecclesiastical affairs enabled him to make great headway. In 1909 he entered the Ministry of Foreign Affairs as coadjutor to Izvolsky, and in 1910 succeeded the latter as Minister and thus became one of the international group of statesmen into whose hands chance rather than personal ambition or specific fitness placed the destinies of their respective countries. This appointment, ascribed to the influence

of his brother-in-law, the dictator Stolypin, was so agreeable to Nicholas II., whom Sazonov attracted by his great charm of manner, that when the Minister fell ill and seemed unlikely to recover, the Tsar steadfastly refused to name a successor.

Sazonov's line of action was definitely traced for him by the European situation on the one hand and by the limitation of his rôle to that of confidential secretary to the Emperor on the other. His chief functions were to parry Austria's fitful thrusts at Serbia, to curb Serbia's explosive impatience, buoying her up with hopes of a vast legacy to fall due on the death of the Emperor Francis Joseph, and to bespeak the help of England, Italy, Rumania and Bulgaria in the coming struggle. These tasks exceeded his powers, and his abortive Near-Eastern policy did not prevent Russia's ruinous collapse during the World War, a momentous event for her allies. Although the principal governments were making ready for the "unavoidable conflict" none was rash enough to provoke it deliberately, and only one was sufficiently purblind to fancy that a ruthless campaign against Serbia might be opened without bringing on a general struggle. In this delusion, harboured by the Austrian Minister, Count Berchtold, lurked the most redoubtable danger which Sazonov and Europe had to encounter. Berchtold strove to catch Serbia on the horns of the dilemma: friendship or enmity. Turkey, the oppressor of the Slavs, he argued, having been eliminated in the Balkan War, Serbia no longer had a motive for maintaining a standing army unless meant for use against Austria. If, therefore, a friend, she must disband her army and cultivate close amity with her powerful neighbour; and if an enemy, she could not complain of being dealt with as such—neither could her protectress, Russia. In this lay the crux of the situation.

This peril might perhaps have been exorcised had Germany insisted on having a say in Austria's Balkan plans. But dreading to forfeit the support of her "last sure ally" she eschewed all preliminary conditions and felt bound withal to uphold the most extravagant sallies of her Austrian partner. This obligation proved fatal at last owing to Berchtold's resolve at the close of the Balkan War to reduce Serbia to the status of a protectorate. By way of thwarting this design Sazonov frankly announced that any attempt to force upon the Slav kingdom terms incompatible with its sovereignty would compel Russia to make the quarrel her own. But neither in Austria nor in Germany was the Tsardom credited with military strength enough to enable it to carry out this threat.

Down to the 11th hour Sazonov, eager to gain time for Stolypin's far-reaching domestic reforms, worked for peace with a fervour which won general recognition but scant success. The arrangements come to during the Tsar's visit to Potsdam (Nov. 4–5 1910) and the Kaiser's return visit to Wolfsgarten (Nov. 11) respecting the Baghdad railway, North Persia and the maintenance of Turkey, eased the strain without dispelling the atmosphere of mistrust. Sazonov was suspected of a lack of a straightforwardness by the Kaiser. Russia's diplomatic representatives abroad were largely to blame for this, and in particular the rashness or awkwardness of ambassador Charykov in Constantinople who secretly proposed to guarantee that city to Turkey and protect her from all attacks by the Balkan States in return for the freedom of the Straits. Other covert moves also lent colour to the charges of underhand dealing. For example, Turkey's prostration during the conflict with Italy suggested to her enemies, the Balkan States, a defensive alliance under Russia's patronage; and this was secretly arranged first (March 13 1912) between Serbia and Bulgaria and then (May 29) between Bulgaria and Greece.

But the difficulty of limiting the alliance to legitimate defence and the imminence of a Balkan War became forthwith so obvious that Russia alone felt incapable of dealing with the situation. Sazonov decided to seek Germany's help in overawing the Balkan States without disclosing to her the secret cause of their combative mood. He accordingly arranged an interview between the Tsar and the Kaiser at Baltischport on July 4–5 1912, which was followed by a three days' exchange of views between the German Chancellor and the members of the Russian Govt. in St. Petersburg. On this occasion Sazonov's advocacy of close co-operation between Germany and Russia was approved by Bethmann Hollweg, but doubts were again awakened concerning the Russian minister's straightforwardness owing to his concealment from Germany of the existence of the Balkan Alliance. Sazonov next repaired to London, Paris and Berlin and the Great Powers authorised him and Berchtold to announce their determination to uphold the *status quo*, so that if the Balkan States broke the peace their victory would be fruitless. But this, like most vetoes of the Powers, was ignored by the restive kingdoms and the sequel justified their disregard. By Nov. Europe was on the verge of a general war. During the crisis the Kaiser oscillated from one extreme to another; Archduke Franz Ferdinand gave proof of surprisingly sound views and Sir Edward Grey successfully discouraged the would-be belligerents. Sazonov, keeping a tight hand on Serbia, obliged her to content herself with a railway harbour on the Albanian coast, a railway connection and the secret assurance that her "promised land" lay within the dual monarchy.

Turkey's future now became one of the main cares of the Great Powers, and Sazonov, in collaboration with Bethmann Hollweg, drafted a liberal scheme of reforms for Armenia (Nov. 5 1913). Immediately afterwards Germany sent military instructors to reorganise the Turkish army and a German General, Liman von Sanders, to wield extensive powers and virtually to garrison Constantinople. Sazonov endeavoured to move the Allies to get Liman recalled or transferred to Asia Minor, but Sir Edward Grey held that a reassuring statement by the Porte would answer all reasonable requirements. Sazonov, however, gave vent to his dissatisfaction in unusually strong terms, but on the Kaiser ordering Liman to lay down the command of the first Turkish army corps, while retaining his other functions, Nicholas II. let the matter drop. Sazonov then drafted a memorandum to the Tsar on Russia's claim to the freedom of the Straits (Nov. 1913) and three months later (Feb. 21 1914) convened a council of political and military experts to discuss the ways and means of realising the scheme in case of a European war. But the military experts announced that in the plans of campaign no such side-problems could be included.

The murder of Archduke Franz Ferdinand on June 28 1914 changed the political outlook radically and supplied Austria with an opening which she utilised to the fullest extent. Berchtold was for an immediate invasion of Serbia. Count Tisza was successful in his demand that an ultimatum should first be sent, but it was in vain that he opposed the terms of the document which were obviously intended to provoke rejection. After having lost much precious time Sazonov proposed modifications which Berchtold declined to accept. He fancied that by undertaking to abstain from annexing Serbian territory he could insure the Tsar's neutrality. Russia meanwhile adopted the military measures known as "pre-mobilisation" (July 25) and the plan of a merely partial mobilisation to follow was entertained by the Tsar and Sazonov in case Serbia should be attacked. But the General Staff objected that it had no plan ready for a transition from partial to general mobilisation, and that as war seemed unavoidable the latter was imperative. Sazonov, however, still insisted on waiting. Meanwhile, Berchtold declared war against Serbia despite her acceptance of most of the humiliating conditions of the ultimatum (July 28), whereupon Sazonov's views underwent a complete change and (in the night of July 28–29) Nicholas signed the fatal edict. A belated telegram, however, from the Kaiser adjuring him to preserve peace for the sake of the monarchic principle moved the Tsar to withdraw the order for general, and substitute that for partial, mobilisation. This command was obeyed in words but the military experts having convinced Sazonov that it would be suicidal, the Minister next morning (July 30) presented himself to the Tsar and obtained his consent to the radical measure advocated by the General Staff. On the following morning this order was posted up in St. Petersburg and the catastrophe broke loose.

During the War Sazonov countered all influences tending to the abandonment of the struggle by Russia but he followed the

Tsar's lead in demanding first the opening of the Straits and the internationalisation of Constantinople and later on the annexation of the Turkish capital. The hostility of Turkey and Bulgaria deprived Russia of aid from the Allies, whereupon Sazonov made a bid for the help of the Poles in the shape of a Home Rule scheme, but the proposal was scouted in Court circles and he was dismissed from his post. Thus ended his career. His fall was gently broken by his appointment as Ambassador to Great Britain, but before he reached his destination the revolution of March 1917 had deposed the Tsar. Sazonov, however, was willing to represent the Government that had thrust aside his imperial master but it too was suddenly swept away. He was next appointed Minister for Foreign Affairs by Admiral Kolchak but played no further part in the destinies of his country.

(E. J. Di.)

SCALDS: *see* BURNS AND SCALDS.

SCAPA FLOW, an expanse of sea, in the south of the Orkneys, bounded by Pomona on the north, Burray and South Ronaldshay on the east and southeast, and Hoy on the west and southwest. The area contains seven small islands and is about 15 m. in length from north to south, and about 8 m. in mean breadth. There are two chief exits—one, 7 m. in length and 2 m. in mean breadth, into the Atlantic Ocean by Hoy Sound, and the other, $3\frac{1}{2}$ m. in length by 2 m. in mean breadth, into the North Sea by Holm Sound.

Admiral Jellicoe chose Scapa Flow in preference to the Cromarty Firth as his chief naval base, but in Aug. 1914 no preparations had been made and everything had to be improvised, guns being landed from the ships to strengthen the defences. By the middle of Oct. 1914 " U " boats were active in the neighbourhood, and on Oct. 16 an enemy submarine was reported to be in the Flow. It was recognised that the base would be unsafe until anti-submarine defences were installed, and by the end of 1914 the entrances had been adequately protected, facilities for carrying out all but the most serious repairs were installed, and Scapa Flow gradually assumed the aspect of a great naval station, which it retained to the end of the War. As a precaution against espionage, navigation in the adjacent waters was very severely regulated, and an everwidening region of the mainland (ultimately extending as far south as the Caledonian Canal) was proclaimed as a prohibited area. The German ships which were surrendered in Nov. 1918 were interned in Scapa Flow, where on June 21 1919 all the battleships and battle cruisers, with the exception of the battleship " Baden " and five light cruisers, were scuttled. Three light cruisers and some smaller vessels were beached.

SCARBOROUGH, England (*see* 24.301), had an area of 2,727 ac. (increased from 2,562 ac. in 1913) and a population of 46,179 in 1921. The town was bombarded by German cruisers in 1914 and by submarines in 1917. The castle (since repaired), the lighthouse, two churches and many other buildings in the town were damaged. The residential districts on the north and south cliffs have increased considerably, and large sums have been spent on buying and laying out the undercliff in the north and south bays, on a park with an artificial lake and on acquiring open spaces. The Floral Hall in Alexandra Gardens was opened in 1910; Londesborough Lodge has been purchased by the corporation to house the trophies given by Colonel Harrison; and the People's Palace, used as a store during the War, and subsequently closed, has also been acquired. The remains of a Roman signalling station, excavated on Castle Hill, were opened to the public in 1925, and a War memorial has been erected on Oliver's Mount. The herring fisheries have been successful, and seven firms were engaged in packing and curing in 1924. A scheme for the improvement of the harbour to meet the growing demand has been drawn up. A special excursion station, half a mile from the main railway station, has been built to provide for the large numbers of summer visitors.

SCARFOGLIO, EDOARDO (1860–1917), Italian journalist, was born at Paganico (Aquila). He was one of the most vigorous and ablest journalists of his time and an excellent newspaper manager as well as editor, although some of his journalistic methods were much criticised. He founded the *Corriere di Roma*, the *Corriere di Napoli*, the *Ora* of Palermo and the *Mattino* of Naples. It is with the latter paper, which he owned and edited for many years, that his name is chiefly associated. He was the husband of the novelist Matilde Serao (*see* 24.661) from whom, however, he had been separated for many years. He died at Naples Oct. 6 1917.

SCARLET FEVER: *see* INFECTIOUS FEVERS.

SCEPTICISM (*see* 24.306) means in Greek philosophical (σκέπτομαι) usage to hesitate, reflect, examine, consider pros and cons, unable to arrive at a decision; to surmise rather than assert. Like certain general terms it conveys one meaning to the technical philosopher, another to the average man. Strictly defined, it is denial of capacity to know reality; that is to say, the human mind, by its very constitution, can never comprehend the ultimate nature of things. For ancient sceptics, the senses deceive, therefore what seems to him to be is true for each individual, rendering fundamental agreement out of the question.

For modern sceptics, the senses alone merit reliance, and, being what they are, confine one to appearances, if not to illusion. But this meaning belongs to the rarefied region of pure theory; so much so that all-round denial has been the exception even among professional thinkers. Hence the historical importance of the less stringent, even popular usage. For, in general acceptation, scepticism commonly suggests denial of current or customary beliefs, pertaining to a definite system usually, and this, in turn, often theological.

Transitional Periods.—Taken thus as a repudiation of traditional or authoritative views, it so far tallies with the stricter philosophical definition in that scepticism has as matter of history flourished most during periods of transition when attacks upon previous systematic (or even common sense) constructions were rife. Obvious examples are furnished by the assaults of the Sophists upon the Greek cosmologists; of Pyrrho and his pupils upon the followers of Plato and Aristotle; of the Middle and New Academies upon Chrysippus and the Stoics; of Sextus Empiricus upon all the principles of Graeco-Roman thought; of Montaigne upon scholasticism; of Glanvil upon the crusted Aristotelians of the Oxford schools; of Locke upon certain aspects of Cartesianism; of Hume upon Locke and the doctrine of representative perception; of Kant upon natural theology; of L. Feuerbach upon Hegel; of agnostics upon the spiritual interpretation of nature and man; of Nietzsche upon the practical postulates of European Christendom.

All agree in repudiation of what they hold to be " overpast standpoints," and, on the whole, with the exception of the thoroughgoing Greeks and Hume, they strike at a definite group of doctrines rather than at the validity of experience itself. Thus, in the light of history, scepticism generally implies dissent from dominant judgments. It may, although it commonly does not, assert human incapacity to grasp ultimate Reality, but this remains the precise philosophical implication. And, when recent movements came in question, the more general meaning is also the more apposite, thanks to the variety, not to say confusion, of " modern " thought.

Compromise and Instability.—Hume aside, scepticism was restrained during the 17th and 18th centuries by a silent compromise which had profoundest statement from Leibniz, most popular from Paley. Rationalism and its theological ally, Deism, agreed to extend " mechanical explanation " to the known universe, always on the understanding, however, that the physical order was secondary because dependent upon a deity whose existence could be demonstrated by abstract proofs. Quite apart from its intellectualism, against which Rousseau revolted, this compromise was inherently unstable. For, as Kant was to indicate, on such premises objective validity attached only to the objects of mathematico-physical science. The euthanasia of Deism, Hume's work, put the agreement out of court.

Positivism and New Types.—Further, during the same centuries, the methods of measurement and enumeration achieved extraordinary success, so that, by 1850, a new scepticism, in the shape of positivism unaware of its own dogmas, acquired vogue.

This was the heyday of materialism. The natural universe, with "matter" as substratum, came to be viewed as a given changeless system wherein everything followed from an irreversible cosmic order. The spiritual must be accounted merely a side-issue, devoid of intrinsic reality. On this scheme gravitation, electricity, magnetism and other forces were paraded as properties of matter—all else betrayed the taint of illusion or, to be plain, superstition. The hidden postulate—that nothing is valid save sense perception—inevitably led to dogmatism. Hence new types of scepticism arose successively, agnosticism the earliest while, very gradually during the final quarter of the 19th century, more rapidly during the first quarter of the 20th, the theological aspect of the issue fell in shadow, thanks to unprecedented extension of natural knowledge and profound socio-economic changes.

The Reign of Law.—The mechanical conception of nature ruled between 1850 and 1870. The atomic theory, reverting to implications as old as Democritus, the theorem of the conservation of energy when energy was accounted a purely mechanical principle, the early hypotheses of physiology after the enunciation of the cell-theory, and the doctrine of evolution thrust into physical categories, lent seeming authority to the uniformity of "matter" as the whole import of the uniformity of nature. The "reign of law," reducing all phenomena to motion, appeared to warrant an ultimate philosophy bound to oust "Romantic" sentimentalism. Experiential test had established calculable truths, therefore it alone can guarantee the truth. In short, Hume's view, that nothing is valid save sense-perception, came to be identified with the system of actual science.

Huxley, to select the most notable name from many, did not catch the theoretical contradiction. Nevertheless, he was among the first to divine the practical difficulty. In *Evolution and Ethics* (1889), he serves notice that, whatever we may say of nature, we dare not treat it as the source of ethical judgments. Accordingly, the universe is two; experience confronts us with incommensurables, which compel agnosticism; for, as concerns the good and the beautiful, the stark unmorality of nature forces us to fall back upon principles incapable of demonstration. Beset by inner strife, experience could not rest here. Push the human factor, and, as Aliotta points out, a sensorial *mythology* is substituted for a mechanical. Exact science ceases to be a description of the course of things; its office is reduced to that of a valuable guide through the maze of events, leading to an economical adjustment of ideas. Agnosticism was quietly dispelling the notion that "force" is "rate of change in momentum;" it was casting doubt upon the grim ultimate which had taken the place vacated by the Supreme Being central to the powerful tradition of natural theology.

Naturalism.—Meanwhile, other influences were leaving their mark, and this agnosticism lost point. The conjoint results of the historical and biological sciences, all presupposing the framework of evolution, served to create a fresh positivism—naturalism. But this type of scepticism maintained itself intermittently. Its silent dogma proved too vulnerable. The doctrine that the terminology of evolution is in every way preferable, because it connects man and his creations with the other phenomena of the universe, obviously implies a plan already elaborated or informed by reason of some sort; and this order reduces to the principle that, if any event can be traced to its origins, explanation then and thereby supervenes. One kind of causality (causality itself remaining unexamined) must bear the entire burden of the possibility of the situation. Like the mechanical theory before it, predeterminate evolution, unable to abide its own simplicity, loosed fresh doubts.

Current forms of scepticism bear intimate relation to discoveries in the natural sciences and psychology, to the perspective induced by the historical outlook, and to social displacements accompanied by the development of anti-intellectualism. A summary (and therefore partial) statement follows:—

Physiologism.—Things are external to us in space. If so, the physiological conditions antecedent to perception interpose a veil between us and objects; direct knowledge is ruled out. Again, the cerebrospinal states on which perception depends may as well be effects of disturbances within the organism as of stimuli from without. Evidently, this view assumes the existence of objects out of relation to consciousness; also that one part of knowledge *is* valid, disclosing, as it does, pertinent reasons for the dubiety of perception.

Psychologism.—Granted that the mind is merely a "natural object," it occurs under the condition of time no less than of space. But reference to past time presupposes memory, and to future time anticipation. Psychologically, both are untrustworthy, therefore man is confined to the specious present. In any case, whatever may be said for knowledge derived from the past, the future baffles penetration; even "laws of nature" may alter or lapse. It would seem to follow that all experiential conjunctions are casual. Scepticism of this kind involves the dogma that hypotheses as to uniformity are inadmissible, and that objective "fact," other minds included, is at best a perilous inference. It may be added that Behaviourism is dogmatic rather than sceptical, being a subtle recrudescence of materialism.

Historicism.—This is sometimes treated as if it were identical with naturalism; that is, given an evolving series, discovery of origins suffices for "explanation," not merely of "species," but also of "values" in the spiritual and social life. The underlying assumptions are too plain to require comment. Thus, in its sceptical drift Historicism rather implies that, on review of the past, all opinions and, equally, their practical consequences, in institutions, etc., can be shown to have been bemused by hopeless diversity of judgment. In particular, thinkers, who profess to decide fundamentals, exhibit irremediable contradiction. It is absurd, then, to claim that ultimates are capable of settlement. This view involves a negative dogma, by denying the possibility of progressive insight—hypothesis can never rise to theory. The process of phenomena, each member its own witness, hides aught that may lie behind.

Pragmatism.—In so far as it embodies a mere protest against certain types of philosophy, pragmatism cannot be identified with scepticism off-hand. But, being a species of geneticism, it favours sceptical tendencies. "Logical forms and structures are distinctions *within the process* of reflective and experimental enquiry." If so, all "laws" must be judged evanescent. On this score, pragmatic geneticism and futurism are anti-intellectual. Notwithstanding, they embrace belief in the creative function of an evolutionary process (Bergson), and justify the voluntaristic creed of modernism (Blondel). Even so, the *reason* for the validity of the hypothesis is made secondary to other considerations. Consequences are *good*, because subserving happiness, etc., not *true*, because in agreement with a *ratio essendi*. Hence the sceptical thrust Truth is relative to individual activity, which, frankly, happens to be in continuous process of transmutation. Thus, truth can never be more than the best relevant, temporary adjustment; hence, all questions about the truth must be reckoned artificial. Coming in at the death, intellect can but offer bad reasons for manifest effects. Meantime, it were prudent, perhaps, to regard pragmatism rather as a search for a technique by a generation eager to formulate new values than as bare scepticism. Taken thus, it employs dogmas of its own—reality on the make in linear progress, for example. Nevertheless, it is the symptomatic philosophy of a period of disintegration, often doubtful whether the "world-spirit" be for it or against it, and seeking a criterion in "social utility."

The achievements of knowledge in modern times have rendered precise scepticism unfashionable. Moreover, the doctrine basal to scepticism is now well understood to imply a dogmatic reference. The deepest doubt has already gone beyond doubt. For the rest, temporary scepticisms would seem to oscillate between attempts to recover the irrecoverable, which necessarily land in mysticism, and protests against "conventional thinking," which, as recent movements show, run the gamut between suggestive criticism at the upper and indefensible *goujaterie* at the lower level. Being what it is, rational experience has some basis (even if we cannot as yet fathom it fully), or we must account it a miracle.

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SCHACHT, HJALMAR (1877–), German financier, was born at Tingleff, near Flensburg, Jan. 22 1877. After studying political economy, he became secretary of the *Handelsvertragsverein* (Trade Agreements League) 1901–3, and was then deputy director of the Dresden Bank until 1916. From 1916 to 1923 he was a member of the Board of the Nationalbank für Deutschland, afterwards the Darmstädter und Nationalbank. He was appointed president of the German Reichsbank in Dec. 1923. In 1924 he collaborated in the Conference of London and the deliberations of the Dawes Committee. Dr. Schacht also established the Gold Bank of issue (*Goldnotenbank*).

SCHEER, REINHARD (1863–), German sailor, was born at Oberkirchen, Hesse-Nassau, Sept. 30 1863. After serving in Cameroon and East Africa, in 1903 he was given command of the 1st torpedo division. In 1910 he became chief-of-staff of the High Sea Fleet under Von Holtzendorf and in 1913 became commander of a battle squadron. At the outbreak of the World War he was stationed at Kiel with his squadron. In Jan. 1916 he was placed in command of the German High Sea Fleet, which he led at the battle of Jutland. On July 2 1918 he succeeded Von Holtzendorf as chief of the Admiralty Staff, but on Nov. 14 1918 he was placed on the retired list, and took up residence in Weimar. Scheer's account of the battle of Jutland appears in his book *Deutschlands Hochseeflotte im Weltkriege* (1920). (*See* GERMANY: NAVAL POLICY.)

SCHEIDEMANN, PHILIPP (1865–), German politician, was born at Kassel July 26 1865. In 1903 he entered the Reichstag as deputy for Kassel, and in the course of the World War became leader of the Majority Socialists. He voted for the government's war credits and supported its policy up to 1917, when he was associated with Erzberger in the "Peace Resolution" of July 19 1917, which demanded "peace without annexation or indemnities." He was already exercising influence in German internal politics and was frequently consulted by Bethmann Hollweg. In June 1918 he became vice-president of the Reichstag, and on Oct. 3 secretary of state without portfolio in Prince Max of Baden's Cabinet. On Nov. 9 Scheidemann proclaimed the German Republic from the buildings of the Reichstag. On Nov. 10 he was one of the three Majority Socialists who formed the first Provisional Govt. of the Republic. Although violently attacked by the Spartacists and Minority Socialists as a "counter revolutionary," he undoubtedly helped to save his country from bloodshed and anarchy, and on Feb. 8 1919 was elected president of the first republican ministry of the Reich by the Constituent Assembly at Weimar. On June 20 1919 he vehemently opposed signing the Treaty of Versailles and resigned when a majority of the government decided to sign. He then resumed the leadership of the Majority Socialists in the National Assembly and subsequently in the republican Reichstag. In Jan. 1920 he was elected first burgomaster of Kassel. His reminiscences *Der Zusammenbruch* published in 1921 form a valuable historical document. (*See* also GERMANY: *Political History*.)

SCHELDE.—The dispute between Belgium and the Netherlands over the control of the Schelde estuary is dealt with in the articles BELGIUM; NETHERLANDS.

SCHENECTADY, N.Y., U.S.A. (*see* 24.319).—The population increased 21·8% in the decade after 1910, reaching 88,723 in 1920 (of whom 20,564 were foreign born),and was estimated by the Census Bureau at 102,161 in 1925. Additions of territory by 1925 had brought the area up to 10·34 square miles.

In the year 1924 when the population reached 100,000 a "progress exposition" was held specially to celebrate the following achievements: the construction of the fine, broad Erie boulevard, along the abandoned bed of the Erie canal; the construction of the Great Western Gateway Bridge across the Mohawk river, connecting the highway systems of the east and south with those of the north and west; the building of the Hotel Van Curler at the eastern bridgehead, commanding a wide view of the Mohawk valley; the installation of "intensive" street lighting; the completion of the Union College Memorial Chapel, built by public subscription; the establishment of a community chest for financing philanthropic agencies; and the expansion of the two leading industrial establishments, the General Electric Co. and the American Locomotive Company. The two latter dominating industries employed (1925) 23,000 and 5,000 persons respectively. The Schenectady establishment of the General Electric Co. is not only the largest of the company's manufacturing concerns, but it includes also the general offices and research laboratories for the entire company, and the broadcasting studio of WGY. The value of all factory products in the city was $38,165,000 in 1909, and $106,531,000 in 1919.

There were in 1925 31 public schools, with a roll of 17,840 pupils, including 1,031 in the continuation schools. The city has five parks, of a total area of 280 ac., with tennis courts, lakes for swimming and boating and four golf courses. There are 37 playgrounds for children, and a health centre, conducted by the Health Dept. which includes various specialised clinics.

SCHIFF, JACOB HENRY (1847–1920), American banker and philanthropist, was born at Frankfurt-on-Main, Germany, Jan. 10 1847. He was educated in the schools of Frankfurt and for a time worked in a bank. In 1865 he went to New York City and organised the brokerage firm of Budge, Schiff & Co. In 1875 he married a daughter of Solomon Loeb, head of the banking firm of Kuhn, Loeb & Co., was taken into the firm and, on Loeb's retirement in 1885, took his place. Largely due to Schiff's energy, the firm greatly expanded its business and became known throughout the financial world. In 1897 his house assisted E. H. Harriman in reorganising the Union Pacific Railway. In 1901 a struggle took place between the Schiff and Harriman interests on the one side and James J. Hill and J. P. Morgan on the other for possession of the Northern Pacific Railway. The resulting compromise was the formation of the Northern Securities Co. as a holding company for their joint interests (*see* 27.733). In his later years he gave much personal attention to charities, especially for the Jewish people. He was a founder and president of the Montefiore Home for Chronic Invalids, New York City. In 1903 he presented a Semitic Museum building to Harvard University. He died in New York City Sept. 25 1920. His estate was estimated at about $50,000,000. He bequeathed $1,350,000 to various institutions, most of which had received benefactions during his life.

SCHIMMEL, HENDRIK JAN (1825–1906), Dutch poet and novelist (*see* 24.326), spent his last years in work on spiritualistic research, and died at Bussum in 1906.

SCHISTOSOMIASIS: *see* BILHARZIASIS.

SCHLESWIG or SLESVIG (*see* 24.334), a district now divided between Denmark and Germany. North Schleswig (Danish) has an area of 1,938 sq. m. and a population of 166,895; South Schleswig (German) forms part of the Prussian province of Schleswig-Holstein, with a total area of 5,802 sq. m. and a population (1925) of 1,534,817.

During the years immediately preceding the World War, German officials and private societies continued their efforts to force Germanisation on the Danish inhabitants of Schleswig by colonisation of the land with Germans and discouraging the use of the Danish language. But their efforts only strengthened Danish national consciousness, so much so that in Aug. 1914 the possible effects of this spirit were so feared in Germany that a number of prominent Danes were arrested and imprisoned. Among them was H. P. Hanssen, a member of the Reichstag, who, however, was released very quickly. During the War the expression of desire for union with Denmark was silenced, both owing to the German censorship and the Schleswig Danes' anxiety not to let Denmark abandon her neutrality. Yet the hope of ultimate union with Denmark was not abandoned; in Aug. 1915 Hanssen indicated on a map to a German colleague a frontier very similar to that now established.

On Oct. 23 1918 Hanssen raised the demand for reunion in the German Reichstag; on the same day the Danish Rigsdag unanimously passed a resolution in favour of a readjustment of the frontier on the principles of nationality. On Nov. 28 the Danish

Govt. communicated its wishes to the Allies, and when the Peace Conference in Feb. 1919 reached the discussion of the Schleswig problem, a united Danish North Schleswig delegation was sent to Paris to present the Danish point of view: a plebiscite *en bloc* in North Schleswig (zone 1); a community ballot in Central Schleswig and Flensburg (zone 2) and voting rights to all those born in the voting district. The Peace Treaty, presented May 7, further provided for a plebiscite in a third zone, but this was later dropped.

On the Peace Treaty coming into force (Jan. 10 1920) an international commission took charge of the plebiscite district. Zone 1 gave 75,431 votes for Denmark, 25,329 for Germany (Feb. 10); zone 2, 48,148 votes for Germany, 13,029 for Denmark (March 14). The frontier established by the treaty of July 5 1920 gave effect to this verdict, and restored to Denmark that part of Schleswig which lies north of the Flensburg fjord, and of a line drawn approximately west from it. On July 7 the international commission handed over the executive power in Zone 1 to Denmark.

The results of subsequent elections have shown the line to be fairly drawn. The highest Danish vote polled in Germany has been 7,700 (1924)—insufficient to return a Danish representative. The German votes for the Rigsdag in 1921 and 1924 totalled 7,500, returning one member under the system of proportional representation prevailing in Denmark. In each country some Social Democrats do not vote nationally. The Treaty of Versailles imposed no special obligations upon Denmark with regard to her German minority, considering the Danish constitution to offer adequate safeguards; on the same grounds the Danish Govt. has declined the proposal for a special treaty with Germany for reciprocal protection of the minorities, a measure which might easily lead to undesirable interference by the Government of one country in the affairs of another. The Danish Govt. has, however, offered the German minority every facility to maintain and develop its culture on a German basis. The entire school system of North Schleswig has been reorganised with this view; parents are allowed to decide whether they will have their children educated in German or Danish at primary schools, while the German private schools receive grants from the State on the same condition as the Danish private schools.

(G. M. G.-H.)

SCHLICH, SIR WILLIAM (1840–1925), British forestry expert, was born at Darmstadt, Germany, Feb. 28 1840, and educated there and at the University of Giessen. In 1866 he entered the Indian Forests Department, became conservator of forests in 1871, and 10 years later inspector-general of forests to the Govt. of India. In 1886 he became a naturalised British subject. He was one of the pioneers of the study of forestry in England, organising in 1885 the first school at Cooper's Hill, which was transferred to Oxford in 1905. He was appointed professor of forestry at Oxford the same year and retained the post until 1919. Among his books on the subject are: *A Manual of Forestry* (1889–95; new ed., 5 vol., 1925) and *Forestry in the United Kingdom* (1904). In 1901 he was elected a fellow of the Royal Society, and in 1909 he was created K.C.I.E. He died at Oxford Sept. 28 1925.

SCHLIEFFEN, ALFRED, Count von (1833–1913), Prussian soldier, was born on Feb. 28 1833 in Berlin, where his father, an officer, lived. The Schlieffen family is of Pomeranian origin and is now found chiefly in Mecklenburg. Schlieffen came from the same nobility and the same province as two other great field marshals, Blücher and Moltke.

In his youth he studied for a short time at Berlin University before he became an officer. He attended the military academy (*Kriegsakademie*) and served in the war of 1866 against Austria and in that of 1870–1 against France as a general staff officer. In 1891, after following the usual career of a general staff officer, he was appointed chief of the general staff of the army. He held this position for 15 years, during which period he exercised an extraordinary influence on the development of the German general staff and the whole German army. There was ever present with him the problem of a war on two fronts which would have to be waged with a single army, far superior in numbers and material to any that had been employed in previous wars. He energetically promoted the training of general staff officers in the leading of huge armies and urged on the development of the German army's technical equipment to the end that rapid transfer and sure handling of the troops might be ensured. Finally he threw the whole weight of his position and authority into the endeavour to equip the army with mobile heavy artillery. He retired in 1907.

On his retirement he proceeded to pronounce his views on war in literary form and he is indeed far better known in his capacity of author than as chief of the general staff of the army. In military science Schlieffen was a disciple of Clausewitz, the Prussian philosopher of war, who in his turn had deduced his doctrine of strategy from Napoleon. Field-marshal Von Moltke, whose successor and disciple Schlieffen was, had also based his ideas on Clausewitz, and it was the Napoleon-Moltke strategy that Schlieffen sought to carry on. The essence of their doctrine is that the enemy forces should be not merely defeated but destroyed. To this end it seemed to them necessary that not only the front but the flanks and if possible the rear should be attacked, so that the enemy should be forced to give battle on a reversed front. Schlieffen pushed this system to its logical conclusion. He saw Germany surrounded on all sides by enemies who, together, were far more powerful than herself. It seemed to him that the only salvation lay in opposing one of the enemies with a superior force, inflicting on him a decisive defeat, and then, using a well-developed network of railways and manoeuvring on inner lines, turning upon the other enemy against whom until then a defensive attitude would have been maintained. For this end rapidly decisive blows were needed and his writings aimed at proving such blows to be possible and showing how troops could be handled for that purpose.

With a marked singleness of purpose Schlieffen sought out the appropriate examples in military history and presented them in a new guise. His works are not military history in the accepted sense; they do not purport to describe objectively the course of campaigns and battles. He used military history as a source from which to draw instances which corroborated the doctrines with which he sought to imbue his pupils and his readers. His books are in fact definitely instructional. He points sarcastically to the errors made by commanders and subordinate commanders and dismisses with cutting irony those opinions which opposed his own. It is plain from his writings how anxiously he watched the military-political situation of his own country and how apprehensive he was lest the grave hour should find, in the position he had had to leave, a man unequal to the overwhelming task. "A commander-in-chief must be inspired by something superhuman, something supernatural, call it genius or what you will."

Schlieffen died in Berlin on Jan. 4 1913, but in 1914—seven years after his retirement—he still played his part in the world's history; for on retiring, he had bequeathed to his successor, General Moltke the younger, the plan for deployment against France. This plan embodies his strategic convictions. It is at once immensely bold and also simple. Only the bare minimum was to remain facing the Russians; in the West the left flank was to be held back and the troops in Alsace were to withdraw behind the Rhine and face attack on the line Metz-Strasbourg. The bulk of the army was to deploy on the right flank and, pivoting on Metz, to drive forward against the line Dunkirk-Verdun. In this way the strongly fortified east front of France would be turned and the French army forced to give battle with a reversed front. Schlieffen intended not to give a recipe for victory, but to indicate the operative idea which, if logically carried out, would make possible the swift decision which alone could save Germany from her doom. The German army commander of 1914 considerably diluted the Schlieffen plan and, particularly in its execution, followed other courses than those pointed to by the dead strategist. And so it was that the inspired scheme of Schlieffen did not bear the fruits which were expected.

How armies are to be handled in the Schlieffen spirit the war on the Eastern front showed. The battle of Tannenberg has very justly been called a super-Cannae, and the campaign of Lodz, the German attack against the Warsaw-Thorn line—the best-conceived operation of the whole War, which was directed solely against the right flank of the Russians—rests upon Schlieffen's ideas. It was not granted to the field marshal to test his strategic thoughts in the fire of battle, but his influence on the German leadership is incontestable and his lifework cannot be ignored by anyone who intends to study the history of the World War. For Schlieffen's writings, see Graf Schlieffen, *Gesammelte Schriften* (Berlin, 1913); *Cannae*, selection from the above (Berlin, 1925).

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SCHMIDT, WILHELM (1868–), Austrian philologist and Roman Catholic priest, was born at Hörde, Westphalia. He held the chair of primitive language and culture in the University of Vienna and devoted himself to the isolation and classification of the Austric family of languages (*see* PHILOLOGY). His works include:—*Die sprachlichen Verhältnisse Ozeaniens* (1900); *Grundzüge einer Lautlehre der Khasi-Sprache* (1905); *Grundzüge einer Lautlehre der Mon-khmer-Sprache* (1906); *Die Sprachlaute* (1907); *Die Stellung der Pygmäenvölker in der Entwicklungsgeschichte des Menschen* (1910); *Der Ursprung der Gottesidee* (1912); *Ethnologische Bemerkungen zur theologischen Opfertheologie* (1912); with W. Koppers, *Völker und Kulturen* (1924); *Die Sprachfamilien und Sprachenkreise der Erde* (1925).

SCHMOLLER, GUSTAV (1838–1917), German political economist (*see* 24.344), died in Bad Harzburg June 26 1917.

SCHNITZLER, ARTHUR (1862–), Austrian playwright and novelist, was born in Vienna May 15 1862. He took a medical degree, and practised for a time as a physician. In 1908 he won the Grillparzer prize. Schnitzler first began to write plays and fiction in the 'nineties, and from that time onward his narrative powers steadily increased, while his dramatic powers hardly diminished. His style is informed by a kind of tempered realism, never quite losing sight of beauty. His province is chiefly the intellectual circles of pre-War Vienna; his problems those of love, life, death and art. His distinction is piquant and graceful dialogue. In modern costume his characters move confidently across his stage; in historical, more uncertainly; nor did his verse attain the inimitable charm of his prose.

The most remarkable of his plays are: the *Anatol* cycle (1898); *Liebelei* (1896); *Der grüne Kakadu* (1899); *Der einsame Weg* (1904); *Der junge Medardus* (1910); *Professor Bernhardi* (1912); *Die Schwestern* (1919); and the much-disputed *Reigen* (printed privately in 1903, produced in 1920). Conspicuous among his tales are the great novel *Der Weg ins Freie* (1908); and the short stories, *Lieutenant Gustl* (1901), *Casanovas Heimfahrt* (1918), Eng. trans. *Casanova's Homecoming* (1922); and *Fräulein Else* (1924, Eng. trans. 1925).

See Monographs by J. Kapp, *Arthur Schnitzler* (1912); and R. Specht, *Arthur Schnitzler* (1922).

SCHOBER, JOHANN (1874–), Austrian politician, was born and educated in Upper Austria, entering the Imperial Austrian police service as a young man, and became the Austrian president of police in 1918, some months before the revolution. On the proclamation of the Austrian republic (Nov. 12 1918), Schober immediately placed his force at the disposal of the new Government, and by this action and by his moderate conduct in general did much to ensure a peaceful and bloodless change of régime. At the same time, he succeeded in securing the safety of the ex-Imperial family, whose departure from Vienna he supervised. During the two years of social democratic Government which followed, Schober's force was reproached by extremists with being reactionary, quite unjustly, as he aimed at strict impartiality. His administrative ability, and above all, his conspicuous honesty, gained him the confidence of all moderate opinion in Austria, and especially of the inter-allied missions and advisers.

Largely because he was known to enjoy this confidence it was expected that if he were chancellor, the Allied and Associate Powers would be willing to grant the large loan necessary to restore Austria's chaotic finances, and he was selected to form a non-party ministry in June 1921. His term of office was not so successful as all friends of Austria had hoped, since the requisite loan was still delayed and Schober, more honest than brilliant, saw that his administration, minus loan, did not satisfy Austrian public opinion. Nevertheless, he really took the first step towards establishing friendly relations between Austria and her neighbours when he concluded the pact of Lana with Czechoslovakia Dec. 16 1921 (*see* AUSTRIA). This move aroused the hostility of the pan-Germans, who formed a part of the Government coalition, and who resented any pact with Czechoslovakia as putting difficulties in the way of the ultimate *Anschluss* with Germany. They withdrew from the Government coalition. The Christian Socialists were not strong enough to govern alone against the opposition of the Social Democrats. On May 24 1922 Schober resigned the chancellorship and returned to the post of president of police.

SCHOLL, AURELIEN (1833–1902), French author (*see* 24.356), died in Paris April 16 1902.

SCHÖNBERG, ARNOLD (1874–), Austrian composer, was born in Vienna Sept. 13 1874. At an early age he began to study violin and cello and also to compose chamber music. In musical theory he was self-taught. After writing a number of songs he composed in 1899 the string sextet *Verklärte Nacht;* and in the following year he commenced work upon *Gurrelieder*, a ballad cycle in three parts for chorus and full orchestra, which was eventually produced in Vienna, 1912–3. In 1903 he began his career as a teacher of theory in Vienna; meanwhile (1902–3) he had composed the symphonic poem *Pelléas and Mélisande*. Further songs and ballads followed and the years 1907–10 saw the development of Schönberg's art from the classical to the new period. He was largely inspired by the painting of Kokoschka and others who inaugurated a new artistic movement at that time. His new style was revealed in a number of piano pieces and the monodrama *Erwartung*. In 1911 he moved to Berlin and in the following year had performed one of his most famous works *Pierrot lunaire*, a cycle of 21 poems for recitation with a piano, flute, clarinet, violin and cello. In 1915–7 he was working upon an oratorio, *Jakobsleiter*, and in 1918 he founded in Vienna the society for private musical performances. A revised edition of his manual *Harmonielehre* (1911) was issued in 1922. See E. Wellesz *Arnold Schönberg* (1924).

SCHÖNHERR, KARL (1869–), Austrian dramatist, was born at Axams in the Tyrol, Feb. 24 1869. He took his degree in medicine, but soon began to devote himself to literature. He began with dialect poems of an unassuming nature and with short stories, but in 1897 he turned his attention to drama and the stage with the unpublished *Judas von Tirol*. Schönherr stood midway between realism and symbolism, and expressed himself in a vigourous and original style. His accomplished technique, applied frequently to peasant or medical life, enabled him to evolve a successful drama with a very limited number of characters. In his pieces, quite elementary and simple emotions, and the problems and crises arising out of them, are presented with inexorable consistency. His treatment was less sure in the realm of fancy or of history: his most famous drama, *Glaube und Heimat* (1910), dealing with the time of the Counter-Reformation, and also *Der Weibsteufel* (1915), have a strong Roman Catholic bias. Schönherr's other important works include *Die Bildschnitzer* (1900); *Erde* (1908); *Volk in Not* (1915); *Frau Suitner* (1916); *Vivat academia* (1922); *Es* (1923); *Hungerblockade* (1925). Most of his dramas were first produced in the Burgtheater and in the Deutschen Volkstheater in Vienna. Schönherr's other works include *Caritas* and *Aus meinem Merkbuch*, which express the same trend of thought and motif as his dramas. He won the Schiller Prize in 1908 and the Grillparzer Prize in 1911, 1917 and 1920. See monographs by Sedlmaier (1920) and Lederer (1925).

SCHOOLS: *see* EDUCATION; PUBLIC SCHOOLS; SECONDARY SCHOOLS.

SCHOULER, JAMES (1839–1920), American lawyer and historian (*see* 24.377), published in 1913 a seventh volume of his *History of the United States of America Under the Constitution*, covering the period of reconstruction (1865–71). The original plan of his work had been enlarged by the publication in 1899 of a sixth volume, covering the period 1861–5. He died at Intervale, N. H., April 16 1920.

SCHREINER, OLIVE (1862–1920), pen name of Mrs. Cronwright Schreiner, was born in Basutoland, the daughter of a German missionary. In 1882 she brought to England the MS of her first novel *The Story of an African Farm* and submitted it to George Meredith, then reader for Chapman and Hall. It was published in 1883 by this firm over the pseudonym "Ralph Iron," and proved an immediate success, entirely surpassing any of her subsequent writings in literary merit. Her later work includes *Dreams* (1891); *Trooper Peter Halkett of Mashonaland* (1897), a much-criticised attack on the first settlers in Rhodesia; *An English South African's View of the Situation* (1899); and *Woman and Labour* (1911), a fragment of an earlier MS which had been burnt during the South African War. She died at Cape Town, Dec. 12 1920. She had married in 1894 S. C. Cronwright, a member of the Cape Parliament, who afterwards took the name of S. C. Cronwright-Schreiner. He wrote *The Life of Olive Schreiner*, which appeared in 1923.

Her brother WILLIAM PHILIP SCHREINER (1857–1919), was born in the district of Herschel, Cape Colony. After studying law at Cape Town, and at Cambridge and London Universities, he was called to the Bar (Inner Temple) in 1882 and on returning to South Africa in the same year was admitted as an advocate of the Cape Supreme Court. He was for many years leader of the Cape Bar; in 1887 he entered Cape politics as attorney-general in the Second Rhodes Ministry. He was Prime Minister on the outbreak of the South African War, (1899). In 1914 he was appointed high commissioner for the Union in London, and he died at Llandrindod Wells, Wales, June 28 1919.

SCHROEDER, EDUARD (1858–), German philologist, was born May 18 1858 in Witzenhausen. He was a high school teacher in Göttingen (1883), Berlin (1887) and Marburg (1889), and in 1902 was appointed professor of German language and literature at the University of Göttingen. His publications comprise works on old German literature, modern German philology and the history of German literature. From 1890, in conjunction with Gustav Roethe of Berlin, he published the *Zeitschrift für deutsches Altertum und deutsche Literatur*.

SCHÜCKING, WALTER (1875–), German jurist, was born Jan. 6 1875 at Munster in Westphalia. He taught at the universities of Breslau and Marburg 1900–21, and in 1921 was appointed a professor at the Berlin commercial high school. In 1919 he was appointed a member of the National Assembly and chief German delegate to the Peace Conference at Versailles. In 1920 and again in 1924 he was elected to the Reichstag and became one of the leaders of the German Democratic party.

His works include: *Das Küstenmeer im internationalen Recht* (1897), "Die Verwendung von Minem im Seekrieg" (in Niemeyer's *Zeitschrift*, vol. 16), *Die Organisation der Welt* (2nd ed. 1909), *Der Staatenverband der Haager Conferenzen* (1912) (Eng. trans. 1918), *Neue Ziele der staatlichen Entwicklung* (3rd ed. 1913), *Internationale Rechtsgarantien* (1918), *Die Satzung des Volkerbundes* (2nd ed. 1924), *Garantiepakt und Rüstungsbeschrankung* (1924), *Das Genfer Protokoll* (1924).

SCHULTZ, HERMANN (1836–1903), German theologian (*see* 24.382), died in 1903.

SCHURMAN, JACOB GOULD (1854–), American educationalist and publicist (*see* 24.386), was appointed in 1912 U. S. Minister to Greece and Montenegro, serving one year. In 1915 he was first vice-president of the N. Y. State Constitutional Convention. In Oct. 1917 he was appointed a member of the N. Y. State Food Commission. He was opposed to many of President Wilson's policies, especially in connection with Mexico, and also to Article X. of the Covenant of the League of Nations, believing that it would involve the United States in war. He resigned the presidency of Cornell University in 1920, giving as his reason that every great institution was entitled to a new chief executive at least once in a quarter of a century. Appointed minister to China in 1921, he returned to the United States on leave of absence in Aug. 1924, and was appointed ambassador to Germany, March 17 1925. Among his later works are *The Balkan Wars, 1912–1913;* lectures at Princeton (1914); *Why America is in the War* (1917).

SCHWAB, CHARLES MICHAEL (1862–), American capitalist, was born at Williamsburg, Pa., April 18 1862. He was educated in the public schools and at St. Francis College, Loretto, Pa., where he gained an elementary knowledge of engineering. From 1878 to 1880 he was a clerk in a store at Braddock, Pa., and then became a stake driver in the engineering corps of the Edgar Thomson Steel Works of Carnegie Bros. & Co. His ability brought him rapid promotion and in 1881 he was made chief engineer and assistant manager. Six years later he was appointed superintendent of the Homestead Steel Works. In 1889, on the recommendation of Henry Frick, he was made general superintendent of the Edgar Thomson Steel Works, and in 1892, after the formation of the Carnegie Steel Co., he was made also general superintendent of the Homestead Works. In 1897 he was elected president of the Carnegie Steel Co., and when this was merged in 1901 in the U.S. Steel Corp. he was made president of the latter. He resigned in 1903. He then turned his attention to shipbuilding and a few years later with other capitalists secured control of the Bethlehem Steel Corp., which owned the Bethlehem Steel Co., and several other corporations engaged in the iron, steel and shipbuilding business. He was made chairman of the board of directors.

After the outbreak of the World War in 1914 and before the United States entered it, these companies filled orders for the Allies aggregating between 400 and 500 million dollars. It was generally understood that German interests made attempts to secure control of the Bethlehem works in order to shut off munitions from the Allies, and a report that Mr. Schwab was offered $100,000,000 for his interest was never denied by him. The division of the stock of the Bethlehem Steel Corp. in 1917 into two classes, A and B, the latter being publicly owned and non-voting, an arrangement designed to prevent German money from obtaining a voice in the company's control, set a precedent for later issues of this type in the financial world. After America's entrance into the War, at the urgent request of President Wilson Mr. Schwab became in April 1918 director-general of the shipbuilding board of the Emergency Fleet Corporation. His power of rousing enthusiasm among workers by personal contact immediately produced results. The resulting output for 1918 was 410 steel vessels, 106 wooden ships and 10 composite ships, a total of 526 vessels. After the signing of the Armistice in Nov. 1918, he resigned from the Emergency Fleet Corp. and returned to his position as chairman of the board of directors of the Bethlehem Steel Corporation. His benefactions include a Catholic church at Loretto, as well as buildings and endowment for St. Francis College; a church at Braddock, Pa., a school at Weatherly, Pa., and a country home on Staten Island, N. Y., for children of the New York Foundling Hospital.

SCHWEINFURTH, GEORG AUGUST (1836–1925), German traveller and ethnologist (*see* 24.392) in 1918 brought out a revised edition of his principal work *The Heart of Africa*. He died in Berlin Sept. 20 1925. His botanical and geological collections were given to the Prussian state.

SCIENTIFIC MANAGEMENT.—Originally this doctrine had reference particularly to the management of shop operations in industrial establishments, but it has been given broader significance. It holds that the accurate investigative methods of science may be utilised to discover the objective facts and laws which govern effective accomplishment of purposive effort, and that such facts and laws, expressed in standards of purpose, instruments and methods, permit control which effects accomplishment with the most economical expenditure of human and material energies.

Origins and History.—Scientific management did not originate as an argument *a priori;* it was the generalisation of an engineer

executive, Frederick W. Taylor (*q.v.*), derived from analysis of controlled experiments in management of shop operations which had been stimulated by problems arising out of particular industrial conditions. The last three decades of the 19th century in the United States were characterised by a second industrial revolution. There was rapid expansion of transportation facilities, which consolidated local markets into a national market, increase of available raw materials and of machinery for their fabrication, increase of population through immigration which enlarged both production and consumption capacity, and a consequent rapid development of large organisations to secure the advantages of large scale production and distribution. This development brought with it serious problems of management, particularly the problem of supervising and co-ordinating the work of men no longer under the immediate supervision of owner-managers. The "management movement," expressing social consciousness of these problems, was generated by these circumstances. This movement became vocal among mechanical engineers because they who were designing and installing the new machines were called upon to devise methods of control in their operation.

Moreover, the mechanical engineers, organised into a professional body (1880), had available the only forum for discussion of managerial problems. Their first attack on the problem sought a solution along the line of differential wage systems, for it was believed these would create an incentive which would accomplish indirectly the results of direct supervision. From wage incentives their attention turned to such mechanisms as cost systems, organisation and systematisation. These contributions in the early stages of the management movement were of importance, but they related to isolated phases of the management problem and did not offer any general doctrine expressing an integrated system of management.

The Work of F. W. Taylor

Taylor's Initiative.—Such a doctrine came from Frederick W. Taylor in *A Piece Rate System* (1895), *Shop Management* (1903) and *The Principles of Scientific Management* (1911). It has served as a focal point around which have gathered the various other contributions to the management movement. Taylor as a young man had been appointed gang boss in 1880 or 1881 in a machine shop of the Midvale Steel Co., Philadelphia. Eager to secure better production, he began his supervision of workers with the driving methods of foremanship then prevalent. Controversy with the workers resulted, so distasteful that his highly imaginative and inventive faculties were challenged. Believing that a prime cause of low production was destruction of workers' good will by such autocratic actions as arbitrarily changed wage rates resulting from management's lack of precise knowledge of what constitutes a proper day's work on each operation, he began a series of investigations and experiments lasting more than 17 years and having no equal outside the field of pure science.

Fortunately, within the first few months these experiments led to positive and important results. He discovered facts and laws pertaining to elements of machine operation—to shafting, belting, machine adjustments, materials and methods of manipulation—which when analysed suggested devices and procedures to increase the output per machine at lowered unit costs without additional human effort. The combination of these best elemental conditions of each operation he set up as a standard for that operation, established identical standard conditions and methods for all machines in the shop, planned and directed more carefully the flow of work under these standardised conditions, and increased the total production of the shop to a revolutionary degree. Subsequent investigations and experiments, at the Midvale Steel Co., the Bethlehem Steel Co. and other plants, served not so much to add new fundamental data to these early basic discoveries as to enlarge their significance and prove their adaption to more complicated conditions.

Taylor's Doctrine.—During the early years of these experiments, Taylor formulated no theories; he was simply first a gang boss, and later foreman and engineer, concentrated upon solving practical problems of management as they came to him. Later, stimulated by contacts at the meetings of the American Society of Mechanical Engineers, he formulated as generalisations from his observations and experiments the doctrine of scientific management.

The doctrine in the final form stated by Taylor consisted of four propositions: (1) The development of a "true science" for each operation to replace traditional, rule-of-thumb methods. This "true science" and a corresponding art for a given operation on a given machine are determined by ascertaining experimentally the combination of conditions which will yield a unit of product with least cost of human and mechanical energy, cost being chiefly a function of time consumed in the production of a unit as measured by stop-watch observations. (2) The selection of workmen and their assignment to operations in accordance with scientific analysis of their natural capacities and acquired skill. (3) Continuous instruction of workmen in the science and the art of each operation. (4) Recognition of qualitative differences, as to capacities required and the conditions of routine performance, between the function of execution in manipulating machine or tool and the function of planning and preparing work; and the grouping of operatives into two major divisions responsible respectively for these qualitatively different groups of functions.

The Management.—The group of workers concerned with planning and preparation Taylor conceived as the "management." Given a true science and art for each operation, and conditions surrounding an operation meeting the requirements of its art, the planning group is enabled to make calculations which will so co-ordinate operations and govern the flow of work as practically to eliminate delays, idle machine time and unbalanced production, to reduce investment in raw and worked materials, and to permit individual equitable wage payments in accordance with that increased productivity which inevitably results from the more perfect technical conditions and manipulation at each machine, and from the more precisely calculated control of work and co-ordination of specialised efforts under division of labour.

The Taylor System.—These propositions were the statement of a *doctrine*. The "Taylor System" is another matter; it is that *system* of practices which Taylor had built up as gang boss, foreman and engineer, from which the conclusions in the doctrines were drawn. He believed the doctrine presented truths of permanent validity, but that the details of his system would be modified by later experience. The framework of his system was as follows:—

1. A planning department in which specialist foreman and workers should (*a*) make the investigations from which are derived the science and art of each operation, formulate the art of each operation for the benefit of operatives in the form of an "instruction card," and establish and maintain standard conditions and standards of performance-time and wage rates; (*b*) plan the sequence of operations, prepare materials and equipments, and in general direct the flow of work; (*c*) check performance against plans as an aid to maintenance of standards. 2. Specification, to aid in selection and assignment of workers, indicating the physical, mental and temperamental characteristics required in workers on any particular operation or group of operations. 3. Functional foremen, *i.e.*, specialists in the different elements of execution, who should train the workers in the various operations. Functional foremanship is essentially instructional as opposed to driving foremanship.

Governing the mechanisms of the system here outlined was a policy of human relations which embraced such ideals as the following: arbitrary authority must give way to the reign of law in management as determined by investigation and experiment; managers and workers are each subject to the respective functional requirements of the same law; high wages are more important than big profits; high wages make low labour costs.

Taylor's Doctrine Restated.—Taylor was not a skilled publicist, and his statement of scientific management was not as scientific as had been his conduct and analysis of the experiments from which the doctrine was derived; yet it constituted an analysis so inclusive and logical that it has provided the dominant element in all subsequent expositions of management theory. From the point of view especially of later knowledge of social organisation and of psychological science, the significance of the doctrine becomes more impressive. It may be restated as follows:—

In modern large-scale organisation with its large investments specialisation of capital in fixed forms and division of labour, management must meet five important technical problems: 1. Conservation of the investment by greater accuracy in calculating the demands of industrial society. 2. Economy in the expenditure of productive energies by more precise specialisation of efforts. 3. More precise co-ordination of specialised efforts. 4. Economy in the expenditure of productive energies by more perfect understanding by each specialist operative of the related part he is to perform. 5. The establishment of good will among the workers to assure effective voluntary application of intelligent effort in the absence of detail supervision.

Referring to these problems in inverse order, the base for the establishment of workers' good will are: removal of the dread of intermittent employment, by more accurate determination of social demand; equitable sharing of the results of joint productive effort, by more accurate measurement of individual efforts and results in terms of standard objectives, instruments and methods; and provision for the opportunity for individual self-expression without violation of co-operative technical responsibility, by formulation of the laws of the technical situation and substitution of voluntary obedience to such laws for involuntary obedience to unstable and inconsistent individual authority.

More perfect understanding on the part of workers may be established by accurate analysis and formulation of functional relationships and of the conditions for most productive results in each elemental operation. More precise specialisation and co-ordination of specialised efforts may be accomplished by a similar analysis of functional relationships and conditions, by accurate calculations of productive capacity in terms of present and future availability, by accurate calculations of the flow of demand in terms of orders or jobs, and by understandable communications to technical co-operators informing each of his task demanded by the law of the situation. Greater accuracy in calculating the demands of industrial society is to be had by applying to the pertinent field of observation and experiment the same order of scientific method which is applied to determination of the adherent requirements of any detail operation. Practically every one of these suggested methods of solving the five basic managerial problems enumerated above were anticipated in the specific system of management which carries Taylor's name.

Dominance of a Sellers' Market.—For the emphasis on shop management in the early statements of scientific management there is an historical reason. It was conceived, formulated, published and discussed during a period when industry in the United States was enjoying a " sellers' market " (1880–1914), when the problem of management was chiefly one of production to meet a rapidly growing consumer demand. In these circumstances the applicability of the doctrine to other aspects of management did not receive especial consideration.

Development of a Buyers' Market.—However, beginning about 1921, as a result of economic maladjustments following the World War, industry in the United States experienced a "buyers' market " in which ascertainment of consumer demand and selling replaced production as the dominant problem of management. This stimulated consideration of scientific management as a doctrine pertinent to all phases of management. Utilising the methods of quantitative measurement made available by a rapidly developing statistical science, industry began to analyse consumer demand (market analysis) as it had already analysed conditions of individual machine operations, and this made possible the formulation of tasks for an enterprise as a whole and for departmental major functional units. These tasks took the form of master and departmental budgets and quotas. Market analysis and the formulation of budgets, schedules and quotas express, for the business as a whole and for its larger functional units, the major principles of scientific management—scientific method in investigation, the establishment of standards, planning and the control of operations in accordance with standards and plans.

Scientific Management in the United States

Scientific management has profoundly influenced the attitude and practice of management in the United States. This influence has been due chiefly to the fact that in a time of necessity scientific management has offered the only consistent and inclusive doctrine concerning management, and also in some measure to the increase in the number of executives in industry who have had college or university training and are accustomed to the ideas and practices of scientific method. However, the particular system of management developed by Taylor as an expression of the doctrine is to be found in reasonable entirety in but few enterprises, although many of the elements of the system, such as segregation of planning, have been widely adopted. The conservatism in adopting the particular system has been due to fear of the practical difficulty of modifying fixed habit of conduct within the personnel of large organisations, particularly the difficulty of making such modifications with a provision which effects changes without disorganising current operations, and to uncertainty concerning the reactions of workers to the doctrine as understood by them and to specific modifications of habit involved.

Relations with Labour.—The reaction of labour, especially organised labour, to scientific management has had interesting phases. Generally where individual plants have undertaken to modify their managerial methods in accordance with the doctrine, the workers concerned have been at first indifferent, later satisfied, in many instances strongly approving. However, following the Eastern Rate Case hearings in 1910, the administrative headquarters of the American Federation of Labor declared strongly against the doctrine as well as against elements of Taylor's system. The political influence of organised labour led to Federal legislation prohibiting stop-watch time study and the use of standards of performance and of remuneration, derived by time study, in arsenals and other government enterprises. This attitude of organised labour was caused by a many-sided fear of scientific management; that intensive investigation and standardisation of operating conditions and methods would break down whatever monopoly there might be in labour's special knowledge of craft skill, that wage payments in accordance with measured individual performance would break down uniform craft rates of remuneration established by labour organisations, that control of work through planning and the assignment of tasks would permit such a speeding up of operations as to impair the workers' health, and in general that these and other elements would put management in a stronger position to resist the increasing influence of organised labour.

The opposition of organised labour has gradually diminished, because labour is conscious of greater strength and security since the World War; because its observations have established the fundamental facts that scientific management's investigations include the problem of human relations in industry and disclose the technical necessity of workers' good will; and because therefore proponents of scientific management are by circumstances led toward sympathetic understanding of labour's problems.

Influence Outside the United States.—Notwithstanding the translation of Taylor's *Principles of Scientific Management* into 10 languages, the influence of scientific management outside the United States has been moderate. This is due in large measure to inhibitive mental attitudes derived from experience under different physical and social conditions of industry, and in no small measure to the fact that the meagre translated literature has not been supplemented by concrete illustrations in practice. In the United States concrete illustrations were in existence before the doctrine was formulated and published; in other countries the doctrine has been published without illustrations in practice. This has resulted in a marked difference in understanding and in influence. In western Europe the literature of discussion gives evidence of understanding of the mechanical aspects of the essential technique, but not, with certain noteworthy exceptions, particularly in France, of scientific management's advanced views concerning human relations. The literature of discussion in eastern Europe gives evidence of the fundamental misconception that scientific management connotes merely the utilisation of the various sciences in industry, and not, what is its outstanding characteristic, the development of a science of managing the elements brought together in enterprise.

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SCOPOLAMINE.—Scopolamine or hyoscine is a complex alkaloid closely related to atropine and having the chemical formula $C_{17}H_{21}NO_4$. It is laevorotary to polarised light but in its commercial form may be mixed with its dextrorotary isomer. Scopolamine occurs in varying proportions and is extracted from deadly nightshade, henbane, thornapple and a few other less-known plants. Hyoscine hydrobromide, the official preparation of the British Pharmacopoeia, consists of transparent colourless crystals which have a bitter taste, are soluble in water and have the formula $C_{17}H_{21}NO_4HBr_3H_2O$. The therapeutic dose is $\frac{1}{200}$ to $\frac{1}{100}$ grain.

Action.—The chief action of scopolamine is hypnotic, a condition very similar to natural sleep being induced. This usually lasts for about six hours and the patient wakes up with an unclouded mind but may complain of thirst and dryness of the mouth and throat. In some cases a stage of excitement, giddiness and incoherent speech may precede that of sleep, and it is this uncertainty of action which renders the drug somewhat unreliable. A certain degree of tolerance is produced after prolonged exhibition of scopolamine so that the dose has to be increased to have the same effect.

Administration.—Scopolamine by itself does not relieve pain, so that for anaesthetic purposes it is usually combined with morphia. Some such mixture as:—Morphine gr. $1\frac{1}{6}$, Scopolamine gr. $\frac{1}{100}$, is injected hypodermically, the scopolamine being repeated as necessary in doses of gr. $\frac{1}{400}$. This "twilight sleep" method does not produce surgical anaesthesia, but has the double action of dulling pain and producing loss of memory. It is thus useful in labour, especially when the process is likely to be prolonged, as in primiparae. In these cases the initial dose should be given when the first stage is well established. The patient should then fall into a somnolent condition from which she is partially roused when each pain occurs. To obtain the best effect, the patient's ears should be plugged with cotton wool, her eyes bandaged, and the room kept perfectly quiet. The chief disadvantage in the "twilight sleep" method in labour is that the child may be born in an apnoeic condition and a considerable time may elapse before regular respiration is established. If skilled attention is available, however, it is rare for the baby to suffer any ill effects. The action of the drug upon the foetal heart appears to be negligible. If forceps have to be applied or any other form of instrumental delivery is necessary, an inhalation anaesthesia will have to be administered in addition.

"Twilight sleep" can also be used as a preliminary to the various types of regional analgesia. For instance, a severe operation can be performed under preliminary morphine-scopolamine injection and subsequent spinal analgesia without the patient being aware that he has been moved out of bed.

Some anaesthetists also use the drugs as a preliminary to general anaesthesia, such as nitrous oxide-oxygen. This method undoubtedly lessens the apprehension of a nervous patient and has the advantage that less general anaesthetic is necessary, but it tends to depress respiration so that cyanosis and a difficult administration may ensue. The breathing may in fact become so shallow that the requisite depth of anaesthesia may be impossible to attain. The blood pressure also tends to fall, while the eye and other reflex signs which are useful in estimating the depth of anaesthesia can no longer be trusted.

Again, scopolamine-morphine is definitely contra-indicated in children, in severe abdominal operations and in cases of intestinal obstruction, as the drugs may tend to increase the paralysis of the gut. Furthermore, it should not be given to patients who are known to have an idiosyncrasy for either of its constituents. For these reasons, scopolamine-morphine should not be used as a routine preliminary injection but should be reserved for selected cases.

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SCOTLAND (*see* 24.412).—The history of Scotland from 1910 to 1925, apart from an important ecclesiastical movement, to which reference will be made later, resolves itself largely into the effect of the World War, and of the conclusion of peace, upon social, industrial and political conditions. For matters that affect Scotland as a part of Great Britain, the article GREAT BRITAIN should be consulted.

By the military operations of the War Scotland was affected only to a small extent; Zeppelins attacked Edinburgh and did considerable damage on April 2 1916, and there were further raids upon Scotland in May and in Aug., but on both occasions the airships lost their way and dropped their bombs in rural areas. On the other hand, for the first time in the history of Great Britain as a seapower, the main activities of the Fleet were conducted in Scottish waters, from Aug. 1914 to the surrender of the German fleet on Nov. 21 1918. It was in Scapa Flow that the crews of 70 German men-of-war scuttled their ships on June 21 1920. An incident of the naval warfare was the bombardment of the remote island of St. Kilda on May 15 1918, when damage was done to the church and some other buildings. The part played by Scotland in supplying man-power, and in providing munitions of war, was worthy of the national tradition; the Clyde, naturally, took the chief part in naval construction and repairs, but all over Scotland munition factories came into existence—the largest was built at Gretna in 1915.

Politics.—Since the conclusion of the War a great change has occurred in the political complexion of the country. The Representation of the People Act (1918) increased the number of voters from 800,448 at the general election of Dec. 1910 to 2,211,178 at the general election of Dec. 1918. It also severed the last link with the old tradition of Scottish parliamentary representation by its redistribution of constituencies; the shire ceased to be the unit of county representation, and the old Scottish system of the separate representation of groups of burghs was almost entirely abandoned. With the change in the electorate came a break in the traditional fidelity of the Scottish constituencies to the Liberal party. In Dec. 1910, Scotland returned 58 Liberal, 11 Conservative and three Labour members; in 1918, when a proportion of Liberals supported the Coalition Govt., there were 58 Coalition, seven Labour, seven Liberal and two Independent members. After the break-up of the Coalition, in the autumn of 1922, the Liberal representation was 28, against 29 Labour and 15 Unionist members. In 1923 the Liberals were reduced to 22, and in 1924 to nine; the Labour members were increased to 35 in 1923 but fell to 24 in 1924; the Conservatives held 16 seats in 1923 and 40 in 1924. One Independent, with a leaning to Labour, was returned at each election, and in 1922 an avowed Communist was elected for the Motherwell division of Lanarkshire.

Land and Temperance Legislation.—The social life of the country was affected by a number of important legislative enactments, most of which were passed immediately after the War. With regard to land tenure, a considerable change has been made by the Small Landholders (Scotland) Act of 1911, by which the Scottish Land Court (which among other duties decides upon applications for small holdings and fixes fair rents) was constituted, the earlier Crofters Acts were extended and amended, and a Scottish Board of Agriculture was created. Further provision for the acquisition of land for small holdings was made by the Land Settlement (Scotland) Act of 1919, which widened the range of activities of the Board of Agriculture.

A pre-War measure which came into operation in 1920 was the Temperance (Scotland) Act of 1913, which provided that

local authorities, on the receipt of signed requisitions from electors in their areas, should take a poll on three alternative resolutions dealing with the number of licences in an area, viz., (1) that there should be no change in the system of licensing, (2) that the licensing court should grant not more than 75% of the licences previously in existence and (3) that all licences in the area should be withdrawn, except, in special circumstances, to *bona fide* hotel and restaurant keepers, who might be allowed to sell drink to residents in hotels or to persons taking meals at restaurants. The areas were defined as burghs of a population not exceeding 25,000; separate wards in larger burghs; and parishes in the counties and the voters as electors to town councils in burghs and to parish councils in the counties. A no-licence resolution requires 55% of the recorded votes in a poll of not less than 35% of the electors in order to be carried; a limitation of licences requires only a bare majority vote in a similar poll, and where a no-licence resolution is not carried the votes given for no-licence are added to those given for limitation. Polls were held in Nov. and Dec. 1920, in 580 out of 1,221 polling areas; in about 300 of the remaining areas no licence existed. Five hundred and nine areas voted for no change, 35 for limitation of licence and 40 for no licence. The contest of 1920 was fought by the Temperance party upon a prohibition programme, and the result was rather a repudiation of prohibition than an indication of satisfaction with existing licensing conditions. Subsequent polls, taken on requisitions made in accordance with the Act of 1913, have not seriously modified the results ascertained in 1920, and it has been generally felt that the Act requires amendment, especially in the definition of an "area" as a single ward in the larger burghs, which must be treated as a whole in order to render possible a more equal distribution in any reduction of licences; in Glasgow the withdrawals of licences after the polls of 1920 were chiefly in middle-class residential districts.

Education.—Just after the close of the War the machinery of the system of education was reorganised, with a large increase of expenditure, both national and local. The English Education Act of 1918 marks an era in State provision for education, and the Education (Scotland) Act which accompanied it swept away the system of parochial or burghal school boards created in 1872. Five large burghs, Edinburgh, Glasgow, Aberdeen, Dundee and Leith, remained separate educational areas (the number was reduced to four by the amalgamation of Leith with Edinburgh in 1920); elsewhere the area is the county, including the burghs within its bounds. Electors to the administrative bodies (known as Education Authorities) are persons registered as local government electors, and voting is conducted on the principle of proportional representation. Education authorities are empowered to expend money on the provision of food and books for the children, and also to give assistance to qualified persons attending a university or training college. The maintenance of a limited number of fee-paying schools is permitted. Nearly all the pre-existing voluntary or denominational schools have been transferred to education authorities in accordance with a provision of the Act; the teachers in such schools are appointed by the local authority after being approved, as regards character and religious belief, by the denomination concerned. The Act contemplated an extension of the school age to 15 years and the provision of an elaborate system of continuation schools, but its provisions have only been partially carried out. Contemporaneously with these developments in elementary and secondary education, the Treasury grant to the universities was largely increased, and, since the end of the War, private benefactions have greatly improved the teaching equipment of all four universities, and especially Glasgow and Edinburgh.

Housing.—The depression in trade and commerce which followed the unproductive activity of the War period and the short post-War "boom" has deeply affected Scotland, and the "heavy" industries in the Clyde valley, and in the Glasgow area generally, have suffered very severely. It is in this area that difficulties in regard to housing have been most severely felt, and the housing problem and the operation of the various Rent Restriction Acts, have been complicated by a series of unfortunate incidents. A decision in the Scottish Law Courts, in the case of Kerr v. Bryde, upheld on appeal to the House of Lords in Nov. 1922, invalidated notices of increase of rent under the Rent Restriction Act of 1920, unless actual notice to quit had been given to the tenant for the date on which the increase was to operate. This decision, interpreting a carelessly drafted statute, placed many owners of houses, chiefly among the poorer classes, in a very difficult position, and also affected the collection of local rates which had been levied on the increased valuation. In Jan. 1924 the eviction of the defender in this case from a tenement in the burgh of Clydebank was followed by a "rent-strike," which produced considerable embarrassment not only to landlords and factors but also to the municipal authorities and the Scottish Office. An intervention by Mr. Adamson, the Secretary for Scotland in the Labour Govt., was unsuccessful, and the struggle, in the course of which eviction scenes caused great local excitement, was not terminated until 1925. An effect of the controversy was to check any private building, and the housing schemes of local authorities have been hampered by trade union disputes and by a scarcity of bricklayers, masons and plasterers. The Royal Commission on Housing estimated the shortage of houses in Scotland in 1917 at over 121,000; official figures show that up to Oct. 1925, only 34,639 houses had been built, and 12,791 were in process of construction, in Scotland, under the Housing Acts of 1919, 1923 and 1924. The failure of Scottish local authorities to solve the housing problem led to Government intervention at the end of 1925.

A reflection on the condition of trade, and possibly of housing, is to be found in the report of the Registrar-General for Scotland for 1923, which estimated the population in the middle of that year at 4,901,100, a decrease of 3,356 upon the estimate of the previous year, though an increase of 18,603 over the figures of the 1921 census. This decrease, a novel feature in statistics of the population of Scotland, is attributed to emigration, the number of emigrants in 1923 showing an excess of 52,345 over the number of immigrants.

Presbyterian Reunion.—A main feature of national interest since the War has been the development of negotiations for a union of the Church of Scotland with the United Free Church; the latter is itself the result of a union between the Free Church and the United Presbyterian Church in 1900. With a view to the reunion of the two great branches of Scottish Presbyterianism, the Church of Scotland obtained in 1921 an Act of Parliament the effect of which was to transform the relations of the Church with the State, and to give the Church liberty both "to adjudicate finally in all matters of doctrine, worship, government and discipline," and to interpret and modify (within the limits of Trinitarian Protestantism) the Articles of the Constitution, which were scheduled in the Act. This legislation removed the difficulties, of historical origin, that led to the Disruption of 1843, but it was felt that the system of endowment also required a readjustment, after the lapse of nearly three centuries since the settlement made in the reign of Charles I. In April 1922 a departmental committee was appointed by the Secretary for Scotland, with Viscount Haldane as chairman, and it made recommendations most of which were embodied in the Church of Scotland (Property and Endowments) Act, 1925.

By that measure the system of endowment has been altered, subject to a reservation of the life interests of existing ministers. Each parochial stipend, which had hitherto been paid by the heritors or proprietors to the minister of a parish, the amount varying with the prices of agricultural produce each year, will become a fixed charge upon the land, payable not to the minister of a parish, but to the general trustees of the Church of Scotland, and the trustees may arrange for the redemption of the charge by the heritor. Redemption, by payment either of one capital sum or of instalments spread over eighteen years, will be compulsory upon all heritors liable to an annual charge exceeding one shilling and not exceeding one pound; liability for an annual payment of one shilling or less will be extinguished. In the past it has been customary in parishes (numbering about 360 out of

884) in which the whole teind had never been assigned in payment of stipend, for ministers to make from time to time applications for augmentation of stipend from the "free" or surplus teinds, and such applications were heard and decided by judges of the Court of Session sitting in the Court of Teinds. This process will now come to an end, but one final application, within eleven years of the passing of the Act, may be made in the case of each parish, and, if it is upheld by the court, the resulting augmentation will follow a scale laid down in the Act.

A further important change is effected by the Act in regard to upkeep of parish churches and manses, a burden which has hitherto been borne by the heritors. They will now be required to put churches and manses into a reasonable state of repair (if necessary), and to hand them over to the general trustees of the Church, who will be responsible for all future repairs. Glebes will also become the property of the trustees, but churchyards will be transferred to the parish councils. After the extinction of existing vested rights, the revenue received by the general trustees as representing any particular parish will be applied in the first place to meeting the requirements of that parish, but the General Assembly of the Church will have power to decide upon such requirements and to transfer any surplus to a fund which will be at the disposal of the Assembly. A body of Scottish ecclesiastical commissioners has been appointed under the Act to give effect to a number of its provisions, including the transfer of endowments to the general trustees of the Church.

The two Acts of 1921 and 1925 were promoted by the Church of Scotland for the purpose of removing "the main causes keeping the two Churches apart," and while the Act of 1925 was passing through its last stages in Parliament the General Assembly of the United Free Church passed, by a majority, a resolution recognising the progress achieved in this direction, and ordered its presbyteries and congregations to send to the Assembly of 1926 indications of their opinions upon the desirability of union.

An ecclesiastical event of minor importance which aroused widespread interest both in England and Scotland was the appointment, on the recommendation of the Labour Govt., of Mr. James Brown, M.P., as Lord High Commissioner to the General Assembly of the Church of Scotland in 1924, the first instance of the selection of a commoner for this post since 1643. The King and Queen themselves visited Edinburgh in Oct. 1922, when they unveiled the memorial to King Edward at Holyrood, and again in July 1923, when they gave a reception and a garden party in the palace.

Scottish National Library.—The year 1925 witnessed the institution of the National Library of Scotland. The Library of the Faculty of Advocates, founded in Edinburgh in the reign of Charles II., was given the copyright privilege by the Copyright Act of Queen Anne, and it became one of the great libraries of the United Kingdom. It was the property of the Faculty of Advocates, which, though its library was open to the public, bore the whole responsibility for maintenance and upkeep. Even before the War this burden was too heavy for a small body of professional men, and the rise in prices after the Armistice rendered it impossible for the Faculty to maintain the library on the old scale and to continue the facilities given to the public. In 1922 the Faculty offered to transfer the library, with the exception of the collection of legal books, to the nation. The Government replied that in the existing state of the national finances it was not possible to accept the proffered gift and to undertake the financial responsibility for the library, but made an annual grant of £2,000 as a contribution towards the cost of upkeep and use. A small endowment trust was formed to raise an endowment sufficient to meet the requirements of the Government with a view to the transfer, and in June 1923, within a few days of the announcement of the creation of the trust, Mr. Alexander Grant (afterwards Sir Alexander Grant, Bart.), intimated a gift of £100,000, the sum stipulated by the Treasury. Negotiations were at once resumed with the Government, whose acceptance of the offer of the library was announced in the House of Commons on June 28. Arrangements for the transfer, and two changes of Government, delayed the passage of a bill which became in 1925 the National Library of Scotland Act. The library is now administered by a body of trustees, some of whom are *ex officio*, and others are appointed by the Crown or by administrative and educational authorities or are co-opted by the trustees. The books continue meanwhile to be housed in the premises belonging to the Faculty of Advocates, which retains in its own possession its collection of professional law-books, but has included in its gift to the nation such part of its existing premises as is not needed for its own administrative purposes.

Miscellaneous.—The most important municipal developments have been the inclusion of the burghs of Govan, Partick, Pollokshaws, and some suburban districts within the city of Glasgow by an Act of 1912, and a further extension of the municipal boundaries of Glasgow by an Act of 1925; the amalgamation of Edinburgh with Leith, and the absorption of the suburban districts of Liberton, Colinton, Corstorphine and Cramond by the city of Edinburgh in 1920; and the amalgamation of Motherwell with Wishaw in 1920. Among miscellaneous matters of interest may be mentioned a series of gifts of historical buildings to the nation—Dryburgh Abbey by the late Lord Glenconner, and Melrose Abbey by the Duke of Buccleuch in 1918, the farm of Ellisland, in Dumfriesshire (occupied by Robert Burns from 1788 to 1791) and Duddingston Loch, near Edinburgh, in 1923. Kelso Abbey, Restenneth Priory (Forfarshire) and Inchcolm Abbey have also been placed under national custody. On the other hand, by an outrage attributed to women suffragists, Scotland lost, on Feb. 26 1914, the church of Whitekirk (East Lothian), one of the few beautiful pre-Reformation churches. A feature of the period has been the increased number of state visits paid to Scotland. An accession Court was held at Holyrood in 1911, and, except during the War, courts have been held periodically in Edinburgh and visits have been paid to other towns. An awakening interest in Scottish history has been shown by a number of celebrations—the quincentenary of the university of St. Andrews in 1911, the sexcentenary of Bannockburn in 1914, the septcentenary of the burgh of Dumbarton in 1922 and the septcentenaries of the foundation of the cathedrals of Elgin and Dornoch in 1925. An announcement, made by the Prime Minister in Dec. 1925, that the Government intends to restore the office of Secretary for Scotland to the dignity of a Secretaryship of State was a recognition of a Scottish demand which had been persistent for years.

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(R. S. R.)

SCOTT, CHARLES PRESTWICH (1846–), British editor and journalist, born at Bath, Somersetshire, on Oct. 26 1846, was the youngest son of Russell Scott. He was educated privately and at Corpus Christi College, Oxford, where he graduated with a first class in 1869. After training under Alexander Russell of *The Scotsman*, he, in 1871, began a long connection with *The Manchester Guardian*, of which his brother-in-law, J. E. Taylor, was proprietor. He himself became editor in 1872, and, after the death of Taylor in 1905, also chief proprietor. He enlisted the services of W. T. Arnold and many of the leading critics of literature, art and music of two generations, so that the paper became one of the foremost journals of the day. Gradually developing from Whiggism to advanced Liberalism, *The Manchester Guardian*, as directed by Mr. Scott, was always sober in tone and scrupulous in policy. It lost nothing by its opposition to the Boer War or its reluctant acceptance of the breach with Germany, and able articles on the strategy of the World War appeared in its columns. The policy of Irish Home Rule was zealously advocated, as well as women's suffrage and proportional representation. After the War a weekly edition and a commercial supplement were instituted. The centenary (1921) of the foundation of the paper was celebrated, not only by the

issue of a special number to which foreign and Dominion statesmen contributed, but by a dinner to the editor attended by eminent men of all political parties. Always active in local politics, after three unsuccessful contests for the representation of North-East Manchester, Mr. Scott was elected Liberal M.P. for the Leigh division of Lancashire in 1895 and sat till 1906.

SCOTT, SIR GILES GILBERT (1880–), British architect, born Nov. 9 1880, was the son of George Gilbert Scott and grandson of Sir George Gilbert Scott, R.A. Educated at Beaumont College, Old Windsor, he began to practice in London in 1902. In the following year his designs for the projected cathedral at Liverpool were accepted, but, in consideration of his youth, G. F. Bodley, R.A. was associated with him as joint architect. In July 1904 the foundation was laid by King Edward, the corner stone of the chapter-house by the Duke of Connaught in 1906, and the Lady Chapel was completed in 1910. After some delay occasioned by the World War, the consecration took place on July 19 1924, in the presence of King George V. and Queen Mary. Designed in Gothic style it was the first Anglican cathedral built in the northern provinces since the Reformation, and when completed, will be the largest church in Great Britain. The exterior is of red sandstone and the building is specially adapted for lighting by electricity. Chief among the other works of the architect are the Church of the Annunciation, Bournemouth; St. Manghold's Church and Presbytery, Ramsey, Isle of Man; the Chapel of the Visitation Convent, Harrow; and new buildings at Clare College Cambridge. Scott also did restoration work on Chester Cathedral. He was elected A.R.A. in 1918, R.A. in 1922, and was president of the Architectural Association in 1920–1. He was knighted after the consecration of Liverpool Cathedral in 1924. (*See* ARCHITECTURE.)

SCOTT, SIR PERCY MORETON (1853–1924), British sailor, was born July 10 1853. He entered the navy in 1866 and served in the Ashantee War 1873–4, the Congo Expedition 1875 and in the Egyptian campaign of 1882. In 1893 he was promoted captain and in the following year became a member of the ordnance committee. In 1896 he took command of the cruiser "Scylla" and came into prominence as the inventor of the "dotter" and "deflection teacher" devices, which signified an important advance in the evolution of naval gunnery. He served with the Naval Brigade in the South African War, when he got the naval 6-in. guns up to Ladysmith and in 1900 assisted the International Brigade in China during the Boxer Rebellion. In 1903 he took command of the gunnery school ship "Excellent," in 1905 became rear-admiral and inspector of target practice and in 1908 was promoted vice-admiral. Created K.C.B. in 1910 in recognition of his services, he was made a baronet in 1913 and retired in March of the same year with the rank of admiral. On the outbreak of the World War he returned to the service and was for some time in charge of the air force defences of London. Sir Percy Scott later became an advocate of the submarine, and was strongly opposed to the building of battleships. He died Oct. 18 1924. He wrote *Fifty Years in the Royal Navy* (1919).

SCOTT, ROBERT FALCON (1868–1912), British sailor and explorer, was born at Devonport June 6 1868. Entering the navy in 1882, he became a commander in 1900, and led the National Antarctic Expedition in 1901–4 (*see* 21.966). On his return he was promoted captain, and commanded successively the "Victorious," the "Essex" and the "Bulwark." In 1910 he set out in command of another expedition to the Antarctic (*see* POLAR EXPLORATION). A party of five under Scott reached the Pole on Jan. 18 1912, but on the return journey the severity of the weather prevented them from reaching supplies at One Ton depôt with the result that they perished on or about March 27 1912. On Nov. 12 1912 a search party found Scott's tent, containing the bodies of Scott, Dr. E. A. Wilson and Lt. H. R. Bowers, as well as Scott's records and diaries, in which was given a full account of the journey and the deaths of Captain Oates and Petty Officer Edgar Evans, the other two members of the party. On Feb. 14 1913 a memorial service was held in St. Paul's Cathedral, London, and a Mansion House fund was subsequently raised to make provision for the surviving relatives of the lost explorers. The rank and precedence of the wife of a K.C.B. were by royal warrant conferred on Captain Scott's widow.

SCOTTISH-GAELIC LITERATURE (*see* 5.635).—In the period 1910–25 the literary use of Scottish Gaelic probably increased. A greater respect for the language, greater desire to become proficient in it and to use it both in speech and in writing were apparent. Among the reasons for this were the continuous activity of An Comunn Gàidhealach, the position which Gaelic now occupies in the universities and in the leaving certificate examination for secondary schools, and above all the clause in the Education Act of 1918, which enjoins that Gaelic shall be taught in all schools throughout the area in which the language is spoken.

Two new forms were attempted with considerable success, the novel and the play. Examples of the former are John MacCormick's clearly written tale of *Dùn Àluinn* (1912), Angus Robertson's *Antogha Mór* (1913), episodical but vigorous, and James MacLeod's *Cailin Sgiathanach* (1923), a thoughtful and well-constructed romance. The authors are Islesmen. The most notable of the plays are perhaps *Mairead* by Archibald MacCulloch, and *Rath-innis* by John MacCormick.

The MacDonald Collection of Gaelic Poetry (1911), edited by Rev. Archibald MacDonald and Rev. Angus MacDonald, contains many pieces hitherto unpublished, some of which are of great merit. A volume of contemporary poetry, entitled *Bardachd Leòdhais* (1916) by natives of Lewis was edited by Ian N. MacLeod; another Lewisman, Murdo Morrison, produced his work under the title of *Fear Siubhal nan Gleann* (1924). In 1688 and following years Duncan Macrae of Inverinyate in Kintail made a MS. collection of poetry, some of it by himself, known as the *Fernaig Manuscript*, written on a phonetic system of his own. Most of it has been dealt with by various scholars from time to time, and in 1923 Malcolm Macfarlane published a complete revised text together with a fairly successful rendering into ordinary spelling. Fifteen poems addressed to Gaelic nobles from the phonetically spelled *Book of the Dean of Lismore* (c. 1530) appeared in *An Gàidheal*, restored by Prof. W. J. Watson, who also edited *Specimens of Gaelic Poetry, 1550 to 1900* (1918) and *Specimens of Gaelic Prose, c. 1000 to 1910* (1915).

During the World War 19 booklets for the use of British Gaelic-speaking soldiers were issued by the Scottish Churches under the editorship of Rev. Malcolm Maclennan and Prof. Donald Maclean, and were much sought after and appreciated. Among new editions may be named the *Songs of Duncan Macintyre* (1912), edited with translation by G. Calder, the *Spiritual Songs of Dugald Buchanan* (1913), edited by Prof. Donald Maclean, and the *Poems of Alexander MacDonald* (1924), edited with translation by the editors of the *MacDonald Collection*.

Mrs. K. W. Grant's *Aig Tigh na Beinne* (1911) is a collection of short stories and sketches. The Hon. R. Erskine edited three volumes of *An Rosarnach* (1917, 1918, 1921) consisting of poems and essays by living writers. Iain Moffatt-Pender's *Mo Nighean Donn Bhòidheach* (1924) is a collection of sketches, including an account of a walking tour on the West Coast, remarkable as being written by a man who has learned to speak and write Gaelic within recent years. Messrs. Blackie & Son published, under the general editorship of Prof. W. J. Watson, a finely produced series of school readers, six in all, of which the prose part is specially written.

An Gàidheal, formerly *An Deo-Gréine*, the monthly magazine of An Comunn Gàidhealach, included many Gaelic articles and essays which obtained prizes at the annual Mòd. The monthly magazines of the Presbyterian Churches have Gaelic supplements, and while all are good, the supplement to *Life and Work*, edited and written by Rev. Donald Lamont, is of quite outstanding literary merit. Gaelic articles form part of the *Transactions* of the Gaelic Society of Inverness, which in 1925 had produced 30 volumes of valuable matter. It is unfortunate for scholarship that the *Celtic Review* ceased during the World War and was not revived. Its 10 volumes included, among much else of value, the text and translation by Prof. Mackinnon of the

Glenmasan Manuscript and of the Gaelic version of the *Thebaid of Statius*. Miss Frances Tolmie gave to *The Journal of the Folk-Song Society* (No. 16) 105 songs of Occupation from the Western Isles, forming a most important contribution towards the preservation of our traditional music and poetry. Mrs. Kennedy-Fraser and Rev. Kenneth Macleod published three volumes of *Songs of the Hebrides*.

Alexander Macbain's studies in *Place Names, Highlands and Islands of Scotland* (1922) were collected in one volume edited by Prof. W. J. Watson. A. R. Forbes's *Place Names of Skye and Adjacent Isles*, though of far less authority, contains much useful information. A most useful dictionary in three volumes, containing the gist of all previous dictionaries, together with new material, was completed in 1911 by E. MacDonald (E. Dwelly), who not only compiled the book but also printed it with his own hands. In 1925 a serviceable *Pronouncing and Etymological Dictionary*, containing Gaelic-English and English-Gaelic, was produced by Rev. Malcolm Maclennan. A list of books printed in the Gaelic of Scotland, entitled *Typographia Scoto-Gadelica*, appeared in 1915, compiled by Rev. Donald Maclean. A. O. Anderson's two volumes of *Early Sources of Scottish History A. D. 500 to 1286* (1922) is a learned and indeed monumental work of over 1,450 pp. of text and 105 pp. of index, a work which, though not in Gaelic, was possible only for a competent Gaelic scholar. (W. J. W).

SCRANTON, Pa., U.S.A. (*see* 24.476), "the anthracite capital," had a population of 137,783 in 1920, of whom 28,568 were foreign born; and 142,266 in 1925 (census bureau estimate). Russians and Lithuanians, Italians and Poles had become more numerous in the mines and in the general population than the Germans, Welsh and English who predominated in earlier days; and diversified industries had developed until the number of wage-earners in factories was larger than the number of coal-miners. The leading manufactures of the district were silk, lace, lace curtains, buttons (3,000,000 a day), phonograph records, hydraulic machinery, cotton and woollen fabrics, mining machinery and heavy hardware. The output of the establishments within the city was valued at $26,365,000 in 1909; $54,630,000 in 1919; $64,169,077 in 1923. Anthracite mining, however, was still the dominating industry: coal-mine operatives were a fifth of all persons engaged in gainful occupations in 1920; breakers, culm piles and surface subsidence were visible evidence of the work underground; and whenever a long suspension or strike occurred, as in 1912, 1922 and 1925 it affected seriously the whole economic fabric of the city.

SCRIABIN, ALEXANDER NICHOLAEVICH (1871–1915), Russian composer, was born at Moscow on Christmas day 1871 (O.S.). His father was a lawyer; his mother, a good pianist and pupil of Leschetitsky, died when he was one year of age. His schooling was received in the Moscow Cadet Corps, but he never showed any liking for the military career for which he was intended, and at 18 entered the Moscow Conservatory of Music where he was a pupil of Safanov and Tanier. On leaving the conservatory Scriabin was greatly helped by the patriotic music publisher Belayev, who brought out his earlier works and arranged a European piano recital tour for him. At 20 he returned to Moscow and joined the conservatory staff. Later he again travelled, this time for six years, visiting the United States amongst other countries. He then settled in Brussels for some time, and in 1910 returned to Moscow. In 1914 Scriabin visited England, giving two piano recitals, playing his own Concerto and appearing as pianist in his *Prometheus*. He was then suffering from a tumour of the lip, from which, soon after his return, he died, April 14 1915.

As a composer Scriabin represents what may be called the classical school carried forward to its most advanced point. The form of his sonata and symphony movements he derives from Mozart, through Beethoven; however bewildering these may at first sound, they will be found, on a second or third hearing, to be laid out on essentially the Mozart-Beethoven lines. In his pianistic idiom and general pianistic qualities of style, Scriabin derives largely from Chopin, of whose work he was a great admirer. All this then indicates a conservative side to his composition, but he was more radical in his harmonies, and it was, probably, largely the novelty of these that retarded appreciation of his later works. Gradually he evolved what may be called a new scale or, from another point of view, a new chord. It consists of the upper partials of the fourth octave from the fundamental note, less two (taking C as the fundamental note—C, D, E, F♯, A, B♭ or, arranged as a superposition of fourths, as Scriabin most frequently uses them, C, F♯, B♭, E, A, D). The hint of this new harmonic scheme may be seen in the earliest compositions, and its development was fairly regular and consistent, until it came to dominate his later output. In his later works he discards entirely the old key signatures. In his orchestration Scriabin calls for a large force, and uses it very freely: his scores are excessively contrapuntal in texture, the various instruments moving very independently and weaving together their respective themes: muted brass plays a large part in his orchestral colour scheme. In the First Symphony a chorus is used in the finale; the "Poem of Fire" also uses a chorus, but in an orchestral way, no words being supplied. For the last-named work the composer also wrote an optional part for a "Tastiera per luce," or keyboard of light, the intention being that varying colours should play upon a screen as the work was being performed. The composer was greatly interested in theories as to a correspondence between the musical scale and the scale of colours. In his great *Mystery* (left unfinished at his death) music, dance, speech, perfume and colour were to be combined; this work was to be rather a work of ritual than of art, and was to express its author's idealistic mysticism through the medium of 2,000 participants.

It is usual to look upon Scriabin's musical work as largely the expression of theosophical views, and undoubtedly much of his inspiration was drawn from the works of Blavatsky and others. He was not, however, a close reader, or a careful thinker. Seizing the main idea of a book or a creed, he would neglect the details, and the imagination would quickly develop a huge scheme of thought having little relation to what he had read. The titles of many of his works and of their separate parts, and the marks of expression affixed to particular passages, indicate plainly the existence of a spiritual "programme." The emancipation of the human soul through ceaseless striving, and its achievement of self-expression, may be said, very roughly, to represent the general sense of the spiritual basis of Scriabin's musical works.

The works of Scriabin have been variously classed into periods. A logical classification is into four periods as follows: 1st period, with a strong Chopin influence; the dividing line between this and the 2nd period runs through the First Symphony, and the 2nd period shows some Wagner and Liszt influences; the dividing line between this and the 3rd period runs through the Fifth Sonata, and a 4th period begins with the "Poem of Fire."

Works.—Orchestral: Revery (*op* 24); Symph. I. (26); Symph. II. (29); Symph. III., or Divine Poem (43); Symph. IV. (54): *Prometheus*, or "Poem of Fire" (60). Piano: Sonatas I. (*op.* 6); II. (19); III. (23); IV. (30); V. (53); VI. (62); VII. (64); VIII. (66); IX. (68); X. (70). A very large number of preludes, études, impromptus, mazurkas, poems, etc., including the great "Vers la Flamme" poem and the much-discussed last work, the Five Preludes (*op.* 74). Piano and Orchestra: Concerto (*op.* 20). No songs or chamber music are included in Scriabin's output. (P. A. S.)

SCRIPPS, EDWARD WYLLIS (1854–1926), American newspaper publisher, was born at Rushville, Ill., June 18 1854. He was brought up on a farm in Winchester Co., O., and in 1872 joined the staff of the Detroit *Evening News*, of which he became city editor in 1875. Three years later he founded the Cleveland *Penny Press*, which under his direction achieved immediate success. He gradually acquired other journals in Ohio and elsewhere, which later became known as the Scripps-Howard group. In 1896 he, in conjunction with M. A. McRae, formed the Scripps-McRae Press Assn. for the purpose of providing his various papers with cable news. He also, in 1901, organised the Newspaper Enterprise Assn., with the object of supplying features to local papers. In 1908 the Scripps-McRae Assn. was merged with the Publishers' Press Assn. and the Pacific Coast Press Assn. under the name of the United Press Assn., Mr. Scripps holding a controlling interest. In 1917 his health broke down under the strain of war work and in 1920 he retired from business activity. In 1924 he transferred control of his various interests to his son Robert P. Scripps. He died on board his yacht in Monrovia Bay, Liberia, W. Africa, March 12 1926, having spent the last four years of his life in cruising around the world.

SCULPTURE (*see* 24.488).—In the years immediately preceding the World War Rodin remained the dominant influence in all schools of sculpture, although by then all his most vital works had been created. However posterity may judge him, it must at least see in him the beginnings of the spirit of revolt against academic art, which is the distinguishing feature of this

period and which had made the rebirth of the craft possible. Rodin himself was not free from the curse which was to a great extent responsible for the decline of sculpture—the use of the full-scale model from which skilled masons or bronze founders produced the finished work. But the passionate emotions of his figures prepared the world for a type in which the presentation of beauty is not necessarily the aim of the artist; and the controversies which centred around the "Age of Bronze" and the "Balzac" showed that sculpture was becoming an art to be reckoned with and not one concerned chiefly with official monuments and the graveyard. The revolt became partly a matter of technique, and the younger artists recognised that only by working in their material themselves could they hope to approach the living art of the great periods of sculpture.

These earlier years were the period of the Vorticists in England, the Post-Impressionists in France and the Futurists in Italy—societies which stated their views with exaggeration—a form of propaganda now generally recognised. Their members were neither madmen nor inefficient artists, but searchers after an art the secret of which had been lost. Their experiments led them into all manner of odd by-ways, but they remained true sculptors, if at times their intentions are difficult to understand, and they have originated a type of sculpture which may ultimately be of considerable importance in the history of art.

I. GREAT BRITAIN

Epstein and Gaudier-Brzeska.—Developments in sculpture in Great Britain since 1910 begin with the work of two foreign artists, the American-born Epstein and the Frenchman Gaudier-Brzeska. Jacob Epstein (*q.v.*) came into general notice in 1908 with his masterly series of figures on the British Medical Assn. building in the Strand. These figures, with their close affinity to archaic Greek art and their essentially sculptural qualities, were followed by a number of experiments in abstract art conceived under the influence of the Vorticist movement, such as the marble group "Two Doves" (1913) and the marble figure of Venus (1914) with its broad planes and monumental structure—one of the most important pieces of sculpture of recent times. The bronze "Christ" (1917–9) foreshadows in its rugged surfaces and intense power of characterisation the long series of bronze portraits of his later period, of which the bust of Lord Fisher in the Imperial War Museum is typical. The much-discussed panel of Rima in the Hudson memorial in Hyde Park is a fine example of the sculptor's direct stone-cutting and extraordinary feeling for form.

Henri Gaudier-Brzeska (b. 1891, killed in France 1915), worked almost exclusively in this country. From his intimate connections with the Vorticists he may be considered as an English artist. Among his expressionist works are "The Dancer," a crouching figure in brown varnished stone, "The Singer" in stone, "The Embracers" (1912–3) in marble and the marble "Seated Figure" (1914)—almost his last work. Three of his more naturalistic figures are in the Victoria and Albert Museum. Eric Gill studied at the Chichester school of art. His early works were exhibited at the Chenil Galleries in 1911, and others have been shown at the Goupil and other galleries in London. His most important commissions have been the low relief "Stations of the Cross" (1914–8) in Westminster Cathedral and a second series in the cathedral at Bradford (1921). The majority of his works, of which the "Boxers" (1913) is typical, are examples of direct stone-cutting. He has also made war memorials for Bryantspiddle in Dorset, Chirk in North Wales (1920) and Leeds University ("The Money Changers")—the latter an example of his unequalled skill as a designer of beautiful lettering.

Frank Dobson (*q.v.*) owes a great deal of his unusual technical skill and knowledge to his work with the sculptor Reynolds-Stephens and the Cornish granite cutters. His first works, of which "The Concertina Man" (1919) and "The Man Child" (1921) are perhaps the most typical, are definitely Cubist in their inspiration. In his later sculpture, such as the figure of "Cambria" and the "Susannah" he has freed himself from the conscious restraint of these earlier figures and has evolved a style of great charm and real sculptural feeling.

The figures of Laurence Atkinson are of a more advanced type, reaching at times the region of pure abstraction. Alan L. Durst worked at first almost entirely in ivory. Since 1921 he has carved a number of important works—excellent examples of direct cutting—which include a wood statue of "The Virgin and Child" (1922) for the Dominican Priory, Haverstock Hill, London. Another "direct" worker is Professor Ernest Cole, who has made groups for the London County Council buildings.

War Memorials.—Among the many War memorials scattered over the country, the group comprising the memorial to the 24th Div. in Battersea Park (1924) by Eric H. Kennington is of interest. The majority, however, are of a more academic type, and most of the well-known sculptors have contributed typical examples of their art. Very accomplished works, if at times a little tedious, they give a fair idea of sculpture of the official class—no better and no worse that that of other countries. The younger sculptors who have executed memorials are John Angel, the Scottish artists Thomas J. Clapperton and W. Reid Dick, Thomas Mewburn Crook, Richard Reginald Goulden, Charles Sargent Jagger, Leonard Jennings, Leonard Stanford Merrifield, Louis Frederick Roslyn, Newbury A. Trent, F. J. Wilcoxson and Alan G. Wyon. In the Durban memorial, Phoebe and Harold Stabler have made a new departure by the use of glazed terra-cotta applied to a huge granite cenotaph.

II. THE UNITED STATES

The United States, with its mixed population, has not yet developed a national school of sculpture, and the constant influx of foreign artists, bringing with them their own typical art, makes such a development more difficult. George Grey Barnard, who was strongly influenced by Rodin, may be considered as the first sculptor whose conception of form and feeling for material are in keeping with modernist tendencies. He is chiefly known in England by his massive figure of Abraham Lincoln, which was refused by London in favour of the more florid statue by Saint-Gaudens, but accepted by Manchester. The most ambitious of his works is the series of groups commissioned by his native State of Pennsylvania for the Capitol of Harrisburg. His later work is well shown in the group "Adam and Eve."

Paul Manship.—To a later generation belongs Paul Manship (b. 1885), although his work, modernist at first sight, is strongly infused with classicism. His figures and groups have a superficial charm which it is difficult to criticise, but they have little feeling for sculptural form. His bronze statuette "Little Brother" (1912), his portrait of his infant daughter Pauline (1914) and his "Dancer and Gazelles" (1916) in the Luxembourg, Paris, are most representative of his eclectic style. The same characteristics are to be seen in the work of several other American sculptors, for example Albert Henry Atkins, Leo Friedlander and Carl Paul Jennewein. Gaston Lachaise received his training in Paris and went to America in 1905, working for a time with Manship. In his earlier figures and animal subjects he shows a vivid power of sculptural simplification, although his later model for a heroic figure for the Telephone and Telegraph building in New York misses some of this quality.

The work of Alfeo Faggi is at times strongly reminiscent of that of the Serbian Meštrović, especially in a figure of St. Francis of Assisi. He has made a number of other statues in which there is the same mystic quality, and his portraits point to considerable powers of characterisation. The Russian painter Maurice Sterne also excels in portrait busts. Among the more advanced American sculptors John Mowbray-Clarke has attained a certain sculptural quality by means of the flattening of his planes and Cecil de B. Howard in such works as his group "Afternoon of a Faun" and other figures shows a definite experiment in the search for a new means of expression.

The work of the more conservative sculptors was well illustrated in the exhibition held in New York by the National Sculpture Society in 1923. In the mass it is not essentially different from that produced in England, and the figures of Chester Beach,

FIG. 1. "The Boxers"; Relief, Eric Gill. FIG. 2. "Susannah"; Frank Dobson. FIG. 3. Portrait of the Artist's Mother; I. Meštrović. FIG. 4. "Two Natures of Man"; George G. Barnard.

(By permission of: 1. Ernest Benn Ltd. 2 and 3. The Sculptor. 4. Museum of Art, New York.)

SCULPTURE

FIG. 5. Lord Fisher, J. Epstein. FIG. 6. "Head of a Woman"; A. Maillol. FIG. 7. "Little Brother"; P. Manship (Detroit Museum of Art). FIG. 8. "The Kneeling Woman"; W. Lehmbrück.

(By permission of: Fig. 5. Imperial War Museum, London. Copyright of the sculptor. Fig. 7. The sculptor. Fig. 8. Photo, P. Cassirer, Berlin

Jo Davidson, Arthur Lee, Malvinia Hoffmann and two artists of English origin, Leonard Craske and John Gregory, fulfil all the canons of academic art. A foreign temperament is discernible in the vigorous work of the Czechoslovak, Albin Polásek. Among the many sculptors of animals are Hunt Diederich, Heinz Warneke (who has carved some admirable figures in brass), Laura Gardin Fraser, Edith Barretto Parsons and Herbert Heseltine (who exhibited in London in 1925). Grace Mott Johnson has made reliefs of animals which have some of the charm of primitive sculpture.

III. FRANCE

Although Rodin did not die until 1917, his work is eminently that of the 19th century in its treatment of plastic forms. A man of immense genius, he made the rejuvenation of sculpture possible and yet at the same time the very facility of his art rendered this rejuvenation more difficult. In the large collection of his works which he gave to the British nation in 1914, and which is now in the Victoria and Albert Museum the two main aspects of his sculpture are clearly visible. The "Age of Bronze" has the quality of cubical content and repose common to all great work; the " Prodigal Son," in its restlessness and broken outline, is of a type only too frequent in modern art. Much recent sculpture on both sides of the Channel has been influenced by this easier, ephemeral side of Rodin's art—helped by the skilled bronze founders of France.

Maillol and Bourdelle.—Aristide Maillol (b. 1861) studied painting at the École des Beaux Arts, coming later under the influence of Gauguin and the Post-Impressionists. By the production of numberless figures of women in various materials he has arrived at a type of static beauty combined with an architectural unity of structure which gives him a foremost place among living sculptors. Rodin's figures are shown at a moment of critical intensity, Maillol's have a restfulness and dignity devoid of all passion. Rodin with his enormous technical skill overstrains his material to capture some fleeting aspect of the emotions; with Maillol the figure and the material grow together and result in an architectural beauty and intelligibility of form closely akin to the monuments of the Egyptians. Among his larger figures the "Pomona" in the Morosoff Museum at Moscow and the dainty " Flora " are typical of the static quality of his art, and even in the works in which movement is involved—such as the well-known relief of " Two Lovers " and his large bronze figure " Action Bound "—the repose and monumental quality are not sacrificed. A few of Maillol's works were shown in the Matisse exhibition at the Leicester Galleries in 1919; among them was his first terra-cotta sketch of a reclining woman for the memorial to Cézanne to be placed in the Garden of the Tuileries. His later works include a war memorial at Banyuls-sur-Mer and a bronze torso exhibited in 1923.

A third artist whose works have had a great influence on modern French sculpture is Emile Antoine Bourdelle (b. 1861 at Montauban). As a young man he became attracted by Rodin, with whom he remained for a number of years. His early work was strongly influenced by his master, but gradually he evolved a more monumental and less emotional style, reminiscent rather of the work of Dalou. His reliefs for Perret's Théâtre des Champs Elysées (1912–3), with their extraordinary fertility of invention and power of design, were a new step in the direction of architectural decoration, paralleled only by Epstein in England and Metzner in Germany. His more recent works are the monument to the Polish poet Mickiewicz (1917), the figure of " The Virgin and Child " (1920–2) erected on the Vosges and the colossal monument to the Argentine general Alvear (1923).

Charles Despiau and Joseph Bernard, in their search for sculptural harmony, may be regarded as followers of Maillol. Despiau has made a number of heads which have at times the quality of Roman portraits or the charm of the Florentine renaissance. Bernard is chiefly known by a number of statuettes and groups, such as his " Girl with a Pitcher " (1912) in the Luxembourg and his " Woman and Child Dancing." Among his sculpture *en taille directe* the marble " Singer " in the Grenoble Museum is a good example. His larger works include a half-length granite figure " The Prayer," " The Voice," also in granite, in the Lyons Museum, and a monument to Michel Servet.

The Expressionists.—With the works of Archipenko, Lipschitz and Brancousi we approach a type af sculpture utterly different from all that had preceded it. It has little or no relation to nature, and must be judged purely from the emotional or aesthetic effect which it has on the spectator. Alexander Archipenko, a Russian, is the greatest exponent of this " expressionist " school. His earlier works, such as the bronze torso of 1909 and his plaster group " Two Women " (1912), have qualities which identify his aims with those of Gaudier-Brzeska in England. His "sculpture-paintings "—uniting form with colour in the manner of Egyptian bas-reliefs, and his " non-being " sculpture, are experiments in purely abstract art which have a strange aesthetic appeal. Other important figures are the marble torso of a woman (1913) in the National Gallery of Berlin and a bronze figure of a woman (1921) in the Rotterdam Museum. Archipenko has had schools in Paris and Berlin and is now settled in New York. With him may be grouped the Russian, Jacques Lipschitz (b. 1891) and Henri Laurens. A typical work by Lipschitz is his panel of " Musical Instruments " (1919).

It is an axiom of modern sculpture that form should be influenced by the material. But many of the most advanced sculptors consider that materials have their own forms and individual characters, and should therefore not be given a resemblance to something that nature has created in another material. This is exemplified in the art of Constantin Brancousi, a Rumanian working in Paris. Three works which were shown at the Chenil Galleries, Chelsea, London, in 1925 were especially noteworthy for their beautiful technical qualities.

IV. OTHER COUNTRIES

Germany.—Although in the 19th century German sculpture had become involved in the morass which had engulfed the art in all European countries, yet the tradition of craftsmanship which had always been the distinguishing feature of German art enabled it to develop, more quickly than in any other country, a modernist style of its own. The earlier lead given by Hildebrand (d. 1921) was eagerly followed by numbers of young artists encouraged by the foundation of the Berlin Sezession in 1899. The colossal " Battle of the Nations " monument at Leipzig, which was completed by the Bohemian, Franz Metzner (1870–1919), in 1912, is a typical development of Hildebrand's theories of architectural sculpture. The influence of Rodin is evident in the early figures of George Kolbe—for example, the " Dancer " (1912) and the Heine monument (1913) at Frankfort-on-the-Main. His style becomes more formal in his later work, two examples of which, the " Water Nymph " (1920) and the " Portrait of a Russian Girl " (1925), were shown at the 29th exhibition of the International Society held at the Royal Academy in 1925. Maillol, rather than Rodin, is the inspiration in the work of the Swiss Hermann Haller, Ernesto de Fiori (b. 1881, the son of an Italian father and a German mother) and, to a lesser degree, Karl Albiker. The " Kneeling Man " (1921) in the Berlin National Gallery is typical of Haller's work. In the sculpture of De Fiori can be seen the struggle between the southern and northern elements of his mixed parentage. The bronze figures of a " Standing Man " (1917–8) at Hamburg and a " Woman " (1919) at Bremen have a vivid sense of surface modelling superimposed on a construction almost primitive in its starkness. In the " Walking Man " he attacks again the same problem of action so successfully overcome by Rodin in his " St. John the Baptist " 40 years earlier.

Although in point of date a contemporary of these artists, Wilhelm Lehmbruck (1881–1919) shows yet another stage on the road towards the " absolute " sculpture of the present day. In his large " Kneeling Woman " at Berlin (1911), Mannheim and elsewhere, in spite of the elongated and attenuated figures, he has attained great rhythmic beauty of form; in " The Thinker " at Berlin the function of thought has become spiritualised. Among his last works are a monument to the fallen (1915–6) and a seated figure of a naked man now placed on the Ehrenfriedhof

at Duisburg, the sculptor's birthplace. Fritz Huf (b. 1888 at Lucerne), who owes much to his early training as a goldsmith, may be regarded as a follower of Ernesto de Fiori and Lehmbruck. The influence of Maillol is again to be seen in the earlier figure of Bernhard Hoetger (b. 1875), but his later work has many of the characteristics of negro art. The modernist movement is carried further by his pupil Emy Roeder in her series of figures of women—" Puberty " (1918), " The Moorlander " (1919), " Pregnancy " (1919) and her group of " Two Horses " (1919)—and by Milly Steger in her graceful dancing figure " Jephtha's Daughter."

The later works of Herbert Garbe, such as his two groups of " Death " (1919) and his " Eros " (1920), show little of the spirit of Maillol which imbued his earlier figures, and in his naked man " Upward " the emancipation from classical art is complete. Ernest Barlach works almost entirely in wood, and has carved a number of reliefs and figures of Russian peasants and beggars, which show strong characterisation combined with extraordinary sense of movement. Kurt Edzard has executed many female figures in terra-cotta and bronze showing the influence both of Rodin and Maillol. " The Bather " and the life-sized figure " Nuna," both of 1923, have a strange individual sense of plastic beauty. Among the modern experimenters in the principles of abstract art are Hermann Obrist, Karl Hermann, Oswald Herzog, William Wauer and Rudolf Belling.

Yugoslavia.—Ivan Meštrović (*q.v.*) studied in Vienna, and the influence of the Secession and Metzner is obvious in his work. He obtained universal recognition at the Rome international exhibition in 1911, and later at the war-time exhibition held at the Victoria and Albert Museum in 1915, and his large series of figures in connection with a projected temple at Kosovo seemed to indicate a new force in European sculpture. In all these works, of which the portrait of the artist's mother is a typical example, there is the feeling of seriousness, even depression, so common to the Slav temperament; but the technical skill, depth of religious sentiment and patriotism—which are the keynote of his early work—are undeniable. With the proclamation of Yugoslav unity in 1918 the religious and patriotic influences have become less insistent, and his later works seem to point towards the development of a freer plastic conception.

Toma Rosandić was born at Split (Spalato) in 1878, the son of a marble mason. He studied for two years in Venice, and later worked at Vienna with Meštrović, who exercised a great influence on his art. He exhibited at Zagreb in 1910 and at Rome in 1911, and became known to the British public by his exhibitions at the Grafton Galleries in 1917–8, Edinburgh in 1918 and Brighton in 1919. The majority of his early works were destroyed at Belgrade during the War. An important feature of his later work is the series of large figures cut in wood, in which he shows great technical powers, and a certain charm and sculptural feeling which is at times absent in the work of his more famous compatriot.

Italy.—Up to within comparatively recent years the influence of classical art and its derivative, the sculpture of the Renaissance, was paramount in Italy, as may be seen from the groups connected with the colossal Victor Emanuel II. monument (1915) at Rome. The work of the younger men, which is little known in this country, shows the divergent influences of Rodin and the Viennese school, but there are few exponents in " expressionist " sculpture.

Among the more important sculptors of religious subjects are Ermenegildo Luppi (whose " Pietà " was one of the most impressive works in the Rome exhibition of 1921), Corrado Vigni, Guido Calori, Nino Galizzi, Giovanni Manzoni and Libero Andreotti. Andreotti also excels as a portraitist. Amleto Cataldi exhibited a number of works in Paris in 1923, from which his figure " Girl Combing Her Hair " was acquired for the Luxembourg. Adolfo Wildt has made portrait busts with strongly simplified planes, of which that of Mussolini is characteristic; by him is a charming symbolic marble relief of " The Virgin with Three Children." The animal sculptors include Sirio Tofanari, Rembrandt Bugatti and Renato Brozzi. Important works have also been produced by Antonio Maraini and Giuseppe Graziosi (both of whom exhibited extensively in the Venice exhibition of 1924), Nicola d'Antino, Michele de Benedetti, Attilio Selva, Claudio Botta and L. de Stefanis.

Belgium.—Joris Minne (b. 1866 at Ghent) was trained at the Ghent Academy, at Brussels under van der Stappen and at Paris. His early works—such as " The Fountain with Five Kneeling Youths," the " Bricklayer " and the Volders monument—had a mystic idealism and a sculptural feeling which was rare in a world accustomed to the florid realism of Meunier. In his more recent figure of a " Young Man Holding a Shell " and various figures of " The Virgin and Child," the starkness and tendency to abstraction shown in his first works has been modified, with a resultant rhythm which is reminiscent of the figures of Maillol.

A complete contrast to Minne's severe sculpture is that of Rik Wouters (1886–1916), whose early death, one of the tragedies of the War, was a great loss to Belgian art. His work is essentially modern, and is marked by a bold and vigorous execution. Among his portraits, those of the painter James Ensor, " M. H. Elslander " and " Madame G.," are important. Other young sculptors whose work is worthy of mention include Ernest Wynants, who worked with Wouters, Josef Cantré, Oscar Jespers, Dolf Ledel, Schirren, De Kat and Gustave Fontaine.

The Netherlands.—An important feature of modern sculpture in the Netherlands is the success with which it has been utilised in architectural decoration and the strongly nationalist art which has been evolved. J. Mendes da Costa and Hendrik Albert van den Eijnde may be regarded as the originators of this style—the latter being more especially concerned with architectural sculpture. Tjipke Visser, J. C. Altorf and L. Bolle—followers of Mendes da Costa—have made some interesting animal studies. Visser has also executed a large number of statuettes and has exhibited at all the European art centres. In his work for the Scheepvaarthuis at Amsterdam (1915–6), for which he made nine granite figures, Van den Eijnde was assisted by Theo van Reijn, who decorated the Polytechnic high school (1921) and other buildings at Delft. Hildo Krop—whose work approaches that of Gaudier-Brzeska more nearly than that of any other Dutch sculptor—and Jan van Lunteren have done important work on public buildings at The Hague and Rotterdam. By the former sculptor are the Albert Hahn monument at Amsterdam (1919) and the marble clock for the Rotterdam Town Hall (1920). Lambertus Zijl also shows in his architectural sculpture the features to be found in the best modern Dutch work—a strong feeling for decorative forms combined with a treatment almost cubist in the simplicity of its planes. Among other sculptors are Johan Raedecker, Herman Frederik Bieling, Bernard Richters, Gijs Jacobs van den Hof, Adrianus Remiëns and Johan Polet.

Denmark.—Foremost among the younger sculptors of Denmark is Einar Utzon-Frank, professor of sculpture at the Royal Academy at Copenhagen. Some of his works were included in the exhibition of Danish art held at Brighton in 1912, and a larger selection was shown at the Leicester Galleries in 1924. Most typical of his art are the small bronze figures of women, which recall the work of Joseph Bernard, as also do those of Johannes Bjerg, Mrs. Old Wagner and Willie Wulff. Kai Nielsen has made a number of large groups for Copenhagen. The figures by Svend Rathsack are more academic, and in his figure, " Adam " (1914) he shows considerable sculptural ability. J. P. Dahl-Jensen has modelled a number of animal groups.

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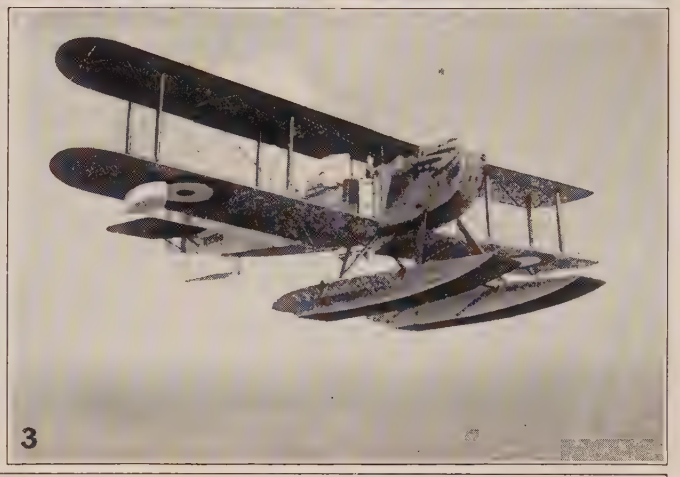

FIG. 1. Fairey "Titania" Seaplane. FIG. 2. Blackburn "Velos" Torpedo-carrying Seaplane. FIG. 3. Fairey III D Seaplane. FIG. 4. Curtiss Seaplane (Winner of 1925 Schneider Cup).

Courtesy of Fairey Aviation Co. (Figs. 1 and 3); Blackburn Aeroplane & Motor Co. (Fig. 2); "Aero Digest" (Fig. 4).

SEAPLANES

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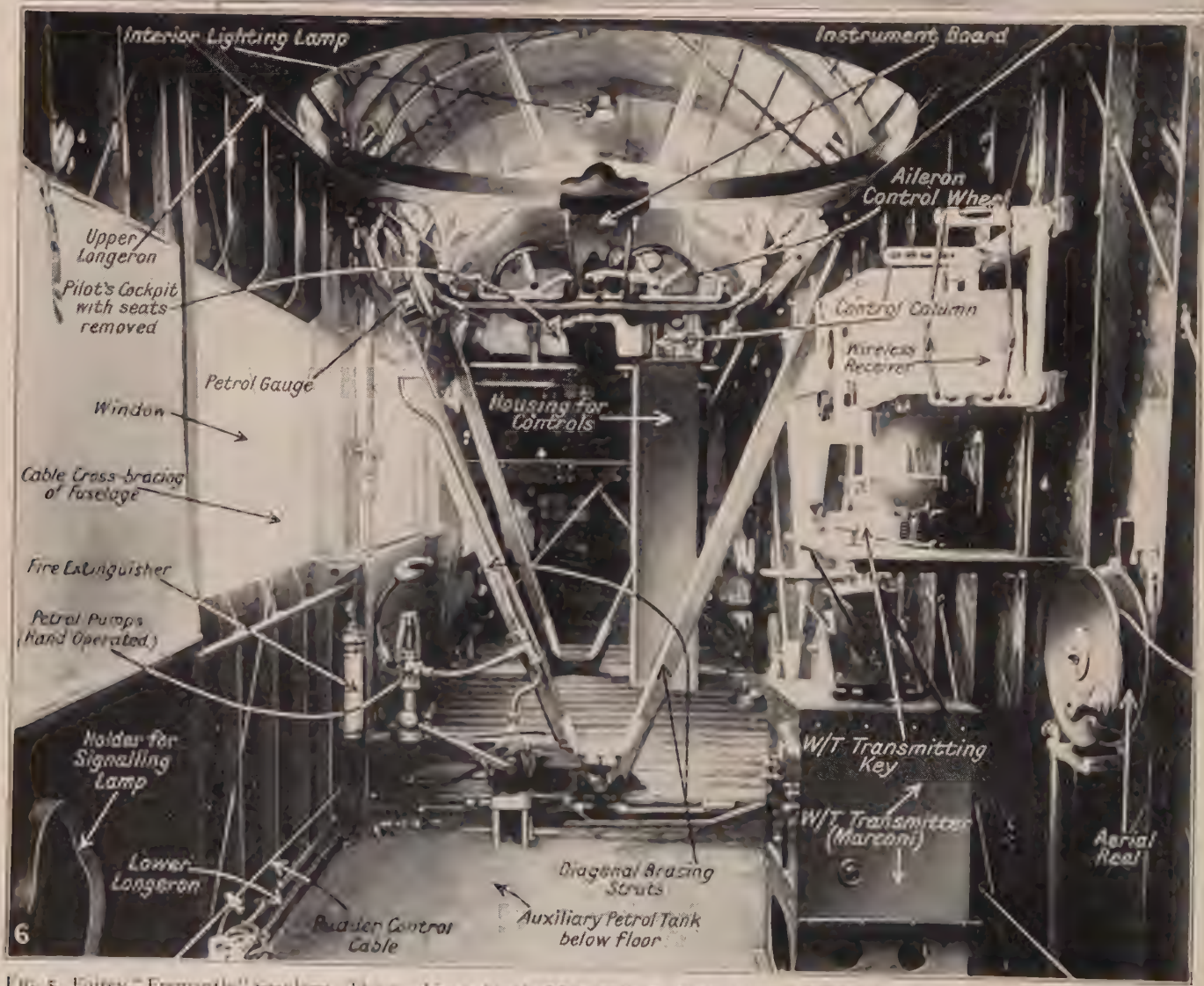

Fig. 5. Fairey "Fremantle" Seaplane. This machine is fitted with a 650 H.P. Rolls-Royce "Condor" engine, and was built for the British Air Ministry. In order that the entire fuselage should be free for other purposes, most of the petrol is carried in tanks inside the floats.

Fig. 6. Interior of same machine.

(By courtesy of the Fairey Aviation Co., Ltd.)

Works on particular artists include E. Pound, *Gaudier-Brzeska* (1916); G. Coquiot, *Rodin à l'Hôtel Biron* (1917); A. E. Gallatin, *Paul Manship* (1917); *Ivan Meštrović*, a monograph (1919); Kosta Strajnić, *Ivan Meštrović* (1919); A. Ujević, *Rosandić* (1920); B. van Dieren, *Epstein* (1920); A. J. J. Delen, *Rik Wouters* (1922); C. Roger-Marx, *Charles Despiau* (1922); A. Matějček, *Jan Štursa* (1923); M. Denis, *A. Maillol* (1925); H. Wellington, *Jacob Epstein* (1925).

(R. P. Be.)

SEALING MACHINE: *see* OFFICE APPLIANCES.

SEAPLANE.—Seaplanes are types of aircraft capable of arising from or alighting on the water. They may be subdivided into the following classes:—

1. Float seaplanes, in which the landing gear consists of one or more floats or pontoons.
2. Boat seaplanes, in which the central portion consists of a boat providing flotation.
3. Amphibians, which may be of either of the above types but with the addition of a landing gear enabling the aircraft to arise from or alight on the land as well as from the water.

The float seaplane in practically every case consists of a normal land type of aeroplane, in which the landing wheels have been replaced by one or more floats. In many aircraft this has actually been done; for example, in the American flight round the world in 1924 the land chassis was removed and substituted by two floats during the long over-sea flights.

In the smaller types of aircraft up to approximately 10,000 lb. total weight, the float seaplane shows advantages over the boat seaplane, the body, wings, airscrew, etc., may be well clear of the water, a high positive metacentric height can be obtained by suitably spacing two floats, and clean external lines, giving a minimum head resistance, can easily be obtained. The latter point is demonstrated by the fact that the last two "Schneider" Cup Races in 1925 and 1923 were both won by seaplanes of the float type.

In larger types of aircraft, the boat seaplane improves on the float type. As the dimensions of the central hull increase so the seaworthiness of the aircraft is improved beyond that of the twin float type. Again, in the larger types, the hull replacing both the fuselage and landing gear of the float seaplane, there is a considerable saving in weight. This saving in weight in the largest flying boats is sufficient to enable them to compare favourably with land aeroplanes of equal dimensions in regard to structural weight. In normal sized boat or float seaplanes, however, the ratio of structural weight to load carried compares unfavourably with that of land aeroplanes.

The float or hull forms employed are designed to act as hydroplanes when the aircraft is leaving the surface of the water, *i.e.*, that as the speed over the water increases the hydrodynamic forces acting upon the float tend to raise the float, thus reducing its displacement and consequently its resistance. The reduction in water resistance is also enhanced by the use of one or more lateral "steps" on the bottom of the float.

Resistance.—As resistance is caused by the water film drawn along by the passage of the float through the water, the step tends to break this water film and replace it by a vortex layer of water and air. These hull and float forms are usually tested by means of small scale models towed in a tank such as the William Froude National Tank at Teddington (London). The forces acting on the model are converted to full scale by multiplying the square of the scale by the square of the corresponding speeds, *i.e.*, by the cube of the scale. As the speed of the hull or float is increased from zero, its resistance at first increases rapidly and then decreases with further increase of speed. The speed at which this maximum resistance occurs is known as the "hump" speed. This hump speed is of the greatest importance in seaplane design. When taking off from the water this speed must be passed through, and, as the air resistance of the wings, body, etc., must be added to the water resistance, the total resistance may be very high.

Airscrew Design.—The airscrew must be capable of exerting a thrust at an air speed corresponding to this speed, which is greater than the total resistance of the aircraft at its hump speed, otherwise the speed of the aircraft on the water will never exceed this speed, and the aircraft will be incapable of taking off the water. To obtain this required thrust, it is often necessary to employ an airscrew which is inferior in efficiency to one designed for flight performance only.

Stability Problems.—Longitudinal dynamic stability in boat seaplane hulls is usually obtained by using one main step slightly abaft the centre of gravity of the aircraft and by the addition of a smaller step further aft. This small step is usually only operative when the hull is running at fairly large positive angles, and is intended to neutralise any tendency to pitch or "porpoise" when taking off or alighting. Float seaplanes may be of the "two-float" or "three-float" type. In the two-float type the floats are made long enough to give longitudinal stability when at rest on the water, and when leaving the water the attitude of this aircraft is determined almost entirely by the dynamic characteristics of the floats. In the three-float type, static stability on the water is obtained by the addition of a small float below the tail. In taking off the water the fore and aft inclination of the aircraft is controlled entirely by the pilot by means of the elevating machinery.

Lateral stability at rest in twin-float seaplanes may be obtained by placing the floats sufficiently far apart, but these are usually supplemented by "wing tip" floats, *i.e.*, small floats on the under sides of the lower planes. These wing tip floats only come into operation under exceptional conditions, such as turning on the water in a strong wind. The single-float seaplane, having one large central float assisted by wing-tip floats has very poor lateral stability unless the wing-tip floats are made very large, and this type is now practically extinct.

In boat seaplanes the metacentric height is usually either very small or even negative, and in this case the lateral stability at rest is dependent largely on the wing-tip floats. Certain designers have modified this method of obtaining lateral stability. Dornier, for example, employs two small, rudimentary wings of symmetrical section, projecting from the sides of the hull at the water line, while in the Rohrbach boat seaplane two fairly large floats similar to those of a two-float seaplane are mounted one on either side of the hull. Aerodynamically, the seaplane varies little from the aeroplane. In boat seaplanes the engines and airscrews are situated high above the hull in order that they may be clear of water and spray, the result being that the centre of thrust is above the centre of gravity of the aircraft.

This high position of the centre of thrust above the centre of gravity forms a negative couple, tending to drop the nose of the aircraft when the engines are running, and a boat seaplane in trim for level flight under these conditions would tend to increase its angle of incidence should the engines be stopped. To counteract this change of trim, a negative angle of incidence is given to the tail plane which is often of cambered aerofoil section inverted, *i.e.*, with its convex surface downwards. This tail plane being in the slip stream of the airscrews causes a large negative moment with the engines running, the moment decreasing when the engines are stopped, thus counteracting the change in thrust and centre of gravity couple.

Modes of Construction.—Constructionally, hulls and floats have followed wood boat building construction, though in the method of obtaining the necessary strength boat seaplane hulls have developed on two lines. Firstly, the rigid hull, in which the hull is itself strong enough to withstand the impact of striking the water when taking off in a rough sea or alighting; and secondly, the flexible type of hull. In the flexible hull, the impact stresses are absorbed by the elasticity of the hull structure. These hulls are usually of circular section with the "steps" added by forming "double bottoms" for certain longitudinal sections only.

Use of Metal.—Lately, the construction of hulls of metal has advanced considerably, duralumin or other aluminium alloy being employed. Steel has not yet been successfully employed for hull construction, as plates of the requisite thickness for lightness and strength yet light enough to complete with the aluminium alloys, would be too thin to withstand any effects of corrosion from salt water or small local impacts. In very large seaplanes of the future it is quite possible that steel hulls may be employed (*see* AERONAUTICS).

(J. C. B.)

SEA POWER (*see* 24.548).—Historical lessons could be drawn about sea power from several wars subsequent to those mentioned in the previous article, as, for instance, from the war between Italy and Turkey in 1912, in which, for lack of sea power, Turkey was unable to hold her islands in the Aegean or her territory in North Africa; also from wars in the Balkans. These were all overshadowed by the World War of 1914–8, which afforded examples not only of the great advantages conferred by sea power, but also of its limitations, and of the difficulties in applying it, now that all nations, whether belligerent or neutral, have become so dependent upon each other for economic prosperity, and even for their very existence.

The lessons about sea power that can be learned from a study of the great conflict can best be considered in four main aspects: (1) the facility which it offers or refuses for transport of troops over a worldwide theatre of war; (2) the supply to armies of the sustenance and munitions necessary to their success in land operations; (3) the protection of merchandise, of raw materials, and of food supplies crossing the seas; and, conversely, (4) the power which it confers of exerting economic pressure, especially against industrial nations, and through them upon the fighting forces which they may employ, by sea, land and air, to force matters to an issue.

Sea Power in the World War

Central Powers' Disadvantages.—It will be convenient to deal with the application of sea power in the World War under those four headings. In the first place, however, it must be borne in mind that the Central European Powers (Germany and Austria-Hungary), though favourably situated, on "interior lines," for the most effective use of armies against their opponents, were severely handicapped by geographical conditions in making use of their sea forces in the oceanic theatre of war. Although they possessed strongly defended naval bases, any forces issuing from those bases were confronted with the problem of running the gauntlet, through comparatively narrow waters, past the territory of strong and hostile sea Powers.

Of the German outlying war vessels the fast battle cruiser "Goeben," which had been refitting at Pola in July 1914, passed northward through the Straits of Messina on Aug. 3, and after bombarding Algerian ports early on Aug. 4 (before Great Britain was at war with Germany), turned eastward, coaled at Messina on Aug. 5 and succeeded in reaching the Dardanelles on Aug. 10, evading the strong British and French forces in the Mediterranean. She ultimately furnished an object lesson in the influence of local sea power upon political issues by bombarding, under the Turkish flag, Russian Black Sea ports. The participation of Turkey in the War on the side of the Central Powers put a new complexion upon the conflict, and caused the dispersion of Allied forces, especially British, both by sea and by land.

In more distant stations, the most formidable German vessels were the fast armoured cruisers "Scharnhorst" and "Gneisenau," which, with some light cruisers, were in the Pacific, under Count von Spee. These, for some time unlocated, met and sank off Coronel in Chile on Nov. 4 1914 an inferior and slower force under Sir Christopher Cradock, thus illustrating the need for superior speed in weak sea forces detached upon missions remote from support by the main fleets, a lesson that was put on record by Kempenfelt in the 18th century, when he pointed out that "faster sailers" were the only vessels competent to perform such missions (G. G. Aston, *Sea, Land and Air Strategy*, pp. 132–4). Von Spee's squadron, in its turn, was destroyed by a superior force of battle cruisers under Sir Doveton Sturdee off the Falkland Islands on Dec. 8, thus affording another illustration of the same principle.

Besides the vessels mentioned above, there were also some German light cruisers and armed merchant vessels in distant seas. These were all rounded up by April 1915. Some of these showed much enterprise and resource, and attained spectacular results, but better perspective will be maintained about the general operations of surface craft in the world theatre of war by quoting the summary from the official British history: "So (in April 1915) ended the first phase of the German attack upon our sea-borne trade. Never in the long story of our wars had the seas been so quickly and so effectively cleaned of commerce destroyers, and, in comparison with what had been anticipated, the whole campaign had been singularly ineffective."

Let us here take note of the point that the want of suitable naval bases "suitably spaced from each other" (A. T. Mahan) added to the difficulties experienced by the Central Powers in conducting operations by sea, a point to be borne in mind when considering the historical precedents afforded by the World War. Another point to be noted is the revolution in facilities, both for protection of merchant ships and transports and for attacks upon them, that were afforded for the passing of information and arrangement of movements by new and more rapid means of communication, especially telegraph cables and radio-telegraphy and telephony, introduced in the years that preceded the World War.

Respective Aims of Allies and Central Powers.—It is desirable also to note that on the one side were belligerents whose interest it was to stop all sea traffic while the issue was being determined by land battles; on the other side, belligerents to whom sea traffic was of vital importance for troop movements, for the supply and equipment of their armies, and for the economic needs of their civil population. The Central Powers accordingly employed without scruple every resource, in the shape of surface vessels, submarines, aircraft and submarine mines sown broadcast on the high seas, in order to make the risks of sea transport prohibitive; whilst the Allies made it their business to keep the seaways open by devising counter-measures to sink, damage, blockade or otherwise render ineffective all these forms of menace. Within about eight months of the outbreak of war all serious risk from the depredations of surface craft in distant seas had, as we have seen, been averted, while the main danger, from the German High Seas Fleet, no longer existed after the battle of Jutland on May 31 1916. The greatest risk from submarines and from submarine mines in the highways of sea traffic (new features in sea warfare) continued until the conclusion of the War, and at one period the victory of the Allied and Associated Powers was in consequence seriously jeopardised.

Another matter to be considered is the effect of modern local defence weapons, especially forts and mines, upon the application of sea power in seas to which access can be obtained only through narrow defended channels. This can best be illustrated by a reference to the part taken by the British Navy, aided by the French, in the Dardanelles campaign for access to Constantinople and the Black Sea. These operations were not directed against any purely naval objective. They were initiated by a decision by the British War Council, in Jan. 1915, that the "Admiralty should prepare to bombard and take the Gallipoli peninsula with Constantinople as the objective." In order to pass beyond the Dardanelles, the war vessels would have had to go through minefields ("paravanes" had not then been invented) against a rapid current, through narrow channels under the close fire of formidable forts, exposed to torpedo attack both from the shore and from hidden torpedo craft, as well as to plunging fire from concealed mobile howitzers. Even had the warships themselves succeeded in running the gauntlet, it would not have been possible for their unarmed fuel and store ships to follow them into the Sea of Azov unless the defences of the Narrows could first be destroyed. The task proved to be beyond the powers of purely naval forces, and lessons taught by historical experience about the limitations of sea power under such conditions were once again confirmed.

Transport of Troops.—Taking now the several headings under which we have grouped the advantages of sea power, we observe, first, that the facility which sea power offered for the transport of hostile troops over a worldwide theatre of war was the dominating factor in the failure of the Central Powers to achieve a victory on land, their plan for so doing having been first to crush the French Army, violating the neutrality of Belgium in order to increase the frontage of advance (and so envelop the

French left flank) and then to turn their attention to the Russian Army.

It was sea power that enabled the small British Expeditionary Force to cross the Channel to stand in the path of von Kluck's enveloping army at Mons and at Le Cateau, and, when the British were cut off by Kluck from their base at Havre, it was through sea power that the base of operations was changed go the Loire. Using a new line of supply, the British were able to cross the Marne to the northward, in the gap between Kluck's and Bülow's armies, and thus to exercise a decisive influence on the most critical day of Joffre's great battle which caused the failure of the German plan of campaign. In the later stages of the War, sea power enabled the Allied and Associated Powers to transport their newly raised armies to the decisive theatre of operations against the German Army, and to take part in various campaigns elsewhere.

The completeness of control over sea communications for this purpose can be gathered from the fact that during the course of the War the sea movements of troops included about 23,000,000 individual voyages of British Empire soldiers to take part in operations overseas, and that, amongst the first 1,000,000 transported, there was not a single casualty, either from enemy action or from marine risks. This immunity continued during the War between surface craft. Subsequent losses of troops at sea, always a very small percentage of the whole, were caused mainly by submarine attack, but this new menace did not prevent the American Army from crossing the Atlantic in 1917–8 to bear its part in the final and most critical stage of the conflict on land.

The Four Main Aspects of Sea Power

Supply of Food and Munitions.—A point not fully realised before the World War, but emphasised by experience therein, was the extent to which modern armies, after their transport to a destination beyond the sea, are constantly and continuously dependent upon sea communication for reinforcements in personnel, and for supplies, stores and equipment, to enable them to carry out their operations. This takes us to (2) the facilities which sea power confers for the supply of the necessary munitions and sustenance to armies. While the Central Powers were more self-contained, their opponents' armies would have been unable to continue the conflict on land without the sea power which placed worldwide resources at their disposal. A condition to be noted in connection therewith (and with the movement of the troops themselves considered under the previous heading), was the strain upon a country's resources in merchant shipping caused by the employment of armies in oversea operations.

The more distant the operations the greater the strain, because the voyages take longer, and more ship tonnage has therefore to be employed in proportion to the loads to be transported. Some idea of this strain upon resources in merchant ships can be gathered from these figures: Nearly 45,000,000 tons of British military stores were transported by sea during the course of the War. Towards its close, about 520 British vessels, of about 1,750,000 total gross tonnage, were employed in British military services. Excepting in the earliest stages, this may be taken approximately as the average so employed, in addition to the British vessels placed at the disposal of Allied Powers, including the vessels that were employed during the last few months in carrying about 250,000 tons dead-weight per month to the American Army in France. These statistics bring out the need for Powers, which depend upon sea communications for the sustenance of their populations, to consider the needs of those populations, when contemplating the scale upon which operations involving the use of armies overseas can be conducted.

This opens up the wide question in the exercise of sea power which we have grouped under the heading (3), the protection of merchandise, raw materials and food supplies crossing the high seas, and, conversely, (4) the amount of economic pressure which can in these days be exerted upon industrial nations, and through them upon the armies which they employ to force matters to an issue. Here again we shall be well advised to bear constantly in mind the special and unusual conditions which applied to the great conflict. These are clearly brought out in C. E. Fayle's British "official" history of *Seaborne Trade*, in which he points out that, for all the belligerents alike, dependence upon overseas supplies was greatly accentuated by the character of the War itself. The development of naval and military material, and the direct demands of the fighting forces upon the products of industry, exceeded everything that had been known or anticipated, and those demands increased directly and indirectly the importance of maritime communications, upon which they threw a heavy strain. The blockage of the passage of supplies inevitably meant widespread interference with neutral trade, and, apart altogether from the legal aspect of the matter, it soon became evident that the dependence of the belligerents themselves on supplies from neutral countries made it impossible to ride roughshod over neutral interests. Owing to the strength of the Allies at sea rendering evasion very difficult, neutral merchants and ship-owners were ready to make large concessions rather than incur delay and inconvenience arising from the exercise by the Allies of their undoubted right of visit and search (*q.v.*), and the Allies also possessed almost a monopoly of certain supplies necessary to the neutral Powers who were in a position to assist in maintaining German trade. For such reasons it is necessary to be cautious in drawing from the World War deductions about the effect, in future wars, of the application of sea power under the headings which we are now considering.

Protection of Merchandise.—Taking these now in detail, the protection by the Allies of their food, merchandise and munitions crossing the high seas furnished them with a new problem of great difficulty when submarines were employed by the Central Powers as commerce destroyers, which disregarded all previous agreements amongst civilised nations for the protection of the lives of neutrals and of noncombatants at sea in time of war. It was clear that the safety of the sea communications, upon which the success of the Allied cause depended, would be of no avail if so much of the world's shipping, belligerent and neutral, could be destroyed that the residue did not suffice to maintain the traffic. Nearly 13,000,000 gross tons in all (about two-thirds British) of merchant shipping was destroyed by enemy action alone, in addition to the normal wastage. Great Britain lost most heavily, having most to lose, but the net result was thus summarised by Mr. Fayle as official historian:—

> At no time was the reduction of supplies sufficient to inflict vital injury upon the life of the country . . . . Had losses continued at the same rate as in the spring of 1917, had the time occupied by the round voyage in the Atlantic continued to be what it was in the autumn of that year, there would have been a different tale to tell, and the gravity of the danger should not be forgotten because it was surmounted; but in the events which happened the strain was never so great as to be intolerable.

Such were the definite results.

Looking to the future possibility of the application of sea power being revolutionised by similar depredations of submarines, note should be taken of the fact that at Washington, in Feb. 1922, representatives of the United States, the British Empire, France, Italy and Japan (the principal sea Powers) bound themselves not to use submarines in this manner, and to treat as pirates all who did so, under whatever flag (*Washington Conference Report*, Cmd. 1,627, 1922).

Economic Pressure.—There remains the experience gained in the years 1914–8 in exerting economic pressure by recognised methods. Owing to differences of opinion about such recognition, it was necessary for belligerents to proceed by negotiation and agreement as well as by decree, and at one time it seemed that the exercise of sea power might be stultified by new conditions (C. E. Fayle, *Seaborne Trade*, vol. 3, p. 456), but if the belligerents were economically dependent upon the neutrals, so were the neutrals upon the belligerents, and there gradually arose around the Central Powers a network of agreements and undertakings, enforced by brisker regulations, embargoes on supplies and financial restrictions, as well as by naval force, which, though no technical blockade was instituted, amounted to a more effective and drastic stoppage of enemy trade than

naval force alone had ever secured." The methods adopted blocked the passages through ports in neutral countries, a result which could not have been achieved by blockading the sea coasts of the continental belligerents. The final result, as affecting Germany, has thus been summarised (*ibid*): "Though Germany's balance of agricultural and industrial strength fitted her to endure a prolonged period of isolation better than any other European Power, she was able to hold out for four and a half years only at the cost of a complete economic and social collapse, which was indeed precipitated by military defeat, but had already become inevitable." Nevertheless Germany was never completely isolated, having had access to Swedish ore to the end, and having twice, by the invasion of Rumania and by the collapse of Russia, replenished her food supplies at periods of acute crisis. Germany's allies were in a still more pitiful plight, and speaking generally, experience in the World War of 1914–8 emphasised, beyond all precedent and beyond all expectation, the importance of maritime communications, and therefore of sea power.

Looking back at the great conflict, we note not only the effect, amounting to complete collapse, of the sea power of the defeated states, but also the redistribution of relative strength at sea between the victors, owing largely to the relative burden borne by them in achieving success. Full details of the economic and financial burden borne by Great Britain in the Allied cause will be found in the concluding chapters of *Seaborne Trade*, vol. 3, from which it suffices to quote the statement that "far more serious in its permanent results than any direct effect of the constriction of supplies was the financial situation produced by the reduction of the export, and the redirection of both the export and the import trade. For these the submarine campaign was, in large measure, responsible." The new conditions affect especially the application of sea power to the Pacific ocean.

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SEATTLE, Wash., U.S.A. (*see* 24.563), increased in population from 237,194 in 1910 to 315,312 in 1920 (113·5 males to 100 females), of whom 80,976 were foreign born, including 6,016 Japanese; in 1925 (estimate based on school census), 355,000. The land area in 1925 was 68·5 square miles. Bank clearings increased 245% between 1910 and 1924 (to $2,039 million); bank deposits, 125% (to $176,608,338). The output of the factories within the city limits was valued at $50,814,000 in 1909; $274,431,000 in 1919; $115,046,908 in 1921; $155,780,967 in 1923, when there were 836 establishments, employing 17,842 wage-earners. During the War shipbuilding employed 30,000 to 40,000 workers, directly and indirectly. Waterborne commerce reached its peak (measured by value) in 1918 and 1919, but after the post-War drop again increased, until in 1924 its value ($664,567,049) was seven times that of 1910. The greatest increase was in foreign imports (1,112%), with domestic imports next (624%), followed by foreign exports (490%) and domestic exports (280%). In 1924 Seattle was a port of call for 65 steamship lines; it received 70% of the raw silk entering U.S. ports.

Under the public corporation known as the Port of Seattle, organised in 1911, harbour facilities were developed to a valuation of $15,000,000 by 1924, including terminal wharves (two of them half a mile long), transit sheds, waterside warehouses and cold-storage plants, grain elevators and tanks for vegetable and fuel oils. In 1911 the city took its first step towards municipal ownership and operation of the street railways; by 1925 it owned and operated 235 m. of the total of 265. The municipal light and power plant, in the face of determined opposition from the private power companies operating in the city, built up its patronage until in 1924 it had 83,000 of the total 108,000 customers in the city. In 1924 the first unit was completed of a development on the Skagit river which will reach ultimately 550,000 to 600,000 horsepower. A large amount of building of all kinds (including a 42-storey building) was done immediately after the War, the permits for 1919–25 (through Oct.) representing a value of $140,286,145. A zoning ordinance was adopted in 1923. A civic centre was developed. Parks and playgrounds were increased until the area amounted to 1,900 acres. Scenic boulevards were constructed to the extent of 35 miles.

SECONDARY SCHOOLS.—This term is used, both in Great Britain and America, for schools in which education beyond the elementary or first stages is given to both boys and girls.

I. IN GREAT BRITAIN

Before the outbreak of the World War in 1914, there was a steady growth in the number and the efficiency of secondary schools in Great Britain. Local education authorities, under the powers conferred upon them by the Act of 1902, took over or made annual grants to existing schools and created new schools; and the Board of Education's regulations for 1907—providing for increased and uniform grants, subject to conditions, of which the most important was the provision of free places for ex-public elementary school children—both stimulated and guided fresh developments. These developments reacted upon the schools which remained independent of state or local control, and provided them with a powerful incentive to efficiency.

In the 10 years ending 1914–5 the number of schools on the grant list in England and Wales rose from 575 to 1,047, and the number of pupils per 1,000 of the population from 2·9 to 5·5; moreover, the average size of the schools has shown a remarkable increase, which has naturally made for efficiency. In 1908–9, 64 out of 912 schools had less than 50 pupils while at the present time, not more than 8% of the total have less than 100. The free place system, working in with the provision of scholarships both by the schools and by local education authorities, and also with the provisions made for the education of teachers, helped the efficiency of the schools; it was largely responsible, especially through the provision of intermediate scholarships at 15–16, for raising the standard of work up to and beyond the matriculation stage, and through the fixing of age limits for scholarships and free places it helped to bring about a general standardisation of the age of entry to secondary schools; and this again affected both the leaving age and the length of school life.

The number of schools in which a considerable amount of sixth form work is done has increased steadily, and though the economic conditions which tend to the premature withdrawal of boys and girls from school are slow to change, there has been a steady improvement; the average school life of boys rose from two years and seven months in 1908–9 to three years and five months in 1922–3, and that of girls in the same period from two years and seven months to three years and six months, while the average leaving age rose in the case of boys from 15·5 to 15·11, and in the case of girls from 15·11 to 16·2.

Most of this development, however, belongs to the period beginning in 1914. Within a few months after the beginning of the War, it became evident that there was an astonishing increase in the demand for secondary education. This demand persisted all through the War, and although the economic difficulties of the last few years have had their effect upon it, and the diminution in the birth rate during the War is bound for some time to lessen the number of children available, this new desire for education is still, and will surely continue to be, alive and active.

That desire has shown itself not merely in the increase in the numbers applying for admission to secondary schools but even more in the support given to the important educational measures introduced during this period.

As to the schools, the numbers on the grant list for England and Wales in 1924–5 were 1,281 (471 boys', 462 girls' and 348 mixed schools), containing 188,268 boys and 171,176 girls; the number of pupils per 1,000 of the population, which in 1904–5 had been no more than 2·9 (1·9 boys, 1·0 girls), was now 9·5 (5·0 boys, 4·5 girls); between 1908 and 1920 the number of boys proceeding to universities increased from 695 to 1,674, and the number of girls from 361 to 1,214. Besides the schools on the grant list, the Board of Education has now recognised as efficient after inspection about 270 public and private secondary schools and about 100 private preparatory schools. The average size of the schools on the grant list rose from 190 in 1914–5 to 281 in 1924–5; the number of free place pupils rose from 65,799 (33·1% of the total numbers) in 1914–5 to 130,188 (36·2% of the total numbers) in 1924–5.

Financial Aspects.—So great an expansion would have been impossible without a great increase in expenditure from both rates and taxes over anything that was contemplated in 1902, or even on the introduction of the free place system in 1907. Though few authorities as yet maintain free secondary schools, and fees have been generally raised by about 50%, there are few schools on the grant list in which any pupil's fees cover as much as half the cost of his education. The increase in the board's grant from £5 per pupil over 12 to £7 in 1917, together with special grants for advanced courses, brought some relief, but it was not until the Act of 1918 repealed the 2d. limit on rate aid to higher education, and also provided that the state contribution should be not less than one-half of the local education authority's approved expenditure, that the necessary progress could be faced.

Status of Teachers.—One of the earliest consequences of this provision was an improvement in the salaries of teachers, brought about for the first time on a national basis in 1920, by the standing joint committee of representatives of local educational authorities and teachers, constituted under the chairmanship of Lord Burnham, at the suggestion of Mr. Fisher. The Teacher's Superannuation Act of 1918 had established a pension system modelled on the civil service scheme; and though financial stress led before long to the requirement of contributions from the teachers to the cost of pensions, and again in 1925 to a modification of the salary agreement, the position of the teachers has been substantially improved and the work of the schools has benefited.

Examination Reforms.—Two valuable reforms were initiated by the Board of Education in 1917. The secondary schools had long suffered from the number and variety of external examinations, many of which had originally served a useful purpose in stimulating a tradition of organised work, but had become oppressive and confusing. The consultative committee of the board had issued a report on the subject in 1911; in 1914 the board, which had already abolished in schools under its control the use of external examinations for lower and middle forms, issued proposals for the recognition of two grades of examination —roughly speaking a fifth form examination for pupils of 16–17 and a sixth form examination for pupils of 18–19—to be conducted by university examining bodies. In 1917, the secondary schools examinations council, representative of the examining bodies, the local education authorities and the teaching profession, was established as a co-ordinating authority, and since then the first and second school examinations of one or other of eight university examining bodies have gradually become a useful element in the organisation, not only of schools under the board's control but of secondary schools of every kind. In grant-aided schools the board pays the examination charges for each pupil up to a maximum of £2. In 1923–4, 39,973 pupils in grant-aided schools took a first examination and 5,342 a second.

Advanced Courses.—The second reform was the encouragement of sixth form work by the provision of special grants for recognised advanced courses in certain groups of subjects; the grouping of subjects, at first conceived on a rather rigid formula, has been greatly modified, and almost any kind of advanced work likely to be done in a secondary school may now be recognised; but the special grant, except for schools taking no aid from local education authorities, has now been merged in the general provision made by the Act of 1918. In 1924–5, 469 advanced courses were recognised (235 in science and mathematics, 37 in classics, 188 in modern studies, 6 in classical with modern studies, 3 in geography).

Connection with Universities.—With the increase in the numbers of secondary school pupils, the relation of the schools both to the universities and other places of university rank and to employment, has become increasingly important. The first and second school examinations are of real value in both connections, and are gradually simplifying the conditions of entrance to the universities and the professions, and even to some extent commerce and industry. Most local education authorities interest themselves systematically in finding suitable openings for the pupils in their schools. In London, two joint committees of heads of schools and employers find employment for a very large number of boys and girls, and this work grows rapidly.

In 1920, the board instituted a scheme for the award of 200 state scholarships to universities for pupils in grant-aided secondary schools; the scheme was dropped in 1922 and 1923, but revived in 1924. The award is based on the second school examination; the amount varies with circumstances but is calculated to finance the whole of the scholar's university course. But the various provisions by which poor students may be aided so as to enable them to pursue university and other higher courses are still in urgent need of revision and co-ordination; this is perhaps the weakest spot in the educational system. (R. F. C.)

II. IN THE UNITED STATES

The high schools of the United States have shown phenomenal expansion in pupil attendance. In 1900 there were 519,251 pupils registered in public high schools. In 1910 the number had increased to 915,061; in 1920, to 1,857,155; in 1922, to 2,229,407. The ratio of registrants to the total population of high-school age is approximately 1 to 3. Nowhere else is there any approach to this ratio. It is estimated that in England and Germany the ratio never was less than 1 to 12 or 20. These statistics make it clear that the most striking fact, with regard to the American democratic school system, is the opportunity which it affords to young people of all social and economic conditions to secure an education beyond the elementary level. Especially striking is the development of a great many small high schools in rural and town communities which a generation ago were satisfied with elementary schooling. When rural communities cannot establish high schools they have very commonly induced the legislatures of their states to provide generously for the payment of tuition of pupils in the neighbouring districts where there are such schools.

Curriculum Changes.—With the increase in pupil population has come an expansion in the curriculum. Changes in the curriculum are due in part to the demands made by the new type of pupils coming into the high-schools, and in part to a recognition on the part of educators that new subjects are necessary to prepare young people for modern life. Chief among the additions to the curriculum are commercial courses (*see* COMMERCIAL EDUCATION) and industrial courses (*see* INDUSTRIAL EDUCATION). Correspondingly there has been a falling off in the percentage of the high school population which takes the classical courses. The details of this change in so far as it affects Latin and Greek and certain other subjects are shown in the following table:—

Percentage of the Total Pupil Registration in High School Taking Various Subjects

	1900	1905	1911	1915	1922
Latin	50·61	50·21	49·05	37·32	27·52
Greek	2·85	1·47	0·75	0·29	0·09
French	7·78	9·14	9·90	8·80	15·46
English Literature	42·10	49·34	57·09	55·82	78·59
Rhetoric	38·48	48·54	57·10	58·42	..
Home Economics	...	...	3·78	12·89	14·27

Trends of Expansion.—There is a strong tendency for the high school to expand downward and upward, so as to include within the scope of secondary education the later years of the traditional elementary curriculum and the early years of the college.

The two special names which have been employed to designate the expansions downward and upward are junior high school and junior college. The growth of the junior high school has been very rapid during the years 1910–25. It was first established in such centres as Berkeley, Cal.; Columbus, O.; and Concord, New Hampshire. It has taken on a great variety of forms. In some cases it has been a pre-vocational school; in others it has administered a curriculum very like the curriculum formerly given in the first year of the high school. In a great many cases it has been a high school only in administrative treatment of the pupils,

retaining the curriculum which belonged to the seventh and eighth grades of the elementary school.

The junior college has developed in about 75 cities of the United States as an extension of the public high school. In approximately an equal number of centres the junior college has developed independently of other higher institutions. There seems to be a tendency to provide very generally for the training of pupils beyond the present high school age by organising college courses in local high schools where they will be readily and economically accessible. There is also an academic reason for this development in the fact that the courses now commonly taken by college freshmen and sophomores are much more closely related in methods of instruction and in content to high-school courses than they are to senior college courses.

Teachers.—The standards for the training of secondary teachers in the United States are steadily rising. College graduation and professional courses in general school administration and in methods of teaching are generally required. Standardising and accrediting associations have been organised in all sections of the country. There were in 1926 more than 14,000 accredited high schools in the United States. (C. H. J.)

SECOND (SOCIALIST) INTERNATIONAL.—The first meetings of the Second International, reconstituted in 1889, had been devoted mainly to discussion of the tactics and methods of the affiliated national parties, but from 1911 onward another question occupied a constantly increasing attention—the question of war and peace. It had already been discussed at the Congress of Amsterdam in 1903, and from that date Jaurès began the study of the question which inspired his book, *L'Armée nouvelle*. At the Congress of Stuttgart in 1903 the question was again discussed, at greater length, and Hervé's outburst on this occasion led Bebel and Volmar to declare roundly that the Social Democrats would instantly rise as one man to defend Germany if ever she were attacked.

Conditions Before the War.—But the European horizon steadily darkened, especially after 1911. The Agadir incident, the Italo-Turkish War and the Balkan Wars, in succession, made the menace of a general conflagration appear imminent, and the efforts of the socialist parties to avert the catastrophe became more urgent and strenuous from that time. Their efforts culminated in the Extraordinary Congress (1912) at Basle, called to consider the international situation and the action to be taken by Social Democrats to prevent war. A manifesto was issued, exhorting all workers to unite to secure from their governments a pacific foreign policy.

This problem of peace—now practically the sole problem, for everything depended on the turn that events would take—was put on the agenda for the 10th Congress of the International which was to have been held in Vienna two years later, in Aug. 1914. The Congress would have coincided with the 50th anniversary of the founding of the International in London in 1864. For this occasion Austrian socialists had prepared an illustrated commemorative album in which Kautsky, Victor Adler and others had related the history of the socialist movement during the last half century. This document, which appeared in print at the moment when the World War broke out, was distributed 10 years after as a souvenir among members of the Executive Committee of the International when they met in the former capital of the Habsburgs in June 1924. The album contains, among other things, a series of medallion portraits of 66 members of the B.S.I. (International Socialist Bureau), which had its headquarters before the War in the Maison du Peuple at Brussels. Lenin's portrait is not among them, although he was a member of the bureau for many years; but there are Rosa Luxemburg and C. G. Rakovsky, together with Jaurès, Ebert (the future president), also Stauning, Branting and MacDonald, who later became premiers of Denmark, Sweden and Great Britain respectively. There are delegates of trade unions too, but these are few and far between. This assembly, representing all the live forces of socialism, met for the last time at the Maison du Peuple, Brussels, on July 29 and 30 1914.

Even at that moment, when the world already lay under the shadow of war, optimism still prevailed. Adler regarded a war between Germany and France as a moral impossibility; Haase, chairman of the Social Democratic group in the Reichstag, relied at this eleventh hour, not on humanity, but on the pusillanimity of the Kaiser. Jaurès, speaking on the evening of July 30 for the last time, still affirmed his confidence in a pacific solution, but prophesied in a flash of inspiration that if, in spite of all, war were let loose on the world by its masters, then, at the close, each nation would turn upon those responsible for the disasters of the war and say: " Go, and seek pardon from God and man." The next day he was assassinated in Paris, and a state of war had been declared in Germany.

The bursting of the storm put an abrupt end to all international activities (*see* SOCIALISM). While the War lasted no single meeting of the Executive Committee took place, but some tentative efforts were made to revive international action. The most important of these were an attempt by the Dutch-Scandinavian Committee (vigorously supported by Camille Huysmans, Secretary of the Second International) to convene an International Congress at Stockholm in 1917, and that of the Italian socialist Morgari to convoke conferences at Zimmerwald (Sept. 1915) and at Kienthal (April 1916). The first of these efforts (the projected Stockholm conference) proved abortive because of the refusal of the Allied Powers to grant passports to the delegates; at the Zimmerwald and Kienthal conferences only certain groups of the international proletariat were represented, and from these elements there was presently to emerge the Communist International known as the Third International.

Activity After the Armistice.—On the morrow of the Armistice the need for international unification was brought home with renewed force. Conferences were summoned successively at Berne (Feb. 1919), Lucerne (Aug. 1919) and Geneva (Aug. 1920) with a view to re-establishing the Second International. Meanwhile, however, the so-called Third International had been formed at Moscow, and for some time parties or groups[1] who were unwilling to be affiliated to either the Second or the Third grouped themselves in a Workers' International Union of the Socialist Parties with Vienna as its centre—hence the name " Vienna International." In the beginning of 1920 this organisation tried to bring about the unification of all proletarian organisations, and succeeded in calling together in Berlin a reunion of the Executive of the three groups in April 1922. But this effort at reconciliation ended in complete failure.

Since then the Communist International has steadily accentuated its violent opposition to Social Democracy. On the other hand the points of dispute between Vienna and London became progressively less. In 1921–2 the French, English, German, Italian and Belgian socialists who were adherents either of the Vienna International or the Second International met first in Paris, then in Frankfort, and of one accord adopted the resolutions which have since become famous as the " Frankfort Resolutions." Anticipating the Dawes scheme, these demanded the reduction of the German debt to a reasonable figure, and, further, demanded the end of military occupations and the annulment of inter-Allied debts.

Congress at Hamburg.—By December of the same year Vienna and London had agreed to call a socialist international congress at Hamburg. This took place on May 27 1923, when the International was reconstituted—the Communists being excluded—and the conditions on which parties or groups could be admitted were defined. Agreement was reached with difficulty on a Franco-German text which, drawing on the Marxian vocabulary for its somewhat heavy terminology, appealed to " those who acknowledged the aim of the working-class to be the replacement of the capitalist mode of production by the socialist mode of production and who see in the *class struggle* (*lutte des classes*) which manifests itself in political and economic action the means of emancipating the working-class."

But when it came to translating this text into English the

[1] The principal groups concerned were the British I.L.P., the German Independent Socialists and the Austrian Social Democrats. (ED. *E. B.*)

British delegates raised a discussion, arguing that the words "*lutte des classes*"—the touchstone of socialism on the Continent—were not in current use in England; that the extremists, who alone used the expression, spoke not of "class struggle" but of "class war" and that it would be better in these conditions to retain the idea but to paraphrase it in some way as this: "independent political and industrial action of the workers' organisations." And so it was arranged. The Franco-German text was retained, for it could only have been altered at the cost of emasculation; but for British consumption a free translation was allowed.

The present writer has thought it necessary to report this little incident, as it cannot fail to be instructive, showing as it does that, in spite of community of words and, on the whole, unity of tactics, English Labour men and continental socialists do not speak quite the same language. Now, these differences of terminology are the outward expression of other more deep-rooted differences arising out of the widely differing environment in which contemporary socialism is formed and developed. On reading such pre-War books, for instance, as the *Études socialistes* of Jean Jaurès, Ramsay MacDonald's *Socialism and Society* or Rakovsky's *Das Erfurter Program*, we see how widely the socialism of Jaurès, instinct with the spirit of the French Revolution, and still more the socialism of Ramsay MacDonald, who draws inspiration from the pacific and fraternal idealism of Christianity, is to be differentiated from the more "materialist" and more "economic" socialism of the German Marxians.

Since the War, however, these differences have become less acute, even from the theoretical point of view. A sort of amalgam has been established between the various national parties: German socialism has become less doctrinaire; French socialism has drawn nearer to Marxianism under Guesdist influence; the socialism of the I.L.P. has almost completely captured English working-class movement. Between those parties which recognise Social Democracy as their basis, there exists not only International unity of organisation, but unity of programme.

This emerges clearly from the two first congresses of the new International. The Hamburg Congress of 1923 succeeded beyond all expectations. There were present 630 delegates from 30 countries, representing 7,000,000 affiliated members. During the debates, which lasted five days, the following points were discussed: international action against international reaction, working-class policy on an imperialist peace, the eight-hour day, and the reform of international social legislation. But the most important achievement of the congress was the fusion of the London and Vienna groups and the adoption of the statutes of the new workers' and socialists' International.

In the three years preceding the Second Congress of the new Second International (Aug. 1925) that organisation was finally consolidated, and began to make itself more and more felt in international politics. There is no gainsaying the fact that direct action by the workers and the existence in all Western countries of a powerful socialist party (either working within the government or using its influence from outside) have to a very large extent determined the new policy which eventually produced the London agreement on reparations (1924) and the Locarno pact of mutual guarantee. To be convinced of this we have only to look for a comparison at the resolutions passed at Hamburg on the reparations problem and those at Marseilles on security. There can be no better instance of the influence which socialism has acquired over the various governments and of its emergence as the decisive factor in matters of international policy. For bibliography *see* the article SOCIALISM. (E. VA.)

SECRET SOCIETIES, CHINESE (*see* 9.870).—Most are merely trade guilds or friendly societies, but the Hung, or Triad, Society is in an entirely different category. It has the largest membership of any secret society in the world, and has existed since A.D. 386, in close association with the White Lotus. Contemporary with the ancient mysteries, it is itself a great mystery rite over 1,500 years old.

A few secular references to it must suffice. In A.D. 386 it was founded, or perhaps reorganised, by the Buddhist patriarch Eon or Hwui-Yin at Rozan, to spread the cult of Amitabha Buddha. In A.D. 630 Zendo joined it to gain instruction, and in 1344 it rebelled against the Mongolian or Yüen dynasty. In 1662 it fell under the ban of Khang Hsi, who in his *Sacred Edict* instituted a persecution of the Buddhists and Taoists, and ordered the suppression of five religious societies, among which the White Lotus and the Hung were specifically named. The exact relation between these societies is still obscure, but, if they were not alternative titles for the same organisation, they were probably the names of different degrees of one common rite. It is just possible, however, that they were similar, but separate, mystical societies.

Partly as a result of this persecution, the Hung Society became political and anti-dynastic, and has raised numerous insurrections against the Manchus, one of the most famous being the Taiping revolt in 1851, and it is more than suspected of being behind the anti-foreign agitation of 1925. The rituals were peculiarly suitable for conversion from religious to political aims, since the slogan of the brotherhood is "Overthrow Tsing and restore Ming."

Ming means Light, and especially the perfected spirit in man; while Tsing means the vital force or, as we should say, the soul immersed in matter. By slightly changing the way in which the character for Tsing is written, it becomes the name of the Manchu dynasty, while the last Chinese dynasty was the Ming. Hence it will be seen that the change from a Buddhist-Taoist mystical initiatory rite to a dangerous political society was easy.

The rituals show a blending of Taoist-Buddhist ideas, having curious analogies with the Egyptian *Book of the Dead*, and with certain "Higher Degrees" in western speculative Freemasonry. The ceremony symbolises the journey of the soul through the Underworld and Paradise to the Holy City of the Gods, here called the City of Willows, and interwoven with this is an allegory of the experiences of the mystic in his quest for union with the Supreme Being. As regards its analogies with Masonry, practically every important incident is found in certain "Higher Degrees" in England and America, while most of the hand signs are known to many Freemasons.

The ceremony falls into four sections. First comes the traditional history, which is given to the candidates in the anteroom before they enter the lodge. It is a moving story, wherein a body of monks who had helped the Emperor are requited by him with the foulest treachery, all being murdered, save five who became the founders of the order. There are three villains, and for political purposes one is a Manchu Emperor, either Khang Hsi in some versions, his son, but originally the story was allegorical.

After this the candidates are "prepared" in the anteroom. The most notable incidents are (*a*) ceremonial washing and changing into white robes to symbolise not only mourning but that they themselves are dead; (*b*) the right arm, shoulder and breast, and also the left knee, are made bare; (*c*) the substitution of grass slippers for ordinary boots. Meanwhile the Master opens and consecrates the Lodge and invests his officers.

The third section deals with the actual admission of the candidates, who have to pass through three gates inside the lodge, and take the oath of blood brotherhood by mingling their blood with that of all members present in a cup of wine, from which each person present drinks. (Women as well as men are eligible.)

The last section consists of a catechism, wherein the Master asks a series of questions, which the conductor answers for the candidates. From these we learn that they have been on a long and mysterious journey, first by land and then by boat, till they reached the City of Willows. Throughout the whole of this part of the ceremony great stress is laid on numbers which have a definite mystical significance. The triangle also plays an important part in the ritual, hence the name "Triad" Society. The brotherhood has many aliases, the most famous being "The Society of Heaven and Earth." The significance of the ceremony is revealed by the opening questions:—

Master: Whence come you?
Vanguard: From the East.
Master: At what time?
Vanguard: At sunrise, when the East was light.

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SECURITY.—The problem of security confronted the Allies immediately after the Armistice of Nov. 11 1918. Germany's military capitulation put an end to hostilities and permitted the victors to impose their conditions of peace on the vanquished. The sum of these conditions was to constitute a guarantee of the new European status and of the peace of the world. But it inevitably involved painful readjustments and burdensome obligations for the conquered party. It was, therefore, necessary to find a system to guard against wars of revenge. The League of Nations was formed for this purpose.

Unfortunately, the Covenant of June 28 1919, while laying down tutelary rules, did not establish sufficiently rapid, precise and energetic practical sanctions against a possible aggressor. Clemenceau and Marshal Foch would have wished France's security to be guaranteed by fixing the western frontier of Germany on the Rhine, and by forming the German territories on the left bank of the Rhine into an independent buffer state. They set out this point of view in a series of notes or memoranda dated Feb. 27 1918, Jan. 10, Feb. 25, March 12 and 31, April 28 and May 6 1919. Having failed to convince the representatives of Great Britain and the United States, Clemenceau ended by accepting the offers of Lloyd George and President Wilson, which substituted for the political and military Rhine frontiers two treaties stipulating that if Articles 42, 43 and 44 of the Treaty of Versailles relative to the demilitarisation of the left bank of the Rhine " may not at first provide adequate security and protection to France," Great Britain (or the United States as the case might be) pledges herself " to come immediately to her assistance in the event of any unprovoked movement of aggression against her being made by Germany." The two treaties hung together, and were not to take effect until they had been approved by the British Parliament and the Senate of the United States of America. The latter having refused its ratification in 1920, the two treaties became null and void.

The Project of a Franco-British Pact

The British Govt. admitted none the less a moral obligation to give France equivalent guarantees of security. In 1921 Briand held negotiations on this subject with Lloyd George and Lord Curzon. At the Conference of Cannes (Dec. 1921–Jan. 1922)[1] concrete proposals were considered. On Jan. 4 1922 Lloyd George laid a detailed memorandum before Briand, in which he declared that the conclusion of a new pact of non-aggression must be dependent on the following conditions: complete understanding between the two countries; no naval rivalry; non-execution of the French programme of submarine construction; whole-hearted co-operation by France with Great Britain in the economic and financial reconstruction of Europe; an immediate summoning of an economic conference at which all European Powers, including Russia, should be represented; a complete agreement between the two countries on the policy to be pursued in the east; the adoption of a broad plan of international co-operation to ensure the peace of Europe as a whole. Briand replied on Jan. 8 by demanding that the engagements be bilateral, and that a military convention be concluded between the two general staffs. He added: " Whatever may be the guarantees offered by the League of Nations, it will be well that the Powers between which, as a result of the peace settlement, causes of dispute are most likely to arise should show, by some means even more precise than the Covenant, the sincerity of their desire for peace." Briand thought fit to accept the summoning of a practically universal conference in Genoa before these broad questions were properly explained, and without having consulted his own Government; he was, therefore, obliged to retire.

At the end of Jan. Poincaré resumed the negotiations, insisting on the necessity for France to be protected against German aggression, and on the necessity of a military convention between France and Great Britain. But the conversations and memoranda revealed little unity. Especially they showed that, as Lord Curzon put it, the general responsibility of Great Britain resulting from the stipulations of the Covenant was " attenuated in the collective responsibilities of the other Powers," [2] and that these stipulations, to be effective, should be complemented either by particular agreements or by a new convention complementary to the Covenant. Simultaneously with the Franco-British project, the projected pact between Great Britain and Belgium, which was being negotiated, fell through. Furthermore, the Cabinet of London refused to conclude a defensive military agreement with Belgium analogous to that which that Power had signed with France in 1920. The problem of security thus passed from the Franco-Belgian-British sphere of action to that of the League of Nations.

[1] The Conference formally opened on Jan. 6 1922, informal conversations having been held previously.

The Plan of the Treaty of Mutual Assistance

The Third Assembly, which met at Geneva in the month of Sept., passed a resolution (No. 14) by the terms of which the states which were members of the League of Nations should pledge themselves mutually to military assistance against aggression. But the end of 1922 and the early part of 1923 were devoted to preliminary negotiations on the means of giving this resolution practical form. On the initiative of Lord Robert Cecil and Col. Réquin, two special commissions succeeded in drawing up a draft Treaty of Mutual Assistance which was presented to the Assembly of 1923. This plan was based on the following ideas:—

(1) A pre-arranged plan of defence;

(2) A pledge binding all members of the League of Nations to come to the assistance of the state attacked;

(3) Liberty for members of the League of Nations to conclude local defensive agreements complementary to their general obligations;

(4) The obligation of assistance to be limited to countries situated in the same part of the globe; the globe to be divided into several regions by which this obligation should be defined;

(5) Control by the League of Nations of the whole operation of the Treaty of Mutual Assistance.

After a detailed discussion, the Fourth Assembly unanimously passed a resolution on Sept. 29 asking the Council to submit the project of a Treaty of Mutual Assistance to the scrutiny of the governments and to ask them to give their opinions on it. In accordance with this resolution, the general secretary had only communicated the plan to the states which were members of the League of Nations. But at its session in Dec. the Council determined to approach the other states as well, notably Germany, the United States of America and Russia.

The answers arrived slowly. The majority were unfavourable. Russia sneered at the efforts of the Powers to ensure universal order. Germany took the opportunity to protest against the status of a suspect assigned to her by the Treaty of Versailles and demanded compulsory and universal disarmament. On July 5 1924 Ramsay MacDonald declared that the League of Nations ought not to take the responsibility of recommending a plan to its members unless this plan was " in all respects reliable and effectual," and that this was not the case with the document submitted to the governments. He rejected the principle of special local treaties, demanded that they should be replaced by a general pact, and recommended arbitration as the solution of conflicts. In the face of this opposition, the projected Treaty of Mutual Assistance could not take form: it was abandoned.

The Protocol of Geneva

At the Fifth Assembly, Herriot gave the outlines of a new programme founded on the three principles of arbitration, security and disarmament. After confidential conversations, MacDonald and Herriot agreed on a scheme which several commissions and subcommissions were appointed to transform into precise arrangements. Thus the Protocol of Geneva was worked out, being

[2] French Yellow Book, 1129.

voted enthusiastically and unanimously on Oct. 2. As regards security, Articles 10 and 16 of the Covenant were complemented by a series of arrangements (Articles 7 to 15) defining the word "aggressor," instituting enquiries into complaints of violation of the obligations of states; fixing the mechanism for the repression of acts of aggression, pronouncing sanctions against aggressors and giving the states authority to undertake engagements among themselves, "each determining in advance the military, naval and air forces which they would be able to bring into action immediately to assure the fulfilment of the obligations in regard to sanctions which result from the Covenant and the Protocol. Two detailed reports handed in by Dr. Beneš and M. Nicolas Politis contained most interesting commentaries.

Article 17 of the Protocol arranged for the meeting at Geneva of an International Disarmament Conference for June 15 1925. Consequently on Oct. 3 1924 the Council appointed a committee to co-ordinate the preparatory work. This was to meet on Nov. 17. But, in the interval, Lord Parmoor informed the Council that, in consequence of the dissolution of the British Parliament, it was desirable to adjourn the meeting. On Nov. 15 the new British Govt. demanded its adjournment to an indefinite date in the future. At the session of March 1925 Sir Austen Chamberlain read out to the Council a declaration which affirmed the rejection of the Protocol by the British Empire on the ground that the obligations involved in it were too great, in view of the extent of the British Empire, and that the Cabinet of London could not undertake to maintain peace in several sectors, for example, in eastern Europe. Without the adherence of Great Britain, the Protocol could not be applied. Accordingly, the Council determined to refer for the consideration of the Sixth Assembly the declaration of the representative of the British Empire, with all other declarations which might be addressed to it on the same subject by the governments of members of the League. A solution of the problem of security by a general pact failed in its turn after it had been found impossible to arrange a Franco-Belgian-British Guarantee Pact. There remained the intermediary solution of a partial pact including several leading Powers and one or more ex-enemy Powers, including Germany.

The Locarno Negotiations

This was a combination which was realised in the course of 1925. Its point of departure was a German memorandum dated Feb. 9, in which Stresemann suggested the conclusion of a Guarantee Pact for Germany's western frontiers and treaties of arbitration with all her neighbours. He let it be understood at the same time that the logical sequence of this Pact should be the evacuation of the Rhineland. The Memorandum was long kept secret, at least in its exact phrasing, and it was several months before it received a direct answer. First France and Great Britain, then Belgium, Italy, Poland and Czechoslovakia agreed in the course of the spring and the summer to lay down the following essential principles in the notes which they delivered on June 16 and Aug. 24:—

(i) Germany and France must engage to respect the present territorial status quo of the Treaty of Versailles, as well as the agreements whose object is to assure their application, and to repudiate any recourse to force of arms or to war against each other.

(ii) The engagements undertaken by these two parties must rest on the demilitarisation of the Rhine frontier and its inviolability. The exceptional cases in which it would be permissible for military forces to cross this frontier must be fixed in precise terms.

(iii) Great Britain, and if necessary Italy, must be guarantor of the execution of the engagements undertaken.

(iv) Germany must enter the League of Nations and assume the rights and obligations of the states which are members of this league.

(v) Germany must conclude treaties of arbitration with her neighbours: the treaties with Czechoslovakia and Poland must be such that they can be guaranteed by France,

At the beginning of Sept. the Allies invited the legal experts of the principal states interested to meet in London and there to work out a plan in conformity with the above principles. The experts finished their task while the Sixth Assembly of the League of Nations was sitting. The statesmen then united at Geneva having considered the results of the work of the experts, the French ambassador at Berlin handed to Stresemann, on Sept. 15, a note proposing that a conference should be held in Switzerland at the end of Sept. or the beginning of October. On Sept. 26 Stresemann accepted the offer for Oct. 5. At the same time he again made the reservation that the entry of Germany into the League of Nations must not be interpreted as recognition of the responsibility with which the German people were charged by Article 231 of the Treaty of Versailles, and he demanded that the Cologne zone be first evacuated. Belgium, France and Great Britain took cognisance of Germany's acceptance, except of the clause containing the reservation relative to Article 231 of the Treaty of Versailles, while they pointed out that it depended on Germany herself to accelerate the evacuation of the Cologne zone by executing her obligations of disarmament. Under these conditions the delegates of the interested Powers met at Locarno on Oct. 5.

As the basis of their deliberations, they took the draft of the experts, several articles of which were adopted as they stood, and others maintained with slight modifications. The question of the responsibility for the War and of the evacuation of the Rhenish zone was left aside. The chief difficulties were those concerning the guarantee of the Treaties of Arbitration, the formulation of these Treaties, the interpretation of Article 16 of the Covenant and the authorisation for France to cross the demilitarised Rhine zone to come to the assistance of her Allies in the east if attacked. After ten days of wearisome negotiations an agreement was reached on the disputed points. Germany abandoned her opposition to the mutual guarantee of the Franco-Polish and Czechoslovak Treaties of Arbitration. The Allies, on the other hand, consented that this guarantee should be worded in the Rhine Pact in the general form which would be more acceptable to Germany without changing anything of its nature or the effectiveness of the guarantee. In the second place, Germany consented that the Czechoslovak and Polish Conventions of Arbitration should be identical with those of France and Belgium, and that they should be integral, that is to say, that the pacific settlement of international differences should be extended to all these questions. Finally, Germany and the Allies arrived at a compromise relating to Article 16 of the Pact of the League of Nations, without infringing in any way on the essential principles of this Article, by means of a collective note. It was thus possible to sign the final Protocol on Oct. 16 containing what is called the Locarno Pact, which consists of the following diplomatic documents:—

(*a*) Treaty between Germany, Belgium, France, Great Britain and Italy, called the Rhine Guarantee Pact;

(*b*) Four Treaties or Conventions between Germany on the one hand, and France, Belgium, Poland and Czechoslovakia on the other;

(*c*) Treaties of Guarantee between Czechoslovakia and Poland and France;

(*d*) A collective note of the states which participated in the Conference of Locarno regarding Article 16 of the Covenant of the League of Nations in case Germany should enter the League of Nations.

The Rhine Pact

The Rhine Pact solved the problem of security in the following fashion:—

(*a*) Germany, France and Belgium undertook to respect the inviolability of the German-Franco-Belgian frontiers.

(*b*) Germany, France and Belgium mutually undertook in no case to attack or invade each other or resort to war against each other; that is to say, they pledge themselves never again to make war.

(*c*) The obligation not to make war in the future does not apply in the case of legitimate self-defence, of resistance to

a violation of the Treaty of Versailles relative to the demilitarised zone, nor to the case of the execution of obligations arising out of membership of the League of Nations and the application of Articles 15, paragraphs 7 and 16 of the Covenant. Armed intervention can take place without the previous decision of the Council of the League of Nations in cases of legitimate self-defence, of flagrant violation of the demilitarised zone and of attack or flagrant violence.

(*d*) Germany, France and Belgium, having resolved never more to make war on one another, pledge themselves at the same time by particular Treaties of Arbitration to regulate all their differences by pacific methods, submitting them either to judges or to a commission of conciliation.

(*e*) Great Britain and Italy guarantee the execution of these obligations by the states concerned.

(*f*) All rights and obligations arising for the contracting parties out of the Covenant of the League of Nations remain intact, that is to say, all these conventions are included within the framework of the League of Nations and are, strictly speaking, only applications of certain principles and definite articles of the Covenant. These engagements will come into force with Germany's entry into the League of Nations.

These arrangements do not certainly procure complete security for the signatory Powers. But between them they take practically all the precautions which it is humanly possible to take. The only reproach that can be levelled against them is that they interlace the rights derived from the Rhineland Pact and the applications prescribed by the Covenant of the League of Nations to such an extent that it will be sometimes difficult to reconcile the former with the latter. For example, under Article 2 of the Treaty of Guarantee analysed above, France would have the right of invading the territory of Germany immediately if the latter violated Articles 42 and 43 of the treaty or attacked one of the signatory states, especially Poland or Czechoslovakia. It has been expressly stated in the public speeches of the Allied ministers that the demilitarised Rhineland zone could not be a "wall" sheltered behind which Germany could commit aggression against states other than France. Nevertheless, by the terms of Articles 3 and 4, any signatory state which considers that a violation of Article 2 or a contravention of Articles 42 and 43 of the treaty has been committed, ought to bring the question immediately before the Council of the League of Nations. One may wonder whether, in case of a military occupation by Germany or of an unexpected case of aggression by Germany against Poland, France should await the decisions of the Council of the League of Nations before invading German territory. On this question the declarations of the Allied ministers seem to agree that this would not be the case. But the German press appears to take the view that France would be bound to wait.

Further, according to Article 8, the treaty "will remain in force until the Council acting on the request of one or another of the high contracting parties notified to the other signatory Powers three months in advance, and voting at least by a two-thirds majority, decides that the League of Nations ensures sufficient protection to the high contracting parties the treaty shall cease to have effect on the expiration of a period of one year from such decision." It would then be possible for a two-thirds majority of the Council to declare the treaty void and to return to the general guarantees of security stipulated in the Covenant. Finally, the treaty imposes no obligation on any of the British Dominions nor on India. This is why the present complementary agreements are maintained and it is permitted to conclude fresh ones, provided they be communicated to the League of Nations and registered by it.

As for the interpretation of Article 16 of the Covenant, it is defined as follows in the letter addressed to the German Delegation: "The obligations resulting from the said Article on the Members of the League must be understood to mean that each state member of the League is bound to collaborate loyally and effectively, in support of the Covenant and in resistance to any act of aggression to an extent which is compatible with its military situation, and takes its geographical position into account."

The Treaties of Guarantee

Besides the arbitration agreements, two Treaties of Guarantee signed by France with Poland and Czechoslovakia, and communicated at Locarno to the other states represented at the conference, complete the system of security. Their essential arrangements, which are identical in the two treaties, are as follows:—

Article 1.—In the event of Czechoslovakia (or Poland as the case may be) or France suffering from a failure to observe the undertakings arrived at this day between them and Germany with a view to the maintenance of general peace, France and reciprocally Czechoslovakia (Poland) acting in application of Article 16 of the Covenant of the League of Nations, undertake to lend each other immediately aid and assistance, if such a failure is accompanied by an unprovoked recourse to arms.

In the event of the Council of the League of Nations, when dealing with a question brought before it in accordance with the said undertakings, being unable to succeed in making its report accepted by all its members, other than the representatives of the parties to the dispute, and in the event of Czechoslovakia (Poland) or France being attacked without provocation, France or reciprocally Czechoslovakia (Poland) acting in application of Article 15, Paragraph 7, of the Covenant of the League of Nations, will immediately lend aid and assistance.

Dr. Benesh, in the exposé made on Oct. 30 to the Permanent Commission of the Czechoslovak Parliament, declared "We must emphasise that the assistance in question would take effect automatically. This means that the (3) contracting states have the full and only right to judge themselves whether they are confronted with a *casus foederis* (that is to say, whether the cases in which Article 15, Paragraph 7, and Article 16 of the Pact of the League of Nations are applicable) and that they are not pledged to wait for the result of any negotiations. Our former treaty with France thus acquires an entirely new character without losing anything of its effectiveness."

Ratification of the Agreements.—The principal speeches made in 1925 by the ministers responsible are as follows:—

Mr. Baldwin, Oct. 8, at Bristol, before the annual congress of the Conservative party;

Sir Austen Chamberlain, Nov. 18, in the House of Commons;

Count Skrzinski, Nov. 26, before the Committee for Foreign Affairs of the Polish Chamber;

Herr Luther, Oct. 28, at Essen, and Nov. 23 in the Reichstag.

After the two latter speeches, the German Parliament consented to the agreements which, in consequence, were solemnly signed in London on Dec. 1, at a special meeting presided over by Sir Austen Chamberlain. On Dec. 14, in the course of the 37th Session of the council, Sir Austen Chamberlain and M. Paul-Boncour deposited the agreements in the archives of the League of Nations. Speeches were made on this occasion by all members of the council recording warm approval of the great results obtained at Locarno. At the beginning of 1926 what was called the "spirit of Locarno" animated all governments: but certain mistrust and even opposition were apparent in important sections of public opinion of several countries.

This opposition was early voiced. In the French Chamber of Deputies, at the end of Feb. and beginning of March, the plan of ratification of the Locarno Treaties encountered vigorous criticism. Then irreconcilable differences of opinion were manifested in the intentions of the various governments respecting the enlargement of the Council of the League necessitated by Germany's entry. The Assembly was convoked on March 8 1926, to pronounce on Germany's request for admission and sat till March 17, without the council's being able to reach an agreement (the council's decisions must be unanimous); Spain and Brazil demanded that their temporary seats be made permanent, and Poland also demanded a permanent seat. Germany, again, wished no one but herself to receive a new permanent seat. After various agitating moves, Brazil (March 16) maintained her opposition to any combination which did not invest her with a permanent seat. In consequence, the representatives of the signatory states of the treaties of Oct. 16

issued a special declaration in which they declared their adherence to the peace work of Locarno, and the Assembly postponed further examination of the question till the Sept. session. A special commission was appointed to study the whole question of the enlargement of the council by that date.

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SEDGWICK, ELLERY (1872–), American editor and publisher, was born in New York City Feb. 27 1872. He graduated at Harvard University (A.B.1894) and taught at Groton School, Mass., 1895–6. He was on the editorial staff of the Worcester *Gazette,* 1896, assistant editor of *The Youth's Companion,* 1896–1900, and from 1900 to 1905 was editor of *Leslie's Monthly,* which under his editorship became *The American Magazine.* After a brief connection with *McClure's Magazine* and with D. Appleton and Co., he became editor of the *Atlantic Monthly* and president of the company in 1909. Under his management the circulation was greatly increased and the high character of the magazine maintained. He had published a *Life of Thomas Paine* in 1899.

SEECKT, HANS VON (1866–), German soldier, was born in Schleswig April 22 1866. He entered the Kaiser Alexander Grenadier Regiment as ensign (fahnenjunker). In 1897 he was appointed to the general staff, becoming chief of staff of the III. Army Corps (Berlin) in 1913, in which capacity he went on active service in Aug. 1914, with the rank of lieutenant-colonel. On Jan. 27 1915 he was promoted colonel, and soon after became chief of staff to Mackensen's army group. He had a large share in conducting the break-through of the Central Powers at Gorlice-Tárnow, May 1915, and the subsequent invasion of Serbia. After the collapse of the Monarchy he became adjutant-general (*Chef des Truppenamtes*) in the *Reichswehrministerium* (Nov. 1919). After the Kapp "putsch" of March 1920 he was appointed chief of the German Army Command. In Jan. 1926 he was again promoted to the rank of general by President von Hindenburg.

SEELY, JOHN EDWARD BERNARD (1868–), British politician, born May 31 1868, was the third son of Sir Charles Seely, Bart., a Nottinghamshire coal owner. Educated at Harrow and Trinity College, Cambridge, he became a barrister. In 1900–1 he served with the Imperial Yeomanry in South Africa, winning the D.S.O., and during his absence was returned to Parliament as Conservative M.P. for the Isle of Wight. His later career as a politician was somewhat varied. Forsaking the Conservative party when Mr. Chamberlain introduced his Tariff Reform proposals, Seely was returned to Parliament after the general election of 1906 as Liberal M.P. for a Liverpool division, and in 1908 he took office as under-secretary for the Colonies. In 1911 he was appointed to a similar position at the War Office and in 1912 he succeeded Lord Haldane as Secretary of State for War. He held this position until the Curragh incident in 1914, when, having initialled a demand by certain officers that they should not be asked to serve against Ulster, he was compelled to resign (*see* ENGLISH HISTORY). During the World War he served on the staff and later commanded a brigade of Canadian cavalry. In 1918–9, having been M.P. for the Ilkeston division of Derbyshire since 1910, he was under-secretary at the Ministry of Munitions, and then under-secretary of state for Air in the Coalition Ministry. In 1923 he again became M.P. for the Isle of Wight, but he lost his seat in 1924. His elder brother, Sir Charles Hilton Seely, died in 1926.

SEGUR, PIERRE MARIE MAURICE HENRI., MARQUIS DE (1853–1916), French author (*see* 24.584), died at Poissy Aug. 13 1916.

SEIGNOBOS, CHARLES (1854–), French historian, was born Sept. 10 1854 at Lamastre (Ardèche). Educated at the Lycée de Tournon, he passed to the École Normale Supérieure. Entrusted with an independent course of historical instruction in 1879 at Dijon, he was appointed to the Sorbonne, first as unattached professor in 1883 and later as special lecturer in 1890. In 1897 appeared his *Histoire politique de l'Europe contemporaine,* which was crowned by the Academie française. His work is distinguished by a broad-minded and often democratic tone, and a grasp of social science which place him in the forefront of modern historical writers.

His other published works include: *Histoire de la civilisation* (1886); *Histoire des anciens peuples de l'Orient* (1890); *La méthode historique appliquée aux sciences sociales* (1901); and in *L'Histoire de France Contemporaine* of E. Lavisse, *La Révolution de 1848* (1921); *Le Second Empire* (1921); *Le Déclin de l'Empire et l'Etablissement de la IIIe. République* (1921).

SEIPEL, IGNAZ (1876–), Austrian statesman and Roman Catholic priest, was born in Vienna July 19 1876. He did not enter politics until the end of the World War, although he published several books on subjects on the border line between his own subject, moral theology, and political science, social science and economics, viz.: *The Economic Teaching of the Fathers* (1907), *Nation and State* (1916); and in 1917 a pamphlet on the *Reform of the Austrian Constitution.* As professor at Salzburg (1909–12) he saw much of the retired economist, Heinrich Lammasch, with whom he worked until 1917 in the preparation of an edition of the writings of Hugo Grotius on international law.

Seipel was appointed to Vienna University in 1917 and his work, *Nation and State,* dealing with the supernational state, such as the Austro-Hungarian Monarchy, as a higher type of State compared with the national State, and thus viewing Austria-Hungary's future optimistically, at the same time favouring a reasonable pacificism, caused the Emperor Charles to include him in the circle of those men who were to prepare the way for peace through unofficial negotiations abroad. At the same time, the German parties in the Austrian Parliament summoned him as scientific expert to the consultations on the reform of the constitution now recognised as overdue, and in these Seipel supported moderate federalism on a national basis. But the downfall of the Austro-Hungarian Monarchy could not be prevented either by reform of the constitution or by the peace policy of the Lammasch Ministry, which took office at the eleventh hour, in Oct. 1918, and which included Joseph Redlich and Seipel as exponents of the peace policy.

After the collapse, Seipel succeeded in preventing the threatened split of the strongest Conservative party in the country, the Christian Socialist, into a Monarchist and a Republican party. This and the necessity of getting new men into Parliament under the new conditions caused his election in 1919 to the National Constituent assembly by the electoral division for central Vienna, and later to the National Council. As long as the Social Democrats were the strongest party, the Christian Socialists joined it in forming a Government coalition. During this time Seipel worked against too close an alliance of the Christian Socialists with the Social Democrats; in particular he prevented the execution of far-reaching schemes for the socialisation of means of production. After the elections of 1920, which returned the Christian Socialists at the head of the poll, Seipel was undisputed leader of his party. Under his influence Austrian policy gradually veered to the right. In the spring of 1920 he succeeded in creating a firm Governmental majority, which included all non-Marxist parties, and remained in power after the elections of 1923.

As soon as the anti-Socialist united front had been formed, Seipel took over the administration as Chancellor May 31 1922. At that time the universal misery had reached its climax owing to the policy of inflation. Seipel, together with his Ministers of Finance, August Ségur and Victor Kienböck, put an end to inflation by the creation of a new note bank independent of the Government and prepared for his negotiations with the League of Nations in the autumn of 1922 by his political journeys to Prague, Berlin and Verona, by which he obtained the guarantee of a foreign loan by a number of States and eventually the loan

itself. This loan, by covering the deficits which were at first unavoidable, gave time and stimulus for the carrying out of the economics and reforms, necessary to balance the budget. Seipel succeeded by hard fighting in carrying through Parliament the acceptance of the Geneva Protocol and of the foreign controller of Austrian finances appointed by the League of Nations, and led Austrian policy to the re-establishment of almost complete financial equilibrium. In the autumn of 1924, when he had hardly recovered from a wound inflicted in an attempt on his life, he encountered strong opposition in the provinces, *i.e.*, from the members of the Austrian Federation, to his endeavours to introduce a few necessary reforms into the constitution and administration. He then resigned his Chancellorship. After that he carried on active propaganda for a lasting peace through his numerous lecture tours in Austria and abroad. He believed that peace would be secured by recreating the economic unity in Central Europe, which had been destroyed by the War and the inadequate Peace Treaties. His object was a European confederation, which would neither coerce nations for economic reasons nor would violate economics for the sake of national aspirations. (A. F. Pr.)

SEISMOLOGY: *see* EARTHQUAKES.

SEITZ, KARL (1869–), Austrian politician, was born at Vienna on Sept. 4 1869, the son of a wood merchant. Although apprenticed to the tailoring trade, he subsequently entered the teachers' seminary at St. Pölten, through the medium of patrons. In this way he became an elementary school teacher. Originally inclined to the German National party, he joined in 1888 the Social Democratic party. He organised the Social Democratic teachers of Vienna, and in the diet of Lower Austria waged a fierce fight against Burgomaster Lueger and the dominant Christian Socialist party. Elected to the Austrian *Reichsrat* in 1901 he became after the death of Pernerstorfer, its vice-president down to its dissolution. After the revolution of 1918 he was president of the German-Austrian National Assembly, and subsequently of the national parliament (*Nationalrat*) until the new elections in Oct. 1920, and acting federal president until Nov. 1920. He was in 1921 chairman of the committee of the Social Democratic party and of the parliamentary party, and vice-president of the *Nationalrat*.

SELBORNE, WILLIAM WALDEGRAVE PALMER, 2ND EARL OF (1859–), British politician (*see* 24.599), on his return from South Africa resumed his prominent position among the Conservative leaders in the House of Lords. He took an active share in defending the House against Liberal attack, and was one of the leading "Diehards" who maintained an uncompromising resistance to the Parliament Bill. When the World War came he was largely occupied with his military duties with the 3rd battalion of the Hampshire Regiment; but he joined the first Coalition Ministry in May 1915, as Minister of Agriculture. As minister he appointed an expert agricultural committee under the chairmanship of Lord Milner, to report on the means of maintaining and increasing food production in England and Wales; but he and the Government rejected their recommendation to guarantee farmers a minimum price of 45s. a quarter for four years. In June 1916 he resigned his office because he disapproved of the Irish policy of compromise accepted by Mr. Asquith's Government. He did not join Mr. Lloyd George's Ministry, and after the War was largely conspicuous in ecclesiastical matters; he was forward in promoting the movement of self-government in the Church which culminated in the Church Enabling Act of 1919. He also identified himself strongly with the policy of reforming the House of Lords and reconsidering the relations between the two Houses under the Parliament Act.

His elder son, Viscount Wolmer (b. 1887) entered Parliament in 1910, and proved an active member of the Conservative party, as well as a leading member of the Church Assembly. He was made assistant postmaster-general in 1924.

SELENIUM (*see* 24.601).—The unrivalled efficiency of selenium as a detector of light has been utilised in several new types of apparatus. The use of selenium as a trigger for actuating a relay, the most striking example of which was the steering of an unmanned boat by a searchlight on shore in 1916, has not yet been very fruitful in practice. Such problems as the automatic lighting of electric street lamps at dusk have not been solved, on account of the prohibitive cost of the apparatus as compared with human labour. Cox's cable relay, a light relay worked with selenium, and producing a more than thousandfold amplification of submarine signals, may, however, be cited as a successful application of a selenium relay. It works by throwing a beam of light from the galvanometer recording the signals alternately upon two opposed networks of a selenium grating.

Detectors.—Among laboratory applications one of the most important is the selenium detector attached to a number of Hilger spectroscopes and monochromatic illuminators. This detector contains a "line-element" of selenium, 2 cm. long and 0·3 mm. wide, made by ruling a shallow groove in a ceramic surface coated with graphite and filling it up with sensitised selenium. Small holes are drilled along the line-element to allow of simultaneous visual observations. The line-element has a resistance of approximately a megohm in the dark. A 30-v. battery is used to produce a deflection in a sensitive galvanometer connected in series with the detector and battery, and the effect of illuminating the line-element is an immediate increase of the deflection. This increase reaches a maximum after a few seconds, and is proportional to the square root of the intensity of illumination. The detector responds to all visible light and also to ultra-violet light down to the limit of the spectrum in air. At the less refrangible end, however, the response of the detector falls off at 6,500 Angström units and ceases entirely at 15,000 units, after covering about an octave of infra-red wave-lengths. Compared with the thermopile, the selenium detector is slightly more efficient in the first region of the infra-red, and very much more efficient in the visible and the ultra-violet regions, where its superiority can be expressed as a factor of several thousand.

Photometry.—Another application concerns photometry, where the limit of accuracy of visual comparisons is approximately 1%. This accuracy has now been greatly exceeded even by the photoelectric cell, with which differences as low as $\frac{1}{20}$% can be registered. In the case of selenium the limit of accuracy is $\frac{1}{100}$% or even less. Here, again the superiority of selenium is more marked in feeble light than in strong light, since strong illumination brings the conductivity near a point of "saturation."

Amplifiers.—Several methods have been devised for amplifying the photoelectric action of selenium by means of the thermionic valve. Selenium being capable of responding measurably to a light-stimulus less than $\frac{1}{1000}$ of a sec. in duration, it is worth while to amplify the effect into a practically useful current impulse. This can be done by making it alter the potential of the grid of a valve. G. G. Blake has devised a number of circuits in which this is done. In some of these circuits the effect of light on selenium is made to change the pitch of a circuit in audio-frequency oscillation, thus producing an audible effect of light on a principle different from that of the optophone. Another method of utilising selenium has been developed by E. O. Symonds, who uses a five-valve amplifier for recording the passage of Fabry-Pérot interference fringes by means of a selenium detector and a Creed relay and undulator.

This device was first shown in action at the Optical Convention in April 1926, where it recorded Fabry-Pérot fringes at the rate of three per sec., working continuously for several hours.

X-rays.—These X-rays increase the conductivity of sensitised selenium. A well-known apparatus for utilising this action for the dosage of X-rays is that of Fürstenau, but it is only suitable for the less penetrating rays, as rays of the shorter wave-lengths are insufficiently absorbed to produce a measurable effect. This may be remedied by using thicker layers of selenium capable of absorbing the most penetrating rays and indicating the distribution of their intensity along the spectrum. Researches in this direction have been undertaken at the London Cancer Hospital.

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SELF-DETERMINATION is a term which, since the World War has been commonly used to denote the right of every people to determine and to direct its political and spiritual destinies; that is, to choose freely such form of government and of political and cultural institutions as it thinks will best correspond to its needs and express its distinctive national genius. In the past it had been applied to a variety of political and other causes. After 1914 it became a war-time slogan, chiefly used by Allied propagandists who represented it as part of the Allied programme to liberate certain subject nationalities of Eastern, Central, Southeastern Europe and of the Middle East, from the control of the races there dominant. In particular the term was associated with the Baltic nations and the subject nationalities of Central and Southeastern Europe. After the Russian Revolution of March 1917, Kerensky proclaimed it as one of his cardinal principles. President Wilson was one of its chief advocates, and included it in his famous Fourteen Points enunciated in 1918. The effect which it has had in practice on international affairs in the period 1914–26 must be gauged by a study of war-time and post-War diplomacy. (*See* EUROPE; PLEBISCITE; those on the various European countries *e.g.* POLAND; RUMANIA.)

SELFRIDGE, HARRY GORDON (1864–), American business man, was born at Ripon, Wisconsin, U.S.A., on Jan. 11 1864. Educated at the public school, Jackson, Mich., U.S.A., he afterwards entered the firm of Marshall Field and Co., of Chicago, from which he retired in 1904. In 1906 he went to London and organised the firm of Selfridge and Co., Ltd., wholesale and retail merchants, which opened in 1909 with extensive premises in Oxford Street. These became known throughout the country, and the firm developed into one of the most successful business enterprises of its kind in the world. Mr. Selfridge wrote a book, *The Romance of Commerce* (1918) in which he attempted to record the growth of commerce from the earliest times until the present day.

SELOUS, FREDERICK COURTNEY (1851–1917), British explorer (*see* 24.614), during the World War served in the East African campaign in the legion of frontiersmen (25th Fusiliers). He was promoted captain and in Sept. 1916 was awarded the D.S.O. He was killed in action at Beho Beho Jan. 4 1917. His private collection of trophies was given by his widow to the Natural History Museum, London, where in June 1920 a national memorial to him was unveiled. A Selous scholarship was also founded at his old school, Rugby. See J. G. Millais, *Life of Frederick Courtney Selous* (1918), and *Geog. Jour.*, vol. 49 (1917).

SEMBAT, MARCEL (1862–1922), French politician, was born Oct. 19 1862, at Bonnières (Seine-et-Oise), and educated at the Collège Stanislas. In 1893 he became Socialist deputy for the 18th *arrondissement* of Paris, and attached himself to the Blanquist fraction of the party headed by Edouard Vaillant. On the constitution of the United Socialist party, however, in 1905, under Jaurès, the factions previously opposed to him under the banners of Blanqui and Jules Guesde were merged in it, and Sembat became one of a brilliant body of extremist debaters which for many years made the Radical-Socialist party the strongest political force in France. He sat for many years on the Budget and Foreign Affairs committees of the Chamber. He gained a reputation not only as a caustic and alert debater, but as a journalist; previous to the formation of the United Socialist party, he contributed to the *Petite République* and *La Lanterne* and when Jaurès founded *L'Humanité* in 1904, became one of its best-known correspondents.

On the outbreak of the World War, Sembat, who had originally been opposed to Socialists taking ministerial office, was one of many members of his party who sank their party grievances in the Union Sacrée, and himself became Minister of Public Works in the Ministry of National defence in Aug. 1914. After the War, Sembat stood out in his resistance to the insidious doctrines of Communism, and saw the United Socialist party broken up by disputes such as those at the Tours Conference of 1920 on the question of adherence to the Third International. But though he had always kept up relations with certain bourgeois elements of the Left, he had not, up to the time of his death at Chamonix on Sept. 5 1922, seen fit to modify his opinions except in a sense even more favourable to pure Socialism. Among his published works are *Matisse et son oeuvre* (1920) and *La victoire en déroute* (Eng. tr. 1925).

SENEGAL, a colony and protectorate of French West Africa (*see* 24.640). The area is 74,000 sq. m. and the population (1925) about 1,500,000. The capital is St. Louis, with a population (1921) of 18,117. In Dakar (32,440) Senegal possesses the largest town, and the only first-class port in French West Africa. A railway (682 m. long) from Thies, on the Dakar-St. Louis line, was completed to Kayes, on the Senegal river, in 1923. At Kayes, this line joins the railway to Kulikono on the navigable Niger. Immense quantities of ground nuts are grown by the natives and form the bulk of the country's trade. The amount exported annually, over the period 1910–24, being from 250,000 to 300,000 tons. The colony of Upper Senegal and Niger was renamed French Sudan in 1920.

SENUSSI (*see* 24.649).—By 1914 the dominating influence which the Senussi brotherhood had formerly possessed in the region between Lake Chad and Darfur had been lost by the conquest by the French of Wadai and the other States of the Central Sudan. While members of the sect were to be found from Morocco to Afghanistan, and there had been an increase of its adherents in Egypt and Arabia, the temporal authority of the Senussi was then confined to Cyrenaica and the oases of the Libyan Desert—Kufara, Jalo, Jaghbub, etc.

The Senussi Sheikh, Sayed (Sidi) Ahmed esh Sherif, had been won over some years previously to Pan-Islamism and he had aided the Turks in 1911–2 in their campaign against the Italian invaders of Cyrenaica. After the Treaty of Lausanne Sayed Ahmed continued the war with Italy. Terms of accommodation might have been reached but the Sheikh refused to accept the position of a "protected Bey." He had effective control of the greater part of Cyrenaica when the World War began.

In 1915, partly as the result of heavy bribes and gross flattery, Sayed Ahmed was induced by Turkish and German agents to break the friendly relations which had hitherto existed between the Senussi and Egypt, and at the end of that year he invaded western Egypt. (For the military operations *see* SENUSSI, OPERATIONS AGAINST THE.)

The war with Egypt had not the approval of all the Senussi chiefs. Notably it was opposed by Sayed Mohammed el Idris the eldest son of the Sheikh el Mahdi, the second head of the Senussi fraternity. When Senussi el Mahdi died in 1902 his sons were minors and the chieftainship had gone to his nephew Ahmed. With Sayed Idris the Italian and British Governments entered into an agreement in 1917; the Senussi chiefs acknowledged Sayed Idris as "Grand Senussi" and in Aug. 1918 the defeated and discredited Sayed Ahmed found it convenient to quit Cyrenaica. He was conveyed by a German submarine from Misurata to Pola, whence he went to Turkey, still claiming to be head of the brotherhood. By the Accord of Regima, Nov. 1920, Sayed Idris acknowledged Italian suzerainty. He was given the hereditary title of emir (prince) with jurisdiction over the oases of Kufara, Jaghbub, Jalo, Aujela and Jedabia.

Italian Occupation of Jaghbub.—Peaceful relations continued for some time, but Italy under Fascist rule found the situation irksome. There was also evidence that Sayed Idris was encouraging the insurgents in Tripolitania, who in July 1922 had invited him to become their leader and prince. "In the beginning of 1923, it being considered that the terms of these agreements [with the Senussi] and the manner in which they were interpreted on the native side were incompatible with the national dignity [of Italy] they were denounced, and since that date the tableland [of Cyrenaica] has been the site of desultory political brigandage and occasional raids on cattle and crops by groups of tribes." This quotation from a report by Mr. L. H. Hurst, British consul at Benghazi, summed up the situation in Sept. 1925. Six months later armed opposition to the Italians was confined to the Jebel el Akhdar, to the east of Benghazi. Sayed Idris himself had in Jan. 1923 withdrawn to Egypt, where he had formerly resided as Senussi envoy. Seemingly he suffered no loss of spiritual prestige, upon which his friends declared he set more store than on

temporal authority. In the Libyan oases his lieutenants continued to rule.

The Italians, however, were placed in an advantageous position to control Senussi activity by an agreement made with Egypt on Dec. 6 1925. This agreement gave them the sovereignty over the oases of Jaghbub, while south of that place the frontier was drawn along the 25th degree of E. longitude, thus including Kufara in Cyrenaica. Jaghbub was occupied by Italian troops in Feb. 1926, without opposition. It is important as containing the tomb-mosque of the founder of the Senussi sect and a *zawia* (monastery) for the training of the *ikhwan* (brethren). It is also on the route from Kufara to Egypt and has some strategic value. The Italians agreed to respect the holy places at Jaghbub and to allow Moslems free access to them. With the Senussi as a religious order they declared that they had no quarrel. During 1920–3 Mrs. Rosita Forbes, Hassanein Bey and M. de Laborie all penetrated to Kufara and each drew a pleasing picture of Senussi culture and Senussi rule in the Libyan oases. (*See* AFRICA.)

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SENUSSI, OPERATIONS AGAINST THE.—The military activity of the Senussi from 1900 to 1910 had been directed against the French in the regions between Lake Chad and the Nile Basin. There was evidence of an increase of adherents to the sect in Egypt and Arabia; in N.W. Africa and the Sudan it had made practically no headway. During 1911 the Senussi Sheikh, Sidi Ahmed, aided the Turks in their campaign against Italy in Cyrenaica. After the treaty of Lausanne, in Oct. 1912, by which Turkey agreed to evacuate Tripoli and Cyrenaica, Sidi Ahmed continued the war against the Italians, who were powerless to penetrate into the interior.

Outbreak of War.—In 1914, the Germans and Turks saw in the Senussi a powerful instrument for attacking the British position in Egypt and the Sudan. For long Sidi Ahmed resisted the efforts to embroil him with Egypt, with which he had always maintained good relations. But the adherence of his enemy, Italy, to the Allied cause in May 1915 gave his Turkish advisers a powerful lever and finally the influence of Nuri Bey, a half brother of Enver, prevailed.

The plan instigated by the Turks and Germans was for simultaneous advances on Egypt along the coastal strip and by the oases leading from Siwa to the Nile. At the same time the Sultan of Darfur was to rise, invade Kordofan and advance on Khartoum. The danger to the British in Egypt and the Sudan was not so much in the military force actually at the command of Sidi Ahmed and his allies as in the spiritual authority he exercised and the possibility of a religious rising.

Hostilities began on Nov. 15 1915. The small garrisons of Es Sollum and other advanced posts were withdrawn, and Mersa Matruh was made the base for the British operations. The difficulty was to collect a sufficient force, for during the Gallipoli operations Egypt had been practically denuded of troops. The force assembled under Maj.-Gen. A. Wallace consisted of Yeomanry, Territorials, Australians, New Zealanders, Indians and Egyptians. The Senussi leader had a few Turkish troops with him, about 5,000 of his own regular forces and a varying number of irregular tribesmen.

A Decisive Engagement.—Gen. Wallace succeeded in striking a severe blow at the enemy on Christmas Day 1915, but the rainy season and a lack of troops and transport prevented any further attempt to bring the enemy to battle till Feb. 1916. On Feb. 20, Maj.-Gen. W. E. Peyton, who had succeeded Gen. Wallace, began an advance to reoccupy Es Sollum. On Feb. 26 at Agagya, about half way to Es Sollum, a decisive engagement was fought. The infantry, which included two South African battalions, captured the Senussites' position. In the pursuit the Dorset Yeomanry, by a fine charge, broke the enemy and captured Jafar Pasha, an able Baghdadi Arab who commanded the Senussites. There was little further fighting. Es Sollum was reoccupied on March 14, the enemy retiring into Cyrenaica. During Feb. and April 1916, the Senussites, under Sidi Ahmed himself, occupied the Bahariya, Farafra, Dakhla and Kharga oases, but made no further advance. The British had at the time no forces available for re-occupation, but kept the oases under observation by aeroplane.

Meanwhile the rebellious Sultan of Darfur, Ali Dinar, in May 1916, was attacked and defeated by a force from the Sudan under Lieut.-Col. P. V. Kelly. The Sultan himself was killed in November. By Oct. 1916 the British had organised a camel corps and light car patrols, and proceeded to re-occupy the oases. Sidi Ahmed retired to Siwa, where he was attacked and defeated at the beginning of Feb. 1917 by a force of armoured cars from Es Sollum under Brig.-Gen. H. W. Hodgson. This action at Siwa discredited the Senussi and removed the danger to Egypt.

During 1917 and 1918 Turkish and German influence amongst the Senussites declined and Sidi Ahmed's own position was discredited. In the summer of 1918 he found it advisable to leave Cyrenaica for Turkey and was succeeded by Sidi Mohammed el Idris, the son of Senussi-el-Mahdi. The new Grand Senussi concluded agreements with Great Britain and Italy, recognising Italian sovereignty. In 1925 a rectification of frontier was made between Egypt and Italy, Jaghbub being transferred to the Italian sphere.

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SERBIA (*see* SERVIA, 24.686), until 1918 an independent kingdom of southeastern Europe. Since that date it has formed part of the Serb-Croat-Slovene kingdom (Yugoslavia). For its present area, population and economic and financial history and for its political history after 1918, *see* YUGOSLAVIA.

I. THE BALKAN LEAGUE

The annexation of Bosnia (Oct. 13 1908) marked a turning-point in the history of Serbia. Henceforth public opinion, supported by prominent statesmen in every party, was practically unanimous in regarding a conflict with Austria-Hungary as sooner or later inevitable. This belief had at once a national and an economic basis; for Count Aehrenthal not merely supported the Hungarian policy of repressing Yugoslav national aspirations inside the Dual Monarchy, but obstructed Serbia's commercial development by tariff and frontier restrictions, by a veto upon either direct access to the sea or a common frontier with Montenegro and by opposition to all idea of Balkan co-operation.

Aehrenthal's policy inevitably strengthened the tendencies towards the creation of a Balkan League, and these were accelerated by the political unrest evoked throughout the Balkan peninsula by the Young Turk revolution. At first the inclusion of Turkey in such a league was openly advocated by Izvolsky, the Russian Foreign Minister, and was actively favoured by Milovanović and Veniselos. But in view of the increasingly chauvinistic attitude of the Young Turk régime in Macedonia and Albania, Veniselos found it advisable to discuss with Bulgaria measures of common defence against a possible Turkish attack; and this was followed in the winter of 1912 by negotiations between Sofia and Belgrade. On March 13 1912 a secret treaty of alliance was concluded between Serbia and Bulgaria, and was supplemented on May 12 by a military convention. On May 29 a similar treaty was concluded between Bulgaria and Greece. There was no actual treaty binding Serbia and Greece, while the Serbo-Montenegrin treaty, concluded as late as Sept. 1912, was less political than military, and provided for separate though parallel action.

By the first of these each State was bound to assist the other with all its forces in the event of an attack, and in particular in the event of any Great Power trying to annex any portion of

Turkey's Balkan possessions. If internal troubles should arise in Turkey, either ally might initiate proposals for military action, and any point upon which agreement was not reached should then be referred to Russia for decision. Special provision was made for possible conquests, Serbia recognising Bulgaria's rights over the territory lying east of the Rhodope mountains and the Struma river, and Bulgaria similarly recognising Serbia's rights north and west of the Šar mountains. The districts lying between these limits, the Aegean and the Lake of Okhrida were to form "a distinct autonomous province," but should their partition prove inevitable, then Serbia undertook to make no claim beyond a line drawn from the Lake of Okhrida to near Kriva Palanka on the old Turco-Bulgarian frontier and including Skoplje, but not Monastir, Prilep or Veles. In the event of a dispute the Tsar was to act as arbitrator, and Bulgaria undertook to accept the more southerly line as its new frontier with Serbia if the Tsar should decide in its favour. In the event of war Bulgaria undertook to place at least 200,000, Serbia at least 150,000 men in the field against Turkey. If either Turkey or Rumania attacked Bulgaria, Serbia was to send 100,000 men to her aid, while she on her part must provide 200,000 men in support of Serbia in the event of an attack by Austria-Hungary.

Internal disorder spread rapidly throughout Turkey-in-Europe in the year following Italy's invasion of Tripoli; and the ferocious policy of suppression adopted by the Committee of Union and Progress towards all the non-Turkish nationalities culminated in a reign of terror at the parliamentary elections of 1912, in a recrudescence of Komitadji activities and in a fresh Albanian rising. The premature death of Milovanović on July 1 not merely deprived Serbia of her ablest modern statesman, but removed one of the few restraining influences in any Balkan capital. He was succeeded as Premier by Trifković and in the conduct of foreign affairs by the Old Radical leader Pašić (Pashitch), who placed almost unreserved reliance on Russian support and worked in the closest accord with Hartwig. On Sept. 12 Pašić became Premier at the head of a purely Old Radical Cabinet.

By this time not even the most pacific statesmanship could have arrested the growing anarchy in Turkey. Public opinion in Belgrade and Sofia was roused by a massacre of Bulgarians at Kočana on Aug. 1, and by the report of similar outrages in the Sanjak. By the middle of the month Usküb, and the entire district recognised by the secret treaty as Serbian, were in the hands of the insurgent Albanians; and the concessions granted by the Porte while failing to arrest the movement only served as an incentive to swift action on the part of the neighbouring States.

The somewhat vague proposals for decentralisation and administrative reform put forward by Count Berchtold on Aug. 20 prompted the Balkan Allies to hasten their preparations. While the slow-moving Concert of Europe was discussing alternative proposals for Turkish reform, the Porte suddenly held up Serbian war material at Salonika and began to mass troops round Adrianople. Before any collective step had been taken by the Powers, the situation was gravely compromised by the almost simultaneous mobilisation of the four Balkan allies (Oct. 1). At the last moment the Porte announced its intention to enforce the Vilayet Law of 1880, which had been allowed to remain on paper for a whole generation. But this was very naturally regarded by the Balkan allies merely as a fresh attempt at evasion, and the Powers still further alarmed them by addressing a conciliatory Note to Constantinople and by simultaneously warning the Allies that even in the event of their victory no change in the territorial *status quo* would be tolerated. The further announcement of the Powers' intention after a lapse of 34 years to enforce the Treaty of Berlin decided the four allies to precipitate events, and before the impending Note could be formally communicated the King of Montenegro, by an act of undoubted collusion, declared war upon Turkey. On Oct. 13 the other three Balkan Governments presented to the Porte a series of far-reaching demands, culminating in racial autonomy for all the nationalities of the Ottoman Empire; and four days later the Turks, without even deigning to answer the note, declared war on Serbia and Bulgaria (*see* BALKAN WARS).

II. THE BALKAN WARS

The First War.—All the Great Powers, though for quite divergent reasons, genuinely attempted to prevent war. That, having failed to do so, they adopted a passive attitude during its early stages, was due to the almost universal assumption in official circles that the Turks would be victorious, and that the refractory Balkan States would soon be only too glad to accept a settlement dictated from without.

The rapid and overwhelming success of the allies radically transformed the situation. By the end of Nov. Turkish rule in Europe was restricted to the Chatalja lines, the Gallipoli Peninsula and the three fortresses of Adrianople, Janina and Scutari. The Serbs in particular, after the victories of Kumanovo and Monastir, were in actual occupation of all Macedonia west of the Vardar and had reached the Adriatic at Durazzo and Medua. They were thus able to go far beyond their obligations under the military convention by sending a force of 47,000 men and heavy siege guns to the assistance of the Bulgarian Army investing Adrianople.

Kumanovo was much more than an ordinary victory. It restored to Serbia that self-confidence which had been so gravely shaken by the rebuffs and scandals of the previous 30 years; and throughout the Yugoslav provinces of Austria-Hungary it was hailed as an atonement for Serbia's downfall on the field of Kosovo and as a pledge of her new mission as the Southern Slav Piedmont.

Austria-Hungary at first adopted a waiting attitude, but as the Serbs approached the Adriatic she suddenly ordered a general mobilisation, and suppressed all public expressions of feeling, while the official press of Vienna and Budapest adopted a menacing tone towards Serbia. Great prominence was given to the alleged insults offered to Prochaska, Austro-Hungarian Consul at Prizren, and for some weeks public opinion was allowed to believe that he had been shamefully mutilated by Serbian officers. It only transpired at a much later date that Prochaska, known to be in touch with the open enemies of Serbia in the Sanjak, had been entirely unmolested by the invaders, but that on the other hand he had received definite instructions from Vienna to create an "incident" such as might provide a pretext for action. The Austro-Hungarian Chief of Staff and War Minister, Generals Conrad and Auffenberg, are known to have favoured a radical solution of the Southern Slav question by immediate war with Serbia; and similar views were held by the leading Ballplatz officials, Macchio, Kanya and the notorious Count Forgács. But both the Emperor and Francis Ferdinand were averse to war, and Germany, finding Italy restive as to any change in the Balkan *status quo*, exercised a moderating influence over Vienna in connection with the fourth renewal of the Triple Alliance (Dec. 7).

Meanwhile, the success of the Balkan allies, and the general relief with which public opinion hailed the downfall of Turkish rule in Europe, led the Powers to accept the accomplished fact and consent to a remaking of the map of Eastern Europe. For the moment all that Berchtold could do was to encourage Bulgarian designs on Constantinople and attempt to sow dissensions among the allies. The Turks, seeing themselves isolated in Europe, made overtures of peace as early as the 11th to King Ferdinand, who was not willing to consider them until his troops had been checked before Chatalja.

The Conference of London.—On the 25th, however, negotiations were opened, and resulted, not in peace, but in an armistice (Dec. 3) pending a general peace conference. When this opened in London on Dec. 16, Serbia was represented by the ex-Premier and historian Novaković, the President of the Skupština Nikolić, and the Minister in Paris Vesnić. At London Turkey pursued a policy of dilatory diplomatic intrigue, and only receded inch by inch before the very drastic demands of the Allies. After a month of fruitless negotiations, complicated by a revolution in Constantinople, the Balkan Delegates broke off the negotiations on Jan. 28. The Council of Ambassadors initiated by Sir Edward Grey continued to sit in London, and devoted especial attention to the Albanian problem and to the friction produced between Albanians and Serbs by the latter's presence on the Adriatic.

The commandant of Scutari, Hassan Riza, having declined to recognise the armistice, hostilities before the town had continued throughout Dec. and Jan., and Serbia sent repeated reinforcements to the aid of the Montenegrins.

When war was resumed on Feb. 3 the brunt fell upon Bulgaria, and the Serbs, being complete masters of Macedonia, were free to contribute 47,000 men and a siege train of 38 guns to the operations against Adrianople, which held out until March 26. The dispute which arose as to whether Shükri Pasha had surrendered to the Bulgarians or to the Serbs was in itself quite unprofitable but was a symptom of the friction which was daily increasing between the two allies. The final phase of the war concentrated round Scutari, which Montenegro and Serbia made desperate efforts to reduce. Even the announcement that the Council of Ambassadors, in fixing the frontiers of the new Albanian State, had definitely included Scutari (while leaving Dibra, Prizren, Peć and Djakovica to the two Serb kingdoms) only served as an incentive to create if possible a fresh *fait accompli*. But Austria-Hungary upheld her veto, and on March 20 addressed a severe Note to Montenegro, reproaching her with the murder of a Bosnian Franciscan and other incidents, and dispatched a strong naval squadron to the Southern Adriatic. Realising the danger of Austro-Hungarian intervention, the Powers on March 31 joined Vienna in ordering Montenegro to cease hostilities, and on her refusal established a naval blockade of her strip of coast. This seemingly illusory measure at least had the effect of restraining Austria-Hungary, who could not act separately so long as the Powers held together. It was, however, simply defied by King Nicholas, who gained time by consenting to the withdrawal of the Serbian troops, and meanwhile closed the frontier and conducted secret negotiations with Essad Pasha, commandant of the town since the assassination of Hassan Riza on March 30. On April 23 Scutari surrendered to the Montenegrins, but the Powers, after a crisis of some weeks, eventually compelled the Montenegrins to surrender Scutari to Admiral Burney, as commander of the international fleet.

Negotiations could now be resumed in London for a general peace May 20, and the Powers found it easier to take a strong line. Before the delegates could be brought to business, it was necessary for Sir E. Grey to inform them, with quite undiplomatic bluntness, that unless they were prepared to conclude peace without further delay they had better leave London altogether. By the Treaty of London (May 30 1913) Turkey ceded to the four allies conjointly the island of Crete and all territory lying to the west of the Enos-Midia line, while the settlement of Albania and the Aegean Islands was referred to the Great Powers.

The Dispute between the Allies.—The Balkan allies were now faced by the thorny problem of dividing the spoils. Macedonian autonomy, which the treaty had laid down as the ideal solution, was from the first abandoned by all parties. Their success, as it had far exceeded their expectations, also increased their appetites and encouraged them to extend their claims. The four governments seemed each bent upon annexing a maximum of territory, and thus too often became the tools of Powers whose ambitious plans of political and military equilibrium they had unconsciously upset. Above all, the long delays in restoring peace stabilised the various régimes of occupation and proved fatal to mutual understanding. Between Bulgaria and Greece there was no territorial bargain, and no obvious means of reaching one, while Serbia as early as Jan. 23 formally raised the question of a revision of the Serbo-Bulgarian treaty. This rested on the argument that Serbia was entitled to compensation for four reasons: (1) that she had furnished her ally with military support far in excess of her bargain; (2) that she had absolved Bulgaria from her military obligations in Macedonia; (3) that she had loyally continued the war three months after her own work was done; and (4) that the acquisition of Adrianople by Bulgaria radically modified the basis upon which the bargain rested.

But if Serbia's attitude is to be justified, it must be on the broader ground that events had transformed the situation still further to her disadvantage in another direction. Her two parallel aims in the war had been the political liberation of her kinsmen under Turkish rule, and her own economic emancipation by means of free access to the sea; and from the practical rather than the sentimental standpoint the second was much the more vital. Her whole calculation centred upon securing the Sanjak and Kosovo and a link with Montenegro, and a port in Northern Albania: and when Austria-Hungary imposed her veto upon the latter, the Vardar valley became Serbia's only possible alternative outlet, and this involved her retention of Veles, Prilep, Monastir and Okhrida as well as the "disputed zone." Bulgaria on her side, insisted on the literal interpretation of the treaty, and showed herself indifferent to Serbia's difficulties on the west.

Meanwhile Russia strained every effort to avert a conflict, Sazonov going so far as to express regret at the Serbo-Greek negotiations (April 17), while warning Bulgaria of possible danger from Rumania, in the event of aggression against Serbia (April 28). On April 30 the Russian Ministers in Sofia and Belgrade simultaneously reminded the two allies of their obligation to submit disputes to Russian arbitration. But Sazonov's success in settling the Bulgaro-Rumanian frontier dispute had only served to render Sofia more unyielding, and on May 19 the Bulgarian commander-in-chief wrote to the Premier assuming war with Serbia and Greece to be inevitable, and urging concentration against the former. The pressure very rightly brought to bear by Sir Edward Grey upon the peace delegates in favour of the Treaty of London was misinterpreted by the Bulgarians (who alone had any motive for haste) as a guarantee of that treaty against Turkey, and as dispensing them from the need of guarding their eastern frontier.

They were still further encouraged by the openly Serbophobe tone which was taken by the official press in Vienna and Budapest; and King Ferdinand had already ordered General Savov to hasten the transference of the army from the Thracian to the Macedonian front, when on May 27 Pašić, under pressure from the Serbian Opposition, publicly committed his Government to the demand for treaty revision. This hastened the resignation of the pacific Gueschoff, behind whose back King Ferdinand was already concerting aggressive action. His successor Danev opposed the suggestion that the Premiers should meet at Petersburg, contended that Russia had already prejudged the case by even considering revision, and relied increasingly upon Austria-Hungary. Serbia and Greece on their part were fully alive to the danger; and concluded first a military convention, and then a definite treaty of alliance for ten years (June 1). While the first of these provided for mutual military support in case of a Bulgarian attack upon either ally, the second extended the *casus foederis* to an attack by a third Power, "in circumstances envisaged by the treaty of alliance between Greece and Serbia." Both the wording and the events of the moment make it clear that the intention was to guard against an Austro-Hungarian attack upon Serbia. In 1913 King Constantine took this risk, in 1915 he was to deny its application.

On June 8 the Tsar addressed a personal appeal to the kings of Serbia and Bulgaria, which closed with the warning that "the first to make war would be responsible before the Slav Cause." King Peter's courteous though somewhat ambiguous answer was never published; but that of King Ferdinand, which threw the entire blame upon Serbia and argued that the Bulgarian claim had long been admitted by Russia, was a fresh blow to the cause of peace. On June 13 Bulgaria rejected the proposal of the Powers in favour of parallel demobilisation, and her attitude stiffened still further after the speech of the new Hungarian premier, Count Tisza, who emphasised the right of the Balkan States to settle differences in their own way—*even by war*—and declared that Austria-Hungary could not allow any other Power to acquire special prerogatives in the Peninsula (June 19).

Danev, rejecting Russia's fresh proposals for a compromise, reiterated the demand for the joint occupation of Macedonia, and added a virtual ultimatum giving Russia a week in which to pronounce an arbiter and 48 hours to announce compliance with the request. With Sazonov's sharp reply bidding Bulgaria to expect nothing more from Russia, St. Petersburg's influence over Sofia may be said to have ended. Count Tarnowski, the Austro-

Hungarian Minister in Sofia, was supreme in the counsels of King Ferdinand during the critical fortnight that followed. The deadlock was complete, when on June 22 the Serbian Cabinet was driven to resign, owing to the resentment of the military party at its alleged moderation. The most it could do was to place itself unreservedly in Russia's hands, and when this was endorsed by the Skupština, after a stormy secret session, Pašić resumed office (June 26). But Russia was by this time powerless to avert the catastrophe.

The Second War.—On the night of June 29, without previous declaration of war, the Bulgarian armies made an almost simultaneous attack upon the Serbs and Greeks, hoping by a sudden shock to drive a wedge between the two, seize the coveted districts of Macedonia and then hold them until the foreign intervention which King Ferdinand believed to be imminent settled the dispute on a basis of *beati possidentes*. This is borne out, not merely by captured dispatches, but by the amazing fact that when Putnik's forces everywhere held their own, Savov on July 1 telegraphed the order to stop hostilities. But the war so lightly begun could no longer be stopped. That afternoon the Serbian counter-offensive opened, and a proclamation of King Peter, prepared some weeks previously in Belgrade, with a blank space for insertion of the date, was issued to the troops. After a desperate struggle of nine days on the Bregalnica front (July 1–9), the Bulgarians found themselves cut into two by the inaccessible Plaškovica Planina, and were obliged not merely to relax their hold upon the Vardar valley at Krivolak, but to abandon the whole Ovčepolje, the strategic key to central Macedonia.

It appears certain that the original attack took place without the knowledge of the Danev Cabinet and contrary to its unanimous decision.[1] But that the Premier was contemplating war at an early date is shown by his request that Vienna should ascertain whether the Turtucaia-Balčic line would buy Rumania's neutrality (June 28), and by his warning to the Rumanian Minister that Serbian resistance would be over before Rumania could complete her mobilisation (July 1).

The Treaty of Bucharest.—By July 17 the Serbs had forced back the Bulgarians at all points to the frontier of 1912, and could henceforth adopt a mainly defensive attitude; but on July 10 Rumania declared war and began to throw troops across the Danube, while on July 15 the Porte repudiated the provisions of the Treaty of London and ordered Enver Pasha to advance upon Adrianople. The frantic appeals of Sofia to the Powers to enforce upon Turkey respect for a treaty concluded under their auspices were disregarded; and Western public opinion was not inclined to save Bulgaria from the consequences of her own act. At the same time the entry of the two new combatants greatly complicated Austria-Hungary's designs of intervention. She was held back by both her allies—Italy, who viewed with alarm the Balkan activities of any outside Power and was determined to insist upon compensation, and Germany, who feared the loss of Rumania for the Triple Alliance and the consequent derangement of the military balance in Europe. William II. was further influenced by a triple personal motive—the appeal of his brother-in-law King Constantine, old friendship for King Charles and active dislike for King Ferdinand. This momentary divergence of view between Vienna and Berlin sealed Bulgaria's fate; though Vienna and St. Petersburg united to hold back Rumania from occupying Sofia or claiming the Ruščhuk-Varna line. Bulgaria had no course left but to sign an armistice on July 31 and to open peace negotiations at Bucharest with her four Christian neighbours. This apparent emancipation of the smaller Powers from the European Concert's control decided Austria-Hungary in favour of belated action against Serbia. But on Aug. 9 the Italian Govt. made it clear to Vienna that it would not recognise the *casus foederis* of the Triple Alliance as applicable to such a case;[2] and the combined pressure of Rome and Berlin, coupled with the certainty of Russian aid to Serbia, again averted war at the last moment.

[1] Gueschoff, *The Balkan League*, p. 92.

[2] The essential facts were first revealed by Signor Giolitti in the Italian Parliament in Dec. 1914.

The Treaty of Bucharest, signed on Aug. 10, assigned to Rumania the Turtucaia-Balčic line, deprived Bulgaria of almost all her conquests in Macedonia and left her to settle the fate of Thrace as best she could with Turkey. Serbia acquired all Macedonia to the west of the Vardar, and to the east the districts of Štip (Istib) and Kočana; but at the last moment Bulgaria was left in possession of a dangerous salient at Strumnica, which enabled her to threaten Serbia's only railway connection with the Aegean. The new Serbo-Greek frontier had already been fixed by mutual agreement, and ran from Gjevgjeli (30 m. north of Salonika) to the S.E. corner of the Lake of Okhrida, leaving Florina and most of the Monastir-Salonika railway to the Greeks. The Treaty of Constantinople, which was concluded between Bulgaria and Turkey Sept. 29 and deprived the former of the greater part of Thrace, did not directly concern Serbia; but the indifference shown by her and her new allies, and still more by Britain and Russia, to Turkey's violation of a treaty which was their joint work, and indeed was morally binding upon them, was to be dearly paid for by Bulgaria's attitude in the World War. The treaties mark a new orientation in the Near East. Slav co-operation is replaced by mutual hatred, which promptly throws defeated Bulgaria into the arms of Turkey and predisposes both for an alliance with Berlin; Rumania's ties with the Triple Alliance are sensibly loosened, while Greece is drawn in two directions by dynastic attractions and party rancours. The military balance had undoubtedly been altered to the disadvantage of the Triple Alliance, yet it was to William II. that King Charles addressed a cordial telegram on the conclusion of peace, "which, thanks to you, remains definitive," and it was to the joint efforts of France and Germany that Greece owed Kavalla.

III. APPROACH OF THE WORLD WAR

The Albanian Conflicts.—Austria-Hungary now concentrated her attention upon Albania, and thereby rendered still more acute the relations between Serbs and Albanians. In the past three decades the latter had been rapidly ousting the former from the historic territories of Kosovo, Prizren and Dečani, and now tried to justify present possession by a claim as autochthonous owners of the soil. The mountainous and inaccessible character of these borderlands and the extreme backwardness of their population made a guerilla warfare almost inevitable; and the summons addressed to Belgrade by the Great Powers for the withdrawal of the Serbian troops (Aug. 19) was a signal for further trouble. Late in Sept. there was a formidable Albanian rising, and the insurgents, aided by numerous bands from beyond the frontier and armed with foreign rifles, seized Dibra and even Okhrida, and forced Serbia to remobilise the Morava division and many of her reserves. In order to prevent fresh raids, the Serbs occupied certain strategic points in Albania, and this gave Austria-Hungary excuse for a sharp warning. Thus for the first fortnight of Oct. there was once more acute friction between Vienna and Belgrade. At last Serbia accepted the inevitable and withdrew her troops, but covered her retreat by a Note to the Great Powers, begging them to enjoin upon their Albanian protégés a respect for the frontiers created for their benefit. Even after this crisis was over, Count Berchtold made further trouble for Serbia by steadily opposing her Government's very natural desire to take over, so far as Serbian territory was concerned, the shares of the Orient Railway hitherto owned by Austrian subjects. Vienna's permanent ill-will was further revealed by attempts to block the conclusion of a concordat between Serbia and the Vatican.

By Christmas 1913 the situation in Old Serbia[3] was rapidly becoming normal, but the administration in the new territory left much to be desired, and the closing of Bulgarian schools, the expulsion of Exarchist clergy and occasional excesses against the Moslem population caused serious unrest and discontent. The Pašić administration became absorbed in defending itself against the increasingly violent onslaughts of the Opposition.

[3] Since 1912 this name was transferred to the original kingdom and the "Old Serbia" of Turkish times came to be called "New Serbia."

In Dec. 1913, and again on June 2 1914, it resigned, but eventually remained in office. On March 4 the Opposition had withdrawn from the Chamber as a protest against alleged unconstitutional action of the Government in budget matters. But though the tension was increased by the activities of a powerful military clique known as "The Black Hand," and by the sudden and arbitrary seizure of its Club premises by the masterful Minister of the Interior, Protić, the Government was still in office in the summer. The visit of Crown Prince Alexander and Pašić to St. Petersburg early in Feb. had given rise to rumours of a new Balkan League under Russian auspices; but the return of Radoslavov to power in Sofia had really made any such plan impracticable, and King Charles of Rumania, though bent upon co-operation with Serbia and receiving the Tsar with special honours at Constanta, had no idea of breaking his connection with the Triple Alliance.

Murder of the Archduke.—On June 24 King Peter, incapacitated by ill-health, appointed Prince Alexander as Regent, and simultaneously dissolved Parliament, Pašić having in April pledged himself to the elections for a "Great Skupština" for constitutional changes. Only four days later the assassination of the Archduke Francis Ferdinand and his wife at Sarajevo revived the latent Austro-Serbian conflict in an acuter form than ever. The authors of the crime, Princip and Čabrinović, belonged to a group of Bosnian Serb students, mostly under the age of 20, who gave terrorist expression to the universal discontent aroused by Austro-Hungarian repression throughout her Yugoslav provinces. The victories of Serbia during the Balkan Wars and the openly hostile policy pursued towards her by Vienna and Budapest had assured to her in the eyes of public opinion the position of a Yugoslav Piedmont. Though the initiative unquestionably rested with the Bosnians themselves, it was proved that the assassins had been in Belgrade and had been secretly smuggled across the Drina into Bosnia, after receiving hand grenades and revolvers from the Serbian Komitadjis Major Tankosić and Ciganović. On these facts the Ballplatz sought to establish the complicity, or at least the foreknowledge, of the Serbian Govt.; yet despite the compromising admissions of Mr. Ljuba Jovanović[1] the theory is improbable. The country was exhausted by two wars; the Albanian campaign in the previous autumn had shown the reluctance of the peasant soldiers to return to the colours, and it was now the eve of harvest. Military stocks were alarmingly low, as the next winter was to show. The young Prince had only just assumed the reins of government: the position of the Cabinet was shaky, and a fierce electoral campaign was opening. Delicate negotiations with Montenegro for a customs and military union, and perhaps even a dynastic arrangement, were still pending. Serbia had every conceivable motive for avoiding aggressive action. After the tragedy, it is difficult to see what other course her Government could have pursued; its one grave omission was to offer a thorough inquiry, without waiting for any suggestion from Vienna.[2]

Ultimatum to Serbia.—The secret of the ultimatum was jealously guarded, and the long delay created, as was intended, a false sense of security in some quarters. Its delivery at Belgrade, which took place at 6 P.M. on July 23, was carefully timed for the moment after President Poincaré's departure from St. Petersburg after his state visit, the object being to disorganise the diplomacy of the allies. The ultimatum, after reminding the Serbian Govt. of its formal undertakings of March 31 1909, charged it with "culpable tolerance" of terrorist propaganda directed against Austria-Hungary, and accused Serbian officers and functionaries of planning the Sarajevo murders. It therefore demanded that the Narodna Odbrana and any similar society guilty of anti-Austrian propaganda should be dissolved, that objectionable passages should be expunged from Serbian educational works, that all officers or officials whom Austria-Hungary might name as guilty of propaganda should be dismissed, and that the Belgrade Govt. should not merely arrest certain specified persons charged with complicity, but should order the trial of others, allow Austro-Hungarian delegates to take part in the inquiry and accept the collaboration of Austro-Hungarian officials "in the suppression of the subversive movement."

The general impression produced by this document upon European opinion is best summarised in the words of Sir E. Grey, who telegraphed the next day to Sir M. de Bunsen that he "had never before seen one State address to another independent State a document of so formidable a character." The fifth demand in particular, that of collaboration, he pointed out "would be hardly consistent with the maintenance of Serbia's independent sovereignty."[3] None the less, Serbia in her reply actually consented to "such collaboration as agrees with the principle of international law, with criminal procedure and with good neighbourly relations." Only on one point did she reply definitely in the negative—the share of Austro-Hungarian officials in the actual inquiry would, it was argued, be a violation of the Constitution and the criminal code; but even this could be met by "communications in concrete cases."

On all other points there was unqualified submission, or only such reservations as were capable of easy adjustment: as a final proof of sincerity, Serbia offered to submit any outstanding points to the decision of The Hague Tribunal or even to the Great Powers which had imposed upon her the declaration of March 31 1909.[4] Thus Serbia is found for the third time in six years offering to submit herself to the verdict of The Hague (the two previous occasions being the Bosnian crisis and the Friedjung trial), and each time it is Austria-Hungary who rejects the proposal. Three days later, as a last resort, the Serbian Govt. informed the Italian Foreign Minister that it was even prepared to swallow the whole note, "if only some explanation were given regarding the mode in which Austrian agents would require to intervene," and went so far as to offer to accept these explanations from a third party, if Austria-Hungary were not disposed to give them to Serbia direct.[5]

Austria-Hungary had demanded an answer to her note by 6 P.M. on July 25, thus leaving a period of 48 hours for either reply or mediation. The official documents published in Berlin and Vienna since the War make it abundantly clear that the Ballplatz deliberately couched the note in such terms as to be unacceptable: but even in 1914 this was obvious from its tenor, and from the significant fact that Baron Giesl, who received the Serbian answer from Pašić a quarter of an hour before the expiry of the time limit, did not even open it, but handed him a fresh note announcing the rupture of diplomatic relations and the immediate departure of himself and his staff. Moreover, the text of the answer was kept secret in Vienna for several days, until a sarcastic commentary could be added; and Belgrade, presumably owing to the confusion which prevailed there, appears to have taken no steps to bring it promptly to the notice of the other Powers.[6] This is the more regrettable, since even William II. (to judge from his marginal notes on diplomatic documents, as published since the revolution) was impressed by the moderation of the Serbs, regarded Vienna's essential wishes as fulfilled and expressed the view that Giesl ought to have remained in Belgrade! His ministers, however, had failed to support Sir E. Grey's proposal for a prolongation of the time limit, and were thus responsible for bringing Russia into action. On July 27 the Tsar replied to a despairing appeal of the prince regent for assistance to Serbia by a telegram strongly urging him to "neglect no step which might lead to a settlement," but conveying the assurance that "Russia will in no case disinterest herself in the fate of Serbia."[7] On July 28 Austria-Hungary formally declared war upon Serbia. Henceforward the Austro-Serbian

[1] See *The Murder of Sarajevo* (reprint from the *Journal of British Institute of International Affairs*, 1925).

[2] For a full account, both of the question of responsibility for the murder and of the subsequent diplomatic negotiations, see *Sarajevo: a Study in the Origins of the Great War* (*1926*), by R. W. Seton-Watson.

[3] *British Diplom. Corresp.*, No. 5.

[4] *British Diplom. Corresp.*, No. 39.

[5] *Ibid.*, No. 64.

[6] *e.g.*, it was communicated to Sir E. Grey by the Serbian Minister on the same day on which it reached London through the Austrian Embassy with Count Berchtold's comments.

[7] *Serbian Blue Books*, Nos. 37 and 43.

quarrel is merged in the larger diplomatic conflict between Alliance and Entente; and the reader may be referred to the special articles dealing with that subject.

IV. THE WAR PERIOD

When Baron Giesl presented the ultimatum, Pašić had been absent electioneering in the provinces; but he at once returned to Belgrade, and on July 25 mobilisation was ordered, and the seat of government and the archives were hastily transferred to Nish. In view of so grave a crisis elections became impossible, and as parliamentary sanction was more than ever necessary, the Government had no other course than to ignore the fact of dissolution and to call the previous Skupština once more into existence. At its first meeting in Nish on Aug. 1, the entire Opposition endorsed the Government's action, and for the moment party life was in abeyance. Parliament also ratified the concordat with the Vatican and a law ensuring to Catholicism full freedom of worship in Serbia. There was an unexpected delay in the invasion of Serbia, and it was not till Aug. 12 that the first Austro-Hungarian troops crossed the Drina and the Save. After 12 days of desperate fighting (known as the battle of the Jader) the invaders were thrown back across the frontier, this being the first definite allied victory in the World War. Unduly elated by this success and by the news of Russia's rapid advance in Galicia, the Serbs were now led to underestimate Austria-Hungary's resources, and, encouraged by the Allies, passed to the offensive early in September. Their rash invasion of Syrmia —a necessary preliminary to any successful penetration of Bosnia from the east—soon proved beyond their strength and had to be abandoned by Sept. 13; and the joyous welcome everywhere accorded to them by the population merely brought down a cruel vengeance on its head when the Austro-Hungarian army returned.

A further mistake was made in attempting to hold the rich but strategically indefensible Mačva district, doubtless owing to the severe excesses committed there by the enemy during its first inroad. None the less the Serbs were able to check a second Austrian advance across the Drina in mid-September. But on Nov. 6 General Potiorek began a third invasion in great force, and during the next month steadily forced back the Serbian forces into the heart of their country. The danger was aggravated by shortage of ammunition, and when at last the necessary supplies began to arrive, a large force of Bulgarians raided the Vardar railway from the Strumnica salient and destroyed an important bridge on the only line by which the new guns could be moved up to the front. The enforced evacuation of Belgrade on Nov. 29 revealed the extremity of the danger, and brought the latent political crisis to a head. On Dec. 13 the purely Radical Cabinet was succeeded by a Coalition Govt., in which Pašić remained Premier, but the leaders of all parties save the Liberals received portfolios. It was, however, in this blackest week that the Skupština unanimously endorsed the Government's declaration that its foremost war aim was "the liberation and union of all our Serb, Croat and Slovene brethren not yet set free." This was the first public step of Serbia in favour of Yugoslav unity.

Serbia after the Austrian Rout.—With the arrival of munitions from the west the army's flagging spirits revived, and the brilliant offensive initiated on Dec. 2 by General Mišič and the I. Army resulted in the complete rout of Potiorek. By Dec. 14 Serbian soil was for the third time entirely free from invaders, and an enormous booty was captured. But the enemy left deadly infection behind him, and by the early spring of 1915 exhausted Serbia was immobilised by a typhus epidemic which is estimated to have caused about 300,000 deaths among the civil population. A notable part in checking its ravages was played by Lady Paget as head of the Serbian Relief Fund units in Skoplje, and by Colonel Hunter and a R.A.M.C. detachment, who organised a scheme of disinfection on the whole Serbian railway system. The latter step appears to have been taken in view of the possibility of Allied troops being employed upon the Danube, an idea which receded from the general design in proportion as the Austro-German recovery in Galicia became more marked. Serbia's negative rôle during 1915 was due not only to exhaustion but to considerations of high policy. The attitude of Bulgaria was from the first extremely equivocal, and Serbia, had she listened to certain ill-considered pleas for a fresh offensive into Hungary, would have been at any moment liable to an attack from the rear, unless she could rely upon Greece or the Allies to hold Bulgaria in check.

Meanwhile the Entente was eagerly working for the intervention of Italy and of Bulgaria, neither of whom could receive adequate satisfaction save at the expense of Serbian aspirations. During the winter pressure was repeatedly brought to bear upon Nish to make territorial concessions to Bulgaria in Macedonia; but the one and only condition upon which Serbia could safely have considered this—namely, that the Allies should guarantee Yugoslav unity in the event of victory—was precluded by their parallel negotiations with Italy, whose official policy it was to prevent, not to further Yugoslav unity, and to whom by the Treaty of London, concluded on April 26 1915, no less than 700,000 Yugoslavs were assigned. The fact that the concealment of this treaty from Serbia was made an absolute condition by Rome did not tend to diminish the reserve of Belgrade which almost immediately learned the essential facts through Supilo's discoveries in official circles at St. Petersburg. The Serbs, who were not formally recognised as Allies by the Western Powers, were more conscious than ever of the value to them of the Vardar valley, which would form part of any serious concessions to Bulgaria; and they were from the first sceptical as to the possibility of winning over Bulgaria, whom they believed to be tied to Vienna and Berlin by a secret compact. They were further handicapped by the attitude of Greece, who in the autumn of 1914 exercised her right of veto, under the Serbo-Greek Treaty, upon any cession of territory to Bulgaria and was prepared to demand Monastir as compensation. This attitude could not be ignored at a period when Greece was still ready to intervene on the side of the Allies, and when even King Constantine had firmly rejected William II.'s suggestion that he should fall upon Serbia and tear up the Treaty of Bucharest.

What changed the views of both Athens and Sofia was simply the unfavourable turn in the military fortunes of the Allies. As long as the Bulgarians thought that the Dardanelles would be forced, they could probably have been secured in return for the promise of Macedonia and the guarantee of an allied occupation; what was lacking was the corresponding pledge to Serbia. The conclusion of a Bulgarian loan in Berlin in Feb. was the first sign of a change, and after March neutrality was the best that the Allies could hope for from Bulgaria, though she showed great skill in furthering Bulgarophil illusions in the West. Thus the concrete proposals addressed to Sofia by the Entente on May 28, over Serbia's head, came two months too late.

The Conquest of Serbia.—During the summer the Radoslavov Cabinet continued to negotiate with the Entente, but it was merely playing for time, and on Sept. 6 concluded a secret alliance with the Central Powers. Meanwhile the Serbian Govt. was unduly optimistic as to Greek and Rumanian intervention, and its disbelief in a German invasion was encouraged by Allied military opinion. Only three weeks before Mackensen crossed the Danube, Lord Kitchener, in conversation with a Serbian representative, gave his opinion that any action from the North was mere bluff. Even after the opening of the Austro-German bombardment along the river front, and the mobilisation of Bulgaria, Allied opinion clung to the illusion that Bulgaria might enter on the Entente side, and therefore a veto was imposed upon the Serbian general staff's plan for an immediate attack upon Sofia before the Bulgarian army was ready (Sept. 27). Next day Sir Edward Grey in the House of Commons announced that in the event of Bulgaria's aggression "we are prepared to give to our friends in the Balkans all the support in our power, in the manner that would be most weclome to them, in concert with our Allies, without reserve and without qualification." Relying on the fulfilment of this pledge, the Serbs devoted their main effort to checking the Austro-German advance and remained on the defensive towards Bulgaria. The danger was increased by King Constantine's repudiation of Greece's treaty obligations

towards Serbia and the overthrow of Veniselos. That statesman, however, had inquired of the Allies as early as Sept. 23 whether, if Bulgaria declared war on Serbia, and if Greece asked Serbia to supply the 150,000 men stipulated by the Serbo-Greek Treaty for such a contingency, France and Britain would assume Serbia's obligation for her; and an affirmative answer was received within 48 hours.

On Oct. 6 the rupture with Bulgaria was complete. The fatal delays in sending the promised troops, coupled with Allied insistence that the Serbs should hold back Mackensen to the last moment, belong to military history; but their results were eminently political. At the critical moment of the Bulgarian menace to the Nish-Salonika railway there were at Salonika not 150,000 Allied troops ready for action, but 35,000 French and 13,000 British, the latter under strict injunctions from London not to cross the frontier into Serbia.[1] Nish was decorated to welcome Allies who never came. The whole Serbian plan of campaign collapsed, and the armies, losing control of the railway southwards, retired precipitately through the passes leading to the plain of Kosovo. General Sarrail, informed that he must not expect reinforcements, was forced to arrest his belated offensive northwards (Nov. 12) and soon to withdraw to the west of the Vardar. The Serbs were thus cut off from Allied help, lost Skoplje and only just escaped being cut off between the converging Austro-German and Bulgarian armies.

The final retreat of the Serbian Army and Govt. took place in the dead of winter across the inhospitable snow mountains of Albania and Montenegro to Scutari, Medua and Durazzo, a smaller section escaping southwards from Prizren and augmenting the Serbian forces south of Monastir. Fortunately the general exodus of the civilian population was checked before it had gone too far; but the retreat stands out as one of the great tragedies of the War. After dreadful sufferings the fugitives were conveyed by Allied transports to Corfu, which for the remainder of the War became the seat of the Serbian Govt. and a base for the convalescence and reorganisation of the army. Notable assistance was rendered by British voluntary units, and some idea of the generous response of the British public to Serbia's need may be gathered from the fact that the Serbian Relief Fund from first to last collected over £1,000,000, in money and material, and employed over 700 workers in Serbia, Albania, Corfu, Salonika, Corsica, Biserta and France; while the Scottish Women's Hospitals, under Dr. Elsie Inglis, performed notable services for the Serbs both on the Balkan and the Russian fronts. The deaths of Mrs. Dearmer, Mrs. Harley (Lord French's sister), Mrs. Haverfield, Dr. Inglis herself and many others set a seal on the new-found friendship of the two nations.

Conquered Serbia was divided for administrative purposes between Austria-Hungary and Bulgaria, the latter holding the Timok, Nish, Skoplje and Macedonia; all that remained to the Serbs was a fragment of territory south of Monastir. Bulgaria now threw off the mask and officially declared the Serbian State to have ceased to exist. It therefore enrolled all men of military age throughout the occupied territory, and in Feb. 1917 extended this to include the whole male population. It refused to recognise the Serbian Red Cross and took possession of the Serbian Legation in Sofia. All ownerless land was confiscated, all Serbian schools, law courts and inscriptions were Bulgarised, libraries and collections were either destroyed or removed to Bulgaria, the Serbian clergy were evicted and there were wholesale deportations. A formidable rising in the mountains behind Kursumlje was brutally repressed, with over 2,000 executions (March 1917). The war aims now repeatedly avowed by Sofia were the annexation not only of Macedonia, but of Kosovo and Prizren, and the whole upper Morava and Timok valleys; a common frontier with Hungary; the prevention of Yugoslav unity and of Russia's acquisition of Constantinople; and (after Rumania's entry) the retention of the whole Dobruja. Radoslavov more than once proclaimed Bulgaria's resolve to keep all her conquests,[2] and his official organs declared that Serbia's reconstitution, "no matter under what form, would be a perpetual menace to Balkan peace" and would never be permitted.[3] Austria-Hungary showed much greater reserve, airing from time to time various alternative schemes for a vassal Southern Slav State under the Habsburgs, keeping Prince Mirko of Montenegro as a possible candidate for its throne and employing agents in Switzerland to sow dissension among the exiles.

The Serbs in Exile.—Soon after the establishment of the Serbian Govt. at Corfu party rivalries began to revive. The deputies were scattered, living mostly on the Riviera, an independent press was impossible, and regular Allied subsidies made the Government virtually immune from serious democratic control. The supersession of the Voivode Putnik and almost all his staff caused great indignation; and though the whole Serbian Coalition must bear the responsibility, it was known to be the work of Pašić and his masterful colleague in the Radical party, Protić, then still out of office. In Aug. 1916 an attempt is alleged to have been made upon the life of the Prince Regent at the front, and the Government, after vainly urging the Skupština to institute a new form of courts-martial, proceeded in the winter—while the joint advance under Sarrail was crowned by the capture of Monastir from the Bulgarians—to order numerous arrests on a charge of conspiracy and murder. Among those implicated were the late Governor of Macedonia, General Popović, the ex-War Minister General Bojanović and several distinguished staff officers; and many line officers known for their gallantry were placed on the retired list or confined to the island of Corfu.

The conspiracy trial which opened in Salonika in Jan. 1917, and was conducted behind the shelter of a strict military censorship, resulted in a death sentence upon nine Serbian officers, and notably of Colonel Dimitrijević, head of the secret society known as "Union or Death," or more colloquially as "The Black Hand," whose chief aim had been to fan nationalist sentiments in the army. There is no doubt that "Apis," as Dimitrijević was called throughout the Slavonic South, interfered unwarrantably in politics, and that he had his hand in the Sarajevo murder; but the evidence for a plot against Prince Alexander was clearly inadequate, and he was the victim of rival military and political cliques. This trial revived all the old party dissensions: the reactionaries had triumphed on the very eve of the collapse of their chief support, the Tsarist Government. Pašić found himself between two fires—the need for a more democratic restatement of foreign policy, and the demand of the Young Radical and Progressive parties for a revision of the Salonika trial. Refusal led to their withdrawal from the Cabinet, and its reconstruction on a purely Old Radical basis under Pašić and Protić.

The last occasion when all parties co-operated was on July 20 1917, when the Declaration of Corfu, drawn up between Trumbić for the Yugoslav Committee and Pašić for the Serbian Govt., met with unanimous approval. It affirms that the Serbs, Croats and Slovenes constitute a single nation, and demands complete national unity under the Karagjorgjević dynasty, a constitutional democratic and parliamentary monarchy and the reference of all details to a Constituent Assembly after the War. Pašić, having strengthened his position abroad by a visit to Paris and London, declined to convoke Parliament for four months after the legal period had expired. At last, as the result of a direct appeal of its President to the Crown, it met in Corfu on Feb. 12 1918 and the Government resigned, but after weeks of fruitless negotiation for a Coalition Ministry was allowed to resume office. The Opposition, which numbered 60 as against 64 Old Radicals, still insisted on the revision of the trial and the transference of Foreign Affairs from Pašić to their own candidate Drašković; and in April, when the budget was introduced, they withdrew in a body from the Chamber, thus leaving the Government without the quorum of 84 required by the Serbian Constitution.

Serbian public opinion was too scattered and disorganised to be effective, and the Corfu Govt. tried to discredit its opponents' action before the uninformed West as defeatist or even Austrophil. Thus throughout the spring and summer of 1918 there was

[1] See General Sarrail, *Mon Commandement en Orient*, p. 27.
[2] *e.g.*, in *Vossische Zeitung*, Oct. 10 1916.
[3] *e.g. Narodni Prava*, May 19; *Kambana*, Oct. 9 1916.

acute and growing tension among the rival Serbian groups, and the real initiative in the Yugoslav question and in the political campaign against Austria-Hungary had passed to Trumbić, Beneš, Lansing and the Allies and to the leaders of the movement inside the Dual Monarchy. On April 8 1918 a " Congress of the Oppressed Nationalities of Austria-Hungary " was opened on the Roman Capitol, at which the agreement reached a month earlier in London between Trumbić, on behalf of the Yugoslav Committee, and Andrea Torre, as representing an influential committee of Italian deputies and senators, was publicly proclaimed as the basis of common action. The result was immediate in two directions. The propaganda organised on the Italian front by delegates of all the national committees (Yugoslav, Czech, Polish, Rumanian) led to wholesale defections from the Austro-Hungarian army, and contributed materially, according to the high command's own admission, to the failure of the last Piave offensive in June. Meanwhile the Roman Congress was deliberately imitated inside the Dual Monarchy by an imposing Congress at Prague, attended by Czech, Polish, Rumanian, Slovak and Yugoslav delegates—among the latter Radić and Pribičević. Their resolutions, though necessarily vague, amounted to a pledge of mutual support in the cause of unity and independence.

During 1918 the initiative among the Yugoslavs of the Monarchy fell more and more into the hands of the Slovenes, led by Father Korošec since the premature death of Monsignor Krek. The official recognition accorded to the Pact of Rome by Lansing in the name of America (May 31) was a fresh encouragement; and Korošec, after constituting a Yugoslav National Council for the furtherance of unity, convoked a new Slav Congress at Ljubljana on Aug. 18. One of its most significant features was the demonstrative share taken by the Catholic hierarchy and leading clergy. In the early autumn, at the Emperor Charles's instance, Count Tisza visited Zagreb, Sarajevo and Dalmatia with the object of promoting a Hungarian solution of the Southern Slav question, but met everywhere with a blank refusal. The surrender of Bulgaria (Sept. 30) naturally rendered the nationalities indisposed to concession, and the Austrian Premier's admission that national autonomy was now inevitable was icily received. The Czech and Yugoslav spokesmen in the Reichsrat now insisted on separate representation at the peace negotiations and the absolute right to decide their own future state allegiance.

The Collapse of Austria-Hungary.—Events now followed each other with lightning speed. On Oct. 4 Austria-Hungary in a note to America accepted President Wilson's speeches as a basis of discussion, and on the 8th Baron Hussarek admitted that the Monarchy's internal structure must be modified and " full-grown nations " determine their own future. This only precipitated the collapse, and while Count Tisza voiced Hungarian public opinion in declaring the basis of the Dual system to be shattered, the Yugoslav National Council was transplanted from Ljubljana to Zagreb and strengthened by the inclusion of representatives of all parties (Oct. 10). On the 16th the Hungarian Govt. declared in favour of Personal Union, and next day Hussarek published an Imperial Proclamation, dated Oct. 16, dividing *Austria* (not Austria-Hungary) into four federal units (German, Czech, Yugoslav and Ukrainian), and leaving the Poles to make their own decision. This project was stillborn and pleased no one. Korošec in the name of the Czech and Yugoslav Clubs unreservedly rejected it, and claimed that the future of both nations was an international problem which only the future Peace Conference could solve.

Henceforth the Yugoslavs acted independently of both Vienna and Budapest; and when on Oct. 21 the news of President Wilson's answer to Count Burián's final Peace Note (refusing to negotiate save on the basis of a recognition of Czechoslovak and Yugoslav national claims) became generally known, the old régime vanished almost as if by magic. Extraordinary scenes took place in many towns, the troops tearing off their military badges with the Habsburg Arms and trampling them underfoot. National councils were speedily formed in Dalmatia and Bosnia, which arranged for the disarmament of the troops pouring northwards from the broken Albanian and Macedonian fronts. As early as the 23rd a Croat regiment stationed in Fiume disarmed the Magyar militia and took possession of the town. On the 24th Count Andrássy was appointed Joint Foreign Minister, but the machinery of State had ceased to work, and both the Austrian and Hungarian Cabinets were in *statu demissionis*.

On the 28th (the same day on which the Czechoslovak Republic was born in Prague) the military command in Zagreb handed over its authority to the National Council, and next day the Diet proclaimed the independence of Croatia from Hungary and assumed control of Fiume. The arsenals of Pola and Cattaro were already in the hands of the insurgents; and the Emperor Charles, in the hope either of winning the favour of the new régime in Zagreb or throwing an apple of discord between it and the Entente, signed a decree on Oct. 31 making over the whole Austro-Hungarian fleet to the Yugoslav State. This was not unnaturally interpreted by the Italian Nationalists as a proof of collusion between Zagreb and Vienna; nor was it generally known that as early as Oct. 4 M. M. Štěpánek and Giunio, as delegates of the Czech and Yugoslav revolutionary committee, reached Italy in a fishing boat, to concert with the Allies a general rising along the coast, but were closely imprisoned in Rome and not allowed to communicate with Beneš and Trumbić till nearly three weeks had been lost. But for this delay the fleet might have been in the Entente's hands a fortnight before the final Italian offensive opened on the Piave. Unhappily, every step led to a fresh misunderstanding. The action of the Supreme Council in Paris in prescribing the frontier line of the Secret Treaty of London as the line of occupation under the Austro-Hungarian Armistice was keenly resented by the Yugoslavs as a breach with Wilsonian principles. The Allies very properly insisted that the fleet must be surrendered into their hands, but before this could take place a deplorable incident occurred in Pola harbour, the " Viribus Unitis " being blown up by an Italian mine, with a Yugoslav admiral and crew on board. In Italy Baron Sonnino's frankly anti-Slav attitude threw Signor Orlando and the Pact of Rome into the shade; and the Consulta worked hard to prevent Yugoslavia's recognition by the Allies.

V. THE UNION

Rival Programmes.—That this recognition had not already been accorded before the collapse of the Central Powers began was due to disunion among the Yugoslavs themselves. During the summer America gave a lead to the Allies by accepting the Yugoslav programme, and after Austria's failure on the Piave there was a growing disposition on the part of the Western Powers to fall into line with Lansing's very clear pronouncements. But Pašić, free from the restraints of a coalition and from all parliamentary control, had reverted to his original Pan-Serb standpoint, and steadily declined to reconstruct his Cabinet on a wider Yugoslav basis. Trumbić on his part could not enter a purely Serbian Cabinet without prejudicing that freedom of choice of his compatriots in the Dual Monarchy upon which the moral case of the Yugoslavs depended. A series of incidents proved the difference of outlook to be not merely personal but fundamental. In July Mihajlović, the Serbian Minister at Washington, was summarily dismissed by Pašić, the reason being his refusal as a good Yugoslav to transmit to the American Govt. a project assigning Bosnia to Serbia as " compensation " in the event of a patched-up peace.

On July 25 at the Mansion House, London, Balfour publicly endorsed the full Yugoslav programme, as formulated by the Serbian Minister, J. M. Jovanović; but the latter's full report to his home Government was answered by a severe snub, and during the winter he too was dismissed for his Yugoslav sentiments. When on Aug. 9 Balfour officially recognised the Czechoslovak National Council as " trustees of the future Czechoslovak Govt." he was ready to extend a similar recognition to the Yugoslav cause, but as a preliminary condition he very reasonably insisted upon unanimity between those who claimed to represent the groups of Yugoslavs. Pašić adhered to his standpoint, and even

the efforts of Veniselos and Take Jonescu to bring him and Trumbić together were unavailing. When in the last week of Oct. the rival statesmen moved from London to Paris, all hope of Yugoslav recognition before the Peace Conference had vanished, owing to the stiffening in the attitude of Italy.

One of the first steps of the new Zagreb Govt. was to recognise Trumbić and his committee as its representatives abroad, and to send delegates to Switzerland to discuss the measures for consummating national unity. On Nov. 9 the Declaration of Geneva was signed by Pašić as Serbian Premier, Korošec, Čingrija (mayor and deputy of Ragusa) and Žerjav (a Slovene Progressive) for the Zagreb Council, Trumbić and four others for the Yugoslav Committee, and Trifković, Drašković and Marinković as chiefs of the Serbian opposition parties. "By this act," it was laid down, "the new State appears and stands from to-day as an indivisible state-unit and as a member of the Society of Free Nations. The former frontiers no longer exist." The Governments of Belgrade and Zagreb were to retain their former spheres until a Constituent Assembly, elected by universal suffrage, could draw up a new Constitution.

Yielding to the unanimous desire of the other delegates, Pašić officially requested the Entente to recognise the Zagreb Council as the supreme authority in the ex-Austro-Hungarian Provinces, and Trumbić as its accredited representative in the West, until unification could be completed. The repeated efforts made by Pašić to avert so distasteful a decision were held to disqualify him from the leadership of the new united Cabinet, but in order to secure his renunciation it was found necessary to exclude the other party chiefs. This arrangement, however, never really came into force, for the simple reason that telegraphic communications between the West and Serbia were hopelessly irregular, and that events continued to move, with the advance of the Serbian Army and civil authorities from the south, and of the Italian Army beyond the armistice line, in the direction of Ljubljana.

To meet the impending danger, the Zagreb Govt. urgently invited the assistance of the Serbian Army, which during the final advance contained a large proportion of Yugoslav volunteers. The first Serbian troops entered Fiume on Nov. 18, and a most dangerous situation arose between them and the Italians in Istria and Dalmatia, which was only very partially mitigated by the dispatch of American military and naval forces to Trieste and Fiume. Much of the blame falls upon the Supreme Council, which shrank from the only effective means of allaying friction —immediate Allied occupation of the disputed zone, pending the decision of the Peace Conference. The Council's occasional outbursts against Italy only rendered Baron Sonnino still more intractable, and irritated Italian public opinion. No satisfactory solution was possible unless the Treaty of London was abrogated, and this involved the abandonment of other secret treaties to which Paris and London clung. America pointedly defined the Adriatic problem as a test case, but amid the pressure of other affairs it was allowed to drift.

The Union.—The equivocal attitude of the Entente towards the new State naturally hastened the process of union. On Nov. 23 the Zagreb National Council proclaimed the union of the territories under its control with the kingdoms of Serbia and Montenegro, and invited the Prince Regent of Serbia to assume the Regency of the new State. This decision (passed with only one dissentient voice, but that unhappily Stephen Radić, the peasant leader) took formal effect on Dec. 1, when Prince Alexander, at the formal request of 24 delegates from Zagreb, proclaimed the union and repeated their cry, "Long live free and united Yugoslavia." Meanwhile on Nov. 26 a hurriedly convoked National Assembly at Podgorica had proclaimed the deposition of King Nicholas and his dynasty and the union of Montenegro with Serbia in the new united State. The first Yugoslav Cabinet was constituted under Protić as Premier and Korošec as Vice-Premier; Trumbić became Foreign Minister; other portfolios were divided more or less equally between Serbia and the new territories.

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See also *History of the Peace Conference* (ed. H. W. V. Temperley, vol. 4.) (R. W. S.-W.)

SERBIAN CAMPAIGNS.—Overshadowed by the scale of operations on the Western and Eastern Fronts, the importance of events which took place on the Southern Front is not always realised. In the Balkans, where the World War started, there were never less than 1,000,000 men of varied nationalities fighting each other in this theatre, and here the crushing defeat of the Bulgarian Army in Sept. 1918 first knocked one of the Central Powers out of the War. The 1914 operations and the conquest of Serbia in 1915 are described in separate sections below, while an account is given of the Allied operations in Macedonia, 1915–8, and of the reconquest of Serbia, under the heading SALONIKA CAMPAIGNS.

I. OPERATIONS IN 1914

The Austro-Hungarian problem in starting a campaign against Serbia was complicated by the prospect of Russian intervention in Galicia; the Austrian staff had, accordingly, drawn up two plans of concentration.

Alternative Austro-Hungarian Plans.—The first plan, in case of war against Serbia and Montenegro, called Concentration B (Balkan), involved the employment of seven corps and two cavalry divisions. The second plan, in case of war with Russia and Serbia, called Concentration R (Russia), involved the employment against Russia of nine corps and five cavalry divisions; against Serbia and Montenegro of a minimum group of three corps and some independent divisions and brigades and the formation of a reserve (four corps, two cav. divs.) which could be directed as required towards the Russian frontier or those of Serbia and Montenegro.

Convinced at first that they would have to deal only with the southern Slavs, Austria-Hungary ordered, on July 26, the partial mobilisation required for Concentration B; but, owing to complications with Russia, general mobilisation was proclaimed on July 31. To avoid confusion, the Austro-Hungarian staff decided to allow Concentration B to be completed before withdrawing the reserve provided for in plan R. The concentration of the Austro-Hungarian armies, therefore, took place in three phases.

TABLE I.

1. July 27—Aug. 16. Balkan Front (Potiorek), II. Army (Boehm-Ermolli); IV., VII., IX. Corps (131 Bns.); Danube-Sava front.
V. Army (Frank); VIII., XIII. Corps (79 Bns.); Lower Drina up to Ljubovija.
VI. Army (Potiorek); XV. XVI. Corps (74 Mountain Bns.).
Višegrad—Foča area.
2. Aug. 4–24. Russian front. Remainder of the Austro-Hungarian forces.
3. Aug. 14–Sept. 8. II. Army transferred to Galicia.

Serbian Mobilisation.—The Serbian general mobilisation, ordered on July 25, yielded 490,000 men at the outset, and some 43,000 more between Aug. and September. Montenegro declared war on Austria-Hungary on Aug. 5 1914. Her forces amounted to about 50,000 militia with very little artillery, and were of no direct assistance to Serbia, though they occupied the attention of three Austrian mountain brigades. Circumstances compelled Serbia to adopt a purely defensive strategy. Her army, com-

THE CAMPAIGNS IN
SERBIA
Scale
English Miles
0 10 20 30 40 50 60 70 80
Kilometres
0 10 20 40 60 80
Main Railways
HUNGARY
BANAT
SYRMIA
Fruška Range
R. Danube
R. Drava
R. Sava
Mitrovica
Rača
Ravnje
Jarak
Mačva
Šabac
Semlin
Belgrade
Ram
Orsova
Temes
Sugel Island
Obrenovac
Semendria
Cer Ridge
Dobrava
R. Drina
Jagar
Loznica
Zvornik
Koraćica
Ljubovija
Kosmaj
Kolubara
Lazarevac
Palanka
Bukulja
Valjevo
Ljig
R. Morava
Rudnik
Maljen
Bajina Bašta
Kragujevac
Užice
Čačak
Kraljevo
Paračin
Zaječar
Negotin
Vidin
Kula
Rakovitsa
Belogradchik
Knjaževac
Kruševac
Sarajevo
Višegrad
Foča
BOSNIA
SERBIA
BULGARIA
Nish
Bela Palanka
Pirot
Novi Pazar
Leskovac
Tsaribrod
Sofia
MONTENEGRO
Mitrovica
Priština
Kosovo Polje
Peć
Vranje
Đakovica
ALBANIA
Prizren
Kačanik
Kyustendil
Scutari
Kumanovo
Skoplje
(Uskub)
Tetovo
(Kalqa(delen)
Veles
(Köprili)
Gradsko
Krivolak
Babuna Pass
Kavadar
Strumitsa
R. Struma
R. Crna
R. Vardar
L. Doiran
Monastir
GREECE
Salonika
Ješnica
Cer Ridge
Kozaningrad
Jagodnja
Krupanj
Pečka
Karačica
Zavlaka
Osečina
Arangjelovac
Topola
Grocka
Miles
Kilometres
R. Ljig
R. Jadar
R. Drina
Bajina Basta

manded by the Crown Prince Alexander, with Voivode Putnik as chief of staff, was therefore concentrated in a central position enabling it to operate either towards the Sava and Danube or towards the Drina:—

TABLE II.

Unit	Commander	Area
G. H. Q.	..	Kragujevac
I. Army (52 Bns.)	Bojović	Palanka-Rača-Topola
II. Army (64 Bns.)	Stepanović	Arangjelovac-Lazarevac-Belgrade
III. Army (28 Bns.)	Yurichić-Stürm	Valjevo
Užice Army (24 Bns.)	Bojanović	Uzice-Bajina Baštah
Cav. Div. (16 Sqdns.)	..	Ub
Belgrade Group (19 Bns.)	..	..
Obrenovac Group (11 Bns.)	..	..
Other frontier Troops (25 Bns.)	..	..

After the withdrawal of the Austrian II. Army, the Serbs had a superiority not only in numbers but also in quality, 90% of them having fought in the 1912–3 wars, and three-quarters of their guns being better than the Austrians'. On the other hand, Austria's equipment and resources in ammunition were far superior.

Jadar Operations, and Cer Battle: Aug. 16–24.—North Serbia is a mountainous country, devoid of good communications, particularly in the northwest, whilst the actual frontier was formed on the north by the formidable obstacle of the Danube and Sava, on the west by the Drina, a river not very broad but swift and difficult to bridge. The plan for the invasion of Serbia, drawn up by Conrad von Hotzendorff and Moltke in consultation, involved a concentric advance from all fronts, but was vitiated by the withdrawal of the II. Army. Potiorek, however, who feared an advance of the Serbs over the Drina to excite insurrection among their kinsmen in Bosnia, launched, on his own responsibility, a preventive offensive.

On the night of Aug. 11–12, the Austrians (VIII., XIII. and elements of IV. and IX. Corps) began to cross on a wide front from Drenovac on the Sava to Ljubovija on the Middle Drina, successfully driving back the Serbian frontier detachments. The Serbian Army moved to oppose the enemy, and by the evening of the 15th the II. Army occupied positions on a line south of Šabac, across the Cer and Iverak ridges and the Jadar valley, connecting with the III. Army who had moved forward from Valjevo to Zavlaka and Krupanj. The I. Army had taken over the whole northern front as far as Obrenovac.

On the 16th, after severe fighting, the Austrian XIII. Corps drove back the left and centre of the Serbian III. Army, capturing Krupanj and threatening the Valjevo-Osečina road behind the Serbian positions. On the right of the II. Army the Serbs were also forced to give way, but in the centre a local counter-attack secured for the Serbs the important position of Kosaningrad (Aug. 18). This enabled General Stepanović to launch on the 19th a counter-stroke along the Cer and Iverak ridges, which swept the Austrian VIII. Corps down in the utmost confusion into the Lješnica and Jadar valleys and over the Drina. The Austrian right wing, less hard pressed, and better organised for mountain warfare, retired in good order, but by the 22nd the whole river front was again occupied by the Serbs. The Austrian II. Army fared no better, losing prisoners and guns in their retreat over the Sava.

By the 24th the first invasion of Serbia was ended, with a loss of about 50,000 men to the Austrians. The Austrian commander-in-chief had greatly underestimated the military value of the forces opposed to him, while, on the Serbian side, Putnik's management of his forces and his choice of the moment and place of counter-attack were masterly.

Syrmian Operation, and Drina Battle.—Meanwhile, no events had taken place on the northern front east of Obrenovac other than the evident withdrawal of the Austrian II. Army. Putnik decided to throw his I. Army across the Sava into Syrmia in order to secure the line Mitrovica-Fruška range—Danube to Semlin and Belgrade. This would thrust back the line of deployment of any future attack from the north and enable the Serbs to invade Bosnia without fear of a sudden attack in the flank and rear.

After making good crossings on the night of Sept. 5–6, the I. Army occupied Semlin and was progressing towards its objective when the situation on the Drina front caused its recall. It was safely withdrawn across the Sava by the 14th and hurried off to the new battle of the Drina. On the Austrian side Potiorek was reorganising his forces for a new thrust across the Drina. His VIII., XIII., XV. and the major part of his XVI. Corps bordered the Drina from the Sava to Ljubovija, where the Serbian II. and III. Armies were also deployed in strength.

Potiorek's second offensive opened on the night of Sept. 7–8. In the north the VIII. Corps only succeeded in securing a bridgehead at Parašnica, but in the south the XV. and the right of the XIII. Corps crossed in force between Zvornik and Ljubovija, driving back the Serbian left to the Gučevo-Boranja-Jagodnja ridge. By the 11th, the situation was serious enough to compel Serbian G.H.Q. to order the transfer of the I. Army from Syrmia to Valjevo-Pecka. On the 13th, the XIII. Corps, having successfully crossed the Drina at Kurtovića, threatened not only to cut the Serbian line in two but to roll up the whole Gučevo-Jagodnja position. After severe fighting, on Sept. 16, a strong counter-attack was launched by the I. Army against the Austrian right. By the 18th the XV. Corps had been driven off the Jagodnja ridge to the line Karačica-Ljubovija, where trench warfare set in.

On the Mačva front the advance of the VIII. Corps from Parašnica was resumed in combination with a crossing at Jarak by Krauss's Corps. Here also trench warfare set in on the line of the two bridgeheads; north of Šabac-Glušci and Ravnje-Serbian Rača. The Serbs barely succeeded in holding up the invaders, whom they failed to drive back over the rivers. Meanwhile the Užice Army and the Montenegrins had successfully undertaken a series of operations designed to prepare the way for the offensive over the Drina, but, being forestalled by the Austrian attack, they had no practical results.

Kolubara and Rudnik Operations.—The Serbs suffered severely from the unfamiliar conditions of trench warfare and a shortage of ammunition, and Potiorek decided to make a third attack, although winter was near at hand. The new offensive opened with an attack in the Mačva by Krauss's and the VIII. Corps, which drove back the Serbs to the line Dobrava-Cer ridge. The main Austrian attack, however, again took place on the right, where the XIII. Corps on Nov. 6 and the XV. and XVI. Corps on the 7th drove the Serbs off the entire Gučevo-Jagodnja ridge. On the 8th the Serbian centre had to be withdrawn. Putnik, after attempting to cover Valjevo, decided to try and hold up the Austrian advance on the so-called "Kolubara line." This line, which ran from Obrenovac in the north along the rivers Kolubara and Ljig to the Maljen ridge, was occupied by the 16th by the Obrenovac Group, II., III. and I. Armies, whilst the Užice Army still covered Užice. The weather was terrible, but the Austrian XVI. Corps, pushing along the Maljen ridge, attacked on the 17th, and drove the Serbs off that ridge. On the Austrian left the advance of the V. Army to the Kolubara made good the passage of the Lower Kolubara by the 25th.

Putnik now resolved to give up Belgrade and to fight for time so as to last out until the arrival of ammunition enabled him to launch a counter-offensive. He therefore withdrew his forces during the night of Nov. 29–30 to a line with its flanks resting on the Danube at Obrenovac and on the Lower Morava, its centre on the heights at Kosmaj and Bukulja and the Rudnik Massif. The Austrians entered Belgrade on Dec. 1.

On the arrival of munitions Putnik undertook a counter-offensive; it opened on Dec. 3 with an attack of the I. Army

under Mišic, which drove a deep wedge in the enemy lines. Further north the II. and III. Armies made little progress at first, the Serbian right being seriously threatened by a counter-attack (Dec. 6–9) effected by Krauss's and VIII. Corps. In the south, however, Mišic's Army swept the Austrians back towards Valjevo and Užice with such success that, on the 9th, Potiorek ordered a general retreat on Belgrade, Šabac and Loznica. All the Serbian armies then took up the pursuit, but mud and exhaustion prevented them from turning the Austrian retreat into a rout. There was, however, heavy local fighting, many prisoners and much booty being taken. By Dec. 16, Belgrade had been re-occupied, while Šabac, Loznica and Bajina Bašta had been retaken by the pursuing I. and Užice Armies. Putnik's decisive victory gave Serbia peace for a few months, but her losses had been very heavy—69,000 killed or died of sickness, 18,000 wounded and some 15,000 prisoners.

II. THE CONQUEST OF SERBIA

The third expedition having ended in failure, Potiorek was relieved of his command, a portion of his troops transferred to other fronts, and General Tersztianski left with a much weakened force. The latter, however, were incapable of taking the offensive, their sorely depleted ranks being further devastated by an epidemic of typhus.

Mackensen Takes Command.—Meanwhile Falkenhayn had become convinced of the necessity of opening up direct railway communications with Turkey, and, the active support of Bulgaria having been secured, a new combined offensive was prepared for the autumn under a German commander, Marshal Mackensen.

His forces consisted of:—

TABLE III.

Unit	Commander	Area
Austrian III. Army (2 Austrian, 1 German Corps)	Kövess	Syrmia
German XI. Army (3 Corps)	Gallwitz	Banat
Bulgarian I. Army (4 Divs.[1])	Bojadiev	Vidin-Kula-Belogradchik-Tsaribroa
Bulgarian II. Army	Tokorov	Kyustendil-Strumitoa

[1] 1 Bulgarian Div. equals 2 normal divs.

The Serbian dispositions were influenced by the threat from the east which the Western Powers had forbidden Serbia to meet by a preventive offensive, and by the hope of assistance from Salonika. Serbian fighting strength was not more than 200,000; but the help of Greece was invoked under the 1913 treaty, and that of the Western Powers promised. Putnik deployed three-fifths of his forces facing north and guarded the route to Salonika with the rest:

TABLE IV.

Unit	Area
III. Army	Drina to Kolubara
Belgrade Group	Belgrade to Grocka
I. Army	Lower Morava
Reserve	Palanka
IV. Army	Zajećar—Kujaževac front
II. Army	Pirot—Vranje, covering Nish
Bojović Group	East of Skoplje (Üsküb), on southern routes from Bulgaria

Mackensen's Attack.—Mackensen assembled a mass of heavy artillery and modern appliances, and a heavy preliminary bombardment opened on Oct. 5, the 6th being fixed as the day of attack for Kövess and Gallwitz and the 11th for the Bulgars. Kövess's main crossing, undertaken by two corps with the support of an intense bombardment, took place at Belgrade. After three days' fierce fighting, bridgeheads were secured and the Serbs forced to evacuate their capital (Oct. 9–10). His third corps, who crossed the Lower Drina and Sava, were held up in the Maćva. Simultaneously after a demonstration at Orsova and a Bulgarian threat towards Negotin, two of Gallwitz's corps secured crossings at Ram, and over Temessziget (Ostrovo) Island, but his third corps was held up between Semendria and Grocka.

On the 11th Putnik began a steady policy of fighting successive delaying actions on the northern front, keeping back the Bulgars on the right and rear in order to gain time for the arrival of French and British aid, the first elements of which (British 10th, French 156th Div.[1]) had started to land at Salonika on Oct. 3. Whilst heavy fighting was going on in the Morava valley and the mountains to the west, the Bulgarian advance began to threaten Pirot and the Salonika railway. Vranje was occupied on Oct. 16, whilst further south Todorov occupied Skoplje (Üsküb) on Oct. 21, thus cutting the Salonika line, and driving a deep wedge between the Serbs and the advancing Anglo-French force under Gen. Sarrail.

Austro-German Successes.—Until then the Austro-German Armies from the north had made but slow progress, but the Bulgarian successes on his right forced Putnik to withdraw his left and centre concentrically towards Kraljevo-Kruševac. Zaječar was evacuated on the 25th, Knjaževac on the 27th, and after repeated counter-attacks from Pirot, Stepanović retired on Bela Palanka on the 29th. From Nov. 1 onwards a desperate effort was made by the Serbs to hold the arc Ćaćak-Kragujevac-Jagodnja-Nish-Leskovac. The Bulgars were held back at Bela Palanka, but the Germans and Austrians advanced steadily. Kragujevac fell with its arsenal on Nov. 1, Jagodnja and Kraljevo on the 3rd, Paraćin on the 5th. By the 9th Nish fell, and the defence of this line was at an end. The Orient railway, Falkenhayn's objective, was now clear from Germany to Constantinople.

Final Serbian Effort.—Making a further effort to envelop the Serbian right, the Bulgar II. Army moved out fanwise from Vranje on Priština and from Skoplje (Üsküb) on Kačanik, Qalqandelen (Tetovo) and the Babuna pass, whilst its left was heavily engaged with considerable Anglo-French forces from Lake Doiran to Krivolak and Kavadar. In a last attempt to break through to the south Putnik assembled the remnants of five divisions round Priština and struck at the Bulgar II. Army on the 9th, driving back its right to Vranje and towards Kumanovo. But the arrival of part of the Bulgar I. Army from Leskovac on his left rear and the pressure of the Germans and Austrians from the north made it impossible for Putnik to persist; he then decided to escape through Albania with what could be saved of his army.

Between Nov. 20 and 25, the historic plain of Kosovo Polje witnessed another last effort of the Serbian people, then everything flowed away towards Peć, Djakovica and Prizyen. The pursuit ceased in the first week of December. The Bulgar II. Army then turned south and drove the Anglo-French force over the Serbian border. By Dec. 16 this force had withdrawn to Salonika (*see* SALONIKA CAMPAIGNS). Montenegro was completely occupied by the third week in Jan. 1916.

The end of the pursuit did not mean rest and reorganisation for the remnant of the Serbian Army. A midwinter march through the Albanian mountains brought those whom its rigour left alive to the coast of the Adriatic. Thence they were transferred to Corfu, and later to Salonika, where the Western Powers provided food, clothing, equipment and stores, mitigating to that extent a disaster which might have been prevented by a more vigorous policy towards Bulgaria and Greece, and the earlier dispatch of the reinforcements which were ultimately sent.

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SERBO-CROAT LITERATURE (*see* 7.476).—Perhaps the most noticeable and important characteristic of the modern literatures of the Serbs and the Croats is to be observed in their marked

[1] These were followed by the French 57th and 122nd Divs. (Oct. 15–31) and British 22nd, 26th, 27th and 28th Divs. (Nov. 10–28).

rapprochement. The tendency to merge or coalesce has grown steadily stronger since the first decade of the present century, when the change in political relations, resulting in the Serbo-Croat coalition of 1906, brought with it the beginnings of a closer relationship between the literary men of both peoples. The blending of thoughts and ideas has been even more pronounced since the union of the two nations in 1918, though it is, perhaps, too soon to speak of one and the same "Serbo-Croat" literature. The two literatures have grown and developed fundamentally under different conditions; consequently, each has retained certain individual traits. Croatian literature until 1918 naturally reflected the political and racial aspirations of the Croats under Austro-Hungarian rule, whereas in Serbia there was no corresponding problem to colour the literature of the time, although it, too, was in some measure concerned with questions of political and social organisation.

The turn of the century marks, nevertheless, in both countries, a change in the attitude of literary men towards their subjects. The attempts of writers during the 'nineties to revive the Romanticism of the middle of the 19th century were superseded by a realism which differed from that of the 'seventies and 'eighties in that it was more consciously opposed to Romanticism both in subject and form. Practically all the modern literary movements of Europe have been reflected in the literatures of the Yugoslavs, and in the 20th century French literature came to exercise a predominant influence, in succession to German, Hungarian and Russian influences, although the last continued until the outbreak of the World War and contributed to the triumph of realism. In Serbia, literature became more individualistic, at first melancholy and pessimistic in tone, but gradually growing happier as the political outlook improved. In Croatia, too, writers were concerned with individuals, but the setting was less local in character, and hence literary works as a whole were less coloured by local atmosphere. Dalmatia, from a literary point of view, remained somewhat apart from these tendencies; it had long felt the influence of Italian literature and has continued to look to Italian sources.

Poetry.—The growth of realism in Serbia and Croatia found expression in the forms taken by literature as well as in subject and spirit. Epic poetry has been neglected and practically abandoned in both countries. Lyric poetry, on the contrary, has made considerable progress, and there are a number of lyric poets of a really high order. But the new lyric poetry is unlike the older lyrics, which, in Croatia especially, are pathetic, declamatory and patriotic; it is "objective" and finished in its style. Its models have been the French "Parnassiens" (Baudelaire, Leconte de Lisle, Hérédia) and the "Symbolists" (Verlaine). From the point of view of language, and of the art of verse especially, it shows a remarkable advance. The foremost representatives of this school are Jovan Dučić (b. 1874), Yugoslav diplomatic agent at Cairo, and M. Rakić (b. 1876), Yugoslav minister at Sofia. Of modern Croatian lyric poets, D. Domjanović (b. 1875), M. Begović (b. 1876) and V. Nazor (b. 1876) are the most prominent.

Fiction.—In prose, the short story has developed further than the novel. It is well represented in both literatures by a number of gifted writers; in Serbian by B. Stanković (b. 1876), I. Čipiko (b. 1869), and P. Kočić (1877–1916); in Croat by D. Šimunović (b. 1873), I. Kozarac (1885–1910), J. Kosor (b. 1879) and A. G. Matoš (1873–1914). It is modelled in general upon the Russian short story, but German and Italian (especially D'Annunzio) models are used among the Croats and in Dalmatia. The long novel as a realistic study is still in its infancy; it fails to reach the standard of the romance of the 19th century, but material is gradually being accumulated which may in the near future provide a basis for realistic novels.

Drama.—Modern Serbian drama, like the novel, has shown decidedly less progress than its Croat fellow, and in spite of frequent prize competitions and a closer co-operation with Croat writers of plays still remains undeveloped. Ivo Vojnović (b. 1851), a Dalmatian novelist and playwright, who is one of a small number of authors midway between the Serb and Croat literatures, has composed plays of distinct merit. Specially noteworthy are his *Ragusan Trilogy* (2nd ed. 1909), part of which has been published in the *Slavonic Review* (No. 1), and *The Mother of the Jugović*. In Croatia proper, drama may be said to have become the most prominent form of contemporary literature. Under the influence of Ibsen and Hauptmann on the one hand, and of Rostand and Maeterlinck on the other, two main currents are to be remarked—the one naturalistic, social, analytic; the other symbolic and lyrical. The former is represented by S. Tucić (b. 1873) and the latter by M. Ogrizović (b. 1871). One of Tucić's plays, *The Liberators*, was published in English in 1918. J. Kosor also has written a number of plays, four of which were published in English in 1917 under the title *People of the Universe*.

Criticism.—Meanwhile in Serbia literary criticism tends to take the foremost place. In this form of literature the Serbs seem always to have been stronger than the Croats. Under the influence of the modern French school, Serbian literary criticism has advanced in judgment and subtlety, although it tends, possibly, to be over-critical and is quicker to blame than to praise. Among the Serbs social as well as literary criticism was represented by Professor J. Skerlić (1877–1914), who, though removed at the early age of 37, had already exercised a profound influence upon the movement for Yugoslav unity. Aesthetics are represented by Professor Bogdan Popović (b. 1863), who belongs to the school of Sainte Beuve and Faguet. Among the Croats, the former is represented by Milan Marjanović (b. 1879) and the latter by B. Livadić (b. 1871). Prominent places must also be given to the following Serbian critics: Prof. Pavle Popović (b. 1868) and B. Lazarević (1883), Yugoslav Minister in Albania.

History.—Serious historical studies are of comparatively recent date. Rački was the founder of a historical school in Zagreb, whose chief living representatives are Klaić and Šišić. Since the death of Novaković the leading Serbian historian is Slobodan Jovanović, author of three brilliant studies on the history of Serbia from 1842 to 1878; and mention should also be made of T. Gjorgjević (social conditions, ethnography and folklore), G. Jakšić, Stanojević and Ćorović. The death of M. Gavrilović, Yugoslav Minister in London, before he had completed the fourth volume of his classical biography of Miloš Obrenović, was a severe loss to historical criticism.

Journalism.—Foremost among literary and political journals are *Srpski Književni Glasnik*, fortnightly (Belgrade); *Nova Europa* (tri-monthly, Zagreb); *Letopis* (published by Matica Srpska in Novi Sad); *Savremenik*, *Novi Život* and *Misao* (Belgrade, 1921), organ of the younger and more advanced literary school. The Serbian academy in Belgrade, the Yugoslav academy in Zagreb and the Srpska Matica in Novi Sad, and the museums of Sarajevo and Spalato (Spljet) are the main centres of learned and scientific publication.

Literary Women.—A development which is of fairly recent date in Serbo-Croat literature should perhaps be noticed here, namely the increasing number of women poets, story writers, essayists and critics. Among these, Isidora Sekulić and M. Janović in Serbia and A. Milčinović and I. Brlić-Mažuranić in Croatia deserve special mention. Of writers who have only come to the front since the War the most prominent are I. Andrić (b. 1891) of Sarajevo, perhaps the most talented of the younger Yugoslav poets; and among story-writers Milan Krleža, whose realistic studies of the War, made a profound sensation in Croatia, and D. Vasić, both the latter being very outspoken in their criticism of political and social conditions. (D. Su.)

SERUM THERAPY.—Serum therapy consists in the introduction into the patient of blood serum containing specific antibodies, performed in some other animal, which will (*a*) neutralise the toxins produced by the corresponding infecting bacteria or (*b*) destroy the corresponding bacteria themselves—thus establishing a condition of "passive" immunity (*q.v.*).

Action of Microbes.—Disease-producing microbes may be divided into two broad groups (1) those secreting poisonous substances or *toxins* into the surrounding tissues or (2) those multi-

plying and invading areas far distant from the point at which they gained entry to the body of their host.

Anti-toxin and Immune Body.—Again, speaking generally, natural recovery from a bacterial infection due to an organism of the first group coincides with the appearance in the blood serum of a neutralising agent known as *anti-toxin* in adequate amount; whilst when dealing with microbes of the second class, nature elaborates, also in the serum, a different anti-body—a bacteriolysin or immune body for the purpose of destroying the invading bacteria. In each instance the resulting anti-body is specific in character—that is to say, it will only act vis-à-vis with the particular toxin in the one case or in the other with the members of that particular species of microbe whose entry into the body provoked its formation—the serum which is the vehicle of the curative substance is termed in this first instance "anti-toxic" and in the second "anti-bacterial." Thus the early and accurate recognition of the bacterium responsible for any infection it is proposed to treat determines the selection of the appropriate anti-serum.

Preparation of Anti-serum.—As these sera are nowadays employed in considerable quantities it is customary to select a large mammal, such as the horse, for immunisation. After a period of observation during which the freedom of the animal from diseases transmissible to man is established, a series of subcutaneous injections is undertaken starting with an artificially attenuated virus or a mixture of toxin and previously obtained anti-toxin as the case may be and gradually increasing the size of the dose and the potency thereof until the animal is able to withstand enormous quantities of highly poisonous material without any ill effects while maintaining perfect physical condition. From time to time small quantities of blood are withdrawn from the animal and the serum tested to ascertain the amount of anti-body that is available, and when a suitable stage has been reached the animal is bled to the extent of several pints, the serum carefully separated from the blood corpuscles and passed through a sterile porcelain filter to ensure its freedom from bacteria. Occasionally the serum is concentrated, some of its unneeded proteins removed and purified.

Standardisation.—It is obvious that a correct appreciation of its valency is necessary for the scientific employment of any serum in the treatment of disease; but, unfortunately, bacterial poisons formed by various micro-organisms, and even by different strains of the same species, not only exhibit many variations in toxicity depending upon biological factors (not all of which are at present known) but they have, so far, proved incapable of isolation in a state of chemical purity. Consequently, it is only possible in the majority of instances to effect a comparison by observing the results of their introduction into suitable experimental animals.

Biological Test.—Indeed only in the case of diphtheria toxin is there any universally accepted standard, for here Ehrlich prepared, many years ago, a standard diphtheria anti-toxin of constant valency which is preserved hermetically sealed in vacuo, by means of which all diphtheria toxins can be graded and the potency of the sera prepared by their means expressed in anti-toxic units.

In the case of toxins produced by other bacteria, and in the preparation of anti-bacterial sera, the plan usually adopted is to inoculate gradually decreasing doses of the virus into susceptible animals until the smallest quantity that will cause death with certainty, and within a specified time, is determined. This is termed the minimal lethal dose (M.L.D.) and forms the basis for the standardisation of the corresponding anti-serum. Varying quantities of serum are in turn mixed with a constant dose of virus—usually 100 M.L.D.—and injected into animals until that amount of serum is determined which will effectively neutralise the test dose. This quantity of serum is then regarded as containing one unit of anti-body and the serum which is in process of standardisation is stated to contain so many units per cubic centimetre.

Anti-toxin Sera.—Of the anti-toxin sera, diphtheria anti-toxin is rightly regarded as the most efficient. Its use, now almost universal, has been largely responsible for the reduction of the death-rate from diphtheria (*see* INFECTIOUS FEVERS) in a most striking manner from over 33% in pre-anti-toxin days to about 7 per cent. This latter figure includes all cases in all stages, but if treatment is instituted on the first day of disease the mortality falls to zero. Tetanus anti-toxin is also of great value, but owing chiefly to the fact that Tetanus (*q.v.*) is rarely diagnosed until the toxin has secured a firm hold upon nervous elements, it has not achieved a position as a therapeutic agent equal to that occupied by diphtheria anti-toxin. On the other hand the mass of evidence accumulated in the World War clearly demonstrates the necessity for its use in the prophylactic treatment of earth-soiled wounds. Gas gangrene, rife during the early days of the World War, led to the production of highly efficient anti-sera for the toxins of B. welchii and the vibrion septique, the necessity for which has largely passed. Another serum, for the neutralisation of the toxin of bacillus botulinus—a germ which gives rise to a particularly fatal type of food poisoning fortunately rare in the British Isles—is also prepared but there is little evidence available as to its efficiency (*see* FOOD POISONING).

Finally, Calmette has obtained an anti-toxic serum, "anti-venene," from horses which he had immunised against both colubrine and viperine venoms.

Anti-bacterial Sera.—Many varieties of anti-bacterial sera have been prepared against many of the microbes of the second group, but few of them have stood the test of time; and at the present day only anti-streptococcic, anti-meningococcic, anti-pneumococcic, anti-anthrax and anti-dysentery sera remain. These have established their positions in the therapeutic armament largely as the result of recent acquisitions to our knowledge of the biology of certain microbes but in part also to improvements in the methods of preparing anti-sera.

The recognition that numberless strains of streptococci exist which though morphologically identical are biologically diverse has resulted in the preparation of polyvalent sera which sometimes produce dramatic recoveries in apparently hopeless cases of septicaemia, although in other instances serum is employed without avail. In the case of infections by the pneumococcus too, several different types may be encountered to some of which no curative serum could be prepared. Within recent years these organisms have been classed into four different groups of which the two first were alone amenable to serum treatment—that designated Type 1 being particularly so. Similarly, and largely as the result of researches necessitated by the prevalence of the so-called "spotted fever" (*see* SPINAL MENINGITIS) during the War the meningococci have been grouped under four types and whilst multivalent sera comprising anti-bodies for all types have been made, the use of appropriate univalent sera has afforded even more successful results. The two anti-sera prepared against pathogenic bacilli, anti-anthrax and anti-dysentery, are both of very considerable value. The first has long been employed either alone or in conjunction with operative measures in the treatment of "malignant pustule," but the position of the latter depends almost entirely upon the ample demonstration of its value in the War provided it is used early in the disease.

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SERVICE, ROBERT WILLIAM (1874–), Canadian poet and novelist, was born at Preston, England, Jan 16 1874, and educated at Hillhead Public School, Glasgow. After serving an apprenticeship with the Commercial Bank of Scotland in Glasgow, he went in 1905 to Canada and settled for a short time in Vancouver island. Later, after pursuing a variety of occupations in different parts of the Pacific coast he entered the Canadian Bank of Commerce in Victoria, B.C. He was afterwards transferred first to White Horse in the Yukon and then to Dawson. In all he spent eight years in the Yukon and travelled widely. During his last years with the bank he wrote verse describing life in the North, notably *Songs of a Sourdough* (1907) and *Ballads of a Cheechako*. In 1910 appeared a novel *The Trail of '98* giving a vivid description

of men and conditions in the Klondike. During the Balkan War of 1912–3 Service was war correspondent to *The Toronto Star* and served this paper in the same capacity during the World War, in which he spent two years as an ambulance driver in the Canadian Army Medical Corps. He described his war experiences in *Rhymes of a Red Cross Man* (1916). After the War he devoted himself entirely to literary work and settled in Paris.

His other works include *Rhymes of a Rolling Stone* (1913); *Ballads of a Bohemian* (1920); *Poisoned Paradise*, a novel of Monte Carlo (1922); *The Roughneck* (1923).

SEVERN, England and Wales (*see* 24.723).—In 1920 a scheme was brought out for a barrage across the River Severn, carrying a road and railway, which should utilise the tides for the production of electrical power. The first part of the scheme provided for the construction of a locked basin, about 27 m. square, on the lower Severn, formed by a barrage close to the line of the Severn tunnel; much of it would accommodate the largest vessels at all states of the tide. High tides would be trapped by the barrage, and the water led out to turbines. Part of the power from this installation would be employed to pump water to a salt-water lake high up in the valley of the Wye, with turbines in the tidal area lower down the river. When the barrage scheme was not working owing to the state of the tide, or at times of heavy pressure, the water from this lake would be used to work the turbines on the Wye. It was estimated that over 500,000 H.P. would be generated for a 10-hour day, with a peak-load capacity of over 1,000,000 horse-power. The water power resources committee of the Board of Trade reported on the scheme as deserving of further investigation, but owing to the necessity of economy it was dropped at the time.

In 1924 the Great Western Railway sought parliamentary powers for the building of a bridge to relieve the congestion of traffic in the Severn tunnel, and this project was postponed whilst a further examination of the barrage scheme was made. Preliminary geological and hydrographical investigations have been undertaken by a committee appointed by the Government, and an engineers' report, to take two or three years to complete, was also being prepared in 1925. The main question to be settled, apart from the engineering problem, is whether the proposed interference with the tidal currents would cause siltage in the ports of Bristol, Cardiff and Newport. (*See* TIDAL POWER.)

SÈVRES, TREATY OF, the Treaty of Peace concluded between the Allied and Associated Powers and Turkey on Aug. 10 1920. It was not ratified and was later superseded by the Treaty of Lausanne (*q.v.*), which was signed on July 24 1923. The principal arrangements of the Treaty of Sèvres were as follows:—

The King of Hejaz was recognised as independent and the Holy Places were placed under his care. The boundaries of Turkey were so drawn as to exclude her from control of any other Arabian States or of Syria, Palestine and Mesopotamia, and Turkey renounced in favour of the Principal Allied Powers rights over territory outside Europe that lay outside her new frontiers (Egypt, Sudan, Libya [Tripoli,] Morocco and Tunis). Palestine was to be entrusted to a Mandatory Power, Syria and Mesopotamia "provisionally recognised as independent States to be advised by Mandatory Powers." Smyrna and the Ionian hinterland were placed under Greek administration for five years, when further arrangements would be made. The Dodecanese islands were ceded to Italy, Imbros and Tenedos to Greece, and Turkey recognised Greece's sovereignty in Lemnos, Samothrace, Mitylene, Chios, Samos and Nikaria. The zone of the Straits from Constantinople and Scutari to the Dardanelles, and a zone on the Asiatic mainland were handed over to an international commission to be internationalised and demilitarised. Western Thrace, which had already been ceded to the Allies as a whole, was ceded by them to Greece by separate treaty. Turkey ceded Greece Eastern Thrace, up to the Chatalja lines. Turkey agreed to recognise Armenia as "a free and independent State" while Kurdistan was to receive local autonomy. The Turkish Army was to be reduced to 50,000, all Turkish aircraft was to be surrendered and all the fleet except a few ships and torpedo boats.

The financial clauses charged Turkey with loss, with damage and with war guilt, but admitted that, as her resources were unequal to payment, such claims should be waived. But immense powers were conferred on a Financial Commission of British, French and Italian representatives with a Turkish representative in a consultative capacity, which was practically empowered to control the budget and the financial laws and regulations of Turkey. The Council of the Ottoman Public Debt was to be similarly formed and to have complete powers over its administration. The Capitulations were to be re-established for the Allies but not for enemy Powers, and the separate postal system of the Allies was also re-erected. Various Turkish ports, Constantinople, Smyrna, Alexandretta, etc., and the River Maritsa, were to be placed under international control. See H. W. V. Temperley, ed. *Hist. of the Peace Conference at Paris*, vol. VI. (1924).

SEWING MACHINE: *see* HOUSEHOLD APPLIANCES.

SEX (*see* 24.745).—The problem of the determination of sex has in recent years been greatly elucidated. Knowledge has come from several sources. Both breeding experiments and cytological observation have severally led, as will be seen, to concordant conclusions, proving that the sex of the offspring is generally decided by one or other of the germ-cells which unite in fertilisation. But though in ordinary circumstances the mode of determination is now known, there are nevertheless indications that in special cases the normal course may be altered or at least disturbed by various influences, the operation of which is not understood. The reconciliation of this latter class of evidence with the former has not yet been satisfactorily effected.

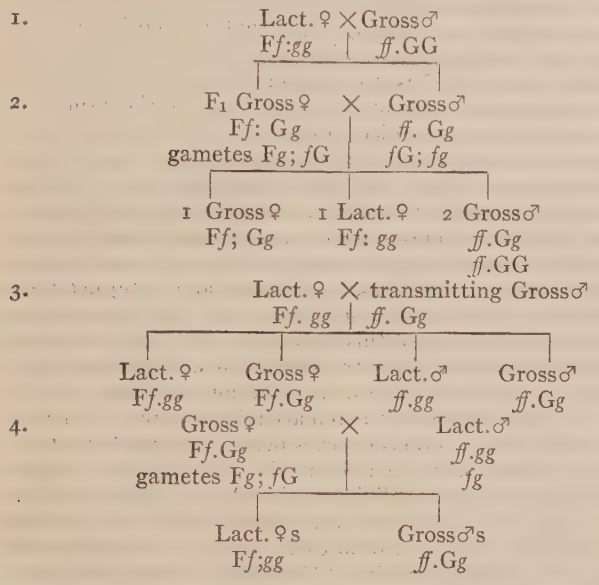
Sex Determined by Spermatozoa.—Knowledge of sex-determination began with the observation of Henking (1891) that in certain insects the spermatozoa were of two kinds, (1) those which contained a supernumerary, unpaired or accessory chromosome (*see* CYTOLOGY), now generally called the X-chromosome, and (2) those without this body. McClung (1902) first suggested that this chromosome might be a determiner of sex, and took it to be the peculiarity of the male, but Miss Stevens (1905) and E. B. Wilson (1905), to whom the development of this part of the subject is chiefly due, proved that the spermatozoa bearing the X-chromosome are in these animals destined to form females. The eggs are alike in each possessing an X, and thus the somatic or diploid cells of the daughters come to have 2 X, one received from their mother and one from their father, whereas the diploid cells of the sons have one only, received from their mother. Since the gametes of the male are of two kinds, that sex is said to be *hetero-gametic*, the female being *homo-gametic*. Further observation, however, showed that the organisation of even nearly allied genera of insects is by no means uniform in respect of the sex-chromosomes. Though unpaired in the males of some genera, the X may in others have a pair or "mate" of smaller size, known as the Y-chromosome. Between these and other genera in which the male has a pair of sex-chromosomes not visibly different from each other there are several transitional conditions. In a considerable number of forms also, the X is represented by a group of separate chromosomes, regarded as collectively the mates of the Y.

The X-chromosome has been seen in several orders of insects, especially Hemiptera, Orthoptera and Coleoptera, in spiders, myriapods and some nematodes. It has also been found in various mammals and in several dioecious plants. In man cytological observation is difficult but the best determination (Painters) gives 48 as the diploid number, with an X and a small Y in the male.

Sex Determined by Ova.—Naturally this discovery that the male is hetero-gametic was at first supposed to be of universal application, but the next advance, which resulted from experimental breeding, showed that this simple view could not be entertained. The Currant Moth (*Abraxas grossulariata*) has a variety *lacticolour*, characterised by a deficiency of black pigment, previously known only in the female. Doncaster, instituting experiments with this variety, found that by breeding such females with normal males the F_1 family consisted of males and females all normal.[1] Interbred, these gave F_2 composed of two normal males: one normal female: one *lacticolour* female. But *lacticolour* ♀ × F_1 ♂ produced families containing normal ♂, normal ♀, *lacticolour* ♂ and *lacticolour* ♀, all in equal numbers. On breeding any normal *grossulariata* ♀ with the *lacticolour* ♂ now produced, the sons were all *grossulariata* and the daughters all *lacticolour*.

[1] In genetics the following symbols are frequently used: ♀ = female; ♂ = male; × = mated with F_1, F_2, etc. = the first filial family, the second, etc.

Other interpretations have been proposed, but it is evident that the eggs of the *grossulariata* ♀ are of two kinds, (1) those which are destined to be females, and do not carry the *grossulariata* factor (2) those which do carry this factor, and are destined to be males (Bateson and Punnett). Taking the factors G, *grossulariata: g*, its absence; F, femaleness: *f*, its absence, the results may be represented symbolically thus:—


1.
Lact. ♀ × Gross ♂
Ff:gg | ff.GG
2.
F1 Gross ♀ × Gross ♂
Ff: Gg | ff. Gg
gametes Fg; fG | fG; fg
1 Gross ♀ 1 Lact. ♀ 2 Gross ♂
Ff; Gg Ff: gg ff.Gg
ff.GG
3.
Lact. ♀ × transmitting Gross ♂
Ff. gg | ff. Gg
Lact. ♀ Gross ♀ Lact. ♂ Gross ♂
Ff.gg Ff.Gg ff.gg ff.Gg
4.
Gross ♀ × Lact. ♂
Ff.Gg ff.gg
gametes Fg; fG fg
Lact. ♀s Gross ♂s
Ff;gg ff.Gg

Sex-limitation and Sex-linkage.—Such a system of heredity is sometimes called "sex-limited," (though more usually "sex-linked" since the limitation is not absolute) and the descent of the character so limited serves as an indication of the mode by which the factor determining sex is transmitted from parent to offspring. The proof that in these moths sex is determined by the eggs, or in other words that the female is the hetero-gametic sex, is thus complete. The same has been shown to be true of birds. In fowls, several conditions have been shown to be sex-limited to females; *e.g.*, *black* as against the *cuckoo-markings* of the Plymouth Rock; *golden* (as in Sebrights or Hamburgs) as against *silver;* the *black pigment* of Silky fowls is suppressed by a sex-limited *factor which inhibits* this development, etc. In canaries the peculiar form of albinism known as *Cinnamon*, and in doves the pale albinotic variety shows a similar behaviour. We have thus to recognise that, paradoxical as it may appear, sex is in some animals determined by the sperm, and in others by the eggs. Man belongs to the former class. The descent of sex-limited conditions, notably colour-blindness, demonstrates this. Substituting male for female, colour-blindness is transmitted in man exactly as the *lacticolour* character is in the moths. A colour-blind man mated with a normal woman has sons and daughters with normal colour-vision. The sons cannot transmit the colour-blindness, but the daughters transmit it to *half* their sons who are therefore colour-blind. Moreover, when the transmitting female is mated with the colour-blind man, the *colour-blind female* is produced, just as in the corresponding mating (3) in the *grossulariata* experiment, the *lacticolour* male was formed. Finally when the colour-blind woman mates with a normal man the sons are all colour-blind and the daughters are all transmitters.

Cytological Interpretation.—This attractive branch of Genetics has been actively developed by T. H. Morgan and his colleagues with remarkable success; and though serious difficulties remain, the incidence of the sex-limited characteristics can so readily be interpreted as depending on the distribution of sex-chromosomes, observed or hypothetical, that a causative influence has with great plausibility been attributed to them. Starting from the now familiar fact that in certain animals the XY male has visibly one X-chromosome and the XX female two, it is argued that the "double dose" of X is the cause of the female characteristics and that one dose of the same element produces the male attributes. If, then, in such animals the dominant factors, which show linkage, be supposed to be also carried in the X-chromosome, the sex-limited distribution of the negative characteristics to males will result. At first sight the fact that in other animals the female is hetero-gametic seems irreconcilable with this scheme, but, by making the assumption that in these females a similar cytological apparatus exists, the genetic observations may be represented on the same plan as that adopted for the hetero-gametic males. For the hetero-gametic female may be represented as XY and the male as XX, and here again if the X carries the positive element, say the G of *grossulariata*, then the gamete of the composition XG is always destined to the sons, and Yg to the daughters, as the facts require.

The "limitation" to sex is in all such examples regarded as a consequence of the attachment of the positive factor, or element concerned, to the X-chromosome. By observation we know that just as in *grossulariata* the normal female is always heterozygous for the recessive *lacticolor*, so in Man the normal male is always heterozygous for the recessive colour-blindness; and this is interpreted to mean that the unpaired or unequally paired sex-chromosome is in each case responsible for contributing the dominant. Nevertheless evidence from other sources, especially the experiments on the fish *Lebistes* (Winge) prevents us from asserting as a universal rule that the X-chromosome (or its analogue) is exclusively the positive contributor, since in that animal the paradox is well established that though females are all alike both in appearance and in genetical constitution, yet the sons always in certain respects resemble the fathers exclusively. The facts suggest that the Y-chromosome, which in species with hetero-gametic males must normally be passed along the male line alone, may contain definite Mendelian factors.

The strongest evidence in favour of the chromosome hypothesis has been found in the phenomenon of "non-disjunction" in *Drosophila*, the fruit-fly, whose genetical composition has been studied more fully than that of any other organism (*see* GENETICS). In this creature the male is hetero-gametic. Exceptionally, unexpected forms appear, as, for instance, red-eyed males in the mating where white-eyed alone should normally be produced. Bridges found that in such individuals and among the families containing these abnormal members, irregularities in the occurrence of the chromosomes could be demonstrated. Apparently in some maturation division two X-chromosomes had passed to the same egg, others receiving none. From this a series of exceptionally constituted gametes are derived which could have brought about the observed exceptions. Another line of argument pointing to the same conclusion has been derived by Morgan and his associates from a study of gynandromorphs—the curious individuals composed of irregular patchwork of male and female tissues, which are formed with some frequency especially among the various orders of insects. A number of these have occurred in the pedigreed families of *Drosophila*, and on analysis it was found possible in almost every case to refer the characters shown in the several parts to their parental origin.

A primary objection to these modes of interpretation is that the cytological conclusions rest on a still slender basis of observation. As regards the forms with hetero-gametic females an unpaired chromosome has been reported to exist in the females of two moths (*Phragmatobia* and a *Psychid*), but in other forms it has been searched for in vain. The student should constantly bear in mind that statements to the effect that a certain character "is borne by the X-chromosome," etc., are often only founded on analogy, and are not rarely made even in regard to forms of life in which we are fairly sure that no demonstrable X-chromosome exists. Conversely in certain animals having an alternation of generations, especially some Nematoda (*see* Boveri, P. Hertwig), though an X-chromosome is easily demonstrated to be unpaired in males though paired in females, no attempt to bring the facts of the life-history into one consistent scheme of sex-determination has been successful.

The presence of two X-chromosomes is thus regarded as the determining *cause* of sex, constituting the female in the one group of animals and the male in the other. Nevertheless the evidence derived from the many curious forms resulting from

non-disjunction in *Drosophila* has led to a modification of this very simple conception. By the errors of cell-division 3 X-chromosomes for example may be together associated in one body and accompanying these may be various numbers of the other chromosomes (autosomes). Such abnormalities may be arranged in a series ranging from infra-males to supra-females and study of their cytological content shows that the several chromosomes must exert an antagonistic action, in which the X especially, but to some extent also the two larger autosomes, must influence the organism towards femaleness, whereas minute 4th chromosome acts in the contrary sense in the direction of maleness. This idea of " balance," as it is called, has been introduced with great plausibility by Bridges.

Cytology has been of great assistance in codifying the apparently contradictory records as to the intricate series of parthenogenetic or agamic and sexual forms of the Hymenoptera and Hemiptera. We have learnt for example that in Hemiptera (Morgan; Von Baehr) when fertilisation produces females only, the fact is due to the death of all the sperms, which do not bear the X-chromosome. In a white fly (Aleyrodes) also Schrader has demonstrated a very simple system, eggs which are not fertilised remain haploid and produce males only. In the hive-bee a similar system obtains though beset by complications still not fully cleared up. Also in these groups it not rarely happens (*Neuroterus*, Doncaster) that the fertilised females give rise parthenogenetically to other females of which, without fertilisation, some produce females only and others males only, but no cytological distinction between these two types of females has been seen. Whatever be the true cytological account of sex-determination, we have nevertheless to recognise that femaleness and maleness respectively, though similar throughout the Metazoa both in outward manifestations and in deeper physiological features, are constructed upon at least two distinct genetic plans. To reconcile the infrequency of visible cytological distinctions between the sexes with the chromosome hypothesis it has been suggested that the critical bodies are in such cases attached to other chromosomes, but this, though undeniable as a possibility, is as an argument dangerously tinged with obscurantism, a comment which applies to many of the subordinate hypotheses supporting the chromosome theory of genetic causation.

The situation is one through which many scientific problems have passed before final solution has been obtained. By independent lines of evidence conclusions largely identical have been reached. The facts are not in dispute, but a consistent interpretation of the whole series has not been obtained up to the present time.

Disturbance of Normal Sex-Ratios: the Production of Inter-Sexes.—Hybridisation is not rarely followed by a disturbance of the normal sex-ratio. For example, from domestic hens crossed with cock pheasants, *male* mules (sterile) are easily bred but female mules seldom if ever. Among Bovidae some crosses give fertile females but sterile males (S. v. Nathusius) and the same occurs in a cross between species of cavies (Detlefsen). Among Lepidoptera a series of such examples are known, the first having been observed by Standfuss, who called attention to the absence or scarcity of females in many species-crosses. Recently Goldschmidt, working with races or species of *Lymantria dispar* brought together from many countries, carried out a remarkable series of experiments. He found that a Japanese race used as ♀ × European ♂ gave normal males and females, but that in the reciprocal cross though the males came normal, the females were intersexes, exhibiting many transitional stages, approaching males in various degrees both in form, colour and instincts. When Japanese males of certain races were used, the whole of the female offspring are said to have been thus transformed into males. Goldschmidt states that the various races can be arranged in an ascending scale according to the completeness with which these effects are produced, but the phenomena showed many complications not as yet adequately represented, notably the appearance of partially transformed *male* intersexes in the F_2 generation raised by inter-breeding the normal offspring raised in the first experiment. It has been pointed out by J. B. S. Haldane (1922) that, apart from certain exceptions, a general principle can be perceived in this group of phenomena. If in hybrid offspring either sex is consistently missing or defective, this will be the hetero-gametic sex, *e.g.*, in birds and Lepidoptera, the female, in mammals, the male.

Sex of Twins.—The facts hitherto dealt with all go to prove that sex is determined by the gametic contribution made by one or other of the parents and that this is the normal course is not open to question. In harmony with that conception of sex-determination, it is found that when, as in twinning of embryos and generally when the fertilized egg multiplies by division, the products are commonly all of the same sex. In the armadillo (*Tatusia novem-cincta*), studied in detail by Newman, four embryos, demonstrably arising by division of one blastodermic vesicle (developing ovum), are usually produced at a birth and are always of the same sex, the four being all males or all females. Patterson found an exception in the case of the parasitic Hymenopteron *Paracopidosomopsis*, which by polyembryonic division sometimes produces both males, females and intermediates. That something analogous to non-disjunction here occurs is an acceptable interpretation of this anomalous instance. But there is a remarkable group of incontrovertible facts which show that sometimes the normal course of sex-development may be disturbed. F. Lillie discovered a remarkable example. When in horned cattle twins of opposite sexes occur, the female is sometimes sterile, being called a free-martin. It might be thought that these twins arose by division of one fertilised ovum, but Lillie by study of material from the Chicago stock-yards proved that an ovum had dehisced from each ovary and that therefore the twins were originally distinct. He further showed that sometimes the twins had an actual anastomosis between their foetal circulations. The presence of a male embryo must therefore be regarded as having the power of inhibiting the development of the female embryo, poisoning it in so far as the formation of at least the external organs is concerned.

Effects of External Conditions.—Disturbance of the normal sex-ratios as a consequence of various interferences, such as starvation, high or low temperature. etc., has several times been alleged to occur, especially in Amphibia, and the evidence of R. Hertwig that delay in fertilising the eggs of the frogs causes the production of a preponderance of males has been fully confirmed. Circumstantial details preclude the obvious suggestion that this is a result of differential mortality. Hertwig thought that inasmuch as the polar bodies are excluded very late after the eggs are laid, his result might perhaps be reconciled with the conception of cytological pre-determination if the conditions of the experiment could in some way have decided which elements should be retained in the egg and which ejected in the polar body. Recently Seiler has made an observation of this kind in regard to a Psychid moth, *Talaeporia*. He states that if the females are kept in a high temperature while the eggs are undergoing maturation, it can be seen on cytological examination that the accessory chromosome more frequently remains in the egg, and that as a matter of observation more males are produced, the converse occurring under cold conditions. As to the genetical composition of the Amphibian intersexes, an important observation has lately been made by Crew. From the eggs of a female frog, fertilised by a male showing intersexual characters, 774 tadpoles were reared, all females.

Hence the important inference may be drawn that though by some unknown cause the sex of a frog, cytologically female XX., may be completely altered to the extent that it grows up in all respects a male, producing sperms which fertilise eggs, yet in the determination of the sex of its own offspring the effect of the original cytological constitution appears, for the sperms all carry the X-chromosome and daughters only result. From other signs, however, we know that sex-determination in Amphibia, and perhaps some fishes also, is beset with complications. In many fishes hermaphrodites are common and the frog is peculiar in the fact that ova are commonly found in very young males, the final determination of sex being postponed, sometimes indefinitely.

According to Baltzer, sex in *Bonellia* is directly determined by the conditions of larval life. The female is of course an animal of considerable size, whereas the male is a minute creature parasitic on her. Larvae which find the proboscis of the female and attach themselves to it are said to develop into males, those which remain free-swimming becoming females. Larvae artificially detached from the proboscis become intersexes. Adequate controls, by which the hypothesis of predisposition may be excluded, would in such an instance be most difficult to institute.

Effects of Castration.—Collateral evidence bearing on the nature of the distinction between the sexes has been drawn from many sources, especially from the results of castration, but though the facts thus empirically observed are of much physiological interest, they have no very direct bearing on the primary problem. The reproductive glands, acting, presumably, by virtue of the secretions (hormones) of their interstitial components, have often a great influence on the development and maintenance of secondary sexual characters, but the part played by the hormones must obviously be of a secondary nature. Removal of the genital glands has divers effects in various animals. In good agreement with the discovery that in the bird the female is the hetero-gametic sex, it is found that both in the fowl and the duck (Goodale) the removal of the ovary induces the plumage and some other characteristics of the male. The female is thus an organism in which the male attributes are concealed or recessive, whereas a capon does not develop hen-feathering. Moreover, Morgan found that in the Sebright bantam, the males of which are " henny " in plumage (not in combs or wattles), after castration the cocks acquire ordinary male plumage, which may naturally be interpreted to mean that the hen-feathering of these cocks is due to their possession of part of the female complex which has been transferred to them. Morgan and Punnett also have shown that the henny character behaves as dominant in breeding, a fact which proves that the dominance proper to the whole female complex of the bird pertains also to that part of the complex which controls the plumage.

Castration performed on moths during the larval stage has not produced modification of secondary sexual characters (Oudemans). In crabs, however, the destruction of the testes by certain parasites produces very striking " feminisation " of the abdomen and appendages (Geoffrey Smith), but we do not know which sex in Crustacea is hetero-gametic, though work on *gammarus* points to this being the male. We are without a satisfactory interpretation of this group of observations, some of which superficially considered seem to run counter to the facts of gametic determination already established, but the disturbances of the normal course may commonly, though perhaps not always, be conceived of as due to interruption of the chain of events by which the full effects of gametic predetermination are developed.

Hermaphrodites.—Attention should be called to a remarkable lacuna in our knowledge of sex-determination. Up to the present nothing has been yet discovered either by cytological or analytical methods as to the genetical relation of the hermaphrodite types among animals to those in which the sexes are distinct. In plants a little progress has, as will appear, been made, pointing to the conclusion that the hermaphrodite is dominant, containing something which the females at least do not, but as to hermaphrodite animals nothing can be said with confidence. This is much to be regretted, as the whole subject might be greatly advanced by such knowledge.

General Considerations.—The primary sexual distinctions evidently depend on factorial elements which follow more or less closely the familiar principles of Mendelian segregation. The determining factor for sex should probably be regarded as a complex, usually transmitted in its entirety, but capable by accidental errors of cell-division of being disintegrated, so that the elements responsible for special characteristics may become detached from the rest and may even be passed over to the sex which normally does not receive them. For example, the races of fowls which do not incubate have presumably thus lost a portion of the dominant sex-complex; the hen-like cocks of the Sebright bantam may be represented as having acquired that ingredient of the female sex-factor which in the normal female inhibits the formation of the sickle-feathers and hackles of the cock, and so on. A similar representation may be applied to those cases (*e.g.*, Phalaropes) in which the cocks are hen-like and normally incubate the eggs. It is not unreasonable to suppose that the transference of an actual fragment of critical material, presumably a portion of a chromosome, is responsible for the physiological abnormality. The literature of obstetrics and of stock-breeding abounds with nostrums for the arbitrary regulation of sex in man and the domestic animals, but from what is accurately known of the mechanism of sex-determination, nothing favourable to these claims can yet be adduced. Nor can any explanation be offered of the fairly constant departures from equality which normally occur in man and various domesticated animals. In the pig, ox and rabbit the male births are said sensibly to exceed the female, but in the horse and sheep there is a small excess of female births. The races of man show definite differences in the proportions of the sexes at birth. Of living births, taking females at 1,000, the males for England and Wales were for some time slightly below 1,040, which, though about the same as the proportion in Japan, is somewhat low in comparison with Germany, several European countries and the white population of the United States, in which the males are about 1,060. On the other hand for the coloured population of the United States the male births are still less in proportion (in the year 1890, 1,024) and occasionally fall actually below the female number (998 in 1900). In all countries for which data can be obtained the proportion of males among *still-births* is very largely in excess of the females. Such divergences usually point to differential mortality or to the action of lethal factors, but in view of the large excess of males among still-births this account is not readily applicable here. The excess of males (surviving infancy) is exceptionally large in certain, though not all, of the families affected with the tendency to bleed profusely from trifling injuries, known as haemophilia. This is one of the sex-linked abnormalities appearing in males which follow much the same system of descent as colour-blindness. Illegitimate births in most countries show a distinct diminution in the excess of males.

Since the publication of Düsing, the proposition which he (following earlier writers) developed, that war produces an increase in the proportion of male births, has been widely disseminated. S. Newcomb investigated data as to births in the United States during the Civil War but found no positive result, and other parts of the evidence have been declared to be fallacious. Nevertheless, statistics for Great Britain and also those for Germany during the World War show a progressive rise which, though amounting to only one or two per cent, can scarcely be deemed insignificant. It should be remarked, however, that this rise had begun in Prussia some years before the War. On the other hand, no similar change has taken place in the neutral countries. For an adequate consideration of the facts many concomitant phenomena must be taken into account; for example, the fact that the total birth-rate of Prussia fell in the war period to less than half. Whatever be the immediate cause of the rise in male births, it is likely that it should be referred to the incidence of a differential pre-natal mortality rather than to any more fundamental genetic process.

Sex in Plants.—The attempt to make a factorial analysis of sex in the higher plants has not led to clear conclusions. Dioecious plants suitable for experiment are few. Correns, from results obtained in reciprocal crosses made between *Bryonia dioica* and the monoecious *B. alba*, inferred that the male of *dioica* was hetero-gametic, but the argument did not amount to proof. Shull's experiments with *Lychnis dioica* and a variation having the elements of both sexes present together were also beset with many complications and obscurities. In dioecious mosses the Marchals proved that segregation, in respect of sex, normally occurs at spore-formation, but their experiments gave indications of further complexities. *Sphaerocarpos*, a liverwort, produces spores in tetrads, and of the four, two became males and two females. C. E. Allen states that the female spores

each receive an accessory chromosome larger than that which passes to the male spores. In *Rumex* Kihara has found evidence that the male is cytologically hetero-gametic. Blakeslee showed that Mucors consist of several strains which may be called + and −, and that conjugation only takes place when a + culture comes into contact with a − culture. These strains may with great probability be regarded as two sexes, but the results were complicated by the discovery of other strains which are indifferent. We meet here the same difficulty noted in the case of animals, that the factorial relations between hermaphrodite plants and the dioecious forms have not yet been successfully represented. Varieties having the stamens to a greater or less degree aborted are not uncommon among the species of flowering plants which are normally hermaphrodite.

If the deficiency is extreme, the variety is not merely in function female, but it is in a condition morphologically not distinguishable from the females of plants dioecious in the strict sense such as *Lychnis dioica* or *vespertina*. When such female varieties are fertilised with pollen from the hermaphrodite type the resulting family may be a mixture of hermaphrodites and females, but not rarely females only are produced. As the hermaphrodite is a dominant this evidence demonstrates that the hermaphrodite factor must thus be relegated to the female side, the male side taking the recessive in which the anthers are aborted. Such "anisogenous" distribution of the factors may exist in regard to colour, double flowers and probably many other factorial distinctions, and the conception of sex-linkage is in a special and limited sense applicable to them (C. Pellew). Otherwise, save in the one case of *Lychnis*, nothing comparable with the sex-linkage of animals has yet been discovered in plants.

Chemical Distinctions between the Sexes.—The search for evidence that the physiological chemistry of the two sexes differs in any fundamental respect, though extensively pursued, has led to little positive result. Lately, however, Manoilov has stated that by the use of certain salts and dyes he has found a method of treating the blood of man and animals and the tissues of dioecious plants in such a way that by the ultimate colour-reaction the sex from which the materials were taken can be distinguished. In this claim there is nothing *a priori* improbable, though before it can be generally accepted repetition and rigorous confirmation must be demanded.

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SGAMBATI, GIOVANNI (1843–1914), Italian composer (*see* 24.757), died at Rome Dec. 15 1914.

SHACKLETON, SIR ERNEST HENRY (1874–1922), British explorer, was born in Kilkee, Ireland, Feb. 15 1874. Educated at Dulwich College, he entered the mercantile marine service. In Scott's Antarctic expedition of 1901–4 Shackleton acted as lieutenant, but had to return home on account of illness. On Jan. 1 1908 he sailed from New Zealand in the "Nimrod" in command of an expedition which reached a point about 97 m. from the South Pole (*see* 21.968). On his return in 1909 he was knighted and received the C.V.O. On Aug. 1 1914 he sailed from England on the "Erebus" in command of the unfortunate 1914–7 expedition (*see* POLAR EXPLORATION). Finally, in Sept. 1921 he set out a third time, in the "Quest." On Jan. 5 1922, off South Georgia Island, he succumbed to an attack of angina pectoris following influenza. He was buried on South Georgia Island. Shackleton gave an account of the 1907–9 expedition in *The Heart of the Antarctic* (1909); and of the 1914–7 expedition in *South* (1919).

See H. Begbie, *Shackleton. A Memory* (1922); A. S. V. Blunt *Shackleton* (1922); H. R. Mill, *The Life of Sir Ernest Shackleton* (1923, new ed. 1924).

SHAGALL, MARC (1888–), Russian painter, was born in Vitebsk, of a family of Jewish artisans. He became, at the age of 20, a pupil of Leon Bakst in St. Petersburg. He went to Paris in 1910, where he stayed four years and exhibited in the "Salon des Indépendants." Under the influence of cubism he painted a series of fantastic pictures, in which he showed extraordinary gifts for colour. On returning to Vitebsk, he painted 60 small pictures, interiors and scenes from Jewish life, in which truth and mystic conceptions were mingled; some of these he exhibited in the "Artistic World." The "Wandering Jew" flying over an orthodox church and the idyllic "Anniversary" (Wiesbaden) finally established his reputation. In 1918 he founded and directed a school of art in Vitebsk, in the following year he executed for the Yiddish theatre in Moscow a series of justly celebrated frescoes. In 1922 he went to Berlin and later settled in Paris. He engraved a cycle of prints entitled "My Life," and made a series of 100 etchings to illustrate Gogol's *Dead Souls*. Exhibitions of Shagall's work have been held in Paris, Berlin and other German cities and New York.

SHANGHAI, China (*see* 24.799), with a population of 1,538,500 in 1923 (including 20,295 foreigners, largely Japanese, in the international settlement), and an area of 8⅔ sq. m., is the first port of China, and among the first four or five ports in the world in point of tonnage. In spite of the interruption of communications and the impositions caused by the civil wars, trade has steadily increased. The port was entered and cleared by 29,500,000 tons of shipping in 1923, as compared with 19,500,000 tons in 1913. In 1924, however, owing to fighting in the neighbourhood, trade received a setback. British shipping in 1921 exceeded the highest pre-War figure by over 1,000,000 tons, and is still predominant, though the American and Japanese trade has also increased largely.

Shanghai is a great clearing house for all kinds of contraband narcotics, and large quantities are seized yearly. A scheme for the regulation of the river was initiated in 1912 by the Whang-

poo conservancy board, who are responsible for the administration of the port of Shanghai, and considerable work in canalising, dredging, reclamation and surveying has been carried out, the cost being derived from taxes on customs and duty-free goods. The inner and outer bars have been eliminated, and the minimum depth is now over 24 feet. A jetty has been built east of the outer bar; the narrow reach at Nantao was widened and a Bund made in 1915–6; and the sea approaches are now buoyed and lighted. Woosung, at the junction of the Hwangpu and the Yangtse, was created an open port and joined to Shanghai by a motor road in 1919, but has little traffic, as the anchorage is small and exposed. The board acquired its own dredging plant in 1916, and it was increased in 1925 and 1926. Further improvements in port facilities being urgently required, owing to the increase in traffic, a special inquiry was undertaken in 1919, and it was proposed to build a new commercial dock and also to provide mail steamer accommodation at the mouth of the Yangtse River.

Shanghai has grown also as an industrial centre, and has a number of silk, cotton, wool and rice mills, and large engineering and shipbuilding works. In 1920 the government decided to start a mint in the city, but after the buildings were nearly finished and the machinery had begun to arrive the scheme collapsed in 1924, owing to financial difficulties. The substitution of modern offices and houses in place of the old native type is making rapid progress. The older buildings on the Bund have been almost all replaced, and many large houses erected in the west district. An imposing building for the Shanghai club was opened in 1911; a public library in 1913; the municipal buildings on the Hankow road, with a tower 150 ft. high, in 1922; and a customs house of nine storeys was being built in 1925. The general hospital on the north bank of the Süchow creek has been rebuilt, and a statue of Sir Robert Hart was unveiled on the Bund in 1913. There are a number of flourishing foreign banks, and the Chinese banks have made great progress. The Shanghai-Hangchow and the Nanking railway are now connected by a line 8½ m. long, and the line to Ningpo was opened in 1912.

There was fighting near Shanghai in 1924 and 1925, and the volunteer corps had to be mobilised to protect the British settlement. Much trouble was experienced with refugees and retreating soldiery. Early in 1925 a strike at large Japanese mills led to anti-foreign demonstrations and attacks on mills and the police station. In June a general strike was declared, and the essential services had to be carried on by volunteers. A force was landed to protect foreign interests.

SHANNON, CHARLES HAZELWOOD (1865–), British painter (*see* 24.801), was elected R.A. in 1920.

SHANNON, SIR JAMES JEBUSA (1862–1923), Anglo-American artist (*see* 24.801), died in London March 6 1923. He was knighted in the previous year.

SHANNON (*see* 24.801).—One of the first matters to engage the attention of the Government of the Irish Free State was the provision of cheap electrical power. Several proposals having been considered, it was decided that power could be most economically produced by the construction of a central generating station capable of utilising the immense resources of the Shannon. Messrs. Siemens-Schückert prepared a plan and an estimate for the construction of such a station, and their proposal was submitted to four independent experts of European reputation, who approved its main features subject to minor modifications. The scheme was formally adopted by the Government and received the approval of the legislature.

Outline of the Scheme.—The preliminary operations were commenced in 1925. The scheme provided for the development of hydroelectric power from the Shannon in three stages—called the partial development, the further development and the full development respectively. In the partial development, which was considered sufficient to meet the requirement of the Free State for five or six years, three turbines, each of 30,000 H.P. were projected; in the further development six turbines all of the same capacity; while in the full development the turbine capacity would not be increased but additional storage would be provided. In the partial development Lough Derg alone was to be used for storage, but the winter level would not be raised. In the further development the storage in Lough Ree and Lough Allen would be added; and in the full development the storage in Lough Derg would be increased by raising the level of the lake above winter high water level. The head race constructed for the partial development was to be the size necessary for the full development; but the tail race, which is mostly in rock, would be enlarged for the further development.

In the Shannon the period of maximum flow coincides with that of maximum demand, thereby reducing storage requirements. On the other hand, as the fall from Lough Derg to the sea is gradual, it was necessary to construct a long head race in order to obtain an adequate fall. The Siemens-Schückert project contemplated utilising the total fall of 100 ft. between Lough Derg and Limerick in a single large step, by leading the water out of the river bed into an inlet canal, or head race, to leave the Shannon at Parteen, above O'Brien's Bridge, and to extend a distance of about 6½ m. to Ardnacrusha, where the power station was to be situated. Here the water was to be conducted to the turbines by large steel pipes 20 ft. in diameter and 140 ft. long and carried back to the Shannon in a tail race 1⅛m. in length. In order to prevent the water backing up the tail race, and so reducing the head in times of heavy flow, the river would be deepened at several points below the mouth of the tail race. The electric energy produced in the power station would be transmitted by means of a high tension network to most of the towns and villages of the Free State with a population of over 500. A 100 kv. transmission line in duplicate would run from the power station to Dublin, and a single 100 kv. line from the power station to Cork, where 100 kv. transformer stations would be erected; and, in the further development, an auxiliary station would be added at Maryborough. From the power station and these three centres a 35 kv. network would radiate in a closed ring formation, so that all stations would be fed from two directions. A further 10 kv. network, also constructed on the closed ring system, would complete the scheme of distribution.

Cost of the Scheme.—The capital outlay was estimated at £5,200,000 for the partial, £7,700,000 for the further and £8,000,000 for the full development; and the annual expenses, including interest on capital at 5½%, amortisation spread over 40 years, maintenance and management at £493,000, for the partial development and £661,000 for the further development. The price at which electricity could be supplied to the consumer would depend upon the density of population in the locality and upon the volume of the general demand. It was estimated that the wholesale price of electric power supplied in bulk at Dublin and Cork should be about 0.6d. and at the end of the 10 kv. lines about 2.5d. Ultimately the current might be supplied at a flat rate, in which case the wholesale price everywhere should be less than 1d. per unit. These figures are considerably less than the costs at the commencement, and the price might be expected continuously to decrease with the growth in the demand for current. It was calculated that the scheme should return from 5½ to 7 % upon the invested capital, provided out of public money.

Benefits of the Scheme.—The success of the scheme will depend largely upon the growth of effective demand for current. At first the Free State was very backward in its use of electricity both for industrial and domestic purposes. Both Siemens-Schückert and the experts who advised on the scheme were of opinion that the supply would create a very rapid growth in demand. Cheap light, heat and power for domestic consumption would be provided; and also power for large and small scale industry, particularly mills and creameries. It was hoped that farmers would use the power to light their premises and to drive farmyard machinery; and that the growth of manufacturing industries of an electro-chemical nature would be stimulated. The electrification of the railway system, apart from suburban lines with heavy traffic, was not contemplated. The organisations for the distribution of electricity would continue to operate as heretofore, except that instead of generating their own power they would purchase it in bulk from the power developed from the Shannon.

Effects on the River.—It remains to consider the effects which the Siemens-Schückert Scheme would have on (*a*) the drainage, (*b*) the navigation and (*c*) the fisheries of the Shannon. As regards drainage, it was claimed that the partial development, in which the winter level of Lough Derg would be maintained for about five months of the year, would by reason of the embankments to be erected, save from 3,000 to 4,000 acres of land from annual flooding; and that the later stages of development, in which the storage capacity would be increased and the consequent embankment extended, would save a further large area. The drainage of the Shannon basin would therefore be improved by the scheme. As regards navigation, it was proposed that there should be erected beside the power station a ship's hoist, and that the head race and tail race should be utilised by boats proceeding up and down the Shannon. The complete protection of the fisheries from damage was admitted to be impossible, but everything possible was to be done to minimise the injury that would be inflicted, and provision made in the scheme for compensation to fishery interests.

BIBLIOGRAPHY.—Full particulars of the Shannon Scheme are to be found in *The Electrification of the Irish Free State; The Shannon Scheme Developed by Siemens-Schückert* and The Report of the Experts appointed by the Government, Stationery Office, Dublin; Dail Eireann, Debates, *Official Report*, vol. 10 and 11. (G. O'B.)

SHANTUNG (*see* 24.803, and CHINA).—A maritime province of northeast China, bounded north by Chihli Province, east by the Gulf of Pechili and the Yellow Sea, west by Honan and south by Kiangsu. It is one of the most densely inhabited provinces of China, its area being 55,984 sq. m. and population 30,803,245 (Post Office estimate, 1923). Historically, Shantung was originally composed of the kingdoms of Ch'i and Lu, both of which names are still retained in various provincial organisations. As the birthplace of Confucius and Mencius, Shantung has always occupied a unique place in the affection of the Chinese people. The grave of Confucius is situated in the southern part of the province, in the picturesque temple of Ch'ü-fu.

Production.—The main agricultural products are millet, corn, barley, sorghum, maize, beans, peas, cotton and tobacco. Peanuts are now widely cultivated, and, with the soya bean, form valuable articles of export on account of the oils which they contain. The chief trees are the pine, poplar, willow, oak, cypress and mulberry, whilst the main fruits are pears, apples, peaches, apricots, persimmons, grapes and plums.

Shantung is very rich in minerals. Coal is found in four main regions—in the neighbourhood of Weihsien, Chih-chuan, Po-shan and I-chow respectively—whilst iron, copper, gold, lead, gypsum, clay and sandstone have also been discovered.

Industry and Communications.—Within recent years Shantung, which is primarily an agricultural province, has greatly increased its industries (which consist chiefly of sericulture, glasswork, pottery, mining, strawbraid, paper and cotton mills) and has improved its means of communication. In addition to the two main railways (the Tsin-Pu and Shantung railways), which traverse the province in a north and south and easterly direction respectively, other lines have been surveyed, the most important of which will connect Chefoo and Weihsien. Several hundred miles of motor roads (for the most part non-metalled) have been built within the last few years, and on some of these (notably the Cheff-Weihsien road) regular services of motor vehicles are now maintained.

Chief Towns.—Tsinan, capital of the province, is situated at the junction of the two main railways and is a growing city of about 300,000 inhabitants. A large portion of the city has been laid out on modern lines, with broad macadamised roads and a number of modern shops and residences. The Shantung Christian University, one of the largest international universities in China, is situated in this city. The other chief towns are Weihsien, Tsiningchow, Tsaochowfu, Chefoo and Tsingtao.

Political History.—The province of Shantung obtained an international reputation during the years immediately following the World War, owing to the difficulties attending the rendition of the Kiao-Chow territory seized by Germany in 1897 (*see* 24.803). The territory remained in the hands of the Germans, who spent large sums of money improving and developing the colony, until Nov. 1914, when it was captured by the Japanese. It was understood that it was to be handed back to the Chinese Govt. at the conclusion of the War, but the Treaty of Versailles confirmed Japan in the possession of the territory. As a result, the Chinese representatives at the Peace Conference refused to sign the Treaty, and an intense anti-Japanese boycott took place all over China. The whole question was carefully considered at the time of the Washington Conference in 1921–2 and prolonged negotiations followed. Through the mediation of the Earl of Balfour (then Mr. Balfour) and Mr. C. E. Hughes, these negotiations were brought to a successful conclusion, the whole territory, including the various public buildings and the Shantung railway, being handed back to China during 1922 in return for Yen 56,000,000 (*see* CHINA; JAPAN).

See H. W. V. Temperley, *History of the Peace Conference at Paris*, vol. VI., pp. 391 *et seq.* (1920 *et seq.*) For the text of the 1922 treaty see *Bulletin of Association for International Conciliation*, No. 172, (March, 1922). (H. BA.)

SHARP, CECIL JAMES (1859–1924), British musician and writer, was born in London Nov. 22 1859. He was educated at Uppingham and at Clare College, Cambridge and, in 1883 went to South Australia where he founded a school of music at Adelaide. He was principal at the Hampstead Conservatoire, London, from 1896–1905, and director of the English Folk-Dance Society which he founded in 1911. He performed valuable work in collecting and arranging English folk-songs and dances, as well as in lecturing on the same subjects; and the renewed interest in English folk-songs was largely owing to his efforts. During his visit to America he discovered in the Appalachian Mountains interesting survivals of old national melodies. He died in London June 22 1924.

Among Sharp's numerous publications may be mentioned: *A Book of British Song* (1902); with C. L. Marson, *Folk Songs from Somerset*, series 1–5 (1904–19); *Folk Songs for use in Schools* sets 1–10; *English Folk Songs from the Southern Appalachians* (1917); *American English Folk Songs*, etc.; *English Folk Songs*, 2 vol. (1921); *Posthum* with A. P. Oppé, *The Dance, an Historical Survey of Dancing in Europe* (1924). *See* Winifred A. S. Shaw, *Cecil Sharp, an Appreciation* (1925).

SHAUGHNESSY, THOMAS GEORGE SHAUGHNESSY, 1ST BARON (1853–1923), Canadian railway magnate, was born at Milwaukee Oct. 6 1853. Educated at St. Gall's academy, Wisconsin, he began railway service at the age of 16, and in 1882 joined the staff of the Canadian Pacific Railway as general purchasing agent. In 1891 he was appointed a vice-president and from 1899 to 1918 he was president and chairman of the board of directors, as well as director of all the allied lines. Knighted in 1901 and created K.C.V.O. in 1907, Shaughnessy was raised to the peerage of the United Kingdom in 1916 as Baron Shaughnessy of Montreal and of Ashford, County Limerick. He was deeply interested in the development of Catholic schools in Montreal, and in 1917 raised a fund of $200,000 for building and development purposes. For many years he exerted his influence in favour of union between Canada and Newfoundland. He died in Montreal Dec. 10 1923.

SHAW, ANNA HOWARD (1847–1919), American reformer, was born at Newcastle-upon-Tyne Feb. 14 1847. When she was a small child her parents moved to the United States. From 1872 to 1875 she studied at Albion College, Mich., and in 1878 graduated from the theological school of Boston University. The district conference of the Methodist Episcopal Church granted her a local preacher's licence, but the New England Conference of the M.E. Church refused to ordain her because of her sex, and the refusal was upheld by the General Conference at Cincinnati in 1880. The same year she was ordained in the Methodist Protestant Church. While preaching she had studied medicine and received the degree of M.D. from Boston University in 1885. In 1886 she became national superintendent of franchise of the Women's Christian Temperance Union, serving for six years. She was also associated after 1886 with the National American Women's Suffrage Assn. in various capacities, and from 1904–15 as president. She was a member of the International Council of Women, the International Suffrage Alliance, the National Society for Broader Education and the League to Enforce Peace. In 1917 she was chairman of the woman's committee of the Council of National Defence. She died at Moylan, Pa., July 2 1919. She was the author with Elizabeth Jordan of *The Story of a Pioneer* (1915).

SHAW, GEORGE BERNARD (1856–), Irish dramatist, was born in Dublin July 26 1856. His father, George Carr Shaw, was an impoverished and humorously helpless member of what, in England, would have been called the middle class, but in Ireland is still called the gentry. He was first employed by the Government in the Four Courts, then the Dublin Law Courts, and when his office was abolished in 1850 compounded his pension for a lump sum, with which he became a member of the Dublin Corn Exchange, engaging in a business of which he was totally ignorant, that of a wholesale corn chandler. He married Lucinda Elizabeth Gurly, the daughter of Walter Bagenal Gurly, a landed proprietor in County Carlow. Three children were born of the marriage, Lucinda Frances, Elinor Agnes and George Bernard.

The financial affairs of the Shaw family did not prosper, but the young wife, who had a *mezzo soprano* voice of remarkable purity, became known as an amateur singer. There was then in Dublin a gifted conductor and teacher of singing, named George John Vandaleur Lee, with whose work Mrs. Shaw became associated. In this way the Shaw children, despite their father's financial straits, acquired a considerable musical culture which was extended to the theatre by her amateur operatic performances. Her son, after a private grounding in Latin grammar from his uncle, the Rev. William George Carroll, vicar of St. Bride's, Dublin, who was reputed to be the first minister of the Church of Ireland to proclaim himself a Home Ruler, was like many other Church of Ireland children, sent to the Wesleyan Connexional School, later known as Wesley College, in Dublin, and was "generally near or at the bottom of his classes." At home however, he acquired an extensive acquaintance with the works of composers of music, so that before he was 15, "he knew at least one important work by Handel, Mozart, Beethoven, Mendelssohn, Rossini, Bellini, Donizetti, Verdi and Gounod from cover to cover." He studied pictures in the National Gallery of Ireland, and at 15 "knew enough of a considerable number of painters to recognise their work at sight."

In 1871, when he was 15 and had no hope of going to a university, he received, through the influence of his uncle, Frederick Shaw, an appointment in the office of a Dublin land agent, Charles Uniacke Townshend, at a commencing salary of £18 per annum. At the end of a year, when he was 16, the important post of cashier unexpectedly became vacant, and he was temporarily appointed to it. He filled it so ably that he was confirmed in it, and his salary, then £24 per annum, was doubled. In 1876, no longer able to endure employment which had always irked him, he withdrew from it and joined his mother, who, some years earlier, had settled in London and become a professional teacher of music. But before he did this he made his first communication to the Press. The American evangelists Moody and Sankey had arrived in Dublin to conduct a revival, and he went to hear them deliver their gospel. After he had heard it he wrote a letter, signed "S.," and dated April 3 1875, to *Public Opinion*, in which he asserted, to the horror of his pietistic relatives, that if this sort of thing was religion then he, on the whole, was an atheist.

The first nine years of his life in London were passed in poverty and oppressed to some extent by a sense of failure. His literary earnings in that time amounted to six pounds. "When people reproach me," he wrote in 1896, "with the unfashionableness of my attire, they forget that to me it seems like the raiment of Solomon in all his glory by contrast with the indescribable seediness of those days, when I trimmed my cuffs to the quick with scissors, and wore a tall hat and *soi-disant* black coat green with decay." In those nine years, 1876–85, he "devilled" for a musical critic; began a Passion Play in blank verse which he did not finish; wrote an article for *One and All*, of which George R. Sims was editor, the payment for which was 15s.; wrote an article for patent medicines for £5, and a verse for a school prizebook for 5s.; and composed five novels. He was supported during these nine years by his mother, and by his father, who was still struggling with his dwindling business on the Dublin Corn Exchange. On a few occasions he endeavoured "to earn an honest living," the last occasion being in 1879, when, for a few months, he was in the service of a company formed in London "to exploit an ingenious invention by Mr. Thomas Alva Edison." Thereafter he insisted on following the bent of his mind. "I did not throw myself into the struggle for life: I threw my mother into it. I was not a staff to my father's old age: I hung on to my father's coat tails. . . . Callous as Comus to moral babble, I steadily wrote my five pages a day and made a man of myself (at my mother's expense) instead of a slave." Such glimpses of London society as he obtained he owed to the possession of a suit of evening clothes and to his being a sufficiently sympathetic accompanist to be tolerated as an amateur in musical circles.

Between 1879 and 1883 the five novels were written—one each year. The first was, "with merciless fitness," called *Immaturity*. It was declined by Chapman and Hall, the publishers, who wrote "No" on it, and it has never been printed. The manuscript was thrown aside and nibbled by mice, but "even the mice failed to finish it." *The Irrational Knot*, *Love Among the Artists*, *Cashel Byron's Profession*, and *An Unsocial Socialist* followed it. No publisher would accept them, and it was not until after he had made many friends in advanced political and humanitarian circles that any of them were printed.

In 1882, when Bernard Shaw was 26 and the author of four unpublished books, he attended a public meeting at the Memorial Hall, Farringdon Street, London, which was addressed by Henry George on the subject of land nationalisation. George believed that the social ills of mankind would be cured by the nationalisation of land, or single tax: all other forms of capital could safely be left in private possession. Shaw resolved to join in George's campaign, but he did not long remain in it, for, on proceeding from a study of George's *Progress and Poverty* to Marx's *Capital* he became a Socialist and demanded the nationalisation of *all* forms of capital, a demand which was repugnant to George. In this campaign Shaw made a number of firm friendships: with James Leigh Joynes, Sydney Olivier (later Lord Olivier), Henry Hyde Champion, the Rev. Stewart D. Headlam, Henry S. Salt and his wife, William Morris, Annie Besant, Edward Carpenter and Sidney and Beatrice Webb.

Propaganda magazines inevitably followed in the trail of these friends; and in one of them, printed by Champion and called *To-day*, *An Unsocial Socialist* and *Cashel Byron's Profession* were serialised. *To-day* died, and was succeeded by *Our Corner*, published by Mrs. Besant, with whom Shaw had become acquainted about the time that he joined the Fabian Society, a society of Socialists founded in 1883. *The Irrational Knot* and *Love Among the Artists* were serialised in this magazine. It, too, died. *Cashel Byron's Profession* had an artistic, but not a popular, success. Stevenson was enraptured by it, and Henley wanted to make a play out of it. Shaw himself, some years afterwards, burlesqued it for the stage under the name of *The Admirable Bashville*, in excellent blank verse.

It was abundantly clear in these novels, written after the style of the 18th century authors, that narrative was *not* the form in which Shaw could best express himself. He ran to dialogue rather than to description or to narrative, and his characters on any or no provocation uttered long speeches that read like platform deliveries rather than conversation. The *story* was always a poor one when there was any story at all; the author was not fastidious about the peg on which he hung his opinions. He shared with Shakespeare a willingness to use any plot that would serve his purpose. But he could not continue to use a form which was intractable in his hands, and so, after many diversions and adventures in search of a suitable instrument, he turned to the stage. It may here be said, however, that the novels were a preparation for the plays. Much of what is in the former was re-used in the latter. The hatred of hypocrisy and pretentious respectability and irrational social cleavages and stupefying poverty and every kind of organised priestcraft, whether of the law or the Church or of medicine or of politics, which he acquired in Dublin as a boy and a youth, was poured into his novels and distilled from them into his plays. Ann Whitefield, who takes the initiative in the sex duel with John Tanner in *Man and Superman*, is descended from Madge Brailsford who hunts down Owen Jack in *Love Among the Artists*. The conclusion of *Love Among the Artists*, as Julius Bab has pointed out, is almost identical in situation and words with the conclusion of *Candida*.

His fortunes now began to mend. He criticised books for the *Pall Mall Gazette* and pictures for *The World*. He was appointed musical critic of the *Star*, under the pseudonym of "Corno di Bassetto," but he presently transferred himself in the same capacity to *The World*, in which he made his initials G.B.S. familiar to the public. Later on he acted as dramatic critic of *The Saturday Review*. During this period of critical activity, however, he was arduously engaged in his political propaganda. Henry George's *Progress and Poverty* directed his attention from the so-called controversies between science and religion to political

economy, to which he devoted several years of study; Karl Marx's *Das Kapital*, which he read in French, completed his disillusion with capitalistic civilisation. He took up public speaking and incessantly addressed "audiences of every description, from University dons to London washerwomen. From 1883 to 1895, with virtually no exception, he delivered a harangue with debate, questions and so on every Sunday—sometimes twice or even thrice—and on a good many weekdays. This teeming and tumultuous life was passed on many platforms, from the British Association to the triangle at the corner of Salmon's Lane in Limehouse." He was now a most active member of the Fabian Society, which he joined in 1884, and was the author of its second and third Tracts.

In 1898 Shaw's health yielded under the weight of his work and he was obliged to refrain from addressing meetings almost nightly. He became, instead, a co-opted member of the Vestry of St. Pancras, afterwards St. Pancras Borough Council. He was invited, but declined, to become a candidate for Parliament. His chief political activities were done in committees of the Fabian Society. By this time he was well known as a brilliant and witty critic and debater, but was hardly known at all to the generality of people as an author, although, in addition to his novels, he had written *The Sanity of Art* (1908), a reply to Dr. Max Nordau's *Degeneration; The Perfect Wagnerite* (1898); *The Quintessence of Ibsenism* (1891); and four plays.

But from 1894 his rise to world fame was steady and swift. He now definitely was a dramatist, although he still did an immense amount of journalism and political propaganda and published his plays for general reading (then an innovation in London) with elaborate prefaces on political, social and finally on religious and biological questions, which were quite independent of the plays to which they were attached. It was as an acted dramatist that he entered into the knowledge of the ordinary man.

At the time of writing (1926), his plays, long and short, number 34. They are as follows, and, as nearly as possible, in the order of their writing: *Widowers' Houses* (1893); *The Philanderer; Mrs. Warren's Profession; Arms and the Man; Candida; The Man of Destiny; You Never Can Tell; Captain Brassbound's Conversion* (1901); *Caesar and Cleopatra* (1901); *The Devil's Disciple* (1901); *The Admirable Bashville* (1909); *Man and Superman* (1903); *John Bull's Other Island* (1907); *Major Barbara* (1907); *How She Lied to Her Husband* (1904); *Passion, Poison and Petrifaction, or, The Fatal Gazogene* (1905); *The Doctor's Dilemma* (1906); *The Interlude at the Playhouse; Getting Married* (1908); *The Shewing-up of Blanco Posnet* (1909); *Press Cuttings, A Topical Sketch compiled from the Editorial and Correspondence Columns of the Daily Papers* (1909); *Misalliance* (1910); *The Dark Lady of the Sonnets* (1910); *Fanny's First Play* (1911); *Androcles and the Lion* (1912); *Over-ruled* (1912); *Pygmalion* (1912); *Great Catherine* (1913); *Heartbreak House* (1917); *O'Flaherty, V. C.* (1915); *Annajaska, the Bolshevik Empress* (1917); *The Inca of Perusden; Augustus Does His Bit* (1916); *Back to Methuselah* (1921); and *Saint Joan* (1923). He also made translation of Siegfried Trebitsch's *Frau Gittas Sühne*, under the title of *Jitta's Atonement*.

The first of these plays was finished in 1892, seven years after it had been begun in collaboration with William Archer. Shaw, it seemed, could write "incomparable" dialogue but "construction was not his strong point"; Archer "could not write dialogue a bit, but. . . considered himself a born constructor." They agreed to pool their abilities and make a play. Archer constructed "a twaddling cup-and-saucer comedy. . . to be called *Rhinegold*." But Shaw held that plot was the curse of fiction, literary or dramatic; and Archer was the apostle of plot and construction. Consequently the plot, in Shaw's hands, underwent such a change that Archer retired from the collaboration, nor did he ever expect to see the play completed. Seven years later, to help the Independent Theatre out of an emergency, Shaw finished the play—a treatise on slum-property—and it was performed for the first time in Dec. 1892. Archer, then dramatic critic for *The World*, earnestly endeavoured to dissuade Shaw from following a career as a dramatist, "for which he has no special ability, and some constitutional disabilities." The last of the plays, *Saint Joan*, was written in 1923. It will be seen, then, that the bulk of Shaw's dramatic work was done after he had passed his 40th birthday, and that half of it was done after he had reached the age at which Shakespeare died. It will also be seen that the three plays which are now considered to be his greatest, *Heartbreak House, Back to Methuselah* and *Saint Joan*, were written when he was well over 60 years of age. Three of the plays, *Mrs. Warren's Profession, The Shewing-up of Blanco Posnet* and *Press Cuttings* were banned by the censor, but the ban was subsequently lifted from then. *Passion, Poison and Petrifaction* is a burlesque melodrama written for the benefit of the Actors' Orphanage. The *Interlude at the Playhouse* is a topical prologue quoted at length in the *Daily Mail*, Jan. 29 1907, and not otherwise published. His political writings, in addition to a number of Fabian tracts and pamphlets, include *Common Sense About the War, Peace Conference Proposals* and *The Intelligent Woman's Guide to Socialism and Capitalism*.

The plays vary from exposure of social wrongs, as for example slum ownership in *Widowers' Houses* and prostitution in *Mrs. Warren's Profession*, to philosophical and religious disquisitions, as in *Misalliance* and *Androcles and the Lion, Heartbreak House*, and metabiological prophecies, as in *Back to Methuselah*, dramatised historical chronicle, as in *Caesar and Cleopatra* and *Saint Joan*. Shaw has ranged through a great variety of scenes in his plays—America, Bulgaria, Egypt, England, France, Germany and Ireland; and he is always careful to make the settings as picturesque and romantic as possible. He goes to extraordinary lengths to introduce oddity into his work, as when he makes Captain Shotover, in *Heartbreak House*, live in a house shaped like a ship, and causes one of the characters in the play to wear the clothes of an Arab chief in the evening. At first, his work seemed to express an absolute determinism—not man, but his environment, was at fault—but in his later plays he insists, in Macbeth's phrase, that man "still has judgment here," and expresses what may be called a neo-Protestant belief. Mankind, in *Back to Methuselah*, reaches through creative evolution a state of longevity which resembles eternal life. Joan of Arc protests that no one shall stand between God and her.

The general religious belief expressed in the plays may be briefly summarised as follows: God, or the Life Force, is an imperfect being striving to become perfect. If He were omniscient, omnipotent and omnipresent, He would not tolerate certain horrors in the lives of His creatures, any more than an ordinary father would tolerate disease in his children if he could prevent it. The whole of time has been occupied by God in experiments with instruments invented to help Him in his attempt to perfect Himself. When He found that these instruments were either useless or no longer serviceable He scrapped them. In this way the disappearance from the world of mammoth beasts, among other creatures, is explained. God eventually found that all His instruments suffered from a common defect, that they were unaware of His purpose and were unable to help Him of their own volition. He thereupon created a new creature, Man, and made him aware of His purpose and gave him a will so that he might deliberately help Him to achieve perfection. Man, in short, can help or hinder God in His efforts to fulfil Himself. All the cruel and wicked things in life are explicable to Shaw as acts of rebellion against God or the consequences of indolent failure to help Him. Disease, poverty, war—all of these are acts done against God by man; and Shaw warns the world that if it will not amend its ways, and endeavour to fulfil God's purpose, He will become impatient and scrap mankind as He scrapped the mammoth beasts. "You should live so that when you die God is in your debt." In 1898, after he had retired from regular journalism, he married Charlotte Frances Payne-Townshend.

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SHAW, RICHARD NORMAN (1831–1912), British architect (*see* 24.813), died at Hampstead, London, Nov. 17 1912.

SHEFFIELD, England (*see* 24.822), had a population of 490,639 in 1921 (511,668 including districts incorporated in that year); it was estimated at over 500,000 in 1925. The borough was enlarged by the inclusion of part of Tinsley in 1911 and part of Bradfield in 1914; and in 1920 powers were sought to include a very large area for the purposes of a bold scheme of regional devolution. The area of land incorporated (in 1921), though less than had been hoped, amounted to 6,697 ac. (making the total area of the borough 31,627 ac.), and included Handsworth and parts of Ecclesfield and Brinsworth. A new ward, that of Handsworth, was created, and four members added to the city council. The old boards of guardians of Sheffield and Eccleshall were dissolved in 1925, and a united board established. Seven members have been returned to Parliament since 1918. The milk supply was municipalised in 1918. An exhaustive civic survey has been carried out, and a zonal town plan prepared; authority for applying the plan to an area of 5,909 ac. was obtained in 1925. Parks and open spaces acquired largely by gift or purchase from the late Duke of Norfolk and his trustees, include Norfolk Park (52 ac.); Buckwood (16 ac.); Bingham and Greystones Parks, Rustlings Road; Luxton Chase (75½ ac.); Blackbrook, Coppice, Hutcliffe and Bowden Houstead woods (altogether 176 ac.); and Woolley Wood, Wincobank; while 154 ac. of the Norton Hall estate were acquired in 1925 adjoining the site presented in 1924 to the joint hospitals council, and Brinkcliffe Tower, with 12 ac., has been given for use as a park after the death of the donor. The total area of parks and open spaces is 1,331 ac. (1,163 in the city itself). Crookes cemetery was acquired in 1910, and 84½ ac. for another at Shire Green in 1925.

In 1914 Sheffield was created a diocese, consisting of the archdeaconries of Sheffield and Doncaster, with that part of the rural deanery of Dronfield which was within the city boundaries. The old parish church of St. Peter and St. Paul became the cathedral. New churches include St. Oswald's, Millhouses (1910); St. Chad's, Norton Woodseats (1912); St. Aidan's Park (1913); St. Clement's, Newhall (1914); St. Margaret's, Jenkin Road (1918); a Swedenborgian church (1912); and the central synagogue, Lee Croft (1914).

The Jonas and Edgar Allen laboratories in connection with the university were opened in 1923, and a hostel for men in Taptonville road in 1912. It was proposed in 1924 to amalgamate and extend the four voluntary hospitals, utilising the present buildings as receiving wards and casualty stations, and carrying on the main work in Norton Hall, which was given, with 120 ac. of land, for the purpose. A new wing of the Royal Infirmary was opened in 1925. New buildings and monuments include the boys' Bluecoat school in Psalter lane (1911); the coroner's court (1914); a statue of King Edward VII. in Fitzalan square (1913); a memorial to men of the Yorkshire and Lancashire regiment in Weston Park; and a War memorial, consisting of a steel mast on a bronze base, in Barker's Pool (1925). A village with a painted fabrics industry for ex-service men has been established at Coal Aston, on the outskirts of the city, and the erection of a large War memorial public hall was to be undertaken in 1926. A new wing of the town hall was opened in 1923, and it was decided in 1925 to build modern abattoirs.

In connection with the Derwent valley water scheme, for utilising the water of the Derwent and Ashop rivers, the Howden reservoir was opened in 1912, and the Derwent reservoir and the service reservoir at Ambergate were finished by 1926. The complete scheme involves about 80 m. of aqueducts, and a tunnel four miles long connecting the new works with those of the corporation at Rivelin. The dams are over 1,000 ft. long, and 100 ft. high from the river bed. Sheffield receives 25% of the water, the rest going to Derby, Leicester, Nottingham and country districts.

SHEFFIELD, UNIVERSITY OF (*see* 27.771).—Since 1910 the following new chairs have been provided: geology, civic art, pharmacology, modern history, fuel technology, glass technology, civil engineering, economics, Greek and international law. New departments have been opened since 1910 for Russian, Spanish, civic art, geology, glass technology, refractories, pharmacology. Degrees and diplomas have been instituted since 1910 in philosophy, technical science, dental surgery, together with an associateship in non-ferrous metallurgy. In conjunction with the University of Leeds a marine zoological laboratory was opened at Robin Hood's Bay. Special posts in physiology and pathology have been established. The holders serve the university and the local hospitals. A chair of pharmacology was founded in 1920 and a field laboratory built and equipped for them.

The university buildings have been considerably enlarged. Two new research laboratories, one for engineering and one for metallurgy, have been built and equipped. In 1919 a union for men students was opened, and in 1920 a union for women students was established. The number of tutorial classes held in conjunction with the Workers' Educational Association has rapidly increased. The research work undertaken in connection with local trades is increasing, especially in connection with the manufacture of steel and cutlery, and glass technology. In the mining department research on problems arising in the industry is carried on and the department of fuel technology deals with problems in fuel.

From 1910–1 the numbers of full-time students showed a steady increase. The first year of the War brought a decrease which continued until 1917. The numbers grew rapidly, due to the influx of ex-service men, and in 1920–1 there were nearly five times as many full-time degree and diploma students as in 1917–8. The number of women students taking full-time courses has increased considerably.

Finance.—Donations amounting to £137,869 have been received for general buildings and endowment and £43,760 was received for buildings and departments for coal mining and non-ferrous metallurgy. Important benefactions have been received from Viscount Bearsted (£10,000), Mr. Edgar Allen (£41,397), the late Mr. Ezra Linley of St. Louis, Miss. (£10,485), Alderman Robert Styring LL.D. (£20,000) and Messrs. George Senior and Sons, Ltd. (£5,000). The subsidy from the South Yorkshire Coal Trade Assn., which in 1913–4 was £200, amounted in 1924–5 to £4,418.

SHERMAN, JAMES SCHOOLCRAFT (1855–1912). American politician, was born near Utica, N. Y., Oct. 24 1855. He graduated from Hamilton College in 1878, was admitted to the Bar in 1880, and practised in Utica until 1907. He was elected mayor of Utica in 1884. In 1886 he was elected to the National House of Representatives and was returned continuously until 1908, excepting the term 1891–3. He was a delegate to the National Republican Convention in 1892; chairman of the Republican State Convention in 1895, 1900 and 1908; and chairman of the Republican National Committee in 1906. At the Republican National Convention of 1908 he was nominated vice-president and was elected on the ticket with William Howard Taft. Four years later he was renominated, but died at Utica Oct. 30 1912, shortly before the elections.

SHERRINGTON, SIR CHARLES SCOTT (1861–), British physiologist, was educated at Caius College, Cambridge, afterwards becoming lecturer in physiology at St. Thomas' Hospital, London, and later professor of pathology at London University. From 1895–1913 he was professor of physiology at Liverpool University, proceeding subsequently to Oxford as Waynflete Professor of physiology. He became a leading authority on the physiology of the nervous system, and the guiding principles of his work are to be found in his book, *The Integrative Action of the Nervous System*, based on the text of the Silliman lectures delivered at Yale in 1904. He was the recipient of numerous British and foreign awards and honours, including the Royal Medal of the Royal Society, of which he was president from 1920–5, the Baly Gold Medal of the Royal College of Physicians, and the Retzius Gold Medal of the Royal Swedish Academy. During the World War he served on the War Office committee on tetanus; in 1918 he became chairman of the Industrial Fatigue Research Board, and in 1925 a member of the Medical Research Council. He received the G.B.E. in 1922, and the O.M. in 1924.

His publications include, *A Manual of School Mammalian Physiology* (1919), numerous papers to the Royal and other scientific societies on the brain and nervous system, and *The Assaying of Brabantius and Other Poems* (1925).

SHEVKET, MAHMUD (1858–1913), Turkish pasha, was born at Baghdad, and from early youth showed marked qualities of intellect and personality. He received his military training at the military college in Constantinople, 1875–80, and after a very brief period of service with the troops was given an appointment on the general staff. Through the influence of Von der Goltz, who at that time was reorganising the Turkish Army, Shevket was sent to Germany to manage the re-equipment of the Turkish Army. As a result, he remained from 1884 to 1894 in the small arms factory of Mauser Bros., at Oberndorf, on the Neckar, and in 1894 was made inspector of military arsenals in Constantinople. From 1901 to 1903 he was military governor of the Hejaz, in Arabia, then in what amounted to a state of war. He next went in a like capacity to Uskub (Skoplje), and there came in contact with the Young Turk movement, which had its headquarters in Salonika. In the spring of 1909 the Old and Young Turks were struggling for supremacy. A powerful Old Turk counter-revolution was prepared, but, in mid-April, the III. Army Corps, under Hussein Husni Pasha, marched from Salonika against Constantinople. At San Stefano Mahmud Shevket took over the command, and, after heavy fighting, forced his way on April 4 into Constantinople.

Impressed by his victory, the National Assembly no longer dared to oppose the will of the Young Turks, and on April 26 voted the deposition of Abdul Hamid. Mahmud Shevket was the hero of the day. But he did not care for politics, which he considered had been the ruin of the Turkish corps of officers, and preferred to confine his activities to purely military matters. The next few years afforded him plenty of opportunities. In 1910–1 he put down a revolt of the Malissors with great energy, and in 1912 fought against the rebels in Albania. In the summer of 1912 he became Minister of War, and in Jan. 1913 succeeded Kiamil as grand vizier. He took a very active part in army reforms, but he came into conflict with the Union Libérale, which took its orders from Sherif Pasha in Paris, and he was murdered by one of its members on June 11 1913.

SHIBUSAWA, EI-ICHI, VISCOUNT (1840–), Japanese financier and business man was born in Saitania-Ken. He began his career as an official of the Tokugawa Shogunate and in the company of a Tokugawa prince visited Europe in 1867–8. When the Imperial Govt. was established, he entered the Treasury Department, but retired in 1873 to become a banker. He founded in that year the First National Bank (Dai-ichi Ginko) and was chairman of the Tokyo chamber of commerce from its inauguration until 1915, when he retired from active business owing to ill-health.

SHINTOISM.—Shintō or "*Kami-no-Michi*" (The Divine Way) (*see* 15.222a) which is the religion of Japan, still living among the Japanese people, is a designation given to the religious belief indigenous to the soil of Japan, in contradistinction to Buddhism, officially introduced into Japan in A.D. 552. The first documentary appearance of the term Shintō is in the Book of the Emperor Yōmei (died in 587) in the *Nihongi* (Aston, English translation, vol. 1., p. 106). Thus Shintō is peculiar to the Japanese mind.

Shintō has two main stages in the course of its development: one is naturalistic, the other cultural. In the two phases of its development, the one gives us an aspect of nature religion, while the other presents that of ethico-intellectualistic (or spiritualistic) religion, greatly influenced by Buddhism and Confucianism.

Nature Religion.—In Shintō as a lower nature religion we find nature worship, fetishism, spiritism, totemism and primitive monotheism. The primitive Japanese worshipped the sun, the moon, the rainstorm, thunder, wind and fire; earth, the sea, the mountain, the deity of the earthquake, volcanoes, wells, hot springs and stones or rocks; the serpent, the tiger, the wolf, the wild boar, the hare, even the silkworm and the louse, trees, herbs and cereals.

Anthropolatry.—Individual personages are also worshipped as *Kami* or deities in their life-time as well as after their death, and we have Shintō shrines dedicated to special divine personages while living. The emperor is regarded as a "Visible Deity" (*Arahitogami* or *Akitsukami*), and some brave warriors or mighty heroes are also deities in human form. Later on the Ryōbu or Dual Shintō made good use of this form of religious syncretism. There are quite a number of examples of necrolatry and ancestor worship in Shintō. The sacred imperial regalia (or heirlooms), consisting of the mirror, sword and jewels, had originally a fetishistic virtue.

Litholatry, etc.—Particularly in Japan sacred stones are regarded as fetishes (litholatry). Different phallic emblems of stone or wood, both male and female in shape, are not very uncommon (phallicism). There is some evidence of totemism in primitive Shintō; *e.g.*, Kamo-Taketsunumi-no-Mikoto, the remote ancester of the Shintō priests of the Kamo Shrine in Kyōto, was once believed to be a large divine crow, afterwards worshipped at a separate shrine. The father of the Emperor Jimmu was traditionally recorded to have sprung from the crocodile or dragon Sea-Goddess Toyotama-Hime, the consort of Hikohohodemi-no-Mikoto.

There is something like a primitive monotheism in Ame-no-Minakanushi-no-Kami, or the Divine Lord of the Very Centre of Heaven, amalgamated with another supreme deity, Kunitokotachi-no-Kami, in later Shintō.

Mythology.—Primitive Shintō appears as a higher nature religion in the heavenly drama of the rich mythology of the *Kojiki* (*Records of Ancient Matters*), the *Nihongi* (*Chronicles of Japan*) and the *Kogoshui* (*Gleanings from Ancient Stories*). Here we find the divine parents Izanagi or the Progenitor and Izanami or the Progenitress, who procreated or begat numberless deities, natural objects and the land of Japan itself. Amaterasu-Ōmikami, the Ancestral Sun-Goddess of the imperial family, the Moon-God Tsukuyomi-no-Mikoto, and the divine brother Susano-O-no-Kami were born of the divine parents. The Solar Goddess reigned alone in the Plain of High Heaven. A conflict between the sun and the rainstorm was graphically delineated in Japanese mythology as a momentous event in the Divine Age. Then a divine council was held to entreat the Sun-Goddess to restore peace and order to the world and to reilluminate it by emerging from the heavenly rock-cave in which she had taken refuge from the violence committed by the impetuous brother Susano-O-no-Kami. Then follows the banishment of the divine culprit Susano-O from heaven to earth. He descended to the province of Izumo, took to wife a daughter of certain local deities, and got by her the famous Ōkuninushi-no-Kami, the Grand Divine Lord of the Locality, who afterwards ceded his whole dominion to the legitimate sovereign Ninigi-no-Mikoto, the Heavenly Grandson of the Sun-Goddess, of whom the Emperor Jimmu was a descendant.

Emperor Worship.—Thus according to tradition, half mythical, half historical, the Japanese imperial lineage has continued unbroken from the Ancestral Sun-Goddess to the present Emperor, who; like his predecessors, enjoys a divine right to the throne, representing in himself both Caesar and Pope—as a divinity in humanity. Even nowadays, in the hierarchy of his theocratic as well as constitutional government, he is often phrased "saîsei-itchi," or the complete unity of political governance and religious observances. Thus Shintō as a national or state religion culminates in the form of emperor worship, not only in its naturalistic but also in its ethico-intellectualistic stage. Therefore Japanese patriotism or loyalty has been suffused with religious zeal. Herein lies one of the peculiar characteristics of the life or essence of Shintō.

As to the course of development of Shintō in its cultural stage, it is polydemonistic (animistic) at the beginning, then polytheistic, and at last pantheistic, with a tinge of monotheism. So, Izawa-Nagahide, a savant of the 18th century, says: "The 'eight hundred myriads of deities' are nothing but a different manifestation of one and the same deity Kunitokotachi-no-Kami (the Eternal Divine Being of the Earth), the Great Unity of

all things in the universe, the Primordial Essence of Heaven and Earth, eternally existing from the beginning to the end "(Ameno-Nuboko-no-Ki). Senge-Takazumi of the 19th century, a high priest of the Grand Shintō shrine of Izumo, also says: " There is no place in heaven and earth, either in the vast expanse of oceans or in the wild mountains, where we do not feel the omnipresence of the Deity." Again, " Even in the leaf of a tree or in a blade of grass the awe-inspiring Divine manifests Itself," says Urabe-no-Kanekuni.

Such a naturalistic pantheism of Shintō is deepened and ennobled by a further idealistic or spiritualistic grasp of the Shintō-Deity. Hayashi-Razan, an eminent scholar of Chinese classics of the 17th century, says: " The Deity is the Spirit of Heaven and Earth. The human mind partaking of divinity is an abode of the Deity, which is the Spiritual Essence. There exists no highest deity Ame-no-Minakan-ushi-no-Kami outside the human mind " (*Shintō-Denju*). The writer of the *Nijū-Issha-no-Ki* (*Records of the Twenty-One Shrines*) says: " A righteous man, pure in mind and just in conduct, is himself a deity, so we understand ' a manifest deity '—mentioned in the Imperial Edicts—in the person of the Emperor, in this ethical sense of the words." Ethico-intellectualistic or spiritualistic Shintō emphasises " inner purity," and not physical purity only. An oracle of the God Hachiman says: " I am none but Benevolence Itself. Moreover Sincerity is my Divine Body " (Urabe-no-Kanena, *Jingishōjū*). Thus Sincerity or Truthfulness, like the principle of Love in Christianity or that of Universal Benevolence in Buddhism, becomes the fundamental principle of the Shintō religion in the cultural stage of its development. Since as an ethical religion Shintō teaches us to worship the Deity *in spirit* and *in truth*, images or shrines can be entirely dispensed with. They are of little use, because the conception of the Deity is too lofty and too spiritual to enshrine it as an image in an abode built by mortal hands. So declares the Japanese savant Ise-Teijō (*Gunshin-Mondō*) of the 18th century, with Shima-Shigeoyu, a Shintō priest of the Grand Shrine of Izumo; while the author of the *Shintō-Gobusho* or *Shintō-Pentateuch* teaches: " What pleases the Deity is virtue and sincerity, and not the various kinds of material offerings," even as the Israelite prophet Hosea preaches, " Not sacrifice but mercy."

Bibliography.—G. F. Moore, *History of Religions*, vol. I (1922); W. G. Aston, *Encyclopaedia of Religion and Ethics, Art Shintoism* (1920). (G. Ka.)

SHIPBUILDING (*see* 24.922).—A survey of the progress of mercantile shipbuilding during the years 1910–25 covers a period of unprecedented fluctuation in the number and tonnage of vessels constructed, associated with continued progress in the design of ships and improved methods in their construction.

For many years prior to 1914 there was a steady increase in the total mercantile tonnage of the world corresponding to the ever-increasing volume of overseas trade, and although the distribution of this tonnage among the maritime nations varied from time to time, the total bore a definite relation to the expanding demand for overseas transport, both of passengers and of cargo.

Effects of War.—The War caused a practical cessation of shipbuilding in some of the countries involved, and a reduction in others which, combined with the loss of ships due to War perils, involved an actual reduction of vessels afloat after the first year of the conflict. At the same time there was an enormously increased demand for shipping for the transport of troops, munitions and general supplies, while the War casualties rose very rapidly. It thus became imperative that the output of new vessels should be expedited, and the various countries engaged in the conflict devoted themselves, as far as possible, to the replacement of lost tonnage, and the facilities for shipbuilding were, wherever possible, expanded to cope with the requirements for more ships. The efforts thus made, extensive as they would have been in normal circumstances, were hopelessly inadequate to meet the situation, and only by the vast expansion of the shipbuilding industry in the United States was the situation met.

Expansion in U.S.A.—Although shipbuilding has always been carried on in the United States it never developed there into a leading industry. No country in the world, however, offered the same possibilities of increased production, and the energy and initiative of the Americans, particularly after the entry of their country into the War, created an expansion in the shipbuilding industry which would have been deemed incredible a few years before.

The vast steel industry of America, together with its enormous structural engineering works, was harnessed to the task; new shipyards sprung up almost overnight and an organisation was created for the production of ships on that gigantic scale which is characteristic of the country. The results of that effort are clearly indicated in the following tables, showing the tonnage owned in the various countries at the end of June 1910, 1914 and 1925, the improved position in this respect of the United States being entirely due to the enormous programme of new construction undertaken during the later years of the War.

Peace Conditions.—With the advent of peace there was a return to more normal conditions, and the output of new tonnage naturally fell off considerably, with the result that the relative positions as regards shipbuilding became nearly the same as before (*see* Table II.). There has been great expansion in the tonnage of vessels devoted entirely to the carriage of goods in bulk, and in particular the transportation of oil has grown enormously with the increased use of that commodity. In 1914, oil tankers accounted for a gross tonnage of about 1,500,000, a figure which has increased in 1925 to no less than 5,500,000.

Experimental Research.—The steady advance in technical knowledge in all branches of science has led to the devotion of much research on the questions relating to the resistance of ships and the determination of the power necessary to propel a ship at a desired speed. There is as yet no mathematical solution to such problems, which can only be investigated experimentally. A marked step was taken in 1912 by the foundation of the William Froude experimental tank at the National Physical Laboratory at Teddington by the generosity of Sir Alfred Yarrow. A number of such institutions were already in existence but were all under either official or private control, while the new tank was founded for the purpose of carrying out investigations for the benefit of the shipbuilding industry generally. Much valuable work has been carried out by the staff of the tank, and the results published for general discussion have led to considerable improvements in the form of ships and the design of propellers. Much has been accomplished, but there is still a vast field to be explored before it will be possible to formulate the relation connecting the most economical form of ship with horse-power of the machinery, speed and carrying capacity.

Design.—Improvement of design has been steady and continuous, if without any outstanding features. For many years there had been a continuous increase in the safety of life at sea, particularly on passenger vessels. The sinking of the " Titanic " in April 1912 with 1,500 passengers and crew, led to the immediate appointment by the Board of Trade of a committee to advise the board as to what would constitute efficient subdivision of a vessel, due regard being paid to the nature of the intended service of the ship. This question had been under discussion for some time prior to the loss of the " Titanic," but that disaster naturally focused considerable attention on the recommendations made by what is generally referred to as the 1912–5 Bulkhead Committee.

Safety Problems.—In addition to the task delegated to this committee, a meeting was convened in London in Nov. 1913, to consider the problem of securing greater safety at sea. All maritime nations were represented on this body, known as the International Convention for the Safety of Life at Sea, which prepared a series of valuable recommendations covering not only the construction of passenger-carrying ships but also many points relating to safety of navigation, wireless telegraphy and life-saving appliances. The convention was signed by all nations represented, but the recommendations have not yet been made fully operative, owing to the effect of the War.

The Bulkhead Committee issued in 1915 a report containing regulations for the more efficient subdivision of merchant ships, which regulations were subsequently found to apply with undue severity to that type of ship which is dependent for its existence on the carriage of both passengers and cargo, as distinct from the purely passenger trade, such as arises in the North Atlantic trade. The regulations were consequently amended and, as now drafted, meet with general approval. On broad lines the object aimed at is to space the bulkheads so that the vessel will remain afloat with either one, two or three compartments open to the sea, depending on the size of the vessel and number of lives on board. Much experience of this nature was gained during the War, and ships built in accordance with the new regulations should be safe, except in the case of accident involving very extensive damage.

Load Line Regulations.—Of considerable interest to the shipping community was the appointment by the Board of Trade, in 1913, of a committee to report on the working of the regulations relating to the load line of ships and as to the alterations desirable to make the rules more suitable for international usage. The compulsory marking of a load line on a ship's side only became operative in Great Britain in 1890 and was followed by similar regulations in many other countries, although even to-day there is no load line law in so important a maritime country as the United States. The Load Line Committee suggested modifications of the existing rules, which removed largely the existing anomalies, but their most important proposal was a standard relation between strength of structure and draught of water. Although no legal action has yet been taken by the Board of Trade, the principal classification societies have revised their rules to bring them into accord with new standard of strength.

Probably one of the outstanding features in connection with the subjects just referred to is the growing consciousness that the interests of the shipping community of the world are best served by the formulation of regulations for universal application, so as to afford equality of opportunity to any and every interest and country.

Construction.—Systematic investigation of the functions of the various parts of a ship's structure, and of the most economical methods of meeting the stresses developed has led to the elimination from the structure of many members which were, at one time, considered indispensable. Among changes of this kind are to be recorded the disappearance of web frames and the abolition of the large side stringers which formed so prominent a feature of the steel structure.

The whole trend in construction has been to simplify the various parts of the vessel by redistributing the material, concentrating on the more important parts of the main structure, the remainder being treated largely on the basis of local considerations. A widely spread practice has arisen reducing the number of the frames by an increase of spacing, the maximum spacing of 36 in. being very common, and the scantlings are otherwise increased to provide equivalent strength. In the double bottom, the closely spaced solid floors have been partially replaced by floors formed of bulb angle frames and reversed frames, while the number of fore and aft girders has also been reduced. The method of supporting the deck by strong girders which, in turn, are supported by large pillars at wide intervals is now almost universally adopted. Greater attention has also been paid to questions of strengthening against local damage, particularly at the forward end to provide against pounding and driving in a seaway. The improved distribution of material has permitted a reduction in the total weight of some 5 to 10 % less than was formerly considered necessary—and this without sacrifice of strength.

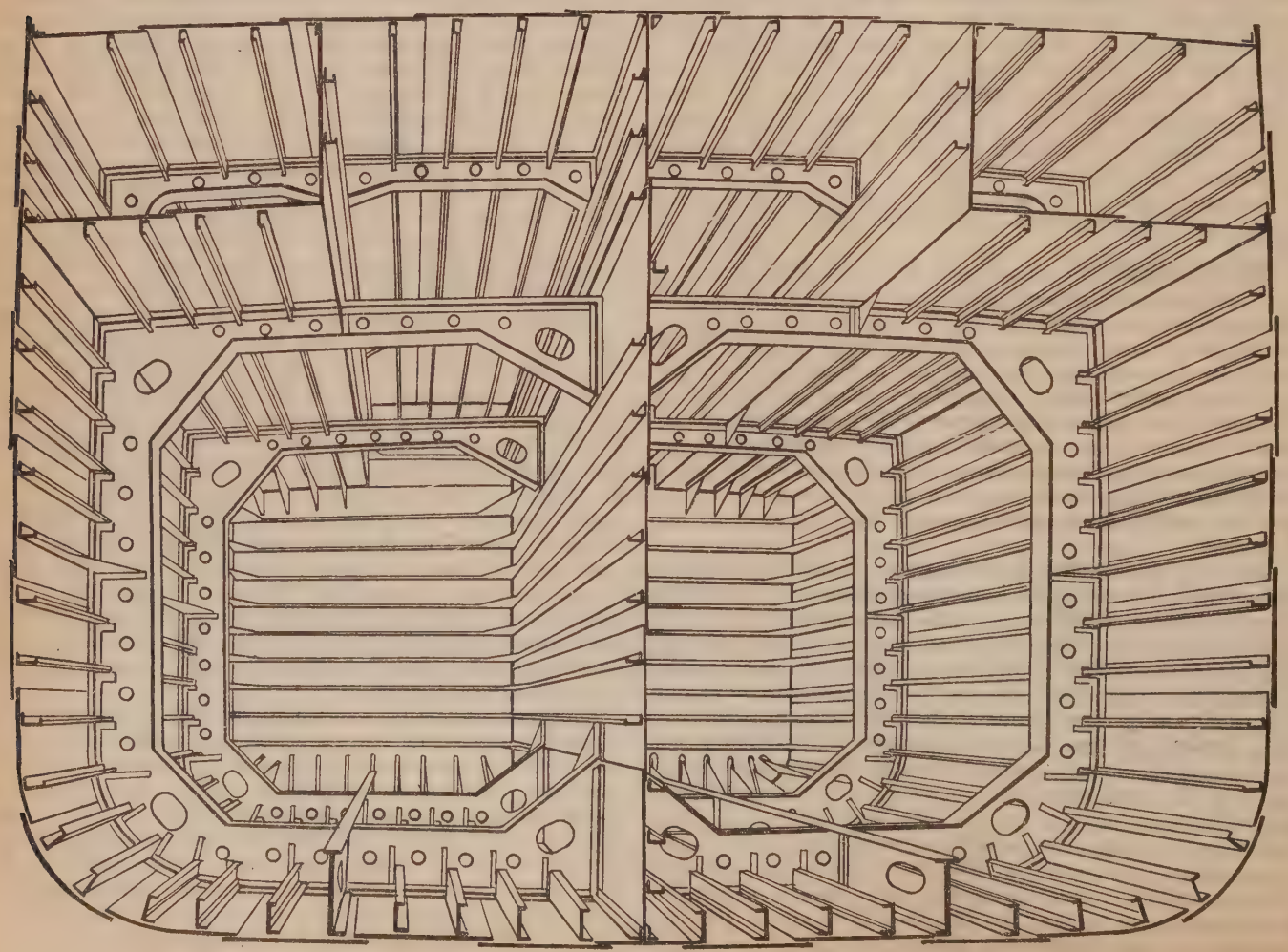

FIG. 1.—Internal view of an oil tank steamer built on the Isherwood principle.

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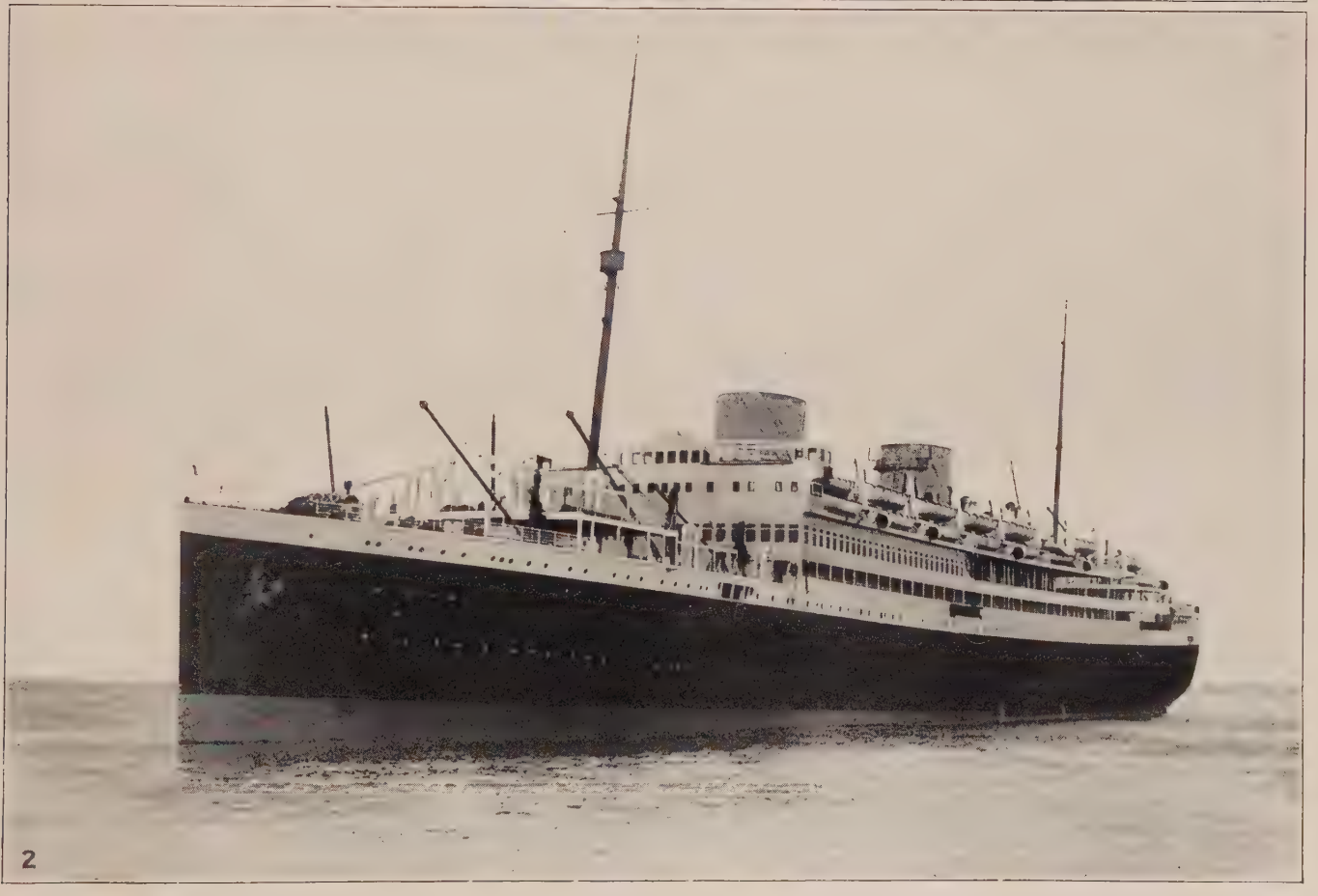

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FIG. 1. S.S. "British Aviator," latest type of oil tank steamer. FIG. 2. M.V. "Asturias," largest and most powerful motor liner completed and in service. Fitted with two sets of 8-cyl. double-acting Diesel engines, developing 20,000 H.P.

(Courtesy of—Fig. 1, Anglo-Persian Oil Co. Fig. 2. Royal Mail Steam Packet Co.)

The outstanding feature in construction has been the system initiated by Sir Joseph Isherwood. In the usual method of construction, the frames and beams supporting the shell and deck plating are arranged transversely, but in the Isherwood system the frames run longitudinally, and thus support the plating in the direction of greatest stress with increased efficiency. Fig. 1 shows clearly the principal features of the design as applied to an oil tanker.

This system, as applied to oil tank vessels, effected a saving in the weight of material in the earlier ships of this type over the transverse framing previously adopted of about 12%. This large saving naturally led to improvements with the transversely framed oil vessel and the difference in weight between the two systems was reduced, although it still remains appreciable. The number of vessels built on the longitudinal system increased rapidly, and to-day practically all new oil tankers are of this type. The number of longitudinally framed vessels built in the last 15 years is nearly 1,500 with a carrying capacity of 12,500,000 tons, of which 700, with a total capacity of 6,500,000 tons deadweight, are ships carrying oil in bulk. The great success of the longitudinal system has encouraged the introduction of designs in which the framing at the bottom and deck is longitudinal, while ordinary transverse framing is retained on the ship's side. A number of ships on this combination system have been built and have, so far, proved satisfactory.

TABLE I. *Gross Tonnage of Merchant Vessels Owned in Various Countries on June 30 of Each Year*

Country	1910		1914		1925	
	Tonnage	Per cent	Tonnage	Per cent	Tonnage	Per cent
Great Britain and Ireland	17,516,479	41·8	19,256,766	39·2	19,440,711	30·1
British Dominions	1,495,815	3·6	1,788,283	3·6	2,781,487	4·3
Denmark	736,562	1·8	820,181	1·7	1,059,846	1·6
France	1,882,280	4·5	2,319,438	4·7	3,511,984	5·4
Germany	4,333,186	10·3	5,459,296	11·1	3,073,713	4·8
Holland	1,015,193	2·4	1,496,455	3·0	2,600,831	4·0
Italy	1,320,653	3·2	1,668,296	3·4	3,028,661	4·7
Japan	1,146,977	2·7	1,708,386	3·5	3,919,807	6·1
Norway	2,014,533	4·8	2,504,722	5·1	2,680,642	4·1
Spain	765,460	1·8	898,823	1·8	1,184,721	1·8
Sweden	918,079	2·2	1,118,086	2·3	1,301,126	2·0
U.S.A. (Sea)	2,761,605	6·6	2,970,284	6·1	12,948,632	20·1
U.S.A. (Lakes)	2,256,619	5·4	2,352,764	4·8	2,364,920	3·7
Other Countries	3,749,079	8·9	4,728,024	9·7	4,744,337	7·3
World	41,912,520	100·0	49,089,804	100·0	64,641,418	100·0

TABLE II. *Gross Tonnage of Merchant Vessels Launched in Various Countries*

Country	1910		1919		1924	
	Tonnage	Per cent	Tonnage	Per cent	Tonnage	Per cent
Great Britain and Ireland	1,143,169	58·4	1,620,442	22·7	1,439,885	64·1
British Dominions	26,343	1·3	358,728	5·0	44,879	2·0
Denmark	12,154	·6	37,766	·5	63,937	2·8
France	80,751	4·1	32,633	·5	79,685	3·6
Germany	159,303	8·1	(No Returns)		175,113	7·8
Holland	70,945	3·6	137,086	1·9	63,627	2·8
Italy	23,019	1·2	82,713	1·2	82,526	3·7
Japan	30,215	1·5	611,883	8·6	72,757	3·2
Norway	36,931	1·9	57,578	·8	25,139	1·1
Spain	3,234	·2	52,609	·7	3,859	·2
Sweden	8,904	·5	50,971	·7	31,211	1·4
U.S.A. (Sea)	177,601	9·1	3,579,826	50·1	90,155	4·0
U.S.A. (Lakes)	153,717	7·9	495,559	6·9	49,308	2·2
Other Countries	31,567	1·6	26,755	·4	25,670	1·1
World	1,957,853	100·0	7,144,549	100·0	2,247,751	100·0

Materials.—It would almost appear that the limit of economy arising from distribution of material has now been reached, and that any further saving can only be attained by the employment of a quality of material superior to that now in use. Progress has already been made in this direction by the introduction of a new type of steel which can experience a stress of 15 tons per sq. in. without any permanent deformation, as compared with a much lower figure for ordinary mild steel. Vessels have been built of this material which show a saving in weight of steel of about 10% and should prove quite satisfactory, although the limited experience available does not yet permit of any definite conclusion. (W. S. A.)

SHIPPING (*see* 24.983).—The movement of oversea commerce dominates the building and running of trading ships, and to understand the shipping problems created by the World War, the nature, volume and distribution of oversea commerce of the world before, during and after the War must be realised. Although trade is based on individual needs, and those needs must be satisfied by individual enterprise, it can be measured by the total volume passing between the countries, and for a period of stable exchange and comparatively steady prices, values can be taken as a measure of fluctuations in volume.

It has been estimated[1] that in the 10 years preceding 1914 the total international trade of the world increased in value from £5,000 million to £8,000 million, and that 80% of such trade was seaborne. Of this trade the share of the United Kingdom in 1913 was £1,400 million, and for that year the volume of her exports was estimated at 94,000,000 tons, and of imports was estimated at 56,000,000 tons, giving a total of 150,000,000 tons weight. If the volume of British oversea trade be taken as typical of that of the world, and there are reasonable grounds for such an assumption, then the volume of the seaborne trade of the world in 1913 represented about 700,000,000 tons weight. On this basis of comparison the same cargoes appear as both exports and imports, and therefore the weight carried was about 350,000,000 tons.

For the carrying of this seaborne trade, steam tonnage under all flags had in the same 10 years increased from 17,000,000 to 25,000,000 tons net register.

In the table on p. 532 the size of the ships is given in tons net register, the method commonly adopted in official returns, as it is upon such tonnage that port and other dues are generally levied throughout the world. In Lloyd's Register, the size of ships is given in gross tons register, whilst in other returns used by the shipping industry sometimes gross tonnage and sometimes dead weight carrying capacity is used. For general purpose the relation between these different methods of measurement may be taken, roughly, as 100 tons net register = 164 tons gross measurement or 250 tons dead weight carrying capacity. But no method of measurement represents the cargo-carrying capacity of the ship during a given period, as such capacity is dependent on the number of voyages made. It follows, therefore, that an estimate of the yearly cargo-carrying capacity of the shipping of the world is a matter of difficulty, but it is indicated very roughly by the recorded entrances and clearances of the ships under all flags in the ports of the world. These records are not complete, and they are not in all instances strictly comparable, but to some extent they can be tested by the records of the shipping passing through the Suez and Panama canals and by figures issued by the various authorities that control the shipping of the world.

As oversea trade developed, the energies of commercial enterprise were devoted to perfecting transit facilities. Ports and facilities for distribution from them were built and added to, to meet the requirements of the areas they could best serve. The energies of commercial enterprise were directed on maintaining a steady flow of traffic through the ports, and minimising the distances over which land distribution must be made.

[1] Parliamentary Papers Cd. 8128, 7786, 7525, summarised in Report of Committee of Chamber of Shipping of the United Kingdom and Liverpool Steam Ship Owners Association, July 1917, vol. ii., p. 76.

The following table gives the steam tonnage owned by each country in 1904, 1913, 1920 and 1925:—

Countries	Tons, Net Register				Percentage of Total			
	1904	1913	1920	1925	1904	1913	1920	1925
United Kingdom	8,751,853	11,109,560	11,043,079	11,771,138	52·03	44·81	35·09	32·25
British Dominions and Possessions	674,620	915,950	1,135,199	1,429,757	4·01	3·69	3·60	3·92
British Empire Total	9,426,473	12,025,510	12,178,278	13,200,895	56·04	48·50	38·69	36·17
Russia including Finland	444,555	462,022	360,890	269,968	2·64	1·87	1·15	0·74
Norway	642,657	1,122,577	1,207,049	1,596,613	3·82	4·53	3·84	4·38
Sweden	408,124	551,964	607,575	764,573	2·43	2·23	1·93	2·09
Denmark	320,291	415,880	438,685	622,937	1·90	1·68	1·39	1·71
Germany	1,774,072	2,877,887	255,758	1,833,091	10·55	11·61	0·81	5·02
Netherlands	341,289	794,840	1,081,336	1,577,920	2·03	3·21	3·43	4·32
Belgium	99,893	186,581	250,258	328,166	0·59	0·75	8·80	0·90
France	696,059	1,029,113	1,806,846	2,024,173	4·14	4·15	5·74	5·55
Portugal	49,454	55,903	143,718	162,994	0·29	0·22	0·46	0·45
Spain	430,153	506,073	571,512	696,905	2·56	2·04	1·82	1·91
Italy	462,259	773,848	1,291,725	1,787,095	2·75	3·12	4·10	4·90
Austria	252,899	629,444	..	..	1·50	2·54	..	..
Hungary	87,762				0·52			
Greece	223,020	443,771	303,046	545,452	1·33	1·79	0·96	1·49
Turkey	57,970	65,402	..	80,338	0·34	0·26	..	0·22
United States (including Great Lakes)	332,493	1,280,958	7,564,708	7,275,342	1·98	5·17	24·04	19·94
Japan	478,419	956,702	1,826,755	2,390,126	2·85	3·86	5·81	6·55
Brazil	84,110	188,645	289,770	272,899	0·50	0·76	0·92	0·75
Argentina	44,678	107,172	79,340	123,593	0·26	0·43	0·25	0·34
Chile	42,164	68,834	54,030	101,159	0·25	0·28	0·17	0·28
Other Countries	123,652	248,337	1,161,658	836,661	0·73	1·00	3·69	2·29
Total	16,822,446	24,791,601	31,472,937	36,490,900	100·00	100·00	100·00	100·00

The table below shows the total tonnage of ships cleared with cargoes from all the ports of the world.

Cleared with Cargoes

	Tonnage			Percentage of Total	
	British	Foreign	Total	British	Foreign
Average:					
1905–9	35,375,867	19,738,097	55,113,964	64·2	35·8
1910–3	37,709,690	23,901,933	61,611,623	61·2	38·8
Year:					
1919	21,962,895	12,599,212	34,562,107	63·5	36·5
1920	23,532,459	13,193,076	36,725,535	64·0	36·0
1921	24,282,304	12,115,137	36,397,441	66·7	33·3
1922	36,817,495	22,864,635	59,682,130	61·7	38·3
1923	42,139,130	28,251,848	70,390,978	59·6	40·4
1924	41,732,088	23,566,671	65,298,759	63·9	36·1
1925	41,413,566	20,897,199	62,310,765	66·5	33·5

For 1926 the figures are not yet available.

Traffic Through the Suez Canal

Nationality	Tonnage			Percentage of Total		
	Average 1910–3	1923	1924	Average 1910–13	1923	1924
British	11,568,291	13,193,457	14,067,405	62·6	61·9	59·0
Danish	130,417	299,695	344,868	0·7	1·4	1·4
Dutch	1,083,229	2,175,234	2,487,352	5·9	10·2	10·4
French	839,480	1,281,223	1,495,116	4·5	6·0	6·3
German	2,897,513	1,213,691	1,646,872	15·7	5·7	6·9
Italian	231,397	981,358	1,472,703	1·2	4·6	6·2
Japanese	339,365	986,283	871,529	1·8	4·6	3·7
Norwegian	72,648	335,597	347,418	0·4	1·6	1·5
Swedish	109,156	275,264	270,197	0·6	1·3	1·1
U.S.A.	2,670	349,224	485,083	0·0	1·4	2·0
Other	1,215,127	211,380	320,111	6·6	1·0	1·5
Total	18,489,293	21,302,406	23,828,654	100·0	100·0	100·0

Traffic Through the Panama Canal

Nationality	Tonnage				Percentage of Total excluding U.S.A.			
	1920	1923	1924	1925	1920	1923	1924	1925
British	2,760,188	4,892,338	6,097,611	5,949,391	58·1	58·3	58·9	56·2
Chilian	212,000	201,411	176,472	129,183	4·5	2·4	1·7	1·2
Danish	32,221	240,053	245,929	160,299	0·7	2·8	2·4	1·5
Dutch	152,535	510,970	551,761	531,251	3·2	6·1	5·3	5·0
French	114,664	252,333	386,640	489,806	2·4	3·0	3·7	4·6
German	52,755	336,149	660,156	723,067	1·1	4·0	6·4	6·8
Italian	98,692	117,782	164,448	241,054	2·1	1·4	1·6	2·3
Japanese	515,243	753,219	815,468	823,869	10·8	9·0	7·9	7·8
Norwegian	397,632	597,359	546,533	672,663	8·4	7·1	5·3	6·4
Peruvian	191,689	216,829	189,046	188,784	4·0	2·6	1·8	1·8
Spanish	106,651	41,201	172,572	159,579	2·2	0·5	1·7	1·5
Swedish	76,825	130,361	161,993	225,593	1·6	1·5	1·6	2·1
Other Nations excluding U.S.A.	43,861	107,245	173,251	289,225	0·9	1·3	1·7	2·8
Total excluding U.S.A.	4,754,956	8,397,250	10,341,980	10,583,764	100·0	100·0	100·0	100·0
					Percentage of Total			
U.S.A.[1]	3,791,088	10,208,536	15,806,899	12,271,387	44·4	54·9	60·4	53·6
Total	8,546,044	18,605,786	26,148,879	22,855,151				

[1] Includes vessels engaged in trade between the Atlantic and Pacific Coasts of the United States, which, as "coasting trade," is reserved exclusively for ships under the United States flag.

Effect of the World War

It is difficult to estimate the direct effect of the War on the volume of international trade, and on the ship-carrying power under all flags. On the declaration of War the great bulk of the oversea trade of Russia, Belgium, Germany and Austria-Hungary ceased, and their merchant fleets disappeared from the high seas. Their trades together represented about 23% of the total international trade of the world, and their shipping about 16% of the ship-carrying power. The international trade of the British Empire represented about 29% and of France about 7% of the total, and their shipping 52% and 4% of the ship-carrying power.

The international trade of the non-belligerent countries represented the remaining 41% and their shipping the remaining 28% of the ship-carrying power. The international trade of these countries was seriously restricted by the War cutting off the sources from which they had obtained the greater part of their imports of manufactured goods, and the markets in which they had sold a considerable part of their exports of food supplies and raw material, and by the general curtailment of international credit, without which oversea trade became difficult, if not impossible. But the whole of their ship-carrying power remained available, while about one-fifth of that of the British Empire and France had to be given up to direct War services.

No records had been published by the end of 1925 upon which the volume of the international trade of the world during War years could be calculated, but it would appear probable that its decrease was greater than the decrease in the shipping available, even after deduction of shipping directly given up for War service. But another factor of the first importance had also to be taken into account; for as the War proceeded it became apparent that the carrying power of the ships had been seriously diminished—that is, the number of cargoes that each individual ship could deliver within a given period of time had materially decreased. Not only had more time to be spent on the actual voyage, in the avoidance of War perils and in serving more distant ports, but the ports, and the railway communications with those ports, were frequently being overwhelmed with War or other unaccustomed traffic. This general slowing down in operations was the principal adverse factor affecting ship-carrying power throughout the War. The result was that the ship-carrying power available was insufficient to meet demands, and in consequence freights advanced all over the world, and, what was of far greater moment, the volume of supplies delivered fell short of the world's requirements and thereby prices were forced up by actual shortage. The position could be met by decreasing the demand for ship carrying, or by speeding up the " turn round " of the ships in port.

Great Britain.—Speeding up in the ports of Great Britain became more and more impossible as the control of the State over the ships and the cargoes they carried increased, notwithstanding the efforts of the Ministry of Shipping. The demand could be lessened in one of two ways: by advancing the freights, or by placing restrictions on the volume of the cargoes carried. Each method involved a selection amongst the cargoes offering, and both were open to objection. If the first were followed, then although ability and readiness to pay the increased freights were evidence of the pressing character of the demand for certain kinds of commodities, they were not necessarily evidence of a real national need for those commodities. The second method involved the rationing of the consumers, and that could only be done by the State. The shipowners had neither the knowledge nor the authority to make the selection; and Governments shrank from assuming responsibility. Up to the end of 1916 the Government relied in the main on the first method, but it endeavoured more and more to combine it with the alternate and inconsistent policy of fixing the freights at which particular classes of imports were to be carried.

From the beginning of 1917, the Government assumed full control over all the ships under the British flag; it determined the voyages to be made, fixed the freights charged, and rationed the nation. As the freights fixed were substantially below the rates ruling in the open freight market of the world, no attraction was offered to ships under foreign flags, which therefore transferred their carrying power to trade with other countries in which they could earn far higher freights with less risk. The result was that the ship-carrying power available was reduced, while the organisation set up to deal with the imports carried at fixed freights, and still more those set up under the rationing policy, intensified the congestions in the ports.

In 1914 Great Britain had about 3,600 steamships, representing some 10,000,000 tons net register, employed in ocean overseas trades. Of these 1,698, representing 4,300,000 tons net register, were lost through war perils, two-thirds of those losses occurring after Jan. 1917. By that time the War demands on the shipbuilding yards and engineering shops were so heavy that replacement was impossible. To meet this loss, and that of the ships under foreign flags driven away by the fixing of freights, ships under the British flag were withdrawn from Eastern and other trades, and concentrated on the shortest routes over which the country could obtain, on credit and not as a commercial operation, its oversea supplies: and in consequence the ports serving the North American route were still further congested.

Allies and Neutrals.—The Allies and the non-belligerent countries did not attempt to fix freights generally on voyages to and from their ports. They suffered heavily from the loss of ships and the slowing down of oversea transport, but they had not sufficient shipping under their own flags to tempt them to run the risk of driving from their trades ships under other flags by refusing to pay current rates of freight. The Allies made enormous demands on British ships to carry War material and national supplies, with the result that, while neither the Allies nor the non-belligerent countries suffered towards the end of the War as heavily as Great Britain from the lack of ship-carrying power, they suffered almost as heavily from the closing of markets, in which they had been accustomed to trade as both sellers and buyers. They were unable to find new sources of manufactured goods, which resulted in the development of home industries in all countries, and a general decrease in international trade all over the world.

The War, and in particular the policy followed by the British Govt. in regard to British merchant shipping, caused nations to attach an exaggerated importance to the ownership under their own flags of ship-carrying power, and ships were built without any regard to the economic forces controlling shipping. The diagram on p. 534 shows the tonnage launched by the principal nations of the world.

Although therefore it is difficult to estimate the direct effect of the War on the volume of international trade and on the ship-carrying power under all flags, it is clear that it was enormous. So far as Great Britain and the Central Powers were concerned, it disorganised almost every trade in which they had been engaged, some of which were entirely destroyed. New competitors arose amongst both sellers and buyers, the United States and Japan, in particular, greatly increasing their trade, and ship-carrying power far in excess of the world's requirements was brought into existence.

Shipping After the War

Great Britain.—In March 1916 the shipping industry appointed a committee to advise as to the measures requisite for the maintenance, after the War, of a mercantile marine adequate to the Empire interests in peace, as well as its needs in war. In their report, made in July 1917, this committee said:—

> Experience during the War, of the State as a manufacturer, a merchant and a shipowner, has demonstrated the impossibility of Government controlled business ever holding its own in international commerce. The ruling principle of our trade policy after the War should therefore consist in the maintenance for each individual citizen, be he producer or consumer, manufacturer, trader, banker, underwriter, shipowner, employer or workman, of the fullest possible opportunities for the exercise of his energies and enterprise in the markets of the world, subject only to such restrictions as must be imposed in the interest of national safety.

This policy is now generally accepted in principle; but it took years for the nation to realise that any other policy must result

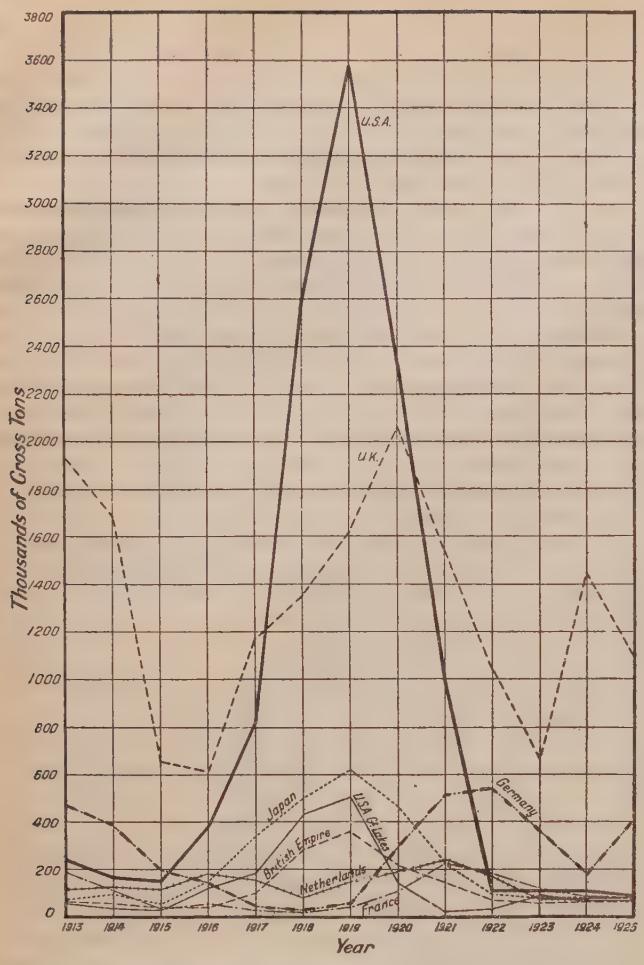

FIG. 1.—Graphs showing tonnage launched each year from 1913 to 1925 in the principal shipbuilding countries. Only vessels of 100 tons gross and upwards are included in the figures, taken from the League of Nations Monthly Bulletin of Statistics, upon which the chart is based. The United States coast and Great Lakes tonnage launched are given separately. The Canadian tonnage launched on the Great Lakes is included in the graph of the British Empire.

in disaster, and indeed it is open to doubt whether that fact was fully recognised by 1926. The Governments of the day would not face the position. No doubt the transition from war to peace conditions was full of difficulties, and even dangers, and it was in the hope of mitigating these dangers that department control was continued throughout 1919 and a part of 1920.

The British shipping industry by the end of 1920 had replaced its War losses of 4,000,000 tons net register, but at the cost of from two and a half to three times that of the ships replaced, and of nearly double the amount it had received from the War risk insurances on such ships. The profits of the industry during the War had been kept down not only by the taxation of all excess profits, but also by the imposition of exceptional conditions of employment at rates of freight calculated on a peace basis. In the result, the industry had neither the means nor the credit to do more than make good its War losses; but the tonnage built was sufficient to place again at the disposal of the country and of the world at large, by the end of 1920, at least as much ship-carrying power under the British flag as was in being before the War.

Other Countries.—In other countries not only were the War losses replaced, but the shipping under their flags was greatly added to, in part out of the unrestricted profits earned by their shipowners during the War, and in part out of national funds. But in those countries the cost of building was also far in excess of the value of the ships based on their future earning power, and much of the tonnage built could never meet the needs of international trade. By reason of the building under other flags, when the War ended the steam tonnage of the world in existence, notwithstanding all the War losses, was in excess of that which had been available at the opening of the War, and by the end of 1920 it exceeded 31,000,000 tons net register, of which Great Britain owned 11,000,000 tons net register.

By the end of 1920, the replacement of the British ships and the complete withdrawal of all state control provided efficient tonnage far in excess of the world's demand for oversea carrying power. Freights accordingly fell by upwards of 60% and went on falling, and ships began to be laid up, as the earnings were insufficient to cover the cost of running. The following table shows the laid-up tonnage of the principal maritime countries on Jan. 1 of 1922, 1923, 1924 and 1925:—

	Jan. 1 1922	Jan. 1 1923	Jan. 1 1924	Jan. 1 1925
	Net Tons	Net Tons	Net Tons	Net Tons
United States	3,237,000	3,249,000	2,604,000	2,575,000
United Kingdom	1,079,000	616,000	554,000	430,000
France	662,000	445,000	274,000	190,000
Italy	357,000	288,000	260,000	137,000
Netherlands	199,000	201,000	143,000	40,000
Norway	126,000	32,000	31,000	15,000
Sweden	124,000	13,000	..	12,000
Greece	104,000	46,000	74,000	15,000
Japan	73,000	60,000	18,000	15,000
Belgium	168,000	104,000	53,000	16,000
Denmark	98,000	10,000	8,000	..
Spain	323,000	317,000	78,000	36,000
Australia	N/A	65,000	52,000	101,000
All other Countries	117,000	120,000	51,000	63,000
Total	6,667,000	5,566,000	4,200,000	3,645,000
Percentage	100	84	63	55

(N. H.)

SHOOTING.—A definite stage in the history of the sport of shooting was marked by the World War. In Scotland and Northern England during the years 1914–8 most of the grouse moors were not shot over, and the majority of the keepers were away at the front. This led, in some places, to over-stocking, which brought in its train disease; elsewhere there was a large increase in hooded crows, black-backed gulls and other enemies of game, which it took the keepers, on their return from the War, some time to reduce. Within two or three years, however, the course of the grouse-shooting seasons became normal, and, with an increased demand for moors, the rentals for shootings rose to figures considerably exceeding those obtained before the War.

But the chief change wrought by the War belonged not so much to Scotland as to estates in England. Before 1914, the sport of pheasant-shooting had, in the opinion of a good many people, assumed rather unnatural proportions. On some estates pheasants were hand-reared in such immense numbers that the principal days' covert-shooting ceased to possess the element of wildness and uncertainty that is the true charm of the sport. During the war, no pheasants were reared by hand, and in the years that immediately followed most of the birds which were shot were wild. Concurrently, a good deal more attention was turned to the best methods of managing partridge manors and increasing partridge stocks. With the gradual resettlement, however, the hand-rearing of pheasants began again, and the industry of the game farmers, producing a yearly supply of game eggs and birds for shooting estates, grew and thrived. The year 1926 saw more game farmers in existence and doing good business that any previous year, while the number of game and gamekeepers' licences taken out in England and Scotland increased from 62,873, with a revenue of £162,901 in 1910, to 70,178, with a revenue of £190,479 in 1924. (E. P.)

United States.—In the United States conditions in field shooting are vastly different from conditions in Europe. There are no grouse moors in the United States, there are not as many private shooting lodges, and but very few persons make a business of game breeding. Wild life has always been regarded as common property, free to be shot by anyone. Though hunters take, it is estimated, game worth about $100,000,000 from the

fields annually, though vermin is credited with taking a toll 10% greater than the sportsman, and though the automobile and good roads have brought the game fields closer, there is more small game to be shot at now than a half century ago. In 1924 from the fields of six states that maintained records of what the hunters bagged, 12,058,512 pieces of game were taken. It is conservatively estimated that 25,000,000 rabbits, 20,000,000 quail, 15,000,000 squirrels, 15,000,000 ducks, 12,000,000 grouse, 10,000,000 geese and 100,000 deer are bagged yearly, as well as millions of other game animals.

The total number of hunters who took out licences in 1922 was 4,207,200. This number increased in 1923 to 4,490,707, in 1924 to 5,321,196 and in 1925 to 6,093,757. These individuals paid more than $7,000,000 for hunting licences alone.

Millions of dollars are being spent by the various states to restock the fields. Game is increasing in all but five states, and Mississippi and North Carolina are the only states without game commissions. Pennsylvania estimates that the game within its borders is worth $150,000,000. Since the beginning of the present century great efforts have been made to secure better and more uniform game laws, and this has caused a deeper interest in the conservation of wild life. There are more than 800 sanctuaries in the United States where game is being propagated and protected in addition to the United States forests where protection is given to more than 700,000 head of game. (P. P. C.)

SHOREY, PAUL (1857–), American classical scholar, was born at Davenport, Ia., Aug. 3 1857. He graduated from Harvard University in 1878, and was admitted to the Chicago bar in 1880. He then continued his studies at the universities of Leipzig (1881) and Bonn (1882) and the American School of Classical Studies, Athens (1882–3), proceeding thence to the University of Munich (Ph.D., 1884). He was professor of Greek at Bryn Mawr College 1885–92, resigning to fill a similar chair at the University of Chicago. He became head of the classical department at Chicago in 1896, and was appointed by Columbia University Roosevelt professor in the University of Berlin (1913–4).

Shorey wrote *De Platonis Idearum Doctrina* (1884); *The Idea of Good in Plato's Republic* (1895); *The Odes and Epodes of Horace* (1898); *The Unity of Plato's Thought* (1903); and *The Assault on Humanism* (1917), the latter a brilliant but bitter polemic directed chiefly against those who minimised the value of humane studies in the educational system. He became managing editor of *Classical Philology* in 1898, and was a constant contributor to its columns.

SHRAPNEL: *see* AMMUNITION.

SIAM (*see* 25.2), an independent kingdom of southeastern Asia and a member of the League of Nations. Area 200,148 square miles. Population (estimated) 9,223,179.

I. POLITICAL HISTORY

On King Chulalong Korn's death on Oct. 23 1910 he was succeeded by one of his sons who had been nominated in 1895 as heir-apparent. The latter was known during the first few years of his reign by his personal name of Vajiravudh, but in 1916 this sovereign issued a decree that "Ramadhipati" (King Rama) should be the dynastic title of his line, and that each previous monarch should be known as "King Rama," with the requisite numerical figure signifying the order of reigning. Thus he was known as Rama VI. until his death on Nov. 26 1925, when, having no male issue, he was succeeded by his younger brother, Prajadhipok, Prince of Sukhodaya.

During the 15 years of King Rama VI.'s reign, Siam's progress externally towards what may be termed treaty independence, and internally towards political and economic development, proceeded without interruption. Though arrangements with certain foreign Powers made in the years immediately preceding the World War contributed to the partial abolition of extraterritoriality, the complete disappearance at no distant date of the jurisdictional restrictions acquiesced in by Siam in the middle of the 19th century was ensured by treaties concluded after 1918.

The most important modern treaties are those made with the United States (1920), Japan (1924), Denmark, France, Great Britain, Holland, Portugal and Spain (1925). In 1926 treaties were being negotiated with Belgium, Czechoslovakia, Italy, Norway, Sweden and other European nations. A provisional economic arrangement was made with Germany in 1925. The treaties have in common agreement on the part of the foreign Power to an increase in Siamese tariff rates, and to the subjection of its nationals to Siamese courts; though certain jurisdictional limitations will remain in effect until the publication of all the Siamese codes, viz.: the penal code, the codes of procedure, the law for the organisation of courts and the civil and commercial code, and for five years thereafter.

The eventual result will be the submission of all foreigners residing in Siam to Siamese law administered in Siamese courts by Siamese judges. As regards Siamese law and its development, it is interesting to note that, whilst urgent situations have been met by the issue of legislative measures in the form of royal decrees, Siam has already published and brought into effect several of the codes here mentioned, and three books of the civil and commercial code. This latter code represents many years' work on the part of a joint Siamese and French commission but awaits a satisfactory translation into Siamese for its final publication.

The Siamese declaration of war in July 1917 against Germany and Austria-Hungary had amongst other consequences the effect of automatically terminating the extraterritorial treaties with those Powers. All enemy subjects residing in Siam were interned, and a quantity of German shipping was seized and condemned as prize.

Much useful legislation has been enacted, and experimental municipalities have been set up in several of the larger provincial towns. Important indications of the awakening and development of the country are: the abolition of the gambling farms; the withdrawal of opium from public tender to government monopoly and progressive restriction of facilities for its use; the gradual extension of a national and, where conditions are suitable, compulsory system of education; a general application of free, compulsory vaccination; the royal encouragement of athletics, more particularly of football; the inauguration by Rama VI. of a now flourishing Boy Scout movement under the name of Wild Tiger Corps; a marked modernisation and expansion of the Siamese language induced by closer contact with the modern world; the introduction of the use of surnames, many thousands of which were devised and assigned by Rama VI.; the rise of a native journalism and press, not devoid of some boldness in criticising high personalities or official laxities. On Sept. 28 1917 a change was made in the national flag. Hitherto all Siamese flags had borne in some form or other the device of a white elephant; the symbol was retained for the royal flags and for military and naval services only. The national flag for general use now consists of a horizontal stripe of dark blue, flanked on either side by a narrower white horizontal band, and outside each of these by a red horizontal band.

II. ECONOMIC AND FINANCIAL HISTORY

Communications.—In 1892 the construction of the first state railway was commenced, a project of 264 km. from Bangkok northeastwards to Korat. In 1924–5 the length of state line open to traffic had advanced to 2,490 km.; 588 km. were under construction, and schemes involving over 3,000 km. further extension were under contemplation.

The northeastern line from Bangkok to Korat was in 1926 being extended by some 300 km. in a due easterly direction to Ubon near the French boundary on the Mekong river; at a point 90 km. from Bangkok a line diverges to Chieng Mai, the principal town of northern Siam, distant 750 km. from Bangkok. This line, on which through traffic to Chieng Mai was opened in Jan. 1921, passes in its northern section through picturesque mountains; and amongst its tunnels is one 1,354 metres in length. A sleeper service is available for the journey between Bangkok and Chieng Mai, which occupies 26 hours.

An eastern line from Bangkok runs 168 km. to M. Krabin, and was being extended to Aranya Prades on the Cambodian frontier, at which point it was due to arrive early in 1926. It is the ambition of the French colonial authorities to bring either their railway or their road touring system out to this frontier, and thereby render it

possible to travel entirely by rail or car between Singapore and Saigon by way of Bangkok.

These railways, all lying to the east of the Me Nam, were at first built standard gauge, but are being rapidly altered to the metre gauge adopted for the Siamese Southern Railway, which has its terminus on the west side of the river. The Southern Railway traverses the length of Siamese territory in the Malay Peninsula, and brings Bangkok in touch with the Straits Settlements. It connects with the Federated Malay States railway system at Padang Besar, on the Kedah-Purlis border for Penang, and another branch goes southeast to the border of Kelantan at Sungei Golok. The length of this railway is about 1,200 km.; construction began in 1908, and by 1918 through communication between Bangkok and Penang was established. The rolling stock now includes comfortable sleeping carriages, and the journey is timed for 36 hours. A large bridge begun in 1923 spanning the River Me Nam Chao Bhraya, on the northern outskirts of Bangkok, will enable the southern line trains to avoid the present terminus on the west bank of the Me Nam Chao Bhraya, and bring passengers direct to the central station in Bangkok.

The royal Siamese railway department is run with marked efficiency, and the annual return on the capital expended ranges from $3\frac{1}{2}$% to $4\frac{1}{2}$%, a remunerative state investment. Under this department there has also been organised a bureau of roads and highways, which hopes to develop a policy of road construction whereby highways will be brought into being as feeders to the railways at the more important trading centres.

There has been a steady and consistent improvement in postal, telegraphic and telephonic communication throughout the kingdom. Wireless installations are found at Bangkok, also at Singora, in the extreme south of Siamese territory and although these are under the control of the naval and military authorities their use under emergency may be granted to the public. Parcel post and money order services have been extended to many remote parts of the country, but the principal innovation in this respect is the adaptation of aviation to postal communication. Siam now possesses a very efficient aviation force; the chief aerodrome at Dorn Muang, 22 km. north of Bangkok, has become well known as an air station since aviators from Great Britain, France, Portugal, Holland, Italy, Argentine and U.S.A., attempting long flights, have made it a port of call. Many towns in the interior have prepared aeroplane landing places, and much valuable service is performed and useful experience is obtained by the aviation force in maintaining regular postal communication with remote provincial places.

Production and Trade.—The bulk of the trade of the country passes through the port of Bangkok: the addition of 10% or 15% to the Bangkok trade figures will give fairly accurate totals of the trade of the whole kingdom. Siam being an agricultural and non-manufacturing country, the amount and value of two or three natural products, *e.g.*, rice and teak, give the measure of its productivity, as do the imports of its prosperity and purchasing power. The following figures show the steadily expanding volume of Siam's production and commerce:—

Year Ending	Exports	Imports	Total
March 31 1911	Tcs.108,907,821 =£8,324,074	Tcs. 68,205,328 =£5,213,090	Tcs.177,113,149 =£13,537,164
March 31 1921 Ex. 9·58 tcs.=£1	Tcs.66,138,000 =£6,903,760	Tcs.147,332,000 =£15,379,100	Tcs.213,470,000 =£122,282,860
March 31 1925 Ex. 10·72 tcs.=£1	Tcs.165,931,496 =£15,478,675	Tcs.153,006,580 =£14,272,450	Tcs.318,938,076 =£29,751,125

In terms of currency the 1925 import figures are a record, the hitherto record year, 1920–1, being some 6,000,000 ticals below the 1925 figure. Of the 1925 import total nearly 67% or 102,000,000 ticals came from British ports: Hongkong 37,000,000, Great Britain 26,000,000, Singapore 22,000,000, India 14,000,000, other British possessions 2,000,000. These statistics do not, however, especially in the case of Hong Kong, necessarily indicate a British origin for the goods imported. The import item of highest value was cottons at 26,000,000 ticals, followed by provisions 14,000,000, iron and steel 11,000,000, cotton yarn 6,000,000, machinery 3,000,000.

The average import for five years ending March 1920 was tcs. 100,381,000. The average import for five years ending March 1925 was tcs. 140,806,800; 125,900,000 ticals, or nearly 76% of the total 1925 export figure, went to British ports, Hong Kong taking 61,500,000, Singapore 54,500,000, Great Britain 3,500,000, India 2,000,000 and other British possessions 4,000,000.

Of the total exports for 1924–5 rice of various grades represents in value no less than 134,876,000 ticals (£12 570,000), or in weight 18,727,000 piculs (1,114,700 tons); this was less than the previous year by 2,983,000 piculs (about 180,000 tons).

In explanation of the diminished value appearing under exports for the year ending March 1921, it should be stated that abnormal floods in 1917 had partially diminished the grain reserve of the country, and the two years prior to 1920 were years of scarcity in India. Countries bordering on Siam sought to draw from her supplies which normally would have been obtainable elsewhere. The result was that rice, though seasonally abundant in Siam, went up to famine prices, and prohibition of export was of necessity imposed from July 1919 onwards, to preserve the food supplies of the country. After deducting the value of rice from the export total in the 1925 figures, only 31,000,000 ticals remain to represent all other exported Siamese products, of which sum teak is responsible for 6,500,000, re-exports 7,500,000 and "all other goods" 16,000,000. The teak forests are carefully conserved, so that on the whole there is little scope for the average annual output to vary.

In connection with rice production due account must be taken of the irrigation schemes which have been or are being carried out in the delta provinces of the country, whereby extensive areas of cultivable land, hitherto dependent upon the uncertainties of the annual rainfall, can count upon an assured supply of water. Upon the chief project, known as the South Prasak scheme, undertaken in 1913 and completed Nov. 1924, approximately £1,200,000 was expended, and it is calculated that an area of 240,000 ac. will benefit. Work is proceeding on what is known as the Suphan programme, the estimated cost of which is about £1,040,000.

Finance.—The revenue for 1908–9 amounted to 58,000,000 ticals or £4,300,000 at the then rate of exchange of about 13·30 ticals=£1. The actual budget figures for the financial year 1923–4 were: revenue, 88,417,733 ticals = £8,186,827 at exchange 10·80 ticals=£1, and expenditure, 91,053,133 ticals =£8,430,845. Revised estimates for the year 1924–5 place the revenue figures at 90,800,000 ticals and expenditure at 94,100,000. Though recent years have shown a budget deficit varying between 3,000,000 and 4,000,000 ticals, skilled attention is being paid to the questions of economy and finance generally, and when allowance is made for Siam's favourable annual trade balance it is reasonable to expect an early return to the former state of things when Siam almost invariably had a favourable balance at the end of her financial year. The currency position is a strong one. At the end of March 1925 the total net issue of notes was 100,968,727 ticals against the possible redemption of which Siam holds a foreign reserve of 56,000,000 ticals. There is also the gold standard reserve, the special object of which is to support the exchange value of the tical currency, amounting to £1,410,000, in addition to coin and bullion held in the currency reserve in Siam.

The country's indebtedness at the end of March 1926 was composed of a balance of £721,220 of the 1905 loan, a balance of £2,303,040 of the 1907 loan, a balance of £4,303,833 of the 1909 loan, £2,000,000 and £3,000,000 of the 1922 and 1924 loans, aggregating £12,328,093.

See the reports of the various departments published by the Siamese Govt. and obtainable through the Siamese Legation; *Statistical Year Book of the Kingdom of Siam* (annual 1916 onwards); *Siam* (British Foreign Office Handbook, 1920); *Siam Directory* (published by *Siam Observer*, annual); *Directory of Bangkok and Siam* (published by *Bangkok Times*, annual). (T. H. L.)

SIBELIUS, JOHAN JULIUS (1865–), Finnish composer, known as Jean Sibelius, was born at Tavastehus on Dec. 8 1865. He studied music under Wegelius at Helsingfors 1885–9, under Becker 1889–90 in Berlin and under Fuchs and Goldmark in Vienna 1890–1. In 1893 he became a teacher of music at Helsingfors. The entry of Sibelius into the musical world marked the appearance of a national inspiration, combined with a strong personality and an accomplished technique. As his genius developed Sibelius became not only an unrivalled master in Scandinavia, but an outstanding personality among the composers of the world. The characteristics of his music are wide imagination and powers of expression, a masculine sentiment and a respect for his art which never allowed him to abuse his profound technical powers for the display of mere virtuosity. Among his compositions are: 10 symphonic poems, seven symphonies, a violin concerto, a string quartet, *Voces Intimae*, *Valse Triste*, several works for choir and orchestra, the music to *Pelleas and Melisande*, *As You Like It*, *The Tempest*, the pantomime, *Scaramouche*, numerous songs and miscellaneous pieces.

SIBERIA (*see* 25.10), the name usually applied to Russia-in-Asia, with the exception of those districts of Central Asia that are grouped under the name of Turkestan.

Siberia is divided into seven governments, three autonomous republics and the autonomous republic of Oiratsk; it covers an area of 2,809,227 sq. m., and has a population of 7,607,919, of whom 1,005,354 are classified as urban. The average density is just over 2·7 per sq. m., but the population is very unevenly distributed, the density being as high as nine in the Novo Nikolaevsk Govt. and only 0·5 in the Yenisei region; vast tracts in the north are almost entirely uninhabited. The principal towns are Omsk (143,380), Irkutsk (88,358) and Tomsk (89,877).

FIG. 1.—Map showing the present (1926) divisions of the vast territory usually known as Siberia.

The autonomous province of Oiratsk contains 77,529 inhabitants, all of whom are classified as rural. There are no towns, and the capital of the province is the village of Ulala. The former Far Eastern Province is divided into four governments; it covers an area of 804,140 sq. m., and has a population of 1,781,324, of whom 385,864 are classified as urban. The largest town is Vladivostok, with a population of 98,922. The average density is 2·28 persons per sq. m., though in Kamchatka the density is only 0·06.

Political History.—After the establishment of the Provisional Govt. in Leningrad (Petrograd) in March 1917 (*see* RUSSIA) Asiatic affairs first came to the fore with the establishment of an All-Russian Moslem Council in May, but no special measures were taken in regard to Siberia and the Far East. The Bolshevik revolution had also little repercussion there at first; a rising took place in Vladivostok in March 1918, which was liquidated by British and Japanese naval forces, who remained in effective control of the port till the following August. Meanwhile Semenov (himself a Buryat) had raised anti-Bolshevik forces east of Lake Baikal in February, but was forced to retire to the Manchurian frontier in May, following a Bolshevik rising in Trans-Baikal. In March a Czechoslovak force, drawn from the Austrian prisoners of war in Russia, was formed, and began a trek to Vladivostok, with the intention of fighting on the Western Front; they seized authority at many points of the railways to and in Siberia.

A provisional Socialist Govt. of Siberia was formed at Novo Nikolaevsk on June 3, and by the end of the month the Czechs were in effective control of the line of the Trans-Siberian railway from Omsk to Vladivostok. In July and Aug. Allied troops landed at Vladivostok with the intention of proceeding West to reconstitute the Eastern front against the Central Powers. By the beginning of Sept. the anti-Soviet forces had re-established communications along the whole Trans-Siberian Railway and had made some progress into Russia proper. On Sept. 24 a congress of all Russian and Siberian parties invested the government in a Directorate of Five at Omsk, but in the middle of Nov. this directorate was overthrown and Admiral Kolchak appointed supreme ruler. In the spring of 1919 Kolchak's offensive reached its zenith, and by May he was in full retreat to Omsk. Inefficiency in command and administration and violent discontent in the rear prevented any further serious attempts at regaining lost territory. In Nov. the Soviet forces took Omsk, and in Dec. Tomsk, while by the middle of Jan. 1920 they had established their authority in Kamchatka. From this time on the area west of Lake Baikal became part of the R.S.F.S.R.

It was, however, more difficult for the Soviet Govt. to establish its authority farther east, and in May a Far Eastern Republic was formed. This Republic seems to have maintained close relations with Moscow, but was not Soviet in constitution and was more moderate in its administration and conduct of affairs. Semenov's bands continued to give trouble during 1920, but in Oct. he was driven out of Chita, which in the following month became the capital of the Far Eastern Republic, whose area was declared to be all Russian territory east of Lake Baikal. Elections for a constituent assembly took place in Jan. 1921, and it met at Chita on Feb. 12. Vladivostok had remained in a special position under Japanese occupation. The local Provisional Govt. was overthrown by Semenov and Kappel in May 1921, and a new Government established under Merkulov, which lasted till June 1922, when it was overthrown, only to be re-established within 10 days. It finally resigned in Aug., after a Zemstvo conference had elected General Dietrichs dictator of the maritime province. Shortly afterwards the Japanese troops began their evacuation, and on its completion at the end of Sept. Soviet forces entered the town. Soviet power was now consolidated over the Far East, and on Nov. 14 1922 the Constituent Assembly of the Far Eastern Republic declared its absorption into the R.S.F.S.R.

Natural Resources.—The immense potential resources of this area still remain almost entirely undeveloped. The area under grain cultivation in 1924 was 4,812,500 desyatins and the crop 232,200,000 poods, but much land suitable for cultivation is still untouched. Of

the estimated forest area of 313 million acres some 209 million have been surveyed but only a fraction of this area is under regular forest supervision; plans have, however, been drawn up to develop these areas. The output of the Kuznetsk coal basin has been raised from 27·2 million poods in 1913 to 62·2 million in 1923, and the coke works near Kolchugino are again supplying the steel works in the Urals. Gold production has been continued on a reduced scale, but in 1925 a concession to work their old properties was granted to the Lena gold-fields and production may be expected to increase.

Communications.—The Trans-Siberian railway is now functioning regularly, and the journey from Moscow to Vladivostok takes 11 days. Plans have been made to improve transport conditions, which remain the principal hindrance to the economic development of the country, but actually all that is being done is to endeavour to maintain existing services and to recondition the existing tracks. Investigations have been made and plans drawn up with a view to establishing a Trans-Siberian air service.

Education.—Educational facilities are being steadily developed, and there are now in Siberia six institutions of quasi-university standing, three at Omsk, two at Tomsk and one at Irkutsk; while in the Far Eastern Province there are two, one at Vladivostok and the other at Chita.

Siberia's Autonomous Republics

Yakutsk Autonomous Socialist Soviet Republic.—This republic was established by a decree of the All-Russian Central Executive Committee on April 27 1922. Its territory lies to the west of the meridian of Irkutsk and to the north of the Trans-Siberian Railway, and comprises *inter alia* the whole basin of the Lena river. It is roughly triangular in shape; the western side marches with Siberia, the eastern with the Far Eastern Province, and the Arctic Ocean forms the northern boundary. The area of the republic is 1,457,068 sq. m. and the population is 266,504, of whom 11,242 are classified as urban. The capital is Yakutsk on the Lena (pop. 9,247). The climate suffers from great extremes of temperature; the June average is 15° C., the Jan. average −52° C.

Mongol-Buryat A.S.S.R.—This republic was established by a decree of Sept. 12 1923. It is a wedge of territory running up north from the Mongolian frontier of the U.S.S.R. and to the east of Lake Baikal. It comprises 152,768 sq. m., and is inhabited by Mongol Buryats, who were formerly nomads, but who are now settling down; cattle breeding is still the chief occupation. The population is 446,373 and the capital is Verkhneudinsk (pop. 22,500).

Qirghiz A.S.S.R.—This republic was established by a decree of Aug. 26 1920. It comprises the southwestern portion of Russian territory north of old Russian Turkestan and stretches from the Caspian to Mongolia, but lies south of the Trans-Siberian railway. It includes the autonomous provinces of Qara-Qalpak and Qara-Qirghiz, the latter (which was granted full autonomy at the end of 1924) comprising the eastern portion of what was formerly Russian Turkestan. The area of the republic is 860,161 sq. m. and the population is 4,945,753, of whom 431,588 are classified as urban. It is divided into nine governments, of which Semipalatinsk and Akmolinsk, each with over 1,000,000 inhabitants, are the largest. The capital is Orenburg (pop. 106,256), and the other important towns are Semipalatinsk (pop. 56,436), Petropavlovsk, the capital of Akmolinsk (pop. 35,884), and Uralsk (pop. 32,208). The average density of the population is 5·6 per square mile. A test census carried out in 1920 revealed an increased population of about 4% compared with 1913; this republic was the only part of the territories now part of the Union of Socialist Soviet Republics to show an increased population in this census.

Qirghiz, the Republic, lies practically entirely in the Steppe region, and except near the Caspian, where the soil is arid, it is for the most part cultivable. Some of the population retain their nomadic customs and breed camels, horses and sheep, but the majority are settling down and taking to agriculture. The climate is very dry with a large range of temperature between extremes, vegetation is scanty and there are frequent salt lakes. In the north the soil is the black earth, and in 1924 the area under grain was 2,092,000 desyatins and the crop was 58,700,000 poods. The mineral deposits are considerable; copper, silver, lead, iron, coal and naphtha being found, but development is only just beginning and the output is irregular. Rock salt is mined near Iletsk. Orenburg is a great cattle market, over 35,000 head of horned cattle and 30,000 sheep are slaughtered there annually.

SICKERT, WALTER RICHARD (1860–), British painter, was born at Munich May 31 1860, the son of the painter, Oswald Adalbert Sickert, a contributor to *Fliegende Blätter*, and grandson of Johannes Sickert of Altona, painter and lithographer. Sickert studied under Whistler in Chelsea, but in 1885, following the advice of Degas, began to paint from drawings instead of from nature. His subject pictures include "Mamma mia po'areta" (1903), "Noctes Ambrosianae" (1906), "The Camden Town Murder" (1906), "Army and Navy" (1913), "Ennui" (1914), "Sinn Fein" (1915), "Pierrots on Brighton Beach at Night" (1915), "Baccarat at Dieppe" (1920) and "Supper at the Casino" (1920). He also produced some architectural paintings, including "Hotel Royal, Dieppe" (1900), "Lansdowne Crescent" (1917) and "Pulteney Bridge" (1918). He became a member of the Société du Salon d'Automne, the Society of Twelve and the International Society, and a fellow of the Royal Society of Painters, Etchers and Engravers. As a teacher he exercised a strong influence over the younger British painters. He was elected A.R.A in 1924, and exhibited characteristic etchings in 1925.

SICKLES, DANIEL EDGAR (1825–1914), American soldier and diplomatist (*see* 25.36), died in New York City May 3 1914.

SIDGWICK, ARTHUR (1840–1920), British scholar (*see* 25.39), died at Oxford Sept. 25 1920.

SIEGECRAFT AND SIEGE WARFARE.—The earlier article on fortification (*see* 10.679) deals with the history and development of siege and siegecraft, and summarises the views prevalent just before the World War of 1914–8. Changes due to the great economic and industrial developments of the latter half of the 19th and early 20th centuries were affecting, not only the design, but the rôle of permanent fortification. The conception of a fortress as a ring of defences protecting an important point, and capable of withstanding an investment unsupported by a field army, though by no means abandoned was being modified. The ring fortresses of the Napoleonic era, which protected important places such as capitals and arsenals and served as secure bases for field armies or refuges for beaten ones, were no longer capable of fulfilling their rôle. These changes were due to two main reasons. Firstly, the increased size of armies provided by universal service necessitated the employment of several lines of communication, wide bases and large areas for their concentration and deployment. Secondly, the greatly increased range and destructive power of artillery necessitated the extension of the perimeter to such a degree that for the defence of a fortress a field army was required. At the beginning of the War, therefore, zone fortification was beginning to be established in the highly organised industrial areas of western Europe. Reliance, however, was still placed in self-sufficing girdle fortresses, such as Paris, Antwerp and Belgrade, and in the less organised areas of Russian Poland.

Use of Fortified Areas.—Before examining the history and trend of opinion on permanent fortification during and since the War, it is advisable to consider the use and limitations of fortified areas. It is a principle of war that "victory can only be won as the result of offensive action," but a defensive attitude may at times be necessary or even advantageous. Fortresses can never win a victory; their use is to gain time and economise force.

1. To delay the enemy on important lines of advance, such as the barrier forts of the Alpine passes, or the fort of Manonvillers, which commanded the main line of railway from Strasbourg to Paris.
2. To protect vital points such as Paris and Antwerp.
3. To canalise the attack and force the enemy—unless he wishes to spend the time and men necessary for the deliberate attack of fortresses—to advance by certain specified lines. The Trouée de Charmes between Toul and Épinal is an example.
4. To act as a pivot of manoeuvre. It was for this purpose that the Germans used the Metz-Thionville zone.

I. FORTRESSES IN THE WORLD WAR

Defences of Belgium.—The fortresses of Belgium consisted of those covering the crossings of the Meuse at Liége and Namur and the entrenched camp of Antwerp. Liége and Namur—commenced in 1890, to close a probable line of advance between France and Germany—were officially described as "simple pivots de manoeuvre des places d'arrêt," while Antwerp formed a secure base for the field army and an ultimate refuge for the Government.

At the beginning of Aug. 1914 Liége with its 12 armoured forts, on a perimeter of 30 m. was defended by some 25,000 troops. Owing to the rapidity of the German attack little could be done to provide field defences for the intervals between the forts, and on Aug. 5 an attempt was made to capture the fortress by a "coup de main." This was repulsed, but the following

day a brigade of infantry penetrated the interval between two forts, and, reinforced by other troops, succeeded in gaining possession of the city, though none of the forts had fallen. Heavy artillery was then brought up, and on the 8th the first fort fell. By the 13th all the forts to the east and south had been rendered untenable, and by the 16th—eleven days after the opening attack and eight days after the first use of heavy howitzers—the remaining forts were compelled to surrender.

Namur, though somewhat smaller (having nine forts on a perimeter of 25 m.), also had a garrison of about 25,000 men. The Germans, profiting from their experience at Liége, waited until their heavy howitzers were in position. On Aug. 21 the bombardment commenced, and within 24 hours five out of the nine forts were reduced to ruins. By the 25th the remainder had been destroyed.

In both cases the rapid result had been brought about by the overwhelming power of the 12-in. and 17-in. howitzers, which the steel and concrete forts, only designed to withstand 8-in. shells, were powerless to resist. On the other hand, the few days gained were of incalculable value to the Allies. Antwerp, on which much money had been spent, had a perimeter of 60 miles. The Germans opened their attack with heavy howitzers against the southeastern section on Sept. 28, and three days later had rendered four of the forts untenable. Meanwhile the Belgians, assisted by men of the Royal Naval Division, had entrenched a position on the line of the rivers Nethe and Rupel, some two miles in rear of the forts. Several attacks were made on these field defences, and it was not until Oct. 6 that the Germans were able to cross the Nethe. The city was now open to bombardment, and the majority of the defenders having been withdrawn across the Schelde the city surrendered on the 9th. Here again the armoured forts were unable to resist the fire of the heavy howitzers and fell in three days, while the hasty defences of the Nethe were able to hold out for six.

Permanent Defences of Northeastern France.—These were planned by General Seré de Rivière in 1874 in three main positions—the first close to the German frontier consisting of the linked fortresses of Verdun-Toul and Épinal-Belfort, with two premeditated gaps, one to the north, the Trouée de Stenay (20 m. wide), between Verdun and the forest of the Ardennes, and the other the Trouée de Charmes (30 m. wide) between Toul and Épinal. Behind these were the La Fère-Laon-Reims line, with the escarpment of Épernay-Nogent and the fortresses of Langres and Dijon to the south; and finally the defences of Paris itself. The northern frontier was protected by the neutrality of Belgium, but as this was one of the historic lines of invasion into the rich

industrial areas of Flanders and Artois it was considered that Lille, Valenciennes, Maubeuge and Mézières should be strengthened and their intervals covered by inundations and detached forts—Flines, Hirson, etc. In addition, certain barrier forts, as Longwy and Manonvillers, were reorganised or built. However, in 1912 it was decided not to maintain the fortresses of the second line La Fère-Laon-Reims or the detached forts on the Belgian frontier. Dijon and Langres were already third class, and Lille on April 3 1914 was declared open, only to be reclassed as a fortress on Aug. 21 and again declared an open town three days later.

The defences of the Verdun-Toul zone, which were the most modern on the French fortresses, were organised in depth with two or three lines of works in which the forts formed centres of resistance. With the exception of an occasional 75 mm. or 155 mm. gun in a steel cupola for direct fire, and " traditore " guns in Bourges casemates for the defence of the flanks, the artillery was situated outside and in rear of the forts. The forts themselves were generally small—Vaux was designed for a garrison of 150 men. They contained concreted underground galleries and casemates protected by masonry arches three ft. thick, with a three ft. cushion of sand between them and the main protective layer of eight ft. of concrete, and were enclosed by ditches 30 ft. wide and 20 ft. deep, which were in turn flanked by fire from concrete counterscarp casements.

The existence of the fortified zone on the Franco-German frontier undoubtedly exerted a profound influence on the German plan of invasion. Moltke, in a memorandum written in 1912 on the subject of the violation of Belgian neutrality, which is quoted by Ludendorff, remarked that an advance through Belgium was likely to be more successful than an attack on the French fortified zone, which would degenerate into fortress warfare, cause great delay and lower the offensive spirit and initiative of the army. General von Kuhl, in *Der Marne Feldzug*, also states that " even the fortresses which were not attacked exercised a great influence on the operations. The existence of the line Verdun-Toul, Epinal-Belfort forced us to undertake the invasion of Belgium."

While the main German attack was from the north, preparations for a subsidiary advance through the Trouée de Charmes were made by the reduction of the barrier fort of Manonvillers. This concreted fort with its steel cupolas and casemates was reduced in two days to ruins by the fire of the heavy German howitzers. The main zones Verdun-Toul and Epinal-Belfort, however, though they formed pivots for the successful defence of the Trouée de Charmes, were not seriously threatened. Later, during the battle of the Marne, the centre of the Verdun-Toul line between the forts of Troyon and Liouville was violently attacked. Troyon, flanked by fire from Fort Genicourt, held but the Germans succeeded in capturing the fort Du Camp des Romains and secured a crossing over the Meuse at St. Mihiel. This gap, however, was too narrow to be of further use.

Maubeuge.—On the northern frontier the only French fortress subjected to siege was Maubeuge. With a garrison of 40,000 men of low category, with few guns, and with defences completely out of date as shown during Gen. Fournier's trial, the fortress held out for 11 days. This was largely due to the energy of the commander, who from the first day of mobilisation employed every available man on constructing a system of field defences and wire obstacles, providing communications and collecting supplies. On Aug. 25 the town was invested, and three days later the heavy artillery bombardment began. Energetic sorties by the garrison kept the besiegers at a distance and compelled them to reinforce their troops. By Sept. 5 the bombardment had rendered the defences on half the perimeter useless and the defenders began to be pressed back. Desperate fighting continued for the next two days and the town finally capitulated on the 7th. This delay was of the greatest value to the Allies. Strong German forces were absent from the Marne and the blocking of the important line of railway made the supply of Von Kluck's army a matter of great difficulty.

Verdun.—The comparatively rapid and shattering fall of the Belgian fortresses in 1914 caused a complete revulsion against the use of permanent fortification. It was considered that under the fire of heavy modern artillery the demolition of fixed defences was a foregone conclusion. Instructions were therefore issued by the French command that reliance was to be placed on continuous zones of field defences, and that any permanent forts were to be incorporated in these zones, their permanent garrisons abolished, armament that would be of use in the field removed, and any elements remaining which might be of use to the enemy prepared for demolition. It was under these conditions that Verdun was attacked on Feb. 21 1916. The lines of trenches and field defences which had been established some 4 m. beyond the outer forts were thinly held. Under the cover of an intense bombardment by weapons of all calibres up to 17 in., the main attack was launched on the east bank of the Meuse. After four days' bitter fighting the line was pushed back about four m. and Fort Douaumont, undefended, was occupied by the Germans. On the following day, in view of the possibility that Fort Vaux might shortly fall into the hands of the enemy, orders were issued for its complete demolition.

These, however, could not be carried out, as it was found that a 17-in. shell had destroyed the electric cables and means of firing the charges. Meanwhile, it had been discovered that the concrete casemates and cupolas of the modern forts had suffered little damage in spite of the violent and persistent bombardment by shells up to 17-inch. General Pétain, who assumed command on Feb. 26, therefore ordered the forts to be reoccupied, put in the best state of defence possible at the time and the demolition charges removed. The intervals between the forts were also to be held to prevent any infiltration. Lt.-Col. Tournes, in an article in the *Revue Mil. Française* of May and June 1923, vividly describes his experiences while holding Fort Vaux, emphasises the great value of the protected observation posts and shell and shockproof casemates, and deplores the lack of any telephonic communication, subterranean passages to the rear and the absence of the flanking guns which had been removed from the Bourges casemates. After months of heavy fighting Verdun was successfully held. The permanent forts with their shell-proof casemates and protected observation posts had proved their value as a part of the trench zone, and had probably saved many casualties. On the other hand, purely field defences such as those of Mort Homme, sited in equally important natural positions, resisted the fiercest attack for many weeks, and exacted an even greater toll of lives before they fell.

Defences of the German Western Frontiers.—In 1870 Moltke wrote: " The most powerful defence is a network of good railways, and the best protection of these railways is the offensive." However, in 1895, Von Schlieffen, whose plan it was to invade France through Belgium, considered it necessary for the success of his plan to have in Alsace-Lorraine a pivot of manoeuvre which could be held with the minimum of troops and strong enough to withstand any attack by the French. Metz and Strasbourg were therefore strengthened, and in 1900 their radius of action increased. At the same time the defences of Metz were extended 25 m. northwards along the Moselle to connect with Thionville, while 10 m. west of Strasbourg the new fortress of Mutzig was built to close the road over the Vosges across the Col de Saales. In these defences a new form of fortified work known as the " feste " appeared.

This, as its name indicates, is rather a self-contained fortress on a small scale than a fort in the old sense. The " festes " built just prior to 1914 covered a large irregular area some 1,200 yd. in depth and width. Within their wired perimeter were sited all the elements of the defence both for infantry and artillery. Strong self-contained infantry works were situated at each of the salient angles; while the batteries (generally 6-in. howitzers and 4-in. guns) were dispersed within the area with their weapons in revolving steel cupolas embedded in concrete. Ditches 20 ft. deep, wired at the bottom and flanked by loopholed galleries, protected the outer face of the infantry works. Each battery and work was surrounded by wire, and the main perimeter wire sunk 6 ft. deep and flanked by the redoubts. There were numerous steel and concrete command and observation posts for the artillery and infantry, and casemates protected by 9 ft. of concrete were provided for the whole garrison. Deep underground galleries and a complete telephone system connected the various parts of the "feste."

These " festes " were never subjected to the test of war, but the fortifications of Thionville-Metz fulfilled their rôle as a pivot of manoeuvre and prevented any French advance while the great wheel from the northward was being carried out.

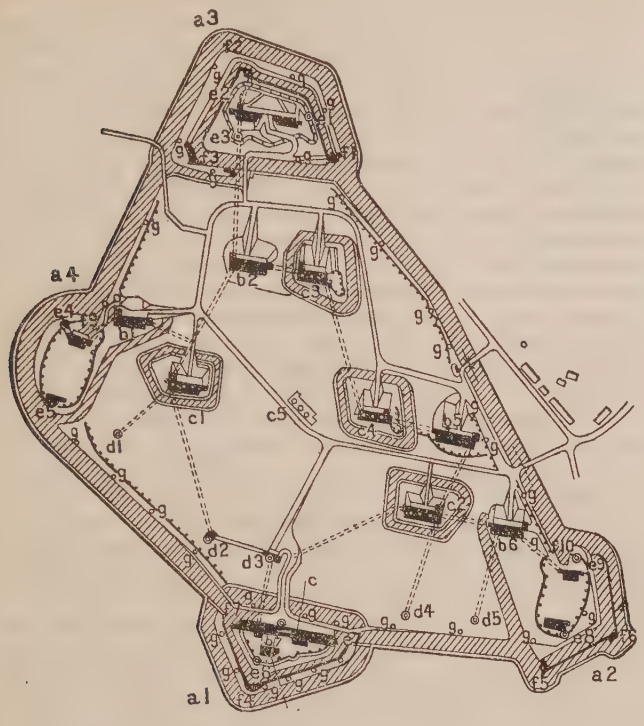

FIG. 1.—Plan of "Feste": a1, a2, main infantry works, b1, b2, etc., concrete casemates. c1, c2, etc., armoured batteries (c5., dummy). d1, d2, artillery observation posts. e1, e2, etc., armoured infantry O.P.'s. f1, f2, etc., posts for enfilading obstacles and ditches. g, infantry look-out posts.

German-Austrian-Russian Frontier.—The fortresses of Poland and Galicia differed from those of France and Belgium in that they were purely ring fortresses, designed to hold the few and therefore very important road and railway junctions of Poland. Of these Modlin (Nowo-Georgiewsk) was invested and rapidly fell by siege, Brest-Litovsk and Grodno fell as parts of the battle line, Dęblin (Iwangorod) was evacuated by the threat of an encircling movement, while Przemyśl alone was successful in withstanding a siege.

In Sept. 1914 the Austrians, driven back in Galicia, left a garrison of about 60,000 men in the fortress. The defences consisted of 65 forts of the early Brialmont pattern (1854) disposed on a perimeter of 35 miles. The concrete was thin and few shelters were capable of withstanding 6-in. howitzers. During the first months of the War, however, trenches protected by strong wire entanglements had been dug in the advanced positions and in the intervals between the forts. Przemyśl, invested by the Russians on Sept. 24, held out against vigorous attacks for three weeks until relieved, caused the attackers 70,000 casualties and detained 250,000 men from the main Russian offensive. In the interval between the first and second sieges, ammunitions and rations for 2½ months were brought into the town. On Nov. 4 the fortress was again invested by a force of 8½ Russian divisions, but without super-heavy artillery. The defenders, by a very active defence and constant sorties, held out for 4½ months, until the last ounce of food, including 21,000 horses, had been eaten and all the ammunition expended. On March 22 1915, having blown up all the guns and the greater part of the works, the defenders surrendered. They had caused the besiegers heavy casualties, blocked the communications of the main Russian Army, and detained a force of twice their own number. Przemyśl, now held by the Russians, was attacked a third time on May 14 1915. The principal forts which had been demolished in March had not been repaired, and ammunition was lacking. The Austro-German Army brought up 12-in. and 17-in. howitzers and bombarded the defences. By the 31st the ruins of the three northern forts were captured, and the Russians, removing their guns, stores and ammunition, withdrew.

The value of both field defences and an active defence is clearly brought out in the first two sieges, while the overwhelming power of superheavy artillery is shown in the third. On the German frontier the fortresses of the Vistula—Toruń (Thorn) and Graudenz,—were never attacked. Of the forward line, however, Königsberg held two Russian army corps from the battle of Tannenberg; and the small fortress of Lötzen, with a strong line of field defences, flanked by the lakes, never gave way.

Trench Systems.—While fortresses and permanent works were falling into disrepute, and the forts gradually merged into the field defences, the continuous trench lines of the Western Front were assuming the aspect of a fortress. The German Wotan-Siegfried (Hindenburg) lines were deliberately planned, with concrete machine-gun and observation posts, masses of wire, deep trenches, tunnelled communications and dug-outs, and were essentially a part of the fortress of Germany besieged by the Allies. A properly organised trench system, having depth and well placed wire and machine-guns, provided its flanks were secure, was found capable of resisting the strongest attacks even after a heavy bombardment. This was the case in all theatres of war, whether in France, Gallipoli or Mesopotamia. The old methods of siege warfare, attack from parallels with bomb and mortar, sap and mine, were therefore revived, and it was not until the advent of a new weapon—the tank—and the arrival of unlimited artillery ammunition that these defences were definitely overcome. The resistance of these field defences to shell fire due to their dispersion and concealment was remarkable. Of their elements, two stand out as of the greatest value—the concrete " pillbox " or machine-gun emplacement and the deep dugout, the one as a protection for the weapons which were required to fire at short notice and the other for command centres and the counter-attack reserves.

Effect of Bombardment on Forts.—The difference in the degree of resistance to shell fire shown by the various forts is remarkable. Manonvillers, though not entirely modern with its two steel cupolas, disappearing 6-in. guns and casemates protected by 8 ft. of ordinary concrete, became a blazing inferno under the rain of 17,000 shells directed upon it. The garrison, after two days, blinded by the dust and fragments, asphyxiated by the fumes of the constantly bursting shells and almost demented by the concussion, were rendered quite incapable of defending the fort, which was captured by the Germans without the loss of a single man. The forts of Liége and Namur similarly, when subjected to the concentrated fire of 17-in. howitzers, were soon rendered untenable; casemates were penetrated, cupolas overturned and the whole structure reduced to ruins. On the other hand, the more modern forts of Verdun appeared to have withstood the heaviest bombardments without vital damage. French writers claim that of the steel gun cupolas only one was permanently destroyed. Forts Moulainville and Vacherauville received 6,000 to 8,000 shells, each of which, in the case of Moulainville 330, were 17-in., without permanent damage to casemates or turrets. In Fort Vaux the only cupola that was destroyed was one from which the demolition charges laid by the French had not been removed. These charges were detonated by a German shell.

The difference in the performance of the forts was due to the higher quality of the French concrete, which was mixed with a large proportion of cement and laid with the greatest care to ensure that the masses were monolithic without lines of cleavage. Also to the great thickness and to the large masses which are necessary to withstand the overturning and disruptive effects of bombardment. The French cupolas had 30 cm. thickness of steel compared with the 22 cm. of the Belgian and German ones. The Belgian forts were large, crowded and conspicuous targets; they contained guns of the main artillery armament and were sited on commanding positions. In spite of the lessons of Port Arthur, they were only built to withstand shells up to 8-inch.

The Italian barrier forts in the battle of the Isonzo failed because their armour and concrete were not sufficiently thick and there was no protection against gas, while the small Austrian works in the south of the Tirol, although bombarded by 12-in. howitzers, held out for months.

II. PRINCIPLES OF MODERN FORTIFICATION

Value of Permanent Works.—From the lessons of the value of permanent works in the War there have grown two schools of

thought. On the one hand it may be argued that the fortresses on the Franco-German frontier completely justified the money expended on them. By their existence they forced Germany to violate the neutrality of Belgium and so brought the British Empire against her. The more modern forts proved their ability to resist bombardment by the heaviest shells and saved many casualties. Verdun as a pivot of a battle line was of incalculable value during the decisive battle of the Marne, and later as a bastion in the trench system. Liége, in spite of its comparatively rapid fall, gained the Allies at least four days, enabled the French V. Army to change front and the British to come into line. Antwerp kept two German corps from the decisive front, and "every day gained at Antwerp meant a French port saved." Maubeuge, Przemyśl, Königsberg all detained important forces from the battles of the Marne, Cracow and Tannenberg. Strasbourg and Metz-Thionville fulfilled their rôle as the immovable pivot for the great German wheel. The expenditure on keeping these fortresses up to date was not great. The average annual amount spent on the defence of Verdun and the heights of the Meuse for the 40 years prior to the War was £200,000, *i.e.*, less than the cost of a destroyer; while the total spent on Metz was about equal to the cost of a modern battleship. Battleships are not expected to last more than 12 to 15 years; they are then considered obsolete, and replaced.

The other school of thought point out that the inherent weakness of fortresses is in their immobility. Once built they remain, and when war comes may not be in the right place. They contravene many of the important principles of war—offensive action, surprise and mobility. Their position and extent is accurately known. They rapidly fall out of date and are expensive and difficult to renew. Apart from the expense involved, their reconstruction is a heavy feat of engineering, and not only takes time but frequently renders them useless for the period of the repairs. In 1914 four of the principal works of Belfort were out of action as they were being rebuilt. New weapons for their destruction are rapidly invented and made. Manonvillers, Liége, Namur and Modlin (Nowo-Georgiewsk) were destroyed with ease and rapidity. Reliance based on the security afforded by fortresses may be a delusion. Of the three great entrenched camps of Antwerp, Paris and Bucharest, designed as a refuge for the Government and Army, not one performed its rôle. Antwerp, on which much money had been expended—and therefore considered by the Belgian nation as up-to-date, was given up by the field army and Government as soon as it became a question of withstanding a siege or continuing the war in the open. Bucharest was surrended as the result of a battle in the foreground; while Paris, though it held as a part of the battle line, was evacuated by the Government.

Field defences, by their conceament, dispersion and facility for rapid renewal, are just as effective for defence as permanent fortification. It was not the permanent forts of Verdun and Przemyśl but the trench lines of the advanced positions and intervals that stopped the enemy. At Verdun the important tactical position of Mort Homme, defended by nothing but field defences, held out against the heaviest bombardments and attacks for six weeks, and caused the attackers terrible casualties. The expenditure is undoubtedly great, and the money could be more profitably spent on the field army, since if the field army is overwhelmed the fortresses must fall.

The answer probably lies between these two points of view, and the line taken will depend on the situation of the country which has to solve the problem. For France and Poland, in close proximity to powerful and potential enemies, the matter is an actuality; while for Great Britain or the United States, except in regard to coast defence, it borders the realm of theory.

Fortresses are expensive and slow to build; if they fail to gain the time they were calculated to gain, or require for their defence more men than the enemy would require to mask or neutralise them, they have been built in vain. It is the difficulty of estimating the time that fortresses are likely to hold out against the unknown weapons of the future that makes their value doubtful. For it will always be easier to make new guns or other weapons to overcome the protection than to increase the thickness of armour or concrete.

There are, however, occasions when material defensive preparations in peace time will have to be made and areas held for military, industrial or political reasons. Munitions play so vital a part in modern war that the retention of certain areas of manufacture or supply may be essential. In other places, where for purely military reasons it might be wiser to withdraw and demolish the communications, public opinion may insist on a forward position being held. Again, the effect of the systematic destruction of industrial areas by an invader is now so great that victory even cannot efface all trace of his presence. Every effort will therefore be made to fight on enemy's ground. But to protect areas until the effect of the offensive is felt, and to economise men so that the striking force is at a maximum, some form of permanent fortification built in peace will at times and in certain places be required. The question is, What form will it take?

Ring Fortresses Obsolete.—From the lessons of the War it appears that ring fortresses are doomed. It was not Verdun the ring fortress, but Verdun as a solid bastion of the battle line, that resisted all assaults. The immense perimeter now necessary as a protection against long-range guns requires a vast garrison, and for the ammunition and supply of this garrison for any length of time railway communication must be kept open. Moreover, an extended perimeter is no protection against bombing aircraft.

There are, however, rare occasions when for political considerations it may be necessary to hold a ring fortress for a limited but definite time. In the northern salient of Poland it is conceivable that the Poles for political reasons alone might wish to retain command of Wilno (Vilna), while withdrawing from the salient until their field army was mobilised and ready to take the field. Zone fortification has its uses, but the maintenance of an unbroken front depends on the security of the flanks. Where a position is long and open, its defence by a continuous zone is impracticable. But when the flanks are secure, as with the Chatalja lines of Constantinople or on the Viborg Isthmus between Lake Ladoga and the Gulf, a fortified zone is of great value.

In other cases defensive curtains or limited zones of defence may be essential to delay and impede an enemy's advance; but when these zones are turned and surrounded they will be of no further use. Some form of parabolic front of defence may, therefore, delay this end. For the same reasons the construction of barrier positions in undeveloped or mountainous countries, combined with a complete destruction of communications in front of the positions, may be advisable. The difficulty and time taken to bring up heavy artillery for their reduction would enable them to justify their rôle of delaying action. Had the Rumanians fortified the passes of the Carpathians before or directly after their declaration of war, the German attack of Nov. 1916 might have failed. But if in the future anti-aircraft artillery is unable to prevent accurate aerial bombing, the use of barrier positions will be further restricted.

The devastation of zones and communications will, however, remain a powerful weapon of defence. This can seldom be carried out in industrial areas, but in less developed countries or where communications are restricted thorough and complete demolitions will cause a modern army considerable delay. The thorough demolition of a tunnel will take months to repair, and the delay caused will be greater than that affected by a barrier fort. In 1918 the destruction of the roads and railways by the retreating German armies delayed the Allies more than their resistance; while the total destruction of the communications in the area between Maubeuge and the Ardennes in 1914 would have had far-reaching effects.

The value of field defences, which can be rapidly made in accordance with the latest tactical ideas and sited in positions found most suitable at the time, is undoubtedly very great. With well sited and concealed machine-guns, anti-tank guns and obstacles, covered by the fire of artillery (itself protected by mobility and concealment), positions will have considerable powers of resistance. These will be increased if certain previous work can be carried out in peace time.

Preparations in Peace Times.—The degree of material preparation attempted in peace time will vary considerably; but in all places where a defensive attitude is considered likely the most important means will be the preparation of complete plans and schemes of defence. The position of battle headquarters, observation posts, machine-guns, batteries with several alternative positions, infantry localities, lines of communication and zones of obstacles will be selected, and large scale maps prepared ready for issue. Arrangements will also be made for the work to be done at the shortest notice, and for the defence schemes to be revised and periodically brought up to date to keep pace with modern requirements.

Where it is decided that for military, economic or political reasons some degree of permanent fortification in peace time is necessary, the limitation of military expenditure will control the amount that can be carried out. Within these limits the following will probably be considered:—

(*a*) The provision of an obstacle against a "coup de main" carried out by cross country armoured vehicles. Waterways and inundations such as those of Fortress Holland or the Yser afford protection, while judicious afforestation would limit the lines of approach. Where these are lacking, ditches with one vertical face or minefields covered by fire would be required.

(*b*) Arrangements for air defence, gun and searchlight emplacements, telephonic communications and sound-location installations.

(*c*) The provision of observation posts for artillery, infantry and intelligence services—concealed, dispersed and protected by armour or concrete, with sufficient interior space for the observers to use their glasses and maps and remain in comfort for some hours at a time.

(*d*) The provision of road, rail and tramway communications or improvement of existing ones, both laterally and from front to rear, in order to facilitate the rapid movement of troops, artillery, ammunition and stores.

(*e*) The provision of a complete system of signal communication with cables buried eight feet deep, connecting all headquarters, observation posts, artillery positions, anti-aircraft defences, sound-ranging and flash-spotting posts.

(*f*) Afforestation to give cover from aeroplane observation to facilitate surprise; and the control of building and planting so as to keep clear the field of fire or view.

(*g*) Construction of shell-proof cover for command posts, signal offices, observation posts, artillery and machine-gun personnel and local reserves, either in mined dugouts 50 ft. deep or in concrete chambers. To give protection against bombardment by the heaviest weapons of the present day at least 6 ft. thickness of ferroconcrete is required, and large masses are necessary to mitigate the effect of concussion and overturning.

(*h*) Construction of subways 50 ft. deep to give protected communication from the rear to important infantry localities, and to connect up the various dugouts. Some of these subways would contain tramways, and their entrances and exits would be carefully concealed.

(*i*) Arrangements for the electric lighting of all subways, dugouts and chambers, their gas-proofing and the supply of pure air.

(*j*) Provision of landing grounds for aircraft kept free of obstructions and provided with sunken sites for hangars to minimise the lateral effect of air bombs.

(*k*) Organisations of important infantry tank-proof localities with obstacles, fire trenches and alternative and concealed machine-gun positions.

Whatever the form or degree of fortification adopted may be, one can seldom rely on the theory of complete protection, or say, like Pétain at Verdun, "On ne passera pas." To gain time and economise force are the objects of fortification, and the essence of defence lies in organisation, concealment, observation, communication and the stout hearts of well-armed men.

III. MILITARY MINING

Mining in Trench Warfare.—Although no new methods had come to light, considerable experience had been gained as to the value and practice of mining during the siege of Port Arthur, and the conclusions reached up to 1910 are described in 10.716. At the commencement of the War the power of the heavy howitzers, which had so rapidly destroyed the Belgian forts, appeared to indicate that for the reduction of fortresses mining would be unnecessary. It soon, however, became evident that with the advent of position warfare, and the difficulty of making any advance above ground in the face of machine-guns and barbed wire, the attack of important localities by mining would be advantageous. Further, the opposing trench lines approached each other so closely that a bombardment of the hostile front trenches could not be carried out by either side without damage to their own. The tactical conditions, which resembled those of fortress warfare, being favourable, the Germans commenced mining in 1914, and by Dec. had exploded mines in several sectors along the front. As a result the Allies were compelled to countermine in reply.

At first these mine systems were shallow—rarely being deeper than 20 ft.—but by 1915 there were a great number of them, and special units and tunnelling companies were formed to carry out the work. For these R.E. units coalminers were enlisted, and the officers selected from those who had mining engineering experience in all parts of the world. In addition, for work in the clay areas, a number of specialists known as "clay kickers" were included. These men, working on their backs and supported on a board, could make rapid and silent progress by using their feet to push a special shovel into the clay. To co-ordinate the work along the whole front a mining staff was established and the advice of expert geologists obtained. By the middle of 1916 the British had 25,000 troops on underground work, and probably over 60,000 men were so employed on the Western Front. During 1915 and 1916 mining continued on an unprecedented scale, and deep systems down to 200 ft. were made. Mines were effectively used in the opening stages of the battle of the Somme, 1916, and some brilliant mine attacks were carried out by the French. A few instances of mining also occurred on the Italian front and in the Dardanelles campaign. It was, however, during the attack on the Messines ridge in 1917 that mining reached its greatest achievement. At 3:10 A.M. on June 7, on a front of 9 m., and within an interval of 30 sec. no less than 20 mines, containing 1,000,000 lb. of explosives, were detonated. The largest of these mines (at St. Eloi) was 125 ft. deep, took months to complete, and contained 43 tons of ammonal, while the earth shake was clearly felt at Cassel, 16 m. away.

The use of these enormous mines, whose destructive effects could not be definitely foretold, was a matter of some anxiety, but they were certainly successful. Ludendorff writes in his memoirs: "We should have succeeded in retaining the position but for the exceptionally powerful mines used by the British which paved the way for the attack. . . . The moral effect of these explosions was simply staggering. At several points our troops fell back before the onslaught of the enemy's infantry."

With the introduction of tanks and certain changes in the tactics of the defence, offensive and defensive mining declined. The tactical results obtained by mining had seldom been worth the labour, time and material expended, and when the front line was no longer strongly held mining objectives were lacking. The mining units were consequently employed on the provision of underground protection against the increasing bombardment by artillery and bombing aircraft. Deep dugouts for the protection of reserves, headquarters, signal offices, dressing stations, etc., and subways for underground communications were constructed. These subways, lighted by electricity, and containing water mains, telephone cables and tram lines, were of considerable extent. On the Vimy front there were 12 subways with a total length of 6 m., while east of Béthune it was possible to patrol four m. underground. Use was also made of the old underground quarries of Arras, which, provided with bunks, cookhouses, latrines, telephones, lighted with electricity and connected by subways to the front line, could accommodate 11,000 men.

Technical Progress.—Efforts to speed up the work at the mine face with the help of mechanical instruments have so far been unsuccessful. The labour and difficulty of disposing the spoil and concealing it from air observation make it essential that the galleries should be small in section—4 ft. 10 in. by 2 ft. 9 in. the normal size. In this confined space it is difficult to use a machine, and reliance is still placed on the miner with his pick, shovel and grafting tool.

While the actual method of making mines has altered but little, considerable improvements have been made in instruments and

accessories. The miner's dial and "dumpy level" facilitate the accurate alignment and levelling of shafts and galleries. Light is provided by electricity, and ventilation improved by means of mechanical fans and blowers. Ammonal and other high explosives have replaced powder.

For mine rescue work, to overcome the great danger of gas poisoning by carbon monoxide, Proto and Salvus sets are used; while mine stretchers enable a man to be dragged along a gallery and lifted out of a shaft. But perhaps the most important advance is in the provision of listening apparatus. Two types are used—the geophone, which works on the principle of the stethoscope, and the seismophone, which is an electrical detector. With two geophones the direction of the source of the sound can be obtained, while with seismophones (which do not give direction) one operator can listen in several galleries if they are connected up to the switchboard of a central listening chamber.

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SIENKIEWICZ, HENRYK (1846–1916), Polish novelist (*see* 25.54), died at Vevey, Switzerland, Nov. 15 1916.

SIERRA LEONE (*see* 25.54).—In 1911 Sierra Leone acquired the Kanre-Lahun area from Liberia in exchange for a district on the Morro river. Revised estimates give the area of the colony and protectorate at 27,250 square miles. Population (1921) 1,541,311. There were 1,161 whites and 599 Asiatics, mostly Syrian traders. The native population had increased by 137,000 since 1911. Freetown, the capital and chief port, had 44,142 inhabitants.

Steady, though somewhat slow, progress has been made since 1910 in education (vocational as well as literary), in sanitation, in communications and in better social conditions generally. In 1920 the importation of "trade spirits" was totally prohibited; in 1926 the last vestige of Government recognition of domestic slavery was withdrawn. Political progress was marked by the grant in 1924 of a new legislative council which contained three members elected in the colony on the basis of manhood suffrage, and also direct (nominated) representation of the protectorate. A notable event in 1925 was the visit to Freetown of the Prince of Wales.

Industry and Trade.—Commercially, Sierra Leone is still dependent on the products of the oil palm and on kola nuts, while ginger is the chief of the lesser exports. Experiments in the cultivation of cotton and maize for export were unsatisfactory, but promising new crops were cocoa, swamp rice and cocoanuts. During 1910–3 trade developed satisfactorily, and in this period a railway to serve the northern province was begun. It was completed to Kamabai, 182 m. from Freetown, in 1916. The World War caused a great shrinkage in trade, Germany having taken 87% of the export of palm kernels. The War, however, demonstrated the loyalty of the natives to Great Britain, and the Sierra Leone forces played a prominent part in the Cameroons campaign. In 1918 there was a severe epidemic of influenza at harvest time and this, added to adverse weather conditions, led to a famine in 1919, which was marked by serious rioting, the Syrian traders being accused of hoarding foodstuffs. The year 1920 was one of great activity and inflated prices. It was followed in 1921–2 by a period of financial stress, but by 1923 trade had revived and in the two succeeding years steadily increased.

Taking 1913 and 1924 as normal years, imports (which are mainly foodstuffs and cotton piece goods) increased from £1,292,000 to £1,475,000; exports from £1,490,000 to £1,510,000. (In 1920 imports had been £3,175,000 and exports £2,916,000). In 1924 Great Britain took 97% of the palm kernels and supplied 65% of the imports. Revenue in 1913 was £618,000 and in 1924 £868,000. Expenditure in 1913 was £622,000 and in 1924 £777,000.

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SIGNALLING (*see* 25.71).—The functions of signal communications in the field are threefold, namely:—

(1) To enable information to be transmitted from front to rear, so that the higher command may know the course of events in the forward area and the administrative requirements of the troops;
(2) to enable orders to be transmitted from rear to front, so that the higher command may exercise effective control;
(3) to facilitate co-operation in battle between different bodies of troops and different arms, and between troops and aircraft.

The importance of these functions increases with every advance in the application of mechanical science to war. When armies fought in close order and generals commanded from the saddle, effective control could be exercised by means of gallopers bearing orders to different parts of the field. To-day infantry and machine-guns, artillery, tanks and aircraft have to act together in a concerted effort which demands the closest intercommunication. A modern commander is provided with an instrument of unprecedented striking power but of such complexity that it cannot be controlled without a very complete system of signal communication.

Provision of Signal Communications.—In the British Army the responsibility for providing signal communications is shared between the Royal Corps of Signals and the regimental signallers of cavalry, artillery and infantry units. The sphere of the Royal Signals extends from the base forward to the headquarters of regiments, batteries and battalions. Within these units communication is provided by their own regimental signallers. Each formation, whether division, corps, army or lines of communication, has a unit of the Royal Signals allotted to it to provide communication between its commander and his subordinates as well as with commanders of formations co-operating with him.

Methods Employed.—Four means of intercommunication are employed. These are: 1. Message-carrying by runners, dispatch riders and sometimes pigeons. 2. Visual telegraphy by lamp, flag or heliograph. 3. Line telegraphy and telephony. 4. Wireless telegraphy and telephony.

A sound signal system demands all four methods, co-ordinated so that each by its special capabilities makes good the weak points of the others. Reviewing each in turn, it may be said that the first, the oldest method of all, remains one of the most important. In the confusion of the infantry fight the runner is often the only possible means of conveying information and orders. At the same time, in the most highly organised signal system the dispatch rider on horse or motor-cycle is indispensable. His usefulness lies in the great volume of correspondence he can carry, and his rôle is to release the telegraph for its legitimate work of sending short and urgent messages without delay. On the other hand, a dispatch rider may be killed or captured with dispatches on him, while his use may be forbidden by natural obstacles or a hostile population. The use of pigeons is limited by the fact that they take a considerable time to learn their way to a loft in a new position. Consequently, they cannot be employed in mobile warfare. In static operations between fixed opposing lines they have proved valuable.

The next method, that of visual telegraphy, has its chief use in the forward area, where complicated electrical apparatus cannot be carried. A small electric lamp is the most generally used instrument for both day and night, except in sunny climates, where the heliograph is extensively used in daytime. The flag under modern conditions is often too conspicuous for use under fire. An important branch of visual telegraphy is the display of signals on the ground, in the form of white canvas strips, to convey information to friendly aircraft.

Thirdly, there is wire communication, for which the medium varies from light cables laid on the ground in the forward area to heavy overhead routes of the regular G.P.O. pattern on the lines of communication. Communication by wire is the best method of all when it can be established and maintained. It carries a greater volume of traffic than any other means, and it

allows telephony to be used. It is comparatively secret, and any number of lines can be run in a given area without mutual interference. The military drawbacks are that a great weight of cable and other material has to be carried; the lines take time to construct; their maintenance absorbs many men, and they may be cut by shell fire or bombing, by raids, enemy agents or a hostile population. So vulnerable were the field cables to shell fire on the Western Front in the World War, that in long established sectors they were buried six ft. or eight ft. under ground.

Finally, we have wireless. This avoids all the drawbacks of line telegraphy, but it has weaknesses of its own. It is easily intercepted by the enemy, and if cipher is used to counteract this it entails serious delay. Communication is liable to interruption by atmospheric disturbance, by our own or neutral stations or by the enemy. The apparatus is delicate, and the technical training of the men is slow and costly. The number of links of communication which can be established in any area, without mutual interference, is limited. But some of these drawbacks should pass in time, and wireless communication has two great advantages. The first is that it is the only effective means of communicating between aircraft and troops; the second is that it reduces the extent to which a commander is tied to a telegraph line. Beyond these palpable facts is the less solid, but no less important, consideration that wireless offers the greatest possibilities of development to meet the needs of the future; whereas the older methods have been exploited, so far as can be seen, almost to their limit. The wireless apparatus ranges from light forward sets carried on a pack animal or on men's backs, for use within brigades, to semi-permanent installations with a range measured in hundreds of miles for use between stationary and widely separated headquarters.

Principles of Employment.—Signals, like every other branch of war, are subject to the principles of economy of force, security and co-operation, and certain rules have been evolved under the stress of experience for applying these principles. The means are economised by making no attempt to provide a direct link wherever communication is required between two points; a system of signal centres is established instead, connected from front to rear and laterally, so as to cover the theatre of operations with a grid of signal communications. Each link of the grid is made as strong as possible by employing on it not one method only, but as many of the four means as are available.

Every headquarters is then either sited at a signal centre or gains touch with the system through the nearest signal centre. In the back area a signal centre may consist of an important signal office at a junction of permanent wire routes with a number of telegraph instruments and a large telephone exchange, several long range wireless stations and a group of motor cyclist dispatch riders. In the forward area it may merely have a small man-carried wireless set, a signalling lamp and a few runners.

During an advance the headquarters of each leading formation moves forward by bounds, establishing at each halting place a signal centre connected with its subordinate headquarters, those on either flank and the higher formation in rear. The higher formation moves forward in its turn, takes over and consolidates the gridwork thus formed, and embodies it in the rearward administrative system.

Co-ordination of the four methods is secured by establishing a signal office at every important headquarters in the field. The signal office controls all the available means of intercommunication at the disposal of the headquarters concerned. It contains the line telegraph instruments and telephone exchange; the wireless stations are sited as close to it as possible, and the dispatch riders are within call. All messages for transmission are handed in there; they are registered briefly so that they may be traced at any time, and are then either handed to a dispatch rider or a telegraph operator, to go by whichever one of the four methods is most appropriate. All messages destined for a headquarters go first to the signal office, whence they are distributed to the officers concerned. For signalling on railways, (*see* RAILWAYS).

See H. M. Dowsett, *Wireless Telephony and Broadcasting*, vol. I (1923). (C. TR.)

SIKHISM.—When Sikhism revived (*see* 25.84) its divisions also sprang into new life. In the main democratic in political and congregational in religious government, the Sikhs had passed through a monarchical phase under Mahārāja Ranjīt Singh and his successors, a phase reflected dimly in a Hinduising tendency in religion. In the soil of India the reformer may graft exotic ideas upon an indigenous stock, but, sooner or later, the alien growth wilts and the old type reasserts its vigour. The Sikh, not unlike David Deans, prone to evolve his own principles and practice, retained his many sects and orders; but all tended to revert to an indigenous type. The strict Sikh neglected all but a few outward signs of his adhesion to the Gurūs, while the laxer brethren became virtually Hindus, worshipping Hindu gods and, perhaps more especially, goddesses, early legends attributing even to Gurū Govind Singh the patronage of Devī, *the* goddess, and merely adding the Sikh Gurūs and many minor holinesses to the Hindu pantheon.

Hinduising Tendencies.—One sect indeed retained its vitality. The Kūkas or "Shouters," always credited with hatred of British rule, maintained in practice an implacable anti-Moslem attitude, which took the shape of carefully planned murders of Mahommedan butchers; it being a characteristic of Sikhism that while it disavowed polytheism it retained the ancient Hindu veneration for the cow and resented the slaughter of kine for food or sacrifice. The sect never regained much influence or repute. Its ethical teaching in its inception was probably that of Govind Singh, but it is said to have fallen to the depths of degradation usual in a secret society. The significance of its emblems, a high, straight turban and a knotted woollen necklace, has never been disclosed, but they suggest a militant asceticism. Of still less moment until recently was the fanatical Akālī order which had given trouble to Ranjīt Singh himself. It had sunk to the rôle of mere buffoons at Sikh gatherings, recalling the preaching fox in a mediaeval choir, but its latent militancy has proved to be only too easily fanned into flames. On the other hand, the great Sikh orders of the Hinduising Right, the Udāsīs and the Nirmalas, the "sad" and the "stainless," had retained much of their wealth, prestige and even spiritual influence, but tended to approximate to sacred castes on the model of the Brahmans.

Failure of the Theocratic Ideal.—In its ideals a theocracy ruled by its sacred volume, the *Granth Sahib*, Sikhdom once possessed a Convocation in its Gurūmatta or House of Clergy, which might have developed into an effective constitutional body by co-optation of the laity but for its complete disappearance under the military chiefs who arose after the death of the last Gurū. The Sikh monarchs made no attempt to resuscitate it. Hence the Sikh congregation, lacking any organisation or central control, rapidly disrupted. Apart from the great fanes, the village became the only real unit. And the orders were equally unorganised, having at best a titular head whose powers were undefined, no corporate body capable of holding property, and only the weakest agencies for enforcing discipline. Thus when a village, as it often did, built itself a *gurdwāra* or "*gurū's* portal" for the recital of the sacred books and the teaching of the sacred script, it would elect as its incumbent a brother of a religious order or even a spiritually minded layman.

The Village Temple.—This humble temple it endowed with a glebe, but, just as the orders had no written statutes, so the temple rarely, if ever, had a written grant. The incumbent was trustee of the glebe and shrine, but no law of trusts existed. At best he was under the *de facto* control of the village congregation and less definitely under that of his order. But the principles of each order varied. Some leaned towards congregational control, others towards priestly authority. Sometimes a vacancy was filled by the disciple designated by the last incumbent, with or without ratification at an assembly of priests convoked from neighbouring shrines; at others it was filled by a loosely constituted gathering of all who frequented the temple. At times efforts were made to set up something not unlike episcopal control or a royal right of presentation. Yet, whatever the founders' intentions, the terms of the traditional grant, the unrecorded rules of the order, or the unvoiced wishes of the worshippers,

the succession both to the spiritual power of the first incumbent and to the temporal benefits of his endowment tended more and more to vest in a holy family by physical inheritance. Even "celibate" Udāsīs founded families who are owners of wealthy religious properties and rich refectories, though bitter dispute as to division of the inheritance and the right to succeed to the office of chief abbot may from time to time impair their resources. Under Sikh rule such matters were doubtless settled not by rule of law, but by the ruler's will. Still they *were* settled, and popular feeling probably kept his caprice within bounds, just as it constrained him to prevent gross abuses. With that achieved he and his subjects were content, and if he failed to do more he had before him a precedent in the history of the Ten Gurūs themselves. No one of them had established any rules for the succession to the Gurūship or method for election to that office.

The Pontificate Itself Hereditary.—The first, Nānak, had appointed his successor and clearly did not intend the pontificate to become hereditary, yet that principle was promptly asserted by the Udāsīs, who ascribe the foundation of their order to his eldest son and set but little esteem upon the teachings of Govind Singh. And the succession to the Gurūship itself soon became almost rigidly hereditary after the 4th Gurū. The Eastern feeling that holiness runs with physical descent was doubtless further strengthened by the rise of the Sikh aristocracy and monarchy, both hereditary and impelled by self-interest to suppress the elective principle. Hence the history of every ecclesiastical office tended to reproduce in miniature that of the Gurūs' dynasty. But this did not result in reducing all the Sikh endowments to personal appanages of saintly families, and many remained under the rude but effective control of the monarch, the orders and even the people, until power and responsibility passed into British hands.

The Act of 1863.—In 1863, however, the British Govt. passed an Act to divest itself of the management of religious endowments, and thereby denuded itself of all power to prevent waste or malversation. The Sikh layman or the religious brother who witnessed the decay of his village *gurdwāra* or the house of his order falling into disrepute could indeed have recourse to the regular law courts, but the complexities of his suit would make it costly beyond the measure of ordinary litigation. To a court trained in the subtleties of ecclesiastical and canon law as laid down for the diverse denominations and varying statutes of religious fraternities in the West the questions arising in such a cause would have been difficult of decision.

The Lay Tribunal's Failure to Prevent Abuses.—To courts innocent of such a learning they were insoluble. The arraigned incumbent would deny his pursuer's membership of his congregation or order, the right of any such member to call him to account and plead his own unworldliness as explaining any deficit in his funds or defects in his administration. But matters were worse when the shrine had become in effect purely private property. As their inheritance followed no law but indeterminate custom the courts adopted the fatal principle that in all points each shrine was governed by its own customs, without regard to the general tenets of Sikhism or the particular rule of the order. The minor temples were in effect freed from all control, and to such a depth of corruption did some sink that a professedly celibate priest was heard to depose that no Udāsī was truly qualified for spiritual office until he had seduced a married woman of his flock. Many endowments were wholly alienated to pay for open debauchery, a result the more regrettable in that the beautiful Hindu temples of the Punjab Himalayan cantons owe their preservation to the fact that the executive has retained control of their secular affairs, leaving religious matters to their priests, but nominating their bursars and auditing their accounts.

Sikh Protests and Lack of Unity.—Sikh discontent at this state of things was expressed against the administration of the Khālsa College and the Golden Temple, both at Amritsar. The council of the former was reconstituted to the general satisfaction, but owing to internal dissensions the latter offered a knottier problem. For years its calm had been disturbed by theological disputes, the more orthodox Sikhs resenting its adornment with pictures from Hindu myths painted at the instance of Hinduising brethren, and other lapses from strict monotheism. Eventually a provisional advisory committee of 175 members, partly nominated by Government, was accepted by a large meeting of Sikhs. It was to draw up a scheme of management, but never functioned. At critical junctures the manager, a Government nominee, had intervened on the side of law and order, exasperating some Sikh feeling by bestowing a dress of honour on Gen. Dyer, after the affair of Jalliānwāla Bāgh, and other steps. Whether the Sikhs had any just cause to complain of his acts as manager is not apparent, but in 1920 on Mahātma Gandhi's suggestion a Sikh public meeting held at Amritsar appointed a Shiromani Gurudwāra Parbandhak Committee—"for the management of shrines."

High-handed Acts of Shrines Committee.—This committee, swollen to 240 in number by 60 co-optations, claiming to have been chosen by universal adult suffrage, seized the Golden Temple and other places of worship. But it went beyond mere irregularities in procedure when it reorganised the Akālīs into lawless gangs or *jathas* recruited from more dubious elements than all Sikhdom could supply. One of its earliest steps, in 1921, was an attack on the very birthplace of Sikhism—Nānkāna, the home of Nānak's mother. Dissatisfied with the Udāsī *mahant's régime* the committee called on him to institute reforms, failing which it would eject him on a certain date. Fearing an attack the abbot enlisted mercenaries, many of whom were Moslem Afghāns. This roused fresh resentment that one of the holiest places should be so guarded, and precipitated matters. A gang of Sikhs seized the sanctuary several days before the date notified. They achieved their purpose but made the enclosure their sepulchre. Massacred by the mercenaries, not one escaped. In this encounter 130 lives were lost. The facts that the *mahant* was defending his property and that the initial aggression was on the Akālīs' side were ignored, and feeling against many *mahants*, especially those of the Udāsī order, was aroused.

Trouble at Gurū kā Bāgh and the Doāba.—Other lawless seizures of shrines followed. That of Gurū kā Bāgh in 1922 led to much unnecessary suffering, fortunately without loss of life. In Feb. a band of Akālīs had captured that *gurdwāra*, but the *mahant* retained its house and lands. The committee took steps to seize some land, claiming it as appurtenant to the shrine. The law was vindicated but 5,000 Akālīs were arrested. By then, however, the Akālīs had thrown out a new and more dangerous offshoot in the Babbar ("lion") Akālī *jatha*, devoted to the task of murdering village officials and others known to be loyal to Government and virtually defenceless in their isolation. Its proceedings deepened the terrorism already imposed by Akālī bands on the fertile country known as the Doāba, between the Sutlej and Biās rivers, and beyond it, full advantage of the temporary paralysis of the administration being taken by the lawless elements in general to commit murders and organise gang robbery. Misplaced economy reduced the police force to a cadre inadequate to protect life or property, and marked men were assassinated openly and with impunity, the employment of soldiery merely maintaining some semblance of order. Yet when in 1923 riots between Hindus and Moslems occurred at Amritsar the Akālīs not only held aloof but aided the authorities.

The Jaitoke Affair.—In 1924, however, their sympathies were aroused by the abdication of the misguided Rājā of Nābha, who had been levying private war against the sister Sikh State of Patiāla. The Shiromani Committee, exceeding its mandate to secure reforms of endowments, espoused the Rājā's cause and asked the Sikhs to conduct perpetual recitation of the sacred volume in all temples for his restoration. This behest was carried out in a temple at Jaitoke in the State territory, a manifesto of revolt against the new ruler. The recital was not in fact interrupted, but a seditious meeting was broken up. "Martyr" bands of Akālīs were thereupon organised to march to the temple and continue the recitation. One band, numbering 500 men, was reinforced as usual by a huge mob, and the latter charged the State forces. Fire was opened on it and it lost some

50 men, including 21 killed; but of the *jatha* nucleus only three or four fell.

The Shrines Act.—More seizures of shrines followed, but without untoward results, and in 1925 the Sikh Gurdwāras and Shrines Bill became law. It might equally well have been enacted in 1863. It provided, for the first time in Sikh history, legal methods for controlling Sikh religious endowments. Unfortunately, it confessedly allows the minority—the Udāsī and other orders—to go to the wall. For this result the failure of the Sikh orders to devise and enforce statutes for their self-discipline and to secure the rights of their congregations is mainly to blame. The Udāsī order is conspicuously distracted, having four or more suborders, bewildering varieties of garb, usage and doctrine, and tendencies to further disruption. So nebulous a body does not lend itself to legislative incorporation.

The Revival Anti-Brahmanical.—Briefly, the genesis of the reform movement may be explained. During the past two decades the Sikhs have swung distinctly to the left, *i.e.*, towards a more democratic, militant, un-Hindu platform. In 1909 their representatives obtained validation by a statute of the marriage ceremony called *anand*—"rejoicing." In Sikh eyes its validity (quite unnecessarily questioned in the courts) consisted in substituting their sacred writings for the sacred fire of the Hindus and in not employing Brahmans at weddings. This simple "reform" was carried by the efforts of the Singh Sabha or True Sikh Union, which aims at purifying Sikhism of accretions. The revival of Sikhism has thus some analogies with that of the Wahhābī sect in Islam. Going back to the teachings of the great Gurūs, the Sikhs are more attracted to the militant teachings of Govind Singh than to the quietist doctrines of Nānak.

Sikh Services in the War.—To this rekindling of the martial spirit may be fairly ascribed the fact that while the Punjab as a whole mobilised one man in 28 as against the rest of India's one in 150, the Sikhs in 1917 had supplied about one-sixth of the fighting forces of the Indian Empire with less than a hundredth of its population. And their contribution was almost entirely to fighting units. As an emigrant also the Sikh has achieved much. With the general anti-government movements in India the Sikhs have had no close solidarity. To a great extent the Sikh liability to paroxysms of popular passion is due to lack of education which makes no marked progress among the community, though it is one of the few in India which gives its women instruction in its sacred script. Nevertheless it is markedly less apt to be swept off its feet by incredible rumours or tendencious canards than some better read denominations. At his best the Sikh is dignified, level-headed, and in action sedate. But he has the defects of his qualities. He is reticent, and it is difficult to fathom the real grievances underlying discontent.

BIBLIOGRAPHY.—The Sikh has produced little recent literature, but Khazān Singh's *History and Philosophy of the Sikh Religion* (Lahore, 1914) is valuable. Gokul Chand Narang, *Transformation of Sikhism* (1912) and "Sikh Relics in Eastern Bengal," *Dacca Review* (1916), also throw light on Sikh history. (H. A. R.)

SILESIA, UPPER (*see* 25.90).—Article 88 of the Treaty of Versailles (1919) provided that the inhabitants of Upper Silesia (pop., in 1919, 2,280,902) should be called upon to decide by plebiscite whether they would belong to Germany or Poland (*see* PARIS CONFERENCE). The purely German districts of Falkenberg (pop. 37,526), Grotthau (pop. 40,610), Neisse (pop. 7,781), part of Neustadt (pop. 25,000) and Hultschin (pop. 45,552), in northern and western Upper Silesia were exempted from the plebiscite. Up to the day of the plebiscite the supreme authority in the plebiscitary area was to be vested in an Inter-Allied commission, consisting of one representative of France, Great Britain and Italy respectively. In this commission France was represented by Gen. Lerond, Great Britain by Col. Percival and Italy by Gen. de Marini. On Feb. 1 1920 Allied troops occupied the plebiscitary district. The local German officials were then subordinated to the Inter-Allied authorities. The German police was replaced by a special polling police (*Abstimmungspolizei*), composed half of German-speaking, half of Polish-speaking inhabitants.

The Plebiscites.—On the whole, the collaboration of the Inter-Allied control and the German officials proved satisfactory; but various differences arose, such as that which led to a strike of judges in May 1920. Both the Poles (under Korfanty) and the Germans opened an active canvassing campaign; and under Polish pressure the Germans in the southern and eastern districts were subjected to oppressive treatment. On Aug. 19 1920 the Poles made an attempt to seize the country by force. Bands, chiefly recruited from Congress Poland, usurped authority. A number of Germans were forcibly carried into Poland, and many were killed. Order was not restored for several weeks. In Jan. 1921 the date of the plebiscite was fixed for March 20 1921. The Polish terrorism immediately revived, especially in the district of Rybnik, Pless, Kattowitz and Beuthen.

It reached its climax in the days preceding the plebiscite. Voters from other parts of the German Reich were frequently refused admission to the polls; sometimes they were maltreated or even murdered; and houses where outvoters were staying were set on fire. The day of the plebiscite passed, however, without disturbance except at a few places, such as Rybnik and Pless, but on the following day the Polish excesses recommenced. The poll showed 717,122 votes for Germany and 483,514 for Poland. In 664 districts there was a German, in 597 a Polish majority. Practically all the towns voted for Germany. There was a Polish majority in the administrative districts of Rybnik, Pless, Beuthen, Tarnowitz and Gross-Strehlitz. The decision of the Inter-Allied Commission as to the allocation of the disputed regions was delayed by differences within the commission itself. The French representative, Lerond, who had from the first been accused of tacitly supporting the Poles, wished to allot the whole of southern and eastern Upper Silesia to them, while the British and Italian representatives wished to apportion the industrial region to Germany. Protracted diplomatic negotiations between Paris, London and Rome led to no result. At the end of April a report became current that the Council of Ambassadors had given only the districts of Rybnik and Pless to Poland.

Korfanty's Insurrection.—In consequence of this rumour the first days of May witnessed a new and more serious Polish insurrection. Korfanty had secretly raised a well-organised Polish force which received arms and reinforcements from Poland. He now occupied the whole southeastern part of Upper Silesia, on a line extending from the south of the district of Kreuzburg through Gross-Strehlitz to the Oder in the south. He nominated himself dictator of the districts under Polish occupation, took over the administration, and treated even the Allied officials with such scant consideration that they were obliged to withdraw to Oppeln and the regions not occupied by the Poles. It was only in the larger towns that the Allied troops, supported by the German population, were able to maintain themselves. A further Polish advance was prevented by the German defence force (*Selbstschutz*) under Gen. Höfer, composed of Upper Silesians and volunteers from other parts of the Reich. There was severe fighting between this force and the Poles, especially round Ratibor and Gross-Strehlitz. Col. Percival, the British representative, was obliged to resign owing to ill-health, and was succeeded by Sir Harold Stuart. Attempts by the Inter-Allied Commission to put an end to the insurrection by negotiations with Korfanty having failed, the Allies dispatched reinforcements of French and British troops to Upper Silesia.

After lengthy negotiations which were carried on with the German defence force, which refused to withdraw unless guarantees were secured that the Poles would first quit the field, an agreement was ultimately effected with regard to the evacuation. By June 20 the British troops had again occupied the larger towns, while the Poles commanded the rural districts. As a result of difficulties in paying and provisioning his followers Korfanty now lost control over them. Independent bands plundered the villages, ill-treated the Germans and murdered many of them. In the industrial districts work in many of the mines and iron works came to a standstill. By the end of June the loss suffered by the industrial region was estimated at three milliard marks.

The Decision of the League of Nations

The French persisted that the greater part of the industrial region should be assigned to Poland. Great Britain, on the other hand, firmly maintained that such a partition would, as Mr. Lloyd George publicly expressed it, be "unfair" to Germany on the basis of the Treaty of Versailles and the result of the plebiscite. There were at one time three rival proposals for partition: (*a*) the Korfanty line, the extreme Polish demand; (*b*) the Sforza line, a proposal put forward by the then Italian Foreign Minister; (*c*) the British proposal, giving Poland only the southeastern corner with the towns and districts of Pless and Rybnik. France was ultimately left in a minority of one on the supreme council, Italy and Japan having adhered to the British view. After prolonged debates and open differences among the principal Allied Powers it was arranged, at a Paris conference in Aug. 1921, that the solution should be entrusted to a commission of the council of the League of Nations. This commission was ultimately constituted by the representatives of Japan, Brazil, China, Spain and Belgium, with the Japanese representative, Baron Ishii, as chairman. On Oct. 20 1921 the text was published of the documents containing the award of the League of Nations on the partition.

The area assigned to Poland contained at least 75% of the aggregate material wealth of the disputed territory. The division here made in the industrial area, previously German, was such that the council of the League declared it to be desirable that measures should be taken to guarantee the continuity of the economic life of the region during a provisional period of readjustment, and to provide for the protection of minorities. It was recommended that a general convention for this purpose should be concluded between Germany and Poland, so as to place Upper Silesia under a special régime during the transitional period, and that an "Upper Silesian Mixed Commission" should be set up as an advisory body, composed of an equal number of Germans and Poles, with a president of some other nationality to be designated by the Council of the League, together with an arbitral tribunal for settling private disputes occasioned by the temporary measures.

The provisional or transitional period was to be 15 years, and certain stipulations were laid down by the League of Nations for the economic arrangements during that period in the "plebiscite area." (1) Railway and tramway systems, privately owned or municipal, were to continue under the terms of their concessions, and the German state railways were to be put under a joint system of operation. Railway rates were to be uniform. The state insurance of employees in the Silesian railway system was to be undertaken by that system. A single accounts office was to be set up for the whole system. Expenses of new construction were to be charged to a separate account, and borne by the state in whose territory it was carried out; the working capital for operation to be lent by the German State, and interest charged to the account of this system; profits or deficits to be divided between the two countries in proportion to the length of line and amount of traffic belonging to each. (2) The German mark was to be the only legal unit of currency, and Poland was to recognise the rights of the Reichsbank for a period not exceeding 15 years, but by agreement the two governments might modify this arrangement earlier. (3) While the German monetary system was maintained in the Polish zone, the postal, telegraph and telephone charges should be in German currency. (4) The customs frontier should coincide with the political frontier, and the German and Polish customs law should apply, with certain exceptions.

For six months incoming goods from other countries, on which German or Polish duties had been paid previously to the partition, should cross the frontier without duty. For 15 years, natural products originating or coming from one of the two zones of the plebiscite area and destined for consumption in the other should cross the frontier free of duty. For six months, raw, half-manufactured and unfinished products of industrial establishments in one zone, destined for industrial establishments in the other, should cross free of duty; and this should continue for 15 years when the products, as finished, were intended for free importation into the country of origin. Natural or manufactured products originating in the Polish zone should, on importation into the German customs territory, be exempt from duty for three years from the date of the frontier-delineation. As regards export, the two countries should facilitate for 15 years the export of such products as were indispensable for industry in either zone. (5) Poland was to permit, for 15 years, the exportation to Germany of the products of the coal-mines in the Polish zone, and Germany similarly to Poland in respect of the mines in the German zone. (6) For the 15 years, any inhabitant regularly domiciled or occupied in the plebiscite area should receive a "circulation permit," free of payment, enabling him to cross the frontier without other formalities. (7) Generally, the two countries should respect private rights.

The League followed up its recommendation by organising a German-Polish conference, which met at Geneva on Nov. 23 1921 under the presidency of M. Calonder (former president of the Swiss Confederation), and resulted in the signature of a detailed convention on May 15 1922. The subsequent friction between the two parties living under this convention was not more than was to be expected, considering the antecedents of the League's award. The most serious incidents were a strike in the Polish area over the question of lengthening the hours of work, which lasted from April to Aug. 1924, and an appeal by the German Govt. to the Permanent Court of International Justice under Art. 23 of the convention of May 15 1922. This article provided for recourse to the International Court in case of disputes over articles 6–22 of the convention, which dealt with the rights of Poland to expropriate private property. The Germans claimed that these articles were being infringed, while the Poles contested the court's jurisdiction in the matter. The German case was filed on May 16 1925, and on July 18 the court found that it did possess jurisdiction, so that the trial of the case proceeded. (*See* GERMANY; POLAND.) (A. J. T.)

SILK (*see* 25.96).—The most important and significant event in connection with silk since 1910 has been that, despite the vast development of artificial silk (*q.v.*), the genuine article has not only held its own but has steadily increased in demand. The chief cause of this growth has been the increasing demand for silk from the United States.

In 1900 the world's total output was 17,211,000[1] kilos. In 1913 the total output was 27,320,000 kilos. It fluctuated during the War, but in 1919 stood at 27,290,000 kilos. The next year marked the commencement of the trade slump, and the first indication of its approach was given by the refusal of the "buyers" to purchase their normal supplies of raw silk. In that year the output fell to 20,349,000 kilos. But the setback was only temporary, and since then output has mounted till, in 1924, the world's total production was 39,100,000 kilos.

Sources of Supply.—The principal sources of supply are Japan, China, Italy, the Levant, France, India and Spain, in that order. Of the various producing countries in 1900, 1913 and 1924, unfortunately India and China are not properly distinguished before 1922, but were included with Japan, which was the chief collecting area in the Far East:—

Countries	1900	1913	1924
	Kilos	Kilos	Kilos
Japan	11,037,000	20,760,000	24,525,000
Italy	3,275,000	3,540,000	5,255,000
Levant	2,079,000	2,588,000	1,095,000
France	736,000	350,000	335,000
Spain	84,000	82,000	95,000
China	..	..	7,715,000
India	..	..	80,000

The manufacturing countries of Europe and the U.S.A. are becoming more and more dependent on Asia, especially on Japan and China, for their supplies of raw material. The year 1924 showed an abnormally high output for Europe, and in particular France had a much bigger production than had been her average for the previous nine years. For example, her output in 1922 was only 198,000 kilos, although the total world's output was 31,660,000 kilos, or the highest previous to 1924.

As France is a very important silk manufacturing centre, the fact is somewhat disquieting. Her consumption in 1924 was 6,031,400 kilos, whereas she produced only 335,000 kilos and had 1,053,476 throwing spindles. Italy, on the other hand, produces nearly as much silk as she uses, the position in 1924 being that she produced 5,255,000 kilos of raw silk and consumed 5,610,000 kilos. The danger is that the important silk manufacturing industry of France is very largely dependent on supplies of raw silk from abroad, and the fact that the main supplies have to be obtained from the Far East means that she and other countries as well, are at the mercy of unforeseen circumstances which may, even temporarily, destroy this source of supply, such as a disease

[1] For full tables see *The Manchester Guardian Commercial Supplement*, "European Textiles," Dec. 10 1925, p. 42.

which attacks the silkworm, an earthquake on a vast scale or serious political disturbances.

On the technical side, nothing very startling has occurred, but it may be that a new invention which appeared in 1925 in Italy may in future years be regarded as important. By this new method the silk can be detached from the cocoon without the use of boiling water, and if this invention proves satisfactory when tried on a large scale two important results will be achieved. Firstly, much illness and even death among the operatives will be eliminated, as the fumes given off in the present process are often very injurious; and at the same time, if desirable, the silkworms themselves, which at present are killed by the boiling water, can be saved and allowed to develop into moths, lay eggs and so considerably increase the supply of silk. In conclusion, it may be added that while the chief demand for silk fabrics is for female attire, an important and comparatively new source of demand is in connection with the development of air navigation, especially for parachutes (*q.v.*).

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SILVER (*see* 25.112).—The annual world production of silver, which exceeded 200,000,000 fine oz. for the first time in 1908, continued above that figure during the next five years. The outbreak of the World War affected the output unfavourably, and the civil wars in Mexico—actively prosecuted during the years 1914–7—still more reduced production, for the Mexican contribution fell from 81,233,887 oz. in 1912 to 22,910,058 oz. in 1915, roughly a reduction of 58,000,000 ounces. The world production in 1914—172,263,596 oz.—was the lowest recorded since the year 1906, 165,054,497 ounces. The official authority for these world statistics is the report of the Director of the U.S. Mint, whose tabulated data from 1910–25 are appended:—

Silver Production (in fine oz.)
(Units of thousands)

Year	U.S.A.	Canada	Mexico	Central America	South America	Africa	Europe	Australasia	Asia	World
1910	57,138	32,869	71,372	2,027	14,477	1,037	15,992	21,546	5,257	221,716
1911	60,399	32,741	79,032	1,212	14,434	1,064	15,693	16,578	5,039	226,193
1912	63,767	31,625	81,234	2,846	13,981	1,217	15,992	14,738	5,505	230,904
1913	66,802	31,525	55,486	2,136	13,126	1,056	16,446	18,129	5,308	210,013
1914	72,455	28,407	26,062	2,755	10,449	1,059	14,535	11,000	5,542	172,264
1915	74,961	26,626	22,910	2,920	13,687	1,188	15,563	9,250	5,894	173,001
1916	74,415	25,460	29,771	2,603	15,580	1,203	14,001	10,700	7,070	180,802
1917	71,740	22,221	42,020	2,370	15,451	1,183	11,916	10,000	9,224	186,125
1918	67,810	21,384	62,517	2,900	14,712	1,257	12,663	9,934	9,982	203,159
1919	56,682	16,021	65,904	2,800	14,753	1,272	6,990	7,188	8,240	179,850
1920	55,361	12,794	66,662	2,700	14,588	1,232	8,372	2,685	8,903	173,296
1921	53,052	13,135	64,465	2,000	15,614	1,012	7,774	5,362	8,870	171,286
1922	56,212	18,581	81,077	2,000	21,395	1,320	8,342	11,485	9,403	209,815
1923	73,296	17,755	90,859	2,500	27,323	1,544	8,674	13,819	10,240	246,010
1924	65,367	19,736	91,486	2,686	26,660	1,802	9,453	10,739	11,139	239,068

Messrs. Samuel Montagu & Co., London, estimate the production for 1925 as follows:—

U.S.A.	Canada	Mexico	Elsewhere	World
66,000	19,000	91,000	64,000	240,000

The above table records a drop in the average Australasian figures for the years 1914–9 of about 8,000,000 oz. from the average of the four preceding years 1910–3. This is chiefly owing to the reduced output outside Australia. The very low figures for 1920 and 1921 were caused by prolonged mining strikes and an outbreak of fire at the Broken Hill Mines—the great producing centre in Australia.

Ever since the discovery, about the middle of the 16th century, of the rich silver deposits in Mexico and Peru, the Americans have contributed the bulk of the world's production: in 1924 their proportion was about 80%. Canada has become an important producer following the discovery of rich deposits in the cobalt region of Ontario, uncovered accidentally during the cutting of the Temiskaming and Northern Ontario Railway. The output in 1904 was 206,875 oz., and in 1910 reached 32,869,264 ounces. It is quite probable that even more valuable deposits, buried beneath the vast Canadian forests, await similar chance discovery. The increase in the Asiatic contribution is chiefly attributable to the active development, under British management, of the Burmese mines; these mines had been worked intermittently in past times by Chinese labour. The output rose from 105,603 oz. in 1916 to 5,287,711 oz. in 1924.

Mexican Output.—The magnificent contribution of Mexico in 1924, amounting to 91,486,136 oz., is by no means the utmost that can be expected from that quarter, though it represented over 37% of the world production. Many wide areas known to be rich in mineralised ore are still untapped, owing to their inaccessibility and to the lack of capital. Given a government whose stability would encourage the entry of foreign capital, and extension of railways, it would be difficult to forecast a limit to the amount of silver which Mexico would produce. Other points worth notice are the gradual exhaustion of the European output, and the substantial increase in the production of South America in consequence of favourable mining developments in Peru. The large production of the United States of America during 1923 was owing to the desire of American mining companies to obtain the high price of 100 cents an oz., paid by the United States Treasury under the Pittman Act. This measure authorised the replacement at that figure of the silver represented by the dollars which were broken up and sold to the Indian Govt. in 1918.

The figures of the world production of silver during the period 1917–24 by no means include all the world supplies for those years, for very large amounts of silver plate were melted and realised, and enormous quantities of silver coins were demonetised owing to the rise in the price of silver, which caused the intrinsic worth of the coins to exceed their nominal value. During 1922 alone over 50,000,000 oz. is estimated to have been placed upon the market. Silver continues to flow, as it has for centuries, from West to East, where it is absorbed by the populous countries of Asia, mostly in payment for foodstuffs and raw material needed by Western nations. Before the World War nearly 50% of the world's production was thus absorbed. The following are the net imports in the official returns of the Chinese and Indian authorities:—

Net Imports of Silver into China (in oz.)

1910	23,756,000	1918	25,609,000
1911	41,753,000	1919	57,907,000
1912	20,981,000	1920	100,976,000
1913	39,205,000[1]	1921	35,349,000
1914	14,849,000[1]	1922	43,134,000
1915	20,036,000[1]	1923	73,243,000
1916	31,259,000[1]	1924	28,342,000
1917	22,871,000[1]		

[1] Net export.

Net Imports of Silver into India (in oz.)

Year	On Government a/c.	On Private a/c.
1910–1	223,237	54,880,471
1911–2	164,061	32,065,039
1912–3	56,025,301	35,052,341
1913–4	35,309,524	35,797,827
1914–5	[1] 4,251,329	60,017,452
1915–6	[1] 2,697,540	35,629,913
1916–7	104,140,566	11,946,760[1]
1917–8	72,150,731	2,380,767
1918–9	233,702,408	3,326,211
1919–20	99,853,233	2,911,451[1]
1920–1	[1] 138,629	22,378,075
1921–2	608,680	63,525,636
1922–3	659,599	85,397,544
1923–4	1,176,094	92,081,963

[1] Net export.

Appreciation During the World War.—The annual totals varied greatly, largely owing to the influence of the War upon the Far Eastern demand. China, taking advantage of the high price of silver as compared with gold, exported silver to India and imported gold, later replacing the silver. Indian demand was increased by restrictions placed upon gold imports from the United Kingdom. Failing the unlimited supply of gold to which they had been accustomed, the natives took silver instead. The high cost of commodities in the United Kingdom and allied countries during the earlier years of the War, together with the need of providing small change to the military camps scattered throughout these countries, called for the provision of subsidiary coins on a large scale. Russia, France and Italy were in a similar plight, and even neutrals like Holland came into the market, impelled by rising prices. As the War continued, the greatest strain fell upon India, which had to provide currency for troops and munitions in three great theatres of the War—Mesopotamia, East Africa and Egypt. The stock of silver rupees in the Indian treasuries on Aug. 15 1914 was 3,776 lakhs; on April 7 1918 it had fallen to 1,044 lakhs. The United States Govt., unable to secure rupees to pay for purchases from India, sold to the Indian Govt. 207,000,000 oz. of silver derived from United States dollars lying idle in the Treasury. At the same time the high value of silver was unearthing supplies of silver coin from out-of-the-way places. Manila dollars, the Maria Theresa dollars current in the Arabian Gulf, and Afghan and other coins were put into the melting pot to be reminted into rupees, whilst most of the silver coins of Russia filtered into the interior of Asia in exchange for goods, in lieu of Russian notes, which, before the Russian debacle, were freely current.

During 1914–7 nearly 90,000,000 oz. were shipped from China to India—a temporary measure only—caused by high prices. These heavy movements account for China's large imports of silver in succeeding years. The replacements of these exports, notwithstanding sales of demonetised silver by Germany and other countries during 1919–20, drove the price of silver on Feb. 11 1920 to 89½d. an oz., the highest quotation on record. Drastic measures were then taken by the British Govt. to check the advance in price, which was adversely affecting the value of the rupee. The quality of the silver currency of the United Kingdom and its dependencies was reduced from ·925 to ·500 fine; the surplus from this source was about 59,000,000 ounces. When this important step was taken by the United Kingdom, the edge of the China demand, then accentuated by speculation for the rise, was blunted. In 1920, 70,000,000 oz. were imported into China from San Francisco and 20,000,000 oz. from London. As the price of silver fell, the United States Treasury commenced purchases in 1920, which were completed in 1922, to replace the silver sold under the Pittman Act to India, and, though the new demand provoked some competition from China, the possibility of shipments of silver from India and supplies of demonetised Continental silver soon restored the market to normal conditions.

In 1924 a new inquiry set in from Europe; silver was acquired for coinage by the governments of Russia, Germany, Austria, Poland and other countries. Currency conditions, however, were still unstable, and some of the newly minted coins, melted into bars, came back to London for realisation after a few months. The employment of silver for the arts and sciences, which languished during the War and in the years immediately succeeding, became more normal by 1924. The amount thus applied is usually about 40,000,000 oz. a year, the great bulk of which is used in the United States. Barring unexpected discoveries, the principal source of supply in the future is likely to be Mexico, should local conditions remain favourable, whilst the great material progress of India, owing to War profits, new industries and a series of good monsoons, will probably keep that great Empire in the forefront of consumers.

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SIMMEL, GEORG (1858–1918), German philosopher and sociologist, was born in Berlin March 1 1858. Professor of philosophy first in Berlin (1901), then in Strasbourg (1914), Simmel was one of the first academic philosophers to apply philosophy to history and sociology. His philosophy centres round the conception of a spiritual life, various in its forms, and obedient to its own laws, whose external manifestations are to be seen in sociology and the arts. The ultimate theme of his works, which are written in a brilliant and very personal style, is nearly always the connection between life and the metaphysical general principles, revealed to the philosopher in concrete existence. He died in Strasbourg Sept. 28 1918.

Simmel's chief works are: *Über Sociale Differenzierung* (1890); *Einleitung in die Moralwissenschaft* (1892–3); *Philosophie des Geldes* (1900); *Kant* (1904); *Die Probleme der Geschichtsphilosophie*, 2nd ed. (1905); *Schopenhauer und Nietzsche* (1907); *Die Religion* (1907); *Philosophische Kultur* (1911); *Rembrandt* (1917); *Grundfragen der Soziologie* (1917); *Lebensanschauung* (1918). See W. Knevels, *Simmels Religionstheorie* (1920); N. J. Spykman, *The Social Theory of G. Simmel* (1925).

SIMON, SIR JOHN ALLSEBROOK (1873–), British politician and lawyer, the son of a Congregational minister, was born Feb. 28 1873 at Bath, and educated at Fettes College, Edinburgh, and Wadham College, Oxford, where he was a scholar. He became president of the Union in 1896, and was subsequently elected fellow of All Souls. He went to the Bar, became Barstow Law scholar in 1898, and was called in 1899. His manifest abilities and the persuasiveness of his advocacy soon brought him to notice; he was chosen one of the counsel for the British Govt. in the arbitration on the Alaska Boundary in 1903; and he rapidly attained so considerable a practice that he was able to take silk in 1908. He had gone into politics, and was elected Liberal member for Walthamstow at the general election of 1906. At first, probably owing to his absorption in his legal work, he did not command nearly so much attention in Parliament as his Wadham contemporary and fellow-lawyer, Mr. F. E. Smith (afterwards Lord Birkenhead). But he gradually made his way, and was appointed by Mr. Asquith Solicitor-General in 1910, was knighted the same year, and became Attorney-General with a seat in the Cabinet in 1913.

On the outbreak of the War in 1914, his resignation, along with those of Lord Morley and Mr. Burns, was confidently expected; but he finally decided to remain with his chief and the bulk of his colleagues. When the first War Coalition Govt. was formed, in May 1915, he was offered the lord chancellorship, but he declined the greatest prize of his profession as he preferred a political career in the Commons. Accordingly he accepted the home secretaryship, and gave up his legal practice. Early, however, in the following year, owing to his inability to accept the Government bill for compulsory military service, he resigned his office and led a fruitless opposition to the measure in the House; and then went out to the front in France as a major in the R.A.F. He subsequently resumed practice as a barrister, and immediately regained his position in the front rank of his profession. On the break between Mr. Asquith and Mr. Lloyd George in 1916, Sir John Simon adhered to the former. He lost his seat in Parliament at the general election in Dec. 1918, but was returned for Spen Valley in 1922. On the occasion of the general strike in May 1926 Sir John Simon argued in Parliament that the strike was not covered by the Trade Disputes Act and his speech, coming from such an eminent legal authority, created a deep impression.

SIMONDS, FRANK HERBERT (1878–), American writer, was born at Concord, Mass., April 5 1878. He graduated from Harvard University (A.B., 1900), after having seen active service in the war with Spain. He became a reporter on the New York *Tribune* 1891, and was its Washington correspondent in 1903 and

its Albany correspondent in 1904. He was Albany correspondent of the New York *Sun* 1905–8. He became a member of the editorial staff of *The Sun* in 1908, editor of the New York *Evening Sun* in 1913, and in 1915 joined the New York *Tribune* as associate editor in charge of its editorial columns. His brilliant articles in *The American Review of Reviews* (1915–8), analysing the military and political situation from month to month, brought him a wide reputation. After the Armistice he continued to contribute articles on international politics to this review and other periodicals. He published, besides other works, *They Shall Not Pass—Verdun* (1916); *History of the World War*, 5 vol. (1917–24).

SIMS, GEORGE ROBERT (1847–1922), British journalist and dramatic author (*see* 25.136), died in London Sept. 4 1922. He published a book of reminiscences, *My Life*, in 1917.

SIMS, WILLIAM SOWDEN (1858–), American naval officer, was born at Port Hope, Ont., Canada, Oct. 15 1858. In childhood he removed to Pennsylvania, and he graduated from the U.S. Naval Academy in 1880. Then for eight years he served on board various ships in the North Atlantic. During 1889–93 he was with the nautical school ship "Saratoga," and then was transferred to the Pacific Station, and later to the China Station. From 1897 to 1900 he was naval attaché to the American Embassy, first at Paris and afterwards at St. Petersburg (Leningrad). In 1900 he returned to the Pacific Station. Convinced of the inadequacy of American methods of target practice, he pressed his views upon the Government, and in the end was enabled to arrange for a gunnery test and prove his claims. In 1902 he was assigned to the bureau of navigation, serving for the next seven years as inspector of target practice, which remarkably improved under his guidance. Meanwhile in 1907 he was made commander and appointed naval *aide* to President Roosevelt. He became commander of the battleship "Minnesota" in 1909. The following year, during a visit of the Atlantic Fleet to England, Commander Sims caused a stir by certain indiscreet remarks made at a dinner at the Guildhall, London, where he said: "Speaking for myself, I believe that if the time ever comes when the British Empire is menaced by an external enemy, you may count upon every man, every drop of blood, every ship and every dollar of your kindred across the sea." A semi-official protest against this utterance was made at Washington by the German Govt., which took offence at it, but the incident ended in a severe reprimand from the Secretary of the Navy.

In 1911 Sims was promoted captain, and for two years was a member of the staff of the Naval War College, Newport, Rhode Island. During 1913–5 he was in command of the Atlantic torpedo flotilla, and then returned to Newport as president of the Naval War College. When America entered the World War in April 1917 he was chosen to command the American naval forces in European waters. In Jan. he had been promoted rear-admiral, and in May he was made vice-admiral. In his book *The Victory at Sea* (1920, in conjunction with Burton J. Hendrick) he shows how the convoy system, used in transporting 2,000,000 American troops, frustrated the submarines. On conclusion of the War he relinquished command of the fleet, and in Feb. 1919 resumed his position as president of the Naval War College. In 1919 he criticised the manner in which naval honours had been awarded. He received the G.C.M.G. from King George V. in 1918. In 1920 he made a formal report to the U.S. Senate, charging the U.S. Naval Board with serious errors in the conduct of naval operations during the War.

SINGAPORE (*see* 25.147).—A hundred years ago, Singapore was no more than an insignificant fishing village built on piles on the outskirts of a tropical forest. To-day it is one of the world's greatest ports, with a population of 457,000, and is the capital of the Crown Colony, the Straits Settlements. Its amazing growth is due to three causes, so closely interdependent that no one of them would have been effective without the other two. First must be put its geographical position on the island of the same name which lies at the southern extremity of the Malay Peninsula (1° 20′ N.—103° 50′ E.); secondly, British enterprise; thirdly, Chinese business capacity and efficient labour. Strategically and commercially it occupies a unique position. It is a natural gateway through which must pass all the vast traffic on its way from Europe to China and Japan, and upon which converge the great ocean routes connecting India with the Dutch East Indies, Australia and the Far East.

With its great advantages Singapore is able to cover expenses without either income tax or death duties; but nearly one half of the revenue is derived from opium. By treaty the Straits Settlements may be called upon to pay 20% of their revenue towards the upkeep of the military establishment maintained for defence, but for many years past the cost has never been more than about two-thirds of that sum. The main defences and the artillery barracks are at present on the island of Blakan Mati; the royal engineers are on a smaller island, Pulau Brani, on which also stand the largest tin-smelting works in existence; the infantry are stationed at Tanglin on the main island.

The War Situation.—At the outbreak of War in 1914 the British battalion which forms the backbone of the garrison was withdrawn for active service elsewhere, and the protection of the island was entrusted to Indian troops, who were not altogether well affected. A large number of German civilians were placed in an internment camp, and there is reason to believe that some communication passed between the prisoners and the troops. A dangerous mutiny broke out in 1915. The Indian troops shot several of their officers, and many other Europeans were killed. For several days the situation was extremely critical, and all women and children were removed from their houses to ships in the harbour. In the absence of regular troops the mutiny was suppressed by local volunteers (by no means all of whom were familiar with the use of arms), who received great assistance from H.M.S. "Cadmus" and from H.H. the Sultan of Johore. French, Japanese and Russian ships hurried to the spot, but by the time they arrived serious trouble was at an end. With this exception the years 1914 to 1918 may be said to have been uneventful in comparison with the terrible experiences in Europe and elsewhere; but so soon as hostilities ceased and the German fleet had surrendered, the military importance of Singapore underwent a remarkable change.

Singapore as a Naval Base.—Properly to understand this change, it is necessary to go back to the Russo-Japanese War, and to remember that the destruction of the Russian Fleet in the battle of the Sea of Japan completely altered the balance of sea-power in the Far East. Up to that moment it had been necessary for Great Britain to maintain a considerable naval force in the China seas, but so soon as the supremacy of the Japanese was unchallenged every available ship was brought back to the North Sea, where the German menace was already making itself felt, and our eastern interests were confided to our Ally. These conditions underwent another complete alteration when the German Fleet had been safely escorted to Scapa Flow. On the one hand all danger had been removed from European waters, while on the other hand our commitments in the East had grown.

It was no longer right, or indeed possible, to ask others to shoulder responsibilities which were our own, and it was argued that we must ourselves be in a position to safeguard our vast trade with China and Japan, as well as with Australia and New Zealand. This could not be done without a base in the Far East, and the choice evidently lay between Hongkong and Singapore. Hongkong had many advantages, but it was somewhat isolated and distant from possible support in India; moreover, a naval fortress there might be taken as provocative and a direct threat to Japan and China. Singapore, on the other hand, provided adequate facilities, and as it was not less than 3,500 m. from Tokyo the establishment of a naval base there could be represented as a reasonable precaution and not as a hostile decision. This decision was followed soon afterwards by the naval conference at Washington (*q.v.*), when the Anglo-Japanese alliance was replaced by the Four-Power Pact. England, as part of her contribution towards peace, bound herself to undertake no new fortification east of 110° of latitude. Hongkong was thus definitely ruled out, and the decision to establish the base at Singapore was almost immediately made public.

Opponents of this decision have declared that it is an infringement of the spirit of the Washington conference, but for this allegation there are no grounds whatever. Great Britain's intention was well known both to America and Japan. Other objections which have been raised are that we are threatening our former Ally, and that Great Britain cannot afford the expense entailed. The former objection has already been answered; with regard to the second it can only be said that security cannot be measured in terms of pounds, shillings and pence. A more serious objection is that Malaya and the Straits, with all their wealth, provide none of the real necessities of life. Everything is imported: meat from Australia, vegetables from Java, rice from Siam, Burma and China, milk in tins from Switzerland. With a large Asiatic population this is a serious consideration; but if we can safeguard our trade routes we can equally safeguard our own supplies. The Singapore base is now an established fact in British Imperial strategy. The Government of the Straits Settlements have made a free gift of the necessary land, and many of the Dominions and Colonies have contributed, or promised to contribute, towards the expense of construction. Its Imperial significance could not receive more sincere or more practical acknowledgment.

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(N. M.*)

SINGING.—In singing and speaking, the voice is produced by the action of breath on the vocal cords, the vibrations of which are transmitted to the air passing upward between them. These vibrations are developed in volume and quantity in the resonating cavities above.

It is generally conceded the world standard of vocal technique in the 20th century is lower than formerly, and considerably lower than that which prevailed in Italy 150 years ago. Various reasons are advanced for this, the absence of standardised theories and methods of teaching, excessive emphasis laid upon physical phenomena and physiological details in the education of singers, the demand for artistic rather than vocal excellence in public performances, the amount of vocal music now written that is not skilfully adapted for the voice, and the unwillingness or inability of singers to give sufficient time to their period of study before launching upon a professional career. Those interested will find the subject discussed in one of the lectures published in Hahn's book, which, however, has, up to the time of writing, not been published in English.

I. THE MECHANISM OF SINGING

Vocal Cords and Larynx.—That the vocal cords do not invariably vibrate throughout their breadth in the same manner has been shown by the experiments of Oertel, Koschlakoff and Simanowski. Further evidence of this has been obtained by Curtis, who has experimented with an improved model of Oertel's stroboscope, and has proved that in the lower or chest register of the voice, the vocal cords vibrate throughout their entire length, and throughout their entire breadth in a manner which increases the extent of the excursion of individual points as their distance increases from the fixed border of the cords. The vibrations of the two cords are synchronous, and the extent of oscillation considerable. When a note of higher pitch is sung, an increase in length and a decrease in breadth in the cords is noticeable.

In the upper register the cords are again seen vibrating throughout their entire length and entire breadth, but the characteristics of the movements are different. The cords are flatter and have thinner edges, and are divided into segments which have their own rate of vibration. The division in each cord is characterised by a faint nodal line, marking off a narrow zone comparatively close to the free border, and this nodal line divides the cord in its breadth into two unequal segments, that nearest the free edge taking up three-quarters of the width, and vibrating freely; and the inner, smaller segment vibrating to a much smaller extent. It has been noticed that the vibrating cords have also on their free edges nodal points in their length, the membrane dividing into separate vibrating segments.

Considerable experiments have been made to determine the functions of the ventricles of the larynx. Working on the similarity (observed by Savart) of the human larynx to the metal decoy-bird of the sportsman (see fig. 1), Baratoux maintains that the ventricles fulfil exactly the conditions found in that instrument.

FIG. 1.—Section of a decoy-bird.

The experiments of Lootens, who discovered the cyclones (which bear his name) existing in tubes made to sound by means of an air current, confirmed by Van Tricht, of Namur, are quoted. These cyclones in the decoy-bird followed a circular course on either side of the cavity, and by variation in breath pressure alone a variation in pitch of two octaves was produced by Savart. In like manner it is claimed by Baratoux that the ventricles of the larynx are inflated and that similar cyclones occur within them, causing regular variations of air pressure, which by their pulsation produce vocal tone.

Registers.—The practice of dividing the voice into three registers is still followed by the majority of musical writers on singing. William Shakespeare, *Plain Words on Singing* (1924), illustrates this with a plate showing the appearance of the vocal cords in chest, medium and head registers. On the other hand laryngologists tend to reduce the number of registers to two, at least so far as mechanical changes in the larynx itself are concerned (Curtis, Moure and Bouyer, Baratoux). The medium register is by some of the latter regarded as a species of *voce mista*, including characteristics of registers above and below it.

Attack.—The subject of attack in both song and speech has received much attention. The evil of the "click" type or *coup de glotte* has been demonstrated by anatomist, physician and singing master (Hulbert, Aiken, Dodds and Lickley), and agreement seems to have been reached that physically, functionally and vocally the most desirable method is that of the simultaneous action of vocal cords and expiratory muscles, whether for singing or speaking.

Vowel Tones.—The division of the resonance of the voice into tone resonance and vowel resonance has been further demonstrated by the researches of Aiken, and also by Sir Richard Paget. The latter has shown, by experiment in public, that it is possible to construct an apparatus which, fitted with a bellows and reed to obtain tone, can be attached to resonating cavities of various kinds which will add vowels to the sounds already produced by the reed, and by using the hands to produce simple

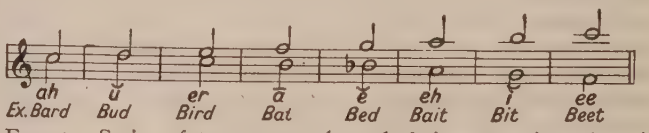

FIG. 2.—Series of tongue vowels and their resonating pitch in each resonator.

consonants like "*l*" to obtain as a composite result words or even short phrases (*see* VOICE SOUNDS). Aiken has experimented extensively with whispered vowels, and states that the two principal vocal resonators are the neck cavity, for tone resonance, and the mouth, for vowel resonance. He therefore regards singing and speech as a combination of two instruments. His series of tongue vowels and their resonating pitch in each resonator is given, in its simplest form, in fig. 2.

The upper note gives the mouth resonance pitch, and the lower the neck resonance pitch, of the vowel printed below. He also gives a list of 12 English vowels with similar resonance pitches for women and men (see fig. 3).

The average pitch of men is a minor third lower than that of women, beginning on the note F, first space treble clef.

Aiken has worked out on this basis a very extensive list of whispered resonances, showing the pitch of the possible har-
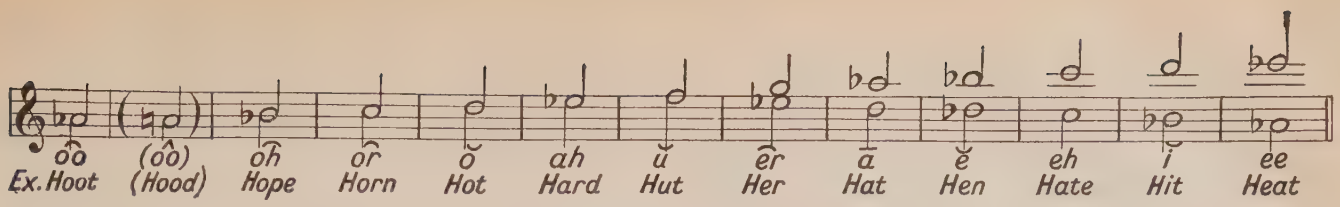
FIG. 3.—List of 12 English vowels with similar resonance pitches for women and men.

monics to be obtained on the simple vowels *oo, aw, ah, eh* and *ee* when sung on each note within a compass of two octaves of the chromatic scale. He claims, therefore, that the singer is playing upon two instruments, one producing notes in obedience to mental perception, the other producing an entirely independent series of vibrations, resulting in articulate speech. The second can perform all its functions, though feebly, in a whispered voice alone, but when assisted by the vibrating note of the first, its influence is much greater. He states that in singing practice "this separation of the two regions in which the conscious activity of each instrument must be definitely realised is one of the fundamental principles of the use and development of the voice, and is absolutely in accord with the physical and physiological distinctions between the two instruments."

On this subject some practical work has also been done by W. S. Drew, who, acting upon the arguments given by D. C. Miller in *The Science of Musical Sounds*, applies the theory of vowel resonance to tone production, and states that the vowel resonator can be tuned to amplify the note which is being sung.

If the resonance region which gives the characteristic sound to a vowel is high up in the scale, there should be no difficulty, for men's voices at least, in singing that vowel throughout the compass; if the characteristic resonance is low there will be found notes, or regions of notes, where it will be difficult to make the vowel sound quite "natural."

He also states that so long as the harmonic which gives the characteristic sound to the vowel is present, the other harmonics may be modified in many ways to give varieties of tone quality, but if the characteristic vowel harmonic is lost then the modification of the pronunciation is apparent, and the vowel itself is heard to have changed.

II. SINGING IN GREAT BRITAIN

Improved Standards.—The development of the musical aspect of song in Great Britain during the first quarter of the 20th century has been greater than in any similar period since the 17th century. In schools, homes, and at so-called "popular" concerts the older type of popular ballad is gradually being superseded by a better type of song in which a lyric of poetic beauty is set to music bearing real art value. Many causes have contributed to this. The work of Parry, Stanford, Mackenzie, and to some extent of Sullivan, has kept the stream of British music flowing, and latterly, the influence of Elgar, though stronger orchestrally and chorally than in song, has been a great factor in national progress. Another factor is the rise, largely through the teaching of Corder at the Royal Academy of Music, and of Stanford at the Royal College of Music, of a school of British composers, who in song are today producing works which at least equal anything that is being produced abroad. Among the best of these are Granville Bantock, Arnold Bax, Arthur Bliss, Rutland Boughton, Frank Bridge, George Butterworth, Thomas Dunhill, Ernest Farrar, Armstrong Gibbs, Hamilton Harty, Gustav Holst, Joseph Holbrooke, John Ireland, Roger Quilter, Cyril Scott, Martin Shaw, Arthur Somervell, S. Coleridge-Taylor, "Peter Warlock" and Ralph Vaughan Williams. It is to be noted also that the World War had a marked effect by turning the attention of the nation to British musical art, and giving more opportunities for the performance of native works. Owing to the increased demand for copies, music publishers had a greater inducement to speculate in the production of the works of British composers.

Lastly, British composers have undoubtedly added to their popularity by adopting to a much greater extent a musical idiom in composition which is founded upon national models, particularly of the Tudor and Elizabethan composers, instead of following the trend of foreign musical taste or development.

Unaccompanied Song.—The most primitive type of song was of course unaccompanied, and some composers have written songs of this type, but with all the freedom of the modern idiom in musical line, rhythm and chromaticism. It is claimed that in modern songs with orchestral accompaniment the human voice is associated with a volume of instrumental tone which overwhelms it, and that, though simplicity for its own sake is not desirable, in songs for voice alone a vehicle for expression is found that is, vocally, more complete; and that, as an artist can express himself in a line drawing and omit nothing that is essential, so a composer may, by the vehicle of the voice, express in song all that is contained in the poet's lyric, and the composer's reflection of his own mental and temperamental counterpart of it in music. Unaccompanied songs have been composed by Herbert Bedford, Cyril Scott, Gerrard Williams, Frederick Austin, Felix White, Jane Joseph, George Oldroyd, Harry Farjeon, Francesca Hall, Eugene Bonner, Liza Lehmann and John Tobin, and a list of 39 is given in Herbert Bedford's book. It is claimed that not only is the poet better served but that the composer and singer alike are freer in their possibilities of expression, and that the audience can be stimulated to an alertness of imagination similar to that required when witnessing a stage play produced without scenery.

Lutenist Songs.—For many years the wealth of song to lute accompaniment contained in the forgotten resources of the British Museum and elsewhere was known to few musicians, and but for some enthusiasts would probably have remained unknown. Thanks to the efforts of Frederick Keel, Philip Wilson, "Peter Warlock" and, most of all, Canon Edmund H. Fellowes, we are becoming familiar with a national heritage of song which is having a strong influence on our musical taste and upon our composers. The English school of lutenist song-writers began in 1597 with the publication of John Dowland's first volume of airs and ended with his *Pilgrim's Solace* (1612), save for one volume of songs by John Attey, published in 1622.

Besides Dowland, who published four books of songs, the principal composers were Thomas Campion (five books), Robert Jones (five books), Thomas Morley, Phillip Rosseter, Thomas Ford, William Corkine and Francis Pilkington, and their combined work produced about 30 books of songs. Each book contained 20 or 21 numbers, and comprised a voice part with accompaniment in lute tablature or notation. A large number of songs were also alternatively arranged for unaccompanied part-singing by four performers. Fellowes states in his preface to the first volume of the reprint of Dowland's airs, "We have in this collection of volumes a rich store of national song, the music of which is wedded to superb verse belonging to the finest period in national literature." The songs are in free rhythm, without time signatures, and, although barred, are quite irregular in time, the accents varying in accordance with the rhythm of the words. The manner is one which is once more being adopted by modern composers, and may be found in some of the songs of Holst, Vaughan Williams, "Warlock" and others, save that in most cases these adhere to time signatures, and change them as often as they desire. In their harmonised forms the lutenist songs resembled more the modern part-song than the contrapuntally written madrigal with which it was contemporary. It is probable that the increasing popularity of the spinet and virginal was responsible for the brevity of the life of the English lutenist school. The lute was much more difficult to play than any keyboard instrument, and though

songs were published with accompaniments for the lute until the end of the 17th century its use was almost confined to the work of professional experts. The rise of the popularity of the violin also detracted from that of the lute.

Folk-songs.—The active interest in English folk-song dates only from the last quarter of the 19th century. Previous to this, collections of Irish, Welsh and Scottish songs had been gathered and published, also W. Chappell's *National English Airs* which appeared in 1840, but until the work of Child, Baring Gould, Frank Kidson and one or two other pioneers drew attention to the beauty of their discoveries, little was known of the folk-music of the English people. There are at present folk-song societies in England, Scotland, Wales and Ireland, though in Scotland a central body has not yet been established, and the work of collection and publication is in the hands of various local societies. Work of great value has been done in England by Cecil Sharp, who devoted his life to folk-song and folk-dancing, R. Vaughan Williams, Frederick Keel, George Butterworth, Lucy Broadwood, H. Fleetwood Sheppard, J. A. Fuller-Maitland, Charles L. Marston and W. G. Whittaker. The recent publication of *Songs of the Hebrides* by M. Kennedy-Fraser and Kenneth Macleod has added yet another and distinctive type, and the arrangements of Irish airs by Herbert Hughes have popularised afresh the national airs of Ireland, though the popularity of these was already assured by the editions of Stanford and research work of W. H. Grattan Flood. A collection of Welsh songs, edited by J. Lloyd Williams and Arthur Somervell, is also a valuable contribution to these publications, as is the work of Sir Richard Terry, whose collection of *Sea Chanties* is already well known.

British composers have of recent years gone increasingly to the folk-song for their pattern and inspiration, either basing their melodies on the style of the folk-song, or using the folk-melodies in their works, as in Rutland Boughton's lyrical drama *Bethlehem* and Gustav Holst's opera *The Boar's Head*. In the collection of the words of *English and Scottish Ballads* the work of Francis J. Child must be noted. From 1882–98 he published five volumes, containing 305 distinct ballads, some with as many as from 10 to 28 variants, with the history and bibliography of each, an index of ballad airs and a collection of tunes.

III. SINGING IN THE UNITED STATES

In many directions vocal music in the United States has made great progress since 1910. The scientific side of singing has been assiduously studied by both laryngologists and singing masters, and many volumes on the subject have been published, notably by Curtis, Herman, Miller, Shaw, etc. The result has been a steady improvement in the general standard of voice production and cultivation. The attention paid to vocal tuition in schools and colleges throughout the country testifies to an increased recognition of the importance of music as a factor in education. As in Great Britain, there has been an active interest in folk-song. Indian, negro, American-English, American-Hungarian and other varieties of folk-melodies have been collected, and have been used by American composers, as, for example, in the orchestral compositions of Henry F. Gilbert, wherein are employed both Indian and negro melodies, Daniel G. Mason's string quartet and John Powell's "Rapsodie Nègre," which are both based on negro themes, and Griffes' "Two Sketches" for string quartet, based on Indian themes.

Interest in opera is undoubtedly growing. The American Opera Society of Chicago publishes a list of 60 American composers of opera, though less than a dozen of their 90 works survived a first performance. A recent statement has been made (March 1926) that there are 24 grand opera companies touring the United States, besides those more or less permanently established in New York and Chicago. Public support of opera is lavish, and new works have opportunities for presentation probably equal to any in Europe, and, though a national school of opera is still in the future, the way is being paved for further talent and enterprise in this direction. German, Italian and Russian opera still hold popular taste to a great extent.

Vocal Composers.—Edward MacDowell, Arthur Foote, George W. Chadwick and Horatio Parker have been termed the "Big Four" of American composers. Their work enjoys international appreciation, and though it cannot be said, even yet, that their musical successors have succeeded in establishing a definite American school of composition, it is undoubtedly true that to-day (1926) there exists a coterie of song composers who are producing works which are of definite value in musical progress, not only in the United States, but internationally. It is unfortunately also true that more bad music, vocal and instrumental, is produced and sold in the United States than in any other country, the taste for jazz and other "best-sellers" being even greater than in Great Britain; but the amount of good music being produced, circulated and taught is growing rapidly, and the songs and vocal works of such composers as the following can be cited as evidence of what is best in American song at the present time: Charles W. Cadman (operas, cantatas, songs), John A. Carpenter (songs), Frederick S. Converse (operas, songs), John Densmore (songs), Henry F. Gilbert (songs), Rubin Goldmark (songs), Charles T. Griffes (songs), Henry Hadley (operas, cantatas, 150 songs), Richard Hageman (songs), Henry H. Huss (cantatas, songs), Edgar S. Kelley (operas, miracle play, songs), Charles M. Loeffler (cantatas, songs), Daniel G. Mason (songs), John Powell (songs), Ernest Schelling (songs), David S. Smith (cantata, anthems, part-songs), Emerson Whithorne (songs). (*See* also CHORAL SINGING; VOICE SOUNDS.)

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SINHA, SATYENDRA PRASSANO, 1ST BARON OF RAIPUR (1864–), Indian statesman, was born of an ancient Kayastha family in the village of Raipur, Birbhum district, Bengal, in June 1864. From the Presidency College, Calcutta, he went to London in 1881 to join Lincoln's Inn, where he won many prizes and scholarships, and was called to the Bar in 1886. He was the first Indian to be appointed advocate-general of Bengal (1908), and the first to become a member of the Government of India. He held the law portfolio from April 1909 to Nov. 1910. He then resumed his lucrative practice at the Bar, and presided at the Indian National Congress session at Bombay in 1915. He and the Maharaja of Bikaner were the first Indians to participate in Empire deliberations in London, for in 1917 they jointly assisted the secretary of state at the meetings of the

Imperial War Cabinet, and were members of the Imperial War Conference. Sinha joined the Bengal executive council in the same year, but returned to England in 1918 as a member of the Imperial War Cabinet and Imperial War Conference, subsequently becoming a representative of India at the Peace Conference.

Knighted in 1914, in 1918 he was made K.C., a distinction not previously conferred upon a barrister of Indian birth or practice. At the beginning of 1919 he established further records for an Indian by being appointed to the Ministry as under-secretary for India, and being raised to the peerage as Baron Sinha of Raipur. He was the second Indian to be sworn of the privy council. He skilfully conducted the Government of India Act, 1919, through the House of Lords, and at the close of 1920 was appointed governor of Bihar and Orissa, being the first Indian to preside over a British province. Ill-health prevented him from serving his full term in that office, and in 1921 he resigned.

SINKING FUND: *see* GREAT BRITAIN: FINANCE.

SISAL: *see* FIBRES.

SKEAT, WALTER WILLIAM (1835–1912), British author (*see* 25.168), died at Cambridge Oct. 7 1912.

SKIN DISEASES (*see* 25.190).—Since 1910 our knowledge of skin diseases has been advanced by the discovery of the cause of certain affections, by the addition of new methods of treatment and by the recognition of new entities.

Classification.—The classification of skin diseases, at first based on naked-eye appearances, and, later, on the underlying pathological changes, is becoming simplified by the adoption of an etiological basis, and, as our knowledge of their causation becomes more complete; such an ideal becomes possible, and is being attempted in the more recent text-books. At the present time, however, the cause of certain skin diseases remains obscure, but, as the gaps in our knowledge become gradually filled in, the group of the unclassified affections becomes correspondingly diminished. With the improvement in classification, the nomenclature also has become more rational and etiological. In the early descriptive period it was complicated by an attempt to divide cutaneous diseases into hard and fast varieties, usually designated by "dog-Latin" adjectives, such as Eczema *erythematosum*, E. *papulosum*, E. *vesiculosum*, etc.; by an effort to indicate the disease by some compound name, suggesting its essential characteristics, such as *Erythema multiforme exudativum;* or, still worse, by the disease being named after him who claimed to have first described it. It has now been simplified by the realisation that certain skin affections, believed in the past to be diseases *per se*, are only variants of a common pathological process, modified by individual peculiarities or situation, and, by making it etiological, as in such names as *blastomycetic dermatitis*—a disease due to a yeast—or *Tuberculosis cutis*—skin lesions caused by the presence of the tubercle bacillus in situ.

Of the new forms of skin disease which have been recognised in recent years, the most numerous have been those occurring in tropical countries, and of them a considerable number are due to fungi, and constitute the group of the tropical dermato-mycoses. In Great Britain the cutaneous lesions associated with diseases of the blood have been the subject of careful study, especially those which occur in connection with the leukaemias and lymphadenoma.

Ringworm.—It is now established that the disease, popularly known as ringworm, is due to a number of mould-fungi, which vary in different climates and countries, like other members of the vegetable kingdom, and which have a wide distribution in the animal kingdom, occasionally even in birds, from which they are capable of being transmitted readily to man. Certain resistant forms of dermatitis, affecting various parts of the body, but more especially the groins and the extremities, which may closely resemble eczema, are not variants of that protean disease, but the result of the presence in the skin of certain ringworm fungi. This type of ringworm has increased since the World War, as it was common among the troops, especially those who went through the Gallipoli campaign, or served in the East, and was brought home and spread by them.

Eczema.—Eczema, the commonest of skin affections, is no longer regarded as a disease due to a single cause, but as a form of cutaneous reaction, due to a variety of irritants, acting either locally, from without, or circulating in the blood, possibly in an individual predisposed by some lowered resistance. In the group of the eczemas it is customary now to include the various forms of occupational dermatitis. These are attracting attention, as they are responsible for considerable disablement. The list of irritants, chemical and physical, which may cause them, is continually being extended, and the problem of their prevention is receiving the close attention of the Public Health Authorities (*see* INDUSTRIAL WELFARE).

Actinic Action.—The actinic rays of light have been shown to be an important factor in causing inflammation of the skin. For years it has been known that they are responsible for the peculiar eruption of the face and hands which recurs in summer in individuals sensitive to light (*Hydroa aestivale*), and for the more serious freckled affection which goes on to cutaneous cancer (*Xeroderma pigmentosum*). It is only recently, however, that the peculiar, dry, atrophic, freckled condition of the skin, dotted over with dilated capillaries, and horny thickenings which may become malignant, has been shown to be due to the sun's rays. This is met with on the unprotected parts, namely the arms, hands and face, of people long exposed to the sun, in countries where its rays are intense, such as India, South Africa, Australia, etc.; it is now designated as chronic solar dermatitis, and corresponds closely to a chronic burn from the X-rays.

Microbial Action.—The rôle of micro-organisms and parasites in causing skin disease is being more appreciated. Bacteria (*see* BACTERIOLOGY) have been shown to be the cause, not only of the common forms of septic impetigo, but of a variety of scaly affections, previously regarded as forms of eczema, which are now included under the heading of Dermo-épidermites microbiennes. Ultra-microscopic organisms, capable of passing through a Berkefeld filter, which have become prominent lately in connection with cancer (*see* CANCER; FILTER-PASSING MICROBES), would seem to be responsible for the small epidermal growths, known as *Molluscum contagiosum*, and it is more than probable that similar organisms will be found to be the cause of other types of benign and malignant epithelial growths. In the Tropics, the so-called Calabar swellings have been found to be of filarial origin, and the Oriental sore to be due to a parasite of the trypanosome family.

Focal Infection.—Focal infection, in the sense of protein poisoning from bacteria in some crypt or tissue, or in the alimentary tract, has of late years been advanced as a possible cause of *Lupus erythematosus*, circumscribed patches of eczema, and other erythematous conditions, and the improvement in them which sometimes follows the injection of an autogenous vaccine has been taken as evidence of an etiological connection.

Nervous System.—Although certain affections of the skin, such as *Herpes zoster*, or shingles, have been proved to be of nervous origin, the trend of recent research has gone to show that the influence of the nervous system as a cause of cutaneous disease has been overrated, and that a number of affections, which were vaguely attributed to reflex nervous disturbances, are either of toxic origin, or due to imperfect action of a ductless gland, or to some disordered state of the blood.

Anaphylaxis.—The doctrine of anaphylaxis (which means the state of hyper-sensitiveness occurring when the organism has reacted to some toxin or irritant and reacts more acutely to a second dose of the same toxin), has contributed to our knowledge of certain cutaneous phenomena, and has explained the liability to recur of a dermatitis due to local irritation, or to the presence in the blood of some foreign protein.

Therapeutics.—The advances in treatment have been remarkable. Internal treatment has become based more on general medical principles and on the discovery and correction of some underlying disturbance in an organ or system than on so-called specific medication. That sheet-anchor of the earlier physicians—arsenic—has lost its position as a panacea for chronic skin affections, and any value it may have in the treatment of psoriasis, pemphigus, etc. is being regarded more as the result of its value as a nerve tonic than as a specific drug. It has attained, however, a new importance in its organic preparations, in the treatment of syphilis (*see* VENEREAL DISEASE).

Organo-therapy.—The increase in our knowledge of the ductless glands (*see* ENDOCRINOLOGY) has added organo-therapy to our methods of treatment, and thyroid medication has proved to be of benefit in various skin affections in childhood, associated with retarded development, and especially in mild ichthyosis, in which eczematous changes are so liable to be superimposed.

Vaccine Therapy.—The value of vaccines (*see* VACCINE THERAPY) in the treatment of skin diseases has been overrated, and their use in the past was too promiscuous. They are of most value in acute suppurating lesions of staphylococcic origin, such as recent boils. The development in local treatment has been even more striking than that from internal medication.

Refrigeration; Diathermy.—Refrigeration, with carbon dioxide as the freezing agent, has become established as a useful means of destroying vascular naevi, moles, warts, superficial rodent ulcers, and of ameliorating Lupus erythematosus of the fixed type. Diathermy has proved of great value in inoperative cases of rodent ulcer, and for cauterisation of malignant growths in the mouth of naso-pharynx (*see* ELECTRO-THERAPY.)

Radiotherapy.—The greatest advances, however, have taken place in connection with radiotherapeutics (*see* RÖNTGENOLOGY). The newer methods of X-ray dosage, made possible by the use of the Coolidge tube, has increased the usefulness of the X-rays as a means of healing chronic ulcers, relieving local irritations, reducing epidermal thickening and causing the defluvium of the hair for the cure of ringworm of the scalp. Radium has proved to be of special service in the treatment of rodent ulcers and hypertrophic scars (*see* RADIUM). The value of the actinic rays of light, when applied locally, in the treatment of tuberculosis of the skin, and in healing chronic ulcers, has been greatly enhanced by its use over the whole cutaneous surface, in the form of actinic ray baths, which have been found to improve the general health by stimulating metabolism and increasing the bactericidal power of the blood. *See* HELIO-THERAPY.

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SKRZYNSKI, ALEXANDER, COUNT (1882–), Polish statesman, was born at Zagorzany, Galicia. Educated at Cracow and Munich, he entered the diplomatic service in 1906 and was appointed secretary to the ambassador to the Holy See in 1910. When the World War broke out he was secretary to the Austro-Hungarian Ambassador in Paris. After a short military service at the beginning of the War, he completed his studies for the Bar, receiving the degree of Doctor of the Law at the University of Vienna. When the new Polish State was established, he was appointed Polish Minister Plenipotentiary at Bucharest, and later succeeded in concluding a Polish-Rumanian political treaty in 1921. In Dec. 1922, after the murder of Narutowicz, the first international President of the Republic, Skrzynski became Minister of Foreign Affairs. He threw himself energetically into the task of settling all open questions, inaugurated a pacific policy based on the final stabilisation of frontiers and gained the necessary confidence of the Powers. When a Cabinet of the Right was formed in May 1923, Skrzynski thereby lost office, and he was appointed in the following month Polish delegate to the League of Nations. In Aug. 1924 he again accepted the portfolio of Minister of Foreign Affairs in the Grabski Cabinet.

By a number of conventions, the regulation of the British and American debts, the concordat with the Vatican, the rapprochement with Czechoslovakia, Skrzynski strengthened Poland's international position, taking an active part in the League of Nations in elaborating the scheme for the Geneva Protocol and in securing settlement of the Danzig disputes in a manner favourable to Poland. He tried to disarm the suspicions of Moscow as to the new configuration of Europe by receiving Chicherin at Warsaw (Sept. 1924). In the negotiations in connection with the German proposals with regard to the Locarno Pact (1925), Skrzynski sought to reconcile Polish interests with the general scheme of the conference, and signed an arbitration agreement with Germany and also a convention with France in accordance therewith. After the fall of Grabski's Government Nov. 13 1925 Skrzynski was entrusted with the formation of a government by Wojciechowski, the President of the Republic, and with the participation of the Socialists formed a coalition cabinet in which he himself was Prime Minister and Minister of Foreign Affairs. In May 1926, however, the Socialists seceded from the Cabinet. Skrzynski considered that the Coalition rested on too narrow a basis, and therefore resigned the Premiership. *See* also POLAND.

SKYSCRAPER: *see* ARCHITECTURE.

SLAVERY AND FORCED LABOUR (*see* 25.216).—Before the first decade of the 20th century was past, a more or less settled administration had been established throughout Africa under European control, except in Abyssinia and Liberia. Forcible seizures and even small raids on frontiers not yet under effective control, especially on the borders of the Sahara, still occurred from time to time, and slave-dealing still surreptitiously existed, but these were dealt with as ordinary crime. Effective administration of the territories controlled by the Great Powers was maintained throughout the World War, and in the world settlement which followed a fresh convention was concluded at St. Germain in 1919, in which the signatories pledged themselves to suppress " slavery in all its forms "—a new and very significant formula.

The New Convention.—This convention superseded the Berlin and Brussels Acts so far as its signatories (the Allies in the War) were concerned, and it seemed doubtful to what extent those Acts remained operative. The new convention, like its predecessors, dealt with many subjects: navigation of rivers, freedom of trade, etc. The liquor traffic and the arms traffic were, however, dealt with in separate conventions, while slavery and the slave trade occupied but a single clause in the convention.

Enquiry by the League of Nations.—The admission of Abyssinia to membership of the League in Sept. 1923—a country in which slavery still remained a legal institution, and in which slave-raiding and the slave trade had until recently been carried on, and were alleged to be still existing—was the proximate cause of the revival of the question as a subject of international concern. The League of Nations appointed a committee to investigate the subject. It met in session in July 1924, and again in the following year. It recommended *inter alia* a new convention, to which the adherence of all States, whether members of the League or not, should be invited. This proposal was accepted, and the British Government submitted a draft convention. All States members of the League, and also Afghanistan, Ecuador, Egypt, Germany, Mexico, the Sudan, Turkey and the United States were invited

> to send to the secretary-general not later than June 1926 any observations they might desire to make regarding its provisions . . . and to assist one another forthwith in the abolition of the slave trade, slavery and conditions analogous thereto by all practicable means.

These " analogous conditions," says the official report, "are intended to include all forms of debt slavery—the enslaving of persons disguised as the adoption of children and the acquisition of girls by purchase disguised as payment of dowry, etc." The convention purports to represent the highest minimum standard to which it was anticipated that general acceptance could be secured, but " it is hoped that no States will be satisfied with compliance with the minimum standard which is now proposed."

Domestic Slavery.—In regard to domestic slavery and serfdom a larger experience has led to recognition that among primitive tribes, and also among communities which have adopted the Moslem faith, or a Christianity (as in Abyssinia) based on the law of the Pentateuch, the institution has become so intimately interwoven with the social fabric that sudden and enforced emancipation would bring ruin and misery to the slaves no less than to their owners. In such cases, therefore, absolute prohibition of the acquisition of new slaves, and of all dealing in slaves, combined with the abolition of the legal status—so that no court of law can recognise any rights based on the claim of property in the person of another—is the preferable method. This gives to every slave the right to assert his freedom without any

ransom or formality, but does not make it a crime for a master to retain a slave if both desire to remain in that relationship. It is *permissive* as contrasted with *compulsory* freedom.

Forced Labour.—The convention " deals for the first time in international agreements with the question of forced labour," which may be viewed from two standpoints. There is probably a consensus of opinion that in certain cases a State may find itself under the necessity of compelling labour for essential public works or services. There is also probably a predominant opinion that such labour should be fairly remunerated, though some hold the view that if compulsory labour is imposed under the guise of a tax—as a fiscal measure—it need not be restricted to urgent public services, and of course would not be remunerated,—as the Central African mandates require. The second principle to be determined is whether it is permissible in any circumstances to use compulsion for the supply of labour, even though paid, in enterprises conducted for private profit. Abuses of the system known in South America as " peonage " fall under this category, by which labourers become involved in debt which they can never repay, and so become slaves for life. The Slavery Commission pointed out that this system merits particular condemnation when an alien employer deliberately adopts measures to secure by such means the life-long servitude of an ignorant and unsuspicious peasantry.

From this brief outline it is evident that the standards and aspirations of to-day show a fuller appreciation of the true interests of the backward races than was possible a couple of decades ago, and a conscientious desire to deal with them by liberal and practical methods.

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(F. D. L.)

SLAVONIA: *see* CROATIA-SLAVONIA.

SLEEPING SICKNESS (*see* 25.240c).—At the International Conference held in London in June 1907 nine problems were stated for future solution. Some of these have been completely, others partly, solved (1) and (2).[1]

Transmission of Infection.—It was at first believed that the transmission of *Trypanosoma gambiense* by the tsetse fly, *Glossina palpalis*, was direct or mechanical, and that a fly lost its power of infecting 24–48 hours after feeding on an infected man. Kleine (1909) showed that this is not the case. In a certain percentage of flies the germs ingested with the blood do not die but multiply exceedingly in the fly's gut, change in form, come forward and at last invade the salivary glands, where they resume their blood form.

During the process, which occupies 14–28 days or more, the fly is not infective, but when the germs are established in the salivary glands it regains its infectivity and may retain it for a long period, for at each feed germs are poured into the puncture. Unless the salivary glands contain the germs a fly is not capable of infecting, but only in a small proportion is this development completed; in nature the proportion of infected flies rarely exceeds one in 1,000. Conveyance is therefore indirect. Direct infection may occur in nature, but the failure of the disease to spread in the absence of tsetse, even though biting insects of many kinds are present, seems to show it must be rare, *e.g.*, hundreds of cases of sleeping sickness were recorded in the West Indies among slaves brought from Africa, but there is no recorded instance of spread in the New World. The disease was formerly rife in the island of Principe in the Gulf of Guinea, where *palpalis* abounded, but no cases occurred in the neighbouring island of San Thomé, with the same insect fauna, but, like America, with no tsetse. Duke believes that when the disease is epidemic direct infection is the rule.

There is no evidence that the fly can transmit the germs to its offspring.

The fly has been shown to be capable of infecting for at least 96 days.

Other species of *glossina*, *e.g.*, *morsitans*, *tachinoides*, become similarly infected, and it is probable that all the species are capable of conveying sleeping sickness; whether they do so or not depends in part on their habits; *e.g.*, some species rarely attack man.

T. Rhodesiense.—In 1909 a second species of trypanosome was discovered in a case of human infection from Rhodesia and called *T. rhodesiense*. It is found in areas infested not by *G. palpalis* but by *G. morsitans*, and was shown by Kinghorn and Yorke (1911) to be conveyed by this species and to undergo in it a similar development. *T. rhodesiense* infections are found in Nyasaland, Portuguese East Africa and Tanganyika Territory, besides northern Rhodesia, and, rarely, south of the Zambezi river. *T. rhodesiense* cannot be distinguished from *gambiense* by its appearance in human blood; after inoculation into animals microscopical differences can be detected; since such inoculations are rarely made it may be more often the cause of sleeping sickness than is believed; its carrier is widely distributed. Indeed, a few cases have been found as far north as the Anglo-Egyptian Sudan; and near Mwanza, south of Lake Victoria, a small epidemic occurred in 1922, conveyed by a tsetse akin to *morsitans*. This type of human trypanosomiasis is rarely epidemic; cases occur in sporadic fashion. It is more acute and more rapidly fatal than the *gambiense* variety, and is more resistant to drugs. Whether or not *T. rhodesiense* is identical with *T. brucei*, the parasite of *nagana*, first described by Bruce in Zululand (1893), is undecided. Bruce and Yorke consider them to be the same; Kleine makes a distinction. They cannot be separated by their appearance under the microscope, the symptoms and course of the illness produced in animals, or the manner and site of development in the tsetse. Both complete their development in the salivary glands. If they are the same, man must, as a rule, be refractory to infection, for *T. brucei* is common in animals over a large fly-infested area of Africa.

T. brucei and *T. rhodesiense* are found in big game, especially Waterbuck, bushbuck, reedbuck, haartebeest, on which *G. morsitans* feeds. These animals are, therefore, reservoirs of germs capable of infecting man, and much discussion has taken place as to the rôle played by big game in the spread of *T. rhodesiense*, some claiming that the passage of the parasite is game to fly to man; others that it is man to fly to man. A decisive opinion cannot even now be given.

An experiment was made in East Africa during the World War in which blood was taken from transport animals infected with *T. brucei* and inoculated by Taute into himself, his colleague Huber and 127 natives. Though animals inoculated at the same time always became infected, there was no single instance of infection in man. They concluded that man is immune to infection by *T. brucei*. This striking experiment, however, does not convince those who believe man to be susceptible but very resistant.

As regards *T. gambiense*, it is generally agreed that infected man is the chief reservoir of infection, though Bruce (1911) found that antelopes can be infected with this trypanosome by allowing infected *palpalis* to feed upon them, and they continue to harbour the trypanosomes in their blood for many months, and though the sitatunga antelope (*Tragelaphus spekei*) is commonly infected under natural conditions on Lake Victoria (Duke). Domestic animals also harbour both trypanosomes, in the case of *T. gambiense* without sign of illness; whether they play any appreciable part in the spread of the human disease is unknown. Field observations have shown that in northern Nigeria and French Africa, south of Lake Chad, another tsetse, *G. tachinoides*, conveys a human trypanosome, probably *T. gambiense*. In these areas *tachinoides* is the only tsetse.

[1] These numbers refer to the problems discussed in 25.240.

Treatment.—Sleeping sickness is now treated by compounds of arsenic, especially *atoxyl* and *tryparsamide*, the latter a product of the Rockefeller Institute; by compounds of antimony, as tartar emetic; and by a drug of undisclosed composition called Bayer 205, or Germanin. The French and Belgians use *atoxyl* largely in the African villages, where doses are injected at the proper intervals by trained natives. A high degree of success is claimed, both curative and preventive, in that the blood is kept free from germs which might be taken up by the tsetse. *Antimonials* are used as a rule in conjunction or alternation with arsenicals. *Bayer 205*, first employed in the treatment of man in 1921, has remarkable successes to its credit in Europeans, especially in cases of the Rhodesian type which were refractory to other drugs; unless used with caution it has a harmful effect on the kidneys. It has been less successful in natives, perhaps because infection is usually detected in them at a later stage when the spinal cord and brain are affected, and at this stage treatment nearly always fails. French chemists have prepared the same or a similar drug. *Tryparsamide*, introduced about the same time, appears to be still more potent, and especially in cases in which the nervous system is involved, but it also has a serious effect in that it sometimes affects vision. Though sleeping sickness in the European is nearly always a fatal disease if left untreated, in the natives of parts of Africa it is very chronic, does not interfere with the patient's activities, and almost certainly may end in natural recovery. The means of prevention of sleeping sickness have been known in principle for 20 years, and depend upon the fact that infection is conveyed by tsetse flies and in no other way.

An International Conference.—At the instance of the League of Nations an International Conference on Sleeping Sickness met in London in 1925. In its recommendations it laid down administrative measures which should be taken on both sides of the frontiers between infected countries for the control of the disease, and advised the dispatch to Uganda of an international commission to study certain problems, such as immunity to the disease, the function of wild and domestic animals as breeding grounds for the virus, and the relations between *T. gambiense* and *T. rhodesiense* infections; work with curative and prophylactic drugs was also envisaged. The commission started work in 1926.

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SLESVIG: *see* SCHLESWIG.

SMALL HOLDINGS: *see* ALLOTMENTS.

SMALLPOX (*see* 25.247).—Since about 1910 much knowledge of the nature of this disease has accrued in the course of attempts to discover the causal organism. This has been sought, though fruitlessly, in many direct investigations of the rash and of the blood by microscopical examination and by attempts to inoculate animals. The failure is explained, in part, by the discovery that the virus of vaccinia and, by analogy, also that of smallpox belong to the group of filter-passing viruses (*see* FILTER-PASSING MICROBES).

Jenner believed that cowpox (vaccinia) and smallpox (variola) have the same origin and nature. But attempts to inoculate the cow with smallpox matter failed and Jenner's opinion was not substantiated until Monckton Copeman and others proved that the virus of smallpox can be inoculated in the cow by a process of transmission or passage and that in the cow, under these conditions, typical lesions of vaccinia are produced. But although vaccinia is the same disease as smallpox, during its passage through the cow it has lost the power of producing a generalised septicaemic infection in man though it induces the typical lesion at the site of inoculation and by means of this local lesion, protects the vaccinated individual against the major infection from which the vaccine matter was derived.

Use of Lymph.—Establishment of the homologous relationship between variola and vaccinia widened the field of investigators into the nature of the contagium of smallpox by providing a material, viz., vaccine lymph, which is at once abundant and easily produced. By experiments in the rabbit, which is susceptible to vaccinia, the immunity conferred by vaccinia has been studied and it has been shown that certain specific substances or antibodies are produced in the blood and tissues of the vaccinated animal similar to those produced in typhoid fever and cholera, and that the antibodies in vaccinia and variola are apparently identical. It has been claimed, though on insufficient grounds, that this identity affords a means of certain diagnosis of the disease in doubtful cases of smallpox.

Serum Therapy.—In so far as the therapeutic application of the knowledge thus acquired is concerned, it has been shown that the serum of animals which are immune to vaccinia not only has protective power against vaccinia but also is possessed of curative properties because it destroys the virus of vaccinia *in vitro*. Whether this curative property is susceptible of increase by means of a graduated increase of dose of virus has not been investigated. In France, the serum of convalescent smallpox patients has been used in treatment and it is claimed that an undoubted curative result was obtained in cases which from clinical experience would almost certainly have proved fatal. But so far the virus of smallpox has not been obtained in quantity sufficient to permit of the attempt to manufacture a therapeutic serum, nor has it been shown that the immunity of an animal to vaccinia can be raised to a degree which might make its serum of value in the treatment of smallpox.

Polyvalent vaccines and serum prepared from pyogenic organisms have been used with some success in the treatment of severe confluent smallpox. This treatment is based on the assumption that the severity of the later stage of the illness in confluent smallpox, *i.e.* the stage of maturation or pustulation of the rash with the secondary fever of the disease, is closely associated with a secondary pyogenic infection.

HISTORY OF THE DISEASE

The mode of spread of smallpox may be illustrated by a short account of the incidence of the disease in Europe since 1910. It is convenient to divide the period into three quinquennia:—1. 1910–4, the period preceding the War; 2. 1915–9, the period of the War; 3. 1920–4, the period of gradual recovery from the War.

Pre-War Incidence.—During the first quinquennium no satisfactory arrangement existed among the European powers for the interchange of information concerning the incidence of epidemic diseases, and particularly from large areas where the disease is endemic and vaccination negligible, such as Spain, the Balkan States, Turkey and Russia, information concerning the rise and fall in incidence or even of serious epidemic extensions of the disease was scanty and unreliable. During this quinquennium the disease was very prevalent in Italy where a severe epidemic occurred in 1911–2. On the other hand, in France, Belgium, Austria, Germany, Denmark, Holland and the Scandinavian countries, smallpox was a rare disease as it had been since the beginning of the century. In England and Wales no extensive epidemic had occurred since the outbreak of 1902-3-4 and in the five years period before the War only 88 deaths from smallpox were recorded in Great Britain.

The War Period.—With the outbreak of War in 1914 the decline was arrested and the movement of armies and migration of civil population to and from the endemic centres in the east of Europe rapidly made itself felt by an uncontrolled and increasing spread of smallpox which reached its greatest intensity in 1919. In the end of 1914 and throughout 1915 severe epidemic smallpox carried by prisoners of war from Russia and refugees occurred in the states of the old Austrian Empire which bordered on Russia and also in the Balkans. Similar agencies scattered the infection throughout Germany and in 1916–7 there were outbreaks in Hamburg and other western towns. The incidence of the disease in Germany rose continuously throughout the

years of the War. Over 2,000 cases were recorded during 1917 and upwards of 5,000 during 1919. The infection reached Sweden on more than one occasion and a few cases occurred in Norway. In the Netherlands at least one serious outbreak occurred.

The experience of France during the war period was remarkable. The serious epidemic which swept over the country during the war of 1870–1 had not been forgotten and the French army of the World War was efficiently protected by vaccination. The invading German troops were also protected and no doubt acted as a screen to France on the east. Throughout the country, with the exception of districts on the Mediterranean coast and bordering on the Spanish frontier, the incidence amongst the civil population was low during the War. The freedom of France was reflected in the freedom of England during this period. The British army, like the French, was vaccinated and therefore in contrast to the experience of England in 1870–71, and in spite of the enormous volume of cross-channel traffic, only a small amount of smallpox infection reached England through France. In the later years of the War the revolution in Russia sent many refugees into this country who brought the infection via Scandinavia and the Murmansk coast. But the close guard maintained on the North Sea ports of Britain and the vigilance of her public health authorities prevented any serious attack on the civil population in spite of the increasing neglect of vaccination among the people.

Post-War Incidence.—In the third quinquennium, 1920–4, the bureau for the service of epidemiological intelligence and public health statistics was initiated under the authority of the League of Nations for the purpose of collection and interchange of information concerning epidemic diseases. The annual report from this source for 1924 deals with 29 European, 17 African, 20 American, 16 Asiatic countries and Australasia, and shows that in Europe smallpox incidence has diminished year by year since 1919. The effects of the War on the incidence of the disease in Russia and neighbouring countries, viz.: Czechoslovakia, Rumania, Austria, Poland, Finland and Germany reached their culminating point in 1919 and since that year the decline in prevalence in all these countries has been continuous and rapid. Similarly in Italy, where 34,365 cases were recorded in 1919, only 190 cases occurred in 1924. Although Spain continues to be the chief endemic centre in the west of Europe, the recorded deaths from smallpox in that country fell from 3,620 in 1919 to 1,214 in 1924. During the quinquennium England and Switzerland were the only European countries in which the incidence rose. In Switzerland the figure for 1924 shows a fall but in England the increase was progressive to the end of the period as seen by the following table:—

Number of Cases of Smallpox Recorded in . . .	1919	1920	1921	1922	1923	1924
In England and Wales . . .	294	263	315	973	2,485	3,765
In Switzerland . . .	3	2	596	1,153	2,126	1,234

In both countries the mild type of the disease associated with the almost complete absence of fatality, led to the concealment of cases and an increasing neglect of vaccination.

Variation of Epidemic Type

Outbreaks of smallpox, like those of other infectious diseases, vary in their lethal power. In 1789 Jenner described an outbreak which occurred about seven years before in Gloucestershire, "of so mild a nature that a fatal instance was scarcely ever heard of . . . . I watched its progress upward of a year without perceiving any variation in its general appearance. I consider it then as a variety of smallpox."

Observers in different parts of the world have directed attention to the occurrence of outbreaks which apparently resemble the one described by Jenner. An outbreak in South Africa was described by de Korté in 1904, under the name of Amaas or Kaffir-pox, another by Ribas in Brazil in 1910, under the name of Alastrim, and others of a similarly mild character have been recorded in the United States, the West Indian Islands, Australia, and, as mentioned above, in England and Switzerland.

The opinions of many modern observers differ from that of Jenner who was satisfied in calling his outbreak a "variety of smallpox." That the form of disease observed in so many parts of the world belongs to the smallpox group is common ground. But some observers hold that it is more closely allied to chickenpox than to smallpox; others differentiate it from both diseases and regard it as a newly identified member of the group, while others maintain that it is a hybrid of smallpox and chickenpox, a true varioloid-varicella. On the other hand the weight of medical opinion in England inclines to the view that the disease is simply a mild type of smallpox.

Clinical.—Differentiation of the smallpox eruptions similar in type has become more certain and rapid through the work of Ricketts. Ricketts' thesis is that the focal rash of smallpox has a characteristic distribution governed by two complementary factors, viz.: exposure to irritation and protection against irritation, which determine a relative increase and decrease of the incidence of the rash on any part of the skin surface. These factors are independent of the course of the disease and of the evolutionary changes which constitute the features of the rash. They are also independent of modification of these changes resulting from variation in immunity possessed by the patient or of variation in the toxic power of the infecting virus. They have the further advantage of being objective and therefore less liable to confusion in interpretation than any others. They begin to be established with the beginning of the outcrop of the rash, are fully established when eruption is completed and remain unchanged as long as the rash lasts.

Experimental.—Blaxall, Cleland and Ferguson, Green and Gordon in England, and Leake and Force in America, have experimented on lower animals with material from the mild disease and also with material from severe cases of acknowledged smallpox, in order to determine what differences, if any, exist between the two conditions and in their immunological relations to each other and to vaccinia. The results of these investigations have been summarised by Ledingham, and confirm the opinion that the mild disease as it exists in England is smallpox of which the virus has lost a degree of its toxicity for man but retains its important properties for other animals. The distinction between the two viruses is one of lethal power only and the factors which govern this property are unknown. Over five years' experience in England of a widespread infection by the mild type of smallpox has afforded very little, if any, evidence of a tendency to increase in virulence. But in the absence of knowledge of the cause of variation in lethal power or of the natural conditions which may favour its occurrence, it is unsafe to assume that a low degree of virulence is a permanent feature of this type of smallpox and on that assumption to relax the stringency of administrative precautions against the disease.

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(A. F. C.*)

SMEDLEY, WILLIAM THOMAS (1858–1920), American artist (*see* 25.251), died at Bronxville, N.Y., March 26 1920.

SMETONA, ANTANAS (1874–), Lithuanian politician and journalist, was born Aug. 10 1874 in the Ukmerge district, Lithuania. In 1897 he went to the University of St. Petersburg (Leningrad) as a law student, and received his diploma in 1902. Smetona edited the first Lithuanian daily, *Vilniaus Zinios* (Vilna News), and the democratic party organ *Lietuvos Ukininkas*. In 1905 he was elected a member of the Presidium of the Vilna (Wilno) Diet, which proclaimed Lithuanian autonomy, but

he continued his journalistic activities as editor successively of *Viltis* and *Vairas*. During the World War Smetona acted as chairman of the Lithuanian war relief committee. On the convocation of the Tautos Taryba, or national council, during the German military occupation of the country, he was unanimously elected its president, and in the spring of 1919 first president of the newly-proclaimed independent state of Lithuania, a post which he held till the spring of 1920, when the Constituent Assembly was convened at Kaunas (Kovno). After his retirement from the Government Smetona returned to journalism as editor of *Balsas*, *Vairas* and *Lietuvis*, which represented the National Progressives. In 1921 he served as chairman of the Lithuanian delegation at Riga during the negotiations on the settlement of the Latvian-Lithuanian boundary dispute. Early in 1923, when the insurrection broke out in the Memel territory against the German Directorate, Smetona was requested by the Lithuanian Govt. to compose the trouble in co-operation with the Allied representatives. In the same year he joined the teaching staff of the newly established university as lecturer on philosophy.

SMILLIE, ROBERT (1859–), British politician, was born on March 17 1859 in Belfast, of Scottish parents. He left school when only 14 and worked first in a Clyde shipyard and later as a miner in the Lanarkshire pits. In 1894 he became president of the Scottish Miners' Federation, and later formed the Miners' Federation of Great Britain. Under his leadership the great strike of coal miners of 1912 was conducted and a national minimum wage secured. He was a member of the royal commission on mines set up in 1919 and presided over by Mr. Justice Sankey. He resigned the presidency of the Miners' Federation in 1921. Though best known as a miners' leader, Smillie possessed strong internationalist sympathies, and was an ardent pacifist during the World War. After seven unsuccessful contests he was elected M.P. for Morpeth in 1923. In 1924 he published *My Life for Labour*.

SMITH, ALFRED EMANUEL (1873–), American politician, was born in New York City Dec. 30 1873. The son of humble parents, his father being a truck driver, he was educated in the St. James parochial school, and for several years was employed in the Fulton fish market. He was very popular with his associates, and at the age of 29 was offered the Democratic nomination for the New York State Assembly by the Tammany leader of the district in which he lived. He was elected for 1903, and by re-election served for 12 years. In 1911 he became Democratic leader in the Assembly, and was appointed vice-chairman of the factory investigating committee, which made a searching inquiry into industrial conditions in the State, resulting in remedial legislation. In 1913 he was Speaker of the Assembly. In 1915 he was chosen a delegate to the State Constitutional Convention, taking an active part in its proceedings. He opposed the constitution as finally revised, one reason being that it contained a provision designed to prevent New York City from having a majority of legislators. He "stumped" the State against its adoption, and it was overwhelmingly rejected. The same year he was elected sheriff of New York county, then a lucrative post because of the system of fees (later abolished), and in 1917 president of the board of aldermen of New York City. In 1918 he was elected Governor of the State of New York. He had been a strong supporter of woman suffrage, and in June 1919, as governor, called a special session which ratified the woman suffrage amendment to the Federal Constitution. The constructive legislation passed during his first term, including emergency rent legislation and the codification of the child welfare laws, established him as a progressive leader. In 1920 he was again the Democratic nominee for governor, but was beaten in the overwhelming Republican landslide of that year; he lost, however, by only 73,000 votes, whereas the Democratic candidate for president was at the same time defeated by 1,000,000 votes in New York State.

In 1922 Smith was renominated by the Democratic party for governor, and was elected by the largest majority ever given to a candidate for the office, receiving 1,397,633 votes as against 1,011,725 for N. L. Miller. At the Democratic National Convention of 1924 he received strong support for the presidential nomination, dividing the votes with W. G. McAdoo so as to produce a deadlock, until, on the 103rd ballot, J. W. Davis was nominated as a compromise. At the state election in Nov. 1924 he was re-elected governor, receiving 1,627,111 votes as against 1,518,550 for Theodore Roosevelt, the Republican nominee. This was the first occasion in one hundred years that a governor had been twice re-elected. This was another striking demonstration of Governor Smith's popularity, especially as the Republicans carried every other state office by large majorities. His record of constructive legislation has continued throughout his three terms, and includes housing legislation, a state park system, improvements in child welfare and labour laws, the recommendation and adoption of bond issues for the construction of State hospitals and other public buildings, and the final adoption of the Hughes plan to reorganise the State government, including the adoption of an executive budget.

SMITH, ALFRED HOLLAND (1863–1924), American railway official, was born in Cleveland, O., April 26 1863. He began work on the New York Central railway system as a messenger-boy in 1879. After serving in various capacities he was in 1890 appointed superintendent of the Kalamazoo division of the Lake Shore and Michigan Southern Railway. He was successively division superintendent, assistant general superintendent and general superintendent of the Lake Shore road. In 1902 he became general superintendent of the New York Central Railroad, in 1906 vice-president of the New York Central system, and in 1914 president. When the American railways were taken over by the U.S. Govt., Dec. 27 1917, he was appointed assistant director-general and worked out the form of central and regional administration under which the railways were managed during the 26 months of Government operation. He was re-elected president of the New York Central lines in June 1919. He died in New York City March 8 1924.

SMITH, FRANCIS HOPKINSON (1838–1915), American author, artist and engineer (*see* 25.260), died at New York City April 8 1915.

SMITH, JEREMIAH, JR. (1870–), American lawyer, was born at Dover, N.H., Jan. 14 1870. He graduated at Harvard University (A.B., 1892) and the Harvard Law School (LL.B., 1895). In 1895 he became secretary to Mr. Justice Gray of the U.S. Supreme Court, but in 1896 commenced the practice of law in Boston. He was a captain in the Quartermaster Corps A.E.F. in France 1918. At the conclusion of hostilities he was appointed counsel to the Treasury Dept. in Europe and was associated in that capacity with the U.S. Peace Commission, acting also as an adviser in financial matters. On the conclusion of peace he resumed practice in Boston. In April 1924 he accepted the position of commissioner-general of the League of Nations in Hungary, and took up his duties in Budapest May 1. He was successful in stabilising the currency and placing Hungarian finance on a sound basis, his report of July 1925 for the fiscal year showing a surplus, instead of the deficit anticipated in the League's reconstruction plan. On the completion of his work, July 1926, he again resumed practice in Boston.

SMITH, THEOBALD (1859–), American pathologist, was born at Albany, N.Y., July 31 1859. He was educated at Cornell (Ph.B., 1881) and at the Albany Medical College (M.D., 1883). In 1884 he was appointed director of the pathological laboratory of the bureau of animal industry, in Washington, where for 11 years he investigated infectious animal diseases. At the same time he was professor of bacteriology at Columbian, later known as George Washington University. From 1895 to 1915 he was director of the pathological laboratory of the Massachusetts State Board of Health, and after 1896 was professor of comparative pathology at Harvard. In 1915 he was appointed director of the department of animal pathology of the Rockefeller institute of medical research, at Princeton, New Jersey.

His numerous scientific papers include *Investigations into the Nature, Causation, and Prevention of Texas or Southern Cattle Fever* (1893); *The Relation between Bovine and Human Tuberculosis*

(1896–8); *The Immunizing Effect of Neutral Toxin-antitoxin Mixtures in Diphtheria* (1909); *Milk-borne Epidemics of Human Streptococci* (1915); *The Protective Value of Colostrum* (1922); *The Relation of Bovine Infectious Abortion to Malta Fever* (1925).

SMITH COLLEGE (*see* 25.273).—Between 1910 and 1926 Smith College added to its equipment Burton Hall for biology, a new music building (Sage Hall) with auditorium, and an additional gymnasium with swimming pool. The number of dwelling houses for students increased from 16 to 45. The library in 1925 contained 121,000 volumes and the Hillyer Art Gallery had increased its endowment to $450,000. The Tryon Gallery had been built.

All students now enter by examination. In 1925–6 there were 204 teachers and 2,158 students, of whom 59 were graduate students, and the endowment was $4,500,000, the total assets being over $10,500,000. The college publishes, besides its permanent bulletin, the *Smith College Studies* in history, modern languages and classics, and contributions of the Dept. of Biology. President Seelye was succeeded in 1910 by Marion LeRoy Burton (b. 1874), who was succeeded in 1917 by William Allan Neilson (b. 1869). In the World War the Smith College relief unit, the pioneer among American college women's units overseas, worked in the Somme, France, from July 1917 until April 1920, with the exception of the period after the retreat of March 1918, until the following January. Another small group worked as a Smith unit with the Near East relief in Armenia. In 1920 a system of special honours was established, by which selected students follow out their individual interests under the direction of tutors; and in 1925 a scheme was initiated of sending students specialising in French to France to spend their junior year in study at French institutions under the guidance of a member of the Smith College staff. In the same year the college established a personnel bureau for greater individualisation in dealing with students, both socially and academically, and an institute for the co-ordination of women's interests to study and experiment with methods of enabling women to maintain their intellectual interests, both cultural and professional, after graduation. The Department of Education conducts a school for retarded children, a progressive day school and a nursery school.

(W. A. N.)

SMITH-DORRIEN, SIR HORACE LOCKWOOD (1858–), British general, was born May 26 1858. He joined the army in 1876, took part in the Zulu War and in the Egyptian campaign of 1882 and, attached to the Egyptian Army, served at Suakim in 1884 and on the Nile in 1885–6. He took part in the Tirah campaign of 1897–8 and showed conspicuous skill in handling troops. His marked ability as a commander in the field won him rapid and repeated promotion first in the final advance to Khartoum and later in South Africa. After being adjutant-general in India, he had the opportunity to show his powers as a trainer of troops, first in command of a division, then at home in command at Aldershot until 1912, when he was transferred to the Southern Command.

On the death of Sir James Grierson in Aug. 1914, Sir H. Smith-Dorrien was appointed commander of the II. Army Corps. His troops received the brunt of the enemy's onset at Mons, and, although his action in giving battle at Le Cateau was criticised, it was subsequently recognised that it saved the British Army from disaster. Afterwards he commanded his corps at the battle of the Marne, on the Aisne, and during the severe fighting in Flanders in Oct. and November. On the splitting-up of the Expeditionary Forces into two armies he was appointed to the command of the II. Difficulties with the commander-in-chief led, in April 1915, to his return to England where he was placed in charge of one of the Home Defence armies. In the following Nov. he was chosen to take charge of the operations against German East Africa, but he fell ill on the voyage out, and had to return home. From 1918–23 he was governor and commander-in-chief of Gibraltar. In 1925 he published *Memories of 40 Years Service.*

SMOKE AND SMOKE PREVENTION.—Industrial and domestic smoke still pollutes the air of towns. Measurements of the extent of air pollution have been carried out on scientific lines, and estimates of the resulting economic loss have been carefully computed. There is no doubt that public opinion is now definitely aroused on the question, and the averagely intelligent citizen is alive to the fact that a polluted atmosphere is both dangerous to health and very expensive. The miners' strike in Great Britain in 1921, which caused town air to be almost smokeless for some months, undoubtedly played a part in educating public opinion.

Measurements of Air Pollution.—In 1912 a British committee for the investigation of atmospheric pollution was appointed as the result of an International smoke abatement exhibition held in London. This committee, although originally unofficial, was subsequently attached to the Air Ministry through the Meteorological Office, and issues an annual report which gives an elaborate analysis of the deposits collected from the atmosphere by means of soot gauges placed at various stations in different parts of the kingdom. Although measurements by this method are subject to error and can only be regarded as approximate at best, they yet give an indication of the magnitude of the yearly sootfall, and they also show the difference in the amount of solid matter deposited in residential, as compared with industrial, towns, and in different parts of the same town.

The following table contains sample readings selected from the *10th Report* published in 1925:—

Town	Annual Total Solid Deposit Tons per square mile	Period
London:		
Golden Lane	425	1923–4
Wandsworth Common	229	1923–4
Glasgow:		
Richmond Park	400	1923–4
Queen's Park	240	1923–4
Birmingham:		
Central	552	4-yr. average
Southwestern	159	4-yr. average
Blackburn:		
Technical college (centre of town)	636	1923–4
Fever hospital (on outskirts)	227	1923–4
Newcastle-upon-Tyne	882	1923–4
Rochdale	762	5-yr. average
Kingston-upon-Hull	403	1923–4
Kingston-upon-Thames	162	1923–4
Southport	128	1923–4
Rothamsted (Harpenden)	123	4-yr. average

It should be pointed out that only a small proportion of British towns keep records; those given above with relatively high readings are not necessarily the smokiest. Several towns with a bad reputation for air pollution have either declined or ceased to record their sootfall.

Comparable figures for cities in the United States, representing for each city the average of from 8 to 16 stations, as reported by H. G. Meller, of the Mellon Institute, University of Pittsburgh, are given below. These figures are for insoluble deposit only, and for average monthly (not annual) deposit.

City	Monthly Insoluble Deposit Tons per square mile	April to September of Years
Pittsburgh	96·1[1]	1923–4
Pittsburgh	170·7	1916
Pittsburgh	82·3	1912
St. Louis	55·6	1916
Cincinnati	43·8[1]	1916

[1] Average of five months only.

In addition to the soot gauge, which measures *deposited* impurities, there is a method of measuring *suspended* impurities by means of an automatic filter invented by Dr. J. S. Owens. The records are taken by means of a circular disk of thick filter paper, the revolution of which is controlled by a clock, and at short intervals a volume of two litres of air is filtered through a

⅛-in. diameter spot on this disk, leaving behind it the suspended impurities. The little discoloured spots left round the edge of the disk are the actual records; the quantity of impurity in the air is estimated by comparison with a calibrated scale. By means of this filter the variation of impurity from hour to hour and from day to day can be ascertained. The 7th report of the advisory committee, issued in 1922, gives an interesting comparison between Sunday and week-day records in London, from which the very important conclusion was drawn that in London the domestic fire was responsible for over two-thirds of the total smoke.

Loss of Sunlight.—Medical discoveries as to the benefit of sunlight in the treatment of disease justify the conclusion that, in ordinary living conditions, light is necessary for the maintenance of health. From this point of view the cutting-off of the ultra-violet rays by smoke must seriously affect the physical well-being of town dwellers. The diagram given below, which was prepared in the department of the medical officer of health for Manchester, shows the relatively small amount of light received in the centre of Manchester in the course of a year compared with Timperley in Cheshire, on the borders of the city.

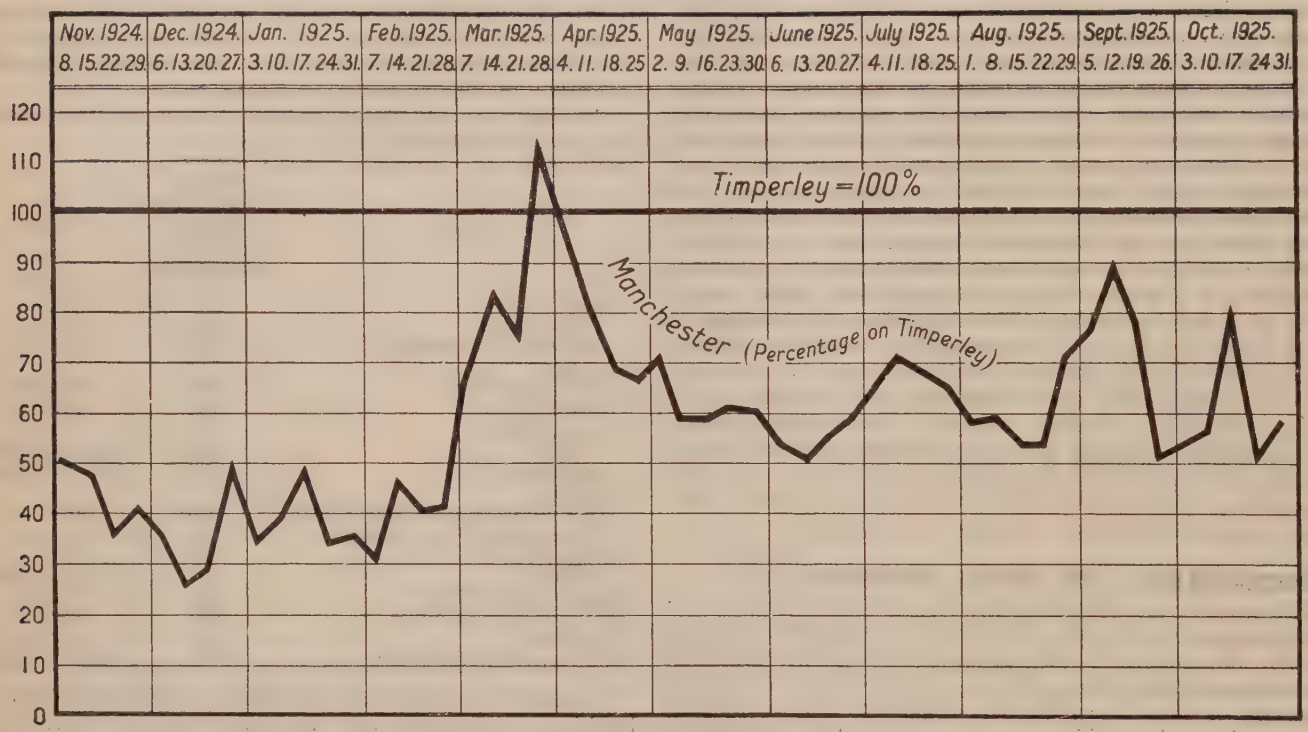

FIG. 1.—Graph showing Manchester daylight, as percentage of light received in Timperley. Each individual record representing average daily light for the week.

Loss through Smoke.—An elaborate investigation into the damage done by smoke was carried out in Pittsburgh in 1912 by a committee of experts, acting under the auspices of the University of Pittsburgh. They computed the damage for that city annually at £2,000,000. As the result of this investigation Pittsburgh embarked upon a thorough and scientific smoke abatement campaign, and succeeded in reducing the air pollution in a marked degree. Another investigation dealing with one item only of the extra cost due to smoke, namely household washing, was carried out by the Manchester air pollution advisory board, a sub-committee of the City Council. The inquiries were made by a trained investigator, and the conclusion, confirmed by a certificate from a leading firm of accountants, who stated that the figures were on a very conservative basis, showed that the cost of household washing in Manchester would be reduced by about £250,000 a year if Manchester were as clean as Harrogate. Sir Frank Baines, director of H.M. Office of Works, who has under his charge 6,000 buildings, including government offices and places of historic interest, is of the opinion that at the very least £120,000 a year could be saved upon their maintenance if the air were as pure in towns as it is in rural districts. These three attempts to estimate the cost of smoke in terms of cash prove beyond doubt that the total loss for the United Kingdom, when all forms of damage have been allowed for, must amount to many millions a year, exclusive of the damage to health, which cannot be measured in money.

British Legislation.—A departmental committee on smoke abatement, which had been appointed in 1914 but suspended during the World War, was reconstituted in 1920 with Lord Newton as chairman. The committee issued their report in 1921, and their general conclusions were that the prevalence of smoke pollution in Great Britain was mainly due to the indiscriminate and wasteful use of raw coal for all purposes, whether industrial or domestic, and to the lax administration of the law by the responsible authorities, coupled with the inaction of the central authority. The committee's chief recommendations as to changes in the law were as follows:—

Industrial Smoke.—(*a*) that the word "black" should be omitted and that smoke of any colour might be dealt with as a nuisance;

(*b*) that there should be a general legal obligation on all manufacturers to use the best practicable means having regard to all circumstances of the case for avoiding pollution of the air by smoke, and that the same law should apply to all Government establishments and all rail and road locomotives, and to steamers on rivers, estuaries and lakes;

(*c*) that the Minister of Health should be empowered to fix standards from time to time, and in any case in which the amount exceeds the standard so fixed the onus of proof that the manufacturer is using the best practicable means should be on the manufacturer.

Domestic Smoke.—(*a*) that the Minister of Health should decline to sanction any housing scheme submitted by a local authority or public utility society unless specific provision is made for smokeless methods of heating;

(It is to be regretted that in view of the immense amount of house building undertaken since 1920, this recommendation, although not requiring fresh legislation, has remained a dead letter.)

(*b*) that the Govt. should encourage the co-ordination and extension of research into domestic heating generally.

(*c*) that local authorities should be empowered to make by-laws requiring the provision of smokeless heating methods in new buildings other than private dwelling houses.

Other proposals dealt with changes in administrative responsibility.

Since the Departmental committee issued its report, three smoke abatement bills, embodying some of the recommenda-

tions, were introduced into the British House of Commons, but up to Dec. 1925 none had been passed. In many quarters it is held that purely punitive legislation will not be sufficient to deal with the smoke nuisance. The Coal Smoke Abatement Society is seeking to insert an amending clause in any future bill for permitting joint action between local authorities, manufacturers and fuel experts (1) to make research into smoke prevention in manufacturing operations and as to the heating arrangements in large buildings, and (2) to arrange for the training of stokers in the best methods of stoking.

The steady expansion of the electrical and the gas industries has, without doubt, effected an improvement in the atmosphere of towns. According to the latest report of the Electricity Commissioners the number of units sold to consumers in the year 1922–3 was 3,762 millions (of which 2,548 millions were used for power). This was three times the number of units sold in the year 1912–3. Gas cooking in urban houses is becoming more and more common, and builders have at last ceased to install kitchen ranges in new houses as a matter of course. The number of gas cookers and grillers in use in England and Wales in the present year (1925) exceeds 4,500,000. Unfortunately it is still doubtful whether low temperature carbonisation coke, which would solve the domestic smoke problem entirely, will be available for general use in the near future. The technical difficulties have been largely overcome, but it is uncertain if the coke can be manufactured at prices that will compete with house coal. Experiments are, however, being made by the Fuel Research Board and by private firms.

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SMOKE: IN WARFARE.—The first historical reference to the use of smoke in war, was the miracle whereby the Israelites were protected during their march from Egypt to the Promised Land (Exodus XIV. 19). In this old Biblical story of the Israelites lies the whole essence of the use of smoke in war—the blinding of one's enemy. In the civil wars of the Roman Empire both Caesar and Pompey used smoke as a weapon of attack, chiefly in landing operations.

Examples from History.—There appears to be little or no mention of the use of smoke for many centuries after this, but we find an instance in the 17th when on July 2 1667 the Dutch Fleet appeared off Landguard and its ships took up their positions to bombard it from all sides at once. Some of them were placed exactly to windward so that the smoke of their guns swept along the beach and so covered the landing of their troops from the sight of the mariners in the fort. Captain Silas Taylor —the keeper of the King's store at Harwich—saw the whole attack from the Dovercourt Cliffs and the next day dispatched the following account of it to Whitehall:—

"It was judged that the eight Dutch ships who sent such clouds of smoke upon the fort out of the Rolling Grounds (part of the sea just south of Landguard Point) were merely for that purpose; that they landed about 2,000 men I have reason to believe from my own guess. . . . In the mean a party of 300 or 400 or more ran along the beach in the smoke that the ships from the Rolling Ground had made, up to the Landguard Fort with scaling ladders, of about 20′ long or more, hand grenadoes etc.

In the battle of Seneff in 1674 smoke was used by the French when, as a stratagem to cover their retirement, they hung up their lighted "matches" in the hedges. In 1770 Charles XII. of Sweden used smoke in the crossing of the Dwina in his campaign against the Saxons. On this occasion specially constructed barges carrying tar barrels were used.

The Waterloo campaign had a great effect on the use of smoke in war, as it was realised at this time at what an enormous disadvantage the defence were in by the use of the black powder, which wrapt them in clouds of smoke, but it was not till 1885 that the introduction of smokeless powder was brought about by the French. Domokos, in the Turko-Greek War of 1897 was the last battle fought in Europe with smoke powder, and a remarkable fact that it was not till 1915—nearly 20 years later—that a means on the battlefield was devised of projecting smoke on an enemy.

An experiment in the use of attacking by throwing forward smoke candles, such as were used for testing drains, was tried at Aldershot before the South African War and was rightly condemned, as the whole essence of the success in the use of smoke is the element of surprise and the blinding of the defenders by the attackers which can be done by smoke projection. No mention of the use of smoke is made in the histories of the South African and Russo-Japanese Wars, though the Boers on occasions lit veldt fires to cover their withdrawal.

The World War.—The first instance of the use of smoke in the World War was probably the lighting of a haystack north of the La Bassée Canal in Oct. 1914, which enabled a company of the Devonshire Regiment to be withdrawn. Shortly after this a battery of artillery in somewhat like manner made good its withdrawal. At Loos in Sept. 1915 smoke was wrongly used as a blind by lighting candles in our trenches, and consequently brought down heavy shell fire. From this battle may be dated the realisation of the necessity of the projection of smoke and its use in attack, and danger to any defence.

By Nov. 1916 smoke shells were in use in some divisions in France, but it was not, however, until the battles of Arras 1917, when they were used by the 9th (British) Div. that the art of accurately projecting smoke-shells, and their great value, came to be really appreciated. Many instances in 1917 and 1918 are on record when numbers of lives were saved by the invention of smoke-shell and when victories were gained with a minimum of casualties by the use of smoke. The Germans quickly copied the British and used it in their offensive of March 1918, while the Australians used it to cover their withdrawal over the Piave in May 1918. The navy used smoke with conspicuous success at Zeebrugge on St. George's Day 1917, when fast coastal motor-boats greatly assisted the blocking operations, by blinding the enemy's observation and shore guns.

Smoke, which may be used in war by artillery, infantry, aircraft and tanks, has certain inherent disadvantages, in particular the blinding of observation, and the variability of wind—the latter is a serious difficulty—but by practice all difficulties can be overcome, and certainly the history of the War has proved that the advantages caused by the use of smoke far outweigh the disadvantages. It may be said of smoke that if properly used it will on almost every occasion in the attack, and also in the withdrawal, save many casualties. By its use the utmost is made of "fire power," and man power is concealed until the decisive stages. Infiltration—an art in war—is facilitated and losses are greatly reduced by the use of cover by ground and cover by smoke. The chief object in the use of smoke-tactics, is, as far as possible, to impose on the defenders the conditions of night, while the attackers have the conditions of day, and thereby effect surprise and reduce casualties. To summarise the use of smoke in war it may be said that it is used to obtain concealment of movement which begets surprise.

(P. R. W.)

SMOOT, REED (1862–), American politician, was born at Salt Lake City, Utah, Jan. 10 1862. He was educated at Deseret University and at the Brigham Young Academy, Provo, Utah. He amassed considerable wealth as a banker and woollen manufacturer. In 1895 he was appointed one of the presidents of the Utah State of the Church of Jesus Christ of Latter Day Saints (Mormon), and in 1900 was made an apostle. He was elected to the U.S. Senate from Utah in 1902. Attempts were made to prevent his entering the Senate because of his connection with the Mormon Church and on the charge that he

personally favoured polygamy and was a polygamist. He was allowed to take his seat; but the matter was referred to the Senate committee on privileges and elections for investigation. In June 1906 the committee by a vote of seven to five recommended that he be unseated; but as the personal charges against him had not been proved the Senate in Feb. 1907, by a vote of 42 to 23 refused to remove him. He was re-elected in 1908, 1914 and 1920. He took an active part against the United States becoming a member of the League of Nations. He is chairman of the Finance Committee of the Senate and a member of the World War Foreign Debt Commission.

SMUGGLING: *see* BOOTLEGGING AND SMUGGLING.

SMUTS, JAN CHRISTIAAN (1870–), South African statesman and general, was born May 24 1870 near Riebeek West, Malmesbury district, Cape Colony, the son of J. A. Smuts and Catharina de Vries. In 1886 he commenced his studies at Stellenbosch, and in 1891 went to Cambridge, where his success was unprecedented. In 1895 he was admitted to the Cape Town Bar. During the early part of his legal career he did a considerable amount of journalistic work, in both English and Dutch. In Oct. 1895 his first political speech was delivered at Kimberley, where, as a result of the understanding between Jan Hofmeyer and Rhodes, he defended the latter's policy. The Jameson Raid, which followed in Jan. 1896, changed the whole complexion of South African politics. Smuts ranged himself on the side of the Transvaal, and shortly afterwards joined the Bar at Johannesburg. In 1898, though two years under the legal age, he was made state attorney by President Kruger, and took part in the negotiations with the British agent at Pretoria concerning the franchise. He also accompanied Kruger to Bloemfontein, where the abortive conference with Milner took place in July 1899.

In the early stages of the Boer War, Smuts' remarkable versatility and capacity for hard work found full vent in legal and organising activity. In the occupation of Pretoria, in 1900, he joined the Boer field forces. From the Eastern Transvaal, where his Government was hard pushed, he made his way to the West, where he had wider scope. He saw much fighting under De la Rey, and subsequently acted as commander-in-chief of the Boer and Cape rebel commandoes in the Cape. He was besieging a mining camp in Namaqualand, when Botha sent for him to take part in the peace negotiations at Vereeniging (1902). He threw in his weight on the side of those who urged a compromise, as against the intransigent commandants.

After peace, Smuts became a strong and active protagonist of Botha's policy—loyalty to the new order, and racial conciliation. Practising as a barrister at Pretoria, he spent a good deal of time in the reconstruction of the remnants of the Boer nation and together with Botha and other leaders he met Mr. J. Chamberlain at Pretoria. The Boers, supported by part of the British population, strongly opposed several points in Milner's policy, *e.g.*, the importation of Chinese coolies for the gold mines, and Smuts was among those who refused Lord Milner's offer of seats in the nominated Legislative Council.

In 1904 Botha and Smuts founded the political organisation open to both races known as " Het Volk " and it was largely owing to its opposition that the Lyttelton constitution for the republics was never put into force. Early in 1906 Smuts visited London, where he worked for fully responsible government in the Transvaal and Orange Free State, which was granted in 1906. Early in 1907 elections for the Assembly were held. Smuts took a prominent part and was returned unopposed for Wonderboom (Pretoria). As Colonial Secretary, under Botha, he became the driving force of the Cabinet, interesting himself particularly in education and defence. His Education Act marked a new departure in South Africa. In May 1908 Smuts openly launched out in favour of the union of the South African colonies. In Oct. of that year, the National Convention, which eventually produced the South African Act, began its labours, Smuts being one of its most valued members, both in debates and in drafting committees. On May 1910 Union was consummated. Smuts was elected member of the legislative assembly for Pretoria West, and became Minister of the Interior, Mines and Defence.

In the Union Assembly Smuts continued to occupy a most prominent place, thanks to his forceful measures as well as striking speeches. In 1911 the South African party was founded at Bloemfontein, where Smuts foreshadowed the political difficulties ahead. Early in 1912 he introduced his Defence Bill, which powerfully affected the future of South Africa. A little later, H. C. Hull (Minister of Finance) left the Botha Cabinet owing to differences with Sauer, a Cape Minister. Smuts thereupon surrendered the Ministry of Interior and Mines, retaining Defence and took over the Treasury. During the Hertzog crisis, at the end of 1912, he did his utmost to prevent a split, but once the fateful step had been taken, he resolutely supported Botha.

In July 1913 a revolutionary strike shook the Rand to its foundations. Botha and Smuts, at great personal risk (and unescorted) saved the situation at Johannesburg, after Lord Gladstone had sanctioned the use of Imperial troops to quell disturbances. In Jan. 1914 an attempted general strike was nipped in the bud by Smuts, who in record time rushed up the commandoes but recently organised under his Defence Act. The deportation of nine strike leaders on the S.S. " Umgeni, " though authorised by the Cabinet, has been chiefly debited to Smuts by his opponents, and at the time created a furore. A double Indemnity Bill, covering the two revolts, led to a violent and protracted parliamentary debate.

The outbreak of the World War shifted the South African centre of gravity to Smuts' office. In Sept. 1914, when Beyers resigned as Commandant-General in the midst of the preparations for a campaign against the Germans in Southwest Africa, Smuts assumed his functions. The rebellion of De Wet, Maritz, Beyers and others followed. This was suppressed by Botha, acting in the closest collaboration with Smuts at headquarters. The execution of the rebel commandant Joseph Fourie, contrasting as it did with the extraordinarily mild treatment meted out to his superiors, caused a great political upheaval and helped to swell Hertzog's following. In 1915, after a visit to Botha's forces in Southwest Africa, Smuts took the leading part in the general election, which was marked by extreme bitterness. On at least one occasion, his life was in great danger at a meeting, the rancour of the Government's opponents being directed chiefly against him. He was re-elected for Pretoria West by a narrow majority. Early in 1916 he refused the command offered him in East Africa by the Imperial Govt., but shortly afterwards yielded to representations. Immediately after his arrival the tide, which had been rather in favour of the Germans, turned. Although their resourceful and gallant commander, Von Lettow-Vorbeck, with a handful of die-hards, succeeded in escaping, the campaign—which had called for the utmost vigour—was virtually over when Smuts left for London via South Africa early in 1917.

Work in London.—In March Smuts arrived in London to represent South Africa at the Imperial War Conference, and was sworn as a privy councillor. After the Conference, a dinner was given in recognition of his war services, by members of both Houses of Parliament. There he made his declaration on the British Commonwealth of Nations, which had become a landmark in constitutional development. Offered the command in Palestine, he declined. He accepted a seat in the War Cabinet, taking a deep interest in the flying services, and his proposals for their unification were accepted by the Cabinet. He was also chairman of the committee that framed the bill for an Air Ministry, and worked out the organisation for the new Force. Incidentally, he supervised London's air defences. He suggested, and became chairman of, the War Priorities Committee, which settled priority of claims among departments concerned in the War, and allocated man-power and other resources. Occasionally he visited the Western front, where he conferred with commanders. In Dec. 1917 Smuts met Count Mensdorff at Geneva, and explored the possibility of a separate peace with Austria; but was finally convinced that it was not possible. The follow-

ing Feb. he spent with Allenby in Palestine, working out plans for a great advance.

After the Armistice, Smuts wrote his Memorandum on the League of Nations, *The League of Nations: A Practical Suggestion* (1918), which received the support of both President Wilson and Mr. Lloyd George, and in substance became the Covenant of the League. With Botha, he represented South Africa at the Peace Conference, where he was mainly concerned with the Covenant and Dominion status. At this time he undertook a mission to Vienna and Pesth, where the Communist Govt. had violated the Armistice.

After the conference, he returned to South Africa. In Aug. 1919, he became Prime Minister of the Union (in succession to Botha). During this period he twice attended the Imperial Conference. In 1921 his visit was notable for the part he played in securing peace in Ireland. During the Conference of 1923 (held while the Ruhr crisis was at its worst), he advocated a fresh attempt to settle the European situation. The suggestion was generally approved, and the Dawes Commission followed.

In 1920, repeated attempts to reunite the South African party and the Nationalists failed. The Unionists, under Smartt, decided to dissolve their organisation and to join the South African party. The consequences of this fusion lost Smuts a certain amount of support among both English and Dutch. A general election, held on that issue, left him, however, with a working majority, and the combined party did fairly well in Parliament. In 1922, however, another workers' revolt on the Rand (which had to be suppressed by the military and burghers, after the exercise of considerable patience) led to a junction of forces between advanced Nationalists and the Labour element. Bye-elections went against the Government, and a formal pact was made by the two Opposition parties. In 1924, after a crucial bye-election, Gen. Smuts took the country by surprise; he dissolved Parliament, realising that the people were probably dissatisfied with him. The result, nationally considered, thoroughly bore out the wisdom of his decision, for the South African party was heavily defeated. Hertzog did not obtain a clear majority, but was able with the assistance of Labour to form a coalition Cabinet. Although Smuts himself lost Pretoria West, he was elected unopposed for Standerton, Botha's old constituency.

As Opposition leader, he continued to pay close attention to affairs of state, while indulging to some extent his fondness for philosophy and botany. In 1925 he delivered, as president of the S.A. Association for the Advancement of Science, the opening address at the congress of that body. In 1926 he published *Holism and Evolution*, a philosophical treatise. (N.Le.)

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SMYRNA (*see* 25.281), a town and vilayet of Turkey. At the Peace Conference in 1919 Greece put forward a claim to the Smyrna area. That area had, it was understood, been assigned by the Agreement of St. Jean de Maurienne (April 17 1917) to Italy, but owing to Russian objections that agreement had never been ratified. M. Veniselos argued on the Greek claim before the Council of Ten on Feb. 3–4 1919. The final decision of the Council of Three, authorising the Greeks to occupy Smyrna, was taken apparently without the knowledge of the Italians, who had withdrawn temporarily from the conference, or of the American expert advisers to President Wilson. The occupation was in theory an Allied occupation, but was generally taken to mean acceptance of the Greek claims. Greek troops occupied Smyrna on May 15 1919.

The first entry of the Greeks was marked with many atrocities against the Turkish population. Under the Treaty of Sèvres, Aug. 10 1920, it was stipulated that the town of Smyrna and the Ionian hinterland were to be under Greek administration for five years. Greece was empowered to maintain military forces in the zone and to incorporate it in the Greek Customs system; but a local parliament, elected on a franchise giving representation to all sections of the population, was to be established and the provisions of the minorities treaty signed between Greece and the principal Allied Powers were to apply to the Smyrna zone. After five years the local parliament might ask for definite incorporation with Greece; the Council of the League of Nations might as a preliminary require a plebiscite. In the event of incorporation, Turkish sovereignty was to cease. The Greek claim was based on ethnographical grounds. Reliable racial statistics for the area were not available, but an American computation of 1914 gave the total population as 1,057,000, including 509,000 Turks, 470,000 Greeks and 78,000 others.

This decision caused general dissatisfaction. Turkish forces under Mustafa Kemal and the Greeks were soon engaged in hostilities, in which at first the Greeks were successful. Mustafa Kemal, however, continued to consolidate his position in Turkey, while the fall of Veniselos (Nov. 1920) and the return of King Constantine to Greece (*see* Greece) weakened the sympathies which Greece had enjoyed in Great Britain, her chief supporter among the Allied Powers. At the London Conference, Feb.–March 1921, it was proposed to place a gendarmerie controlled by the Allies in the Ionian area, and to have a Christian governor of the whole area under the League of Nations, the arrangement to be subject to review by the League of Nations at the end of five years. Both the Greek and the Kemalist delegates to the Conference rejected these terms. The Greeks renewed their offensive but their initial successes were not sustained. The Paris Conference, Feb.–March 1922, proposed to restore the Smyrna zone to Turkey; but the negotiations broke down on other points, and the Kemalists drove back the Greek Army, which with many thousands of Greek refugees from all parts of Asia Minor embarked hurriedly and left Smyrna, which the Turks entered on Sept. 9 1922. Under the Treaty of Lausanne (July 24 1923) Smyrna and the surrounding zone reverted under full Turkish sovereignty.

Meanwhile, the town and district had suffered frightfully under the atrocities of both belligerents, and these sufferings culminated when, a few days after the Turkish entry into the town, fire broke out in the Armenian quarter, and Smyrna was soon in flames. When the conflagration had burnt itself out, only the wretched Turkish quarter on Mount Pagus was untouched, and more than three-fifths of the city was destroyed, including all the banks, business houses and consulates in the European quarter on the quay. The loss of life was impossible to compute. A town planning scheme for the rebuilding of the city met with opposition on the grounds of expense, since before the fire only 14% of the total area of Smyrna was not built over, and the new plan gave 55%. A plan was said to have been approved in Sept. 1925. The city was then still in ruins, with the exception of the Turkish quarter.

Before the World War Smyrna extended for some three miles along the gulf of the same name, for about a mile along the Gulf of Burnabat, and almost to the summit of Mount Pagus. In 1925 the flour-milling industry was growing and improving, there were two cotton spinning establishments, and the carpet-making industry was reviving. Smyrna is the second port of Turkey in importance, it has good railway connections with the interior, and trade is again improving, but is hampered by lack of facilities, and by the regulation which forbids vessels to enter or leave the gulf of Smyrna between sunset and sunrise. Efforts have been made to develop an air service, with headquarters at Smyrna, but owing to the shortage of pilots and mechanics it has not become efficient. Turkish sources in 1924 estimated the population of the town at 98,846, a reduction of nearly two-thirds on the population in 1914. (O. J. R. H.)

SMYTH, ETHEL MARY (1858–), British composer, was born in London April 23 1858, the daughter of Gen. J. H. Smyth, C.B. She studied music at Leipzig under Heinrich von Herzogenberg, whose wife was a friend of Brahms. Though encountering much opposition in her musical career, she successfully produced her first opera *Fantasio* at Weimar in 1898, others being given at Leipzig, Prague and Vienna. Her first opera to be produced in London was *Der Wald*, given at Covent Garden in 1902

which was followed by *The Wreckers* (1909), a vividly romantic work. Her *Mass in D*, first performed in 1893, was revived 30 years later. *The Boatswain's Mate*, a comic opera, was produced in 1916 with considerable success. Dr. Ethel Smyth took a prominent part in the militant suffragist movement, and composed *The March of the Women* (1911) the battle song of the W.S.P.U. In 1922 she was made a Dame of the British Empire. Her compositions include *Fête Galante* (1923) and *Entente Cordiale*, 1924, operas; also chamber music, choruses and songs, all characterised by energy of invention, exuberant vitality and adroitness of workmanship. In 1919 Dame Ethel published her brilliant memoirs *Impressions that Remained*, followed by *Streaks of Life* (1921).

SMYTH, HERBERT WEIR (1857–), American classical scholar, was born at Wilmington, Del., Aug. 8 1857. He was educated at Swarthmore (A.B., 1876), Harvard (A.B., 1878), Leipzig and Göttingen (Ph.D., 1884). During 1883–5 he was instructor in Greek and Sanskrit at Williams College, and then for two years was reader in Greek at Johns Hopkins University. From 1887–1901 he was professor of Greek at Bryn Mawr. In the latter year he was appointed professor of Greek literature at Harvard. During 1899–1900 he was professor at the American Classical School at Athens. From 1889–1904 he was secretary of the American Philological Assn. and editor of its *Transactions*, and in 1904 was elected president.

His works include *The Ionic Dialect* (1894); *Greek Melic Poets* (1900); *Greek Grammar for Colleges* (1920); *Aeschylus*, text and translation (1923). He was also author of various contributions to philological journals. He was editor of the *Greek Series for Colleges and Schools* (20 vol.).

SNOUCK HURGRONJE, C.: *see* HURGRONJE, CHRISTIAN S.

SNOWDEN, PHILIP (1864–), British Labour politician, was born on July 18 1864 at Cowling, Yorkshire. Educated at an elementary school, he read widely, and became a clerk in the customs and excise department of the Civil Service. Joining the Independent Labour party in the year after it was founded (1893) he became one of its most effective speakers and, in 1903, and again in 1917 its chairman. His first parliamentary attempts, for Keighley and Blackburn, failed, but, in 1906, he was returned for Blackburn as Labour M.P. In the House he at once made his mark, notably on financial matters. When war broke out in 1914 he was in Australia. On his return he at once ranged himself with J. R. MacDonald and shared much of the latter's unpopularity. Defeated in the 1918 election, he won Colne Valley for Labour in 1922, and held the seat with increased majorities in 1923 and 1924. His appointment as Chancellor of the Exchequer in Mr. MacDonald's Cabinet was approved on all sides.

In his Budget, introduced in April 1924, while limited by the commitments of his predecessor, Mr. Snowden went a long way to redress the burden of taxation on the poor by his reduction in the food duties, and by making provision, in his contingent Old Age Pensions Act, for the removal of the oppressive features of the thrift disqualification. At the same time, he stood fast to the Free Trade principles of which he had been so doughty a champion in earlier years, by repealing the McKenna duties on imported motor-cars, clocks, musical instruments, etc., and terminating the duties imposed under the 1922 Safeguarding of Industries Act. Later in the session he introduced plans of constructive work designed to relieve the prevalent unemployment. At the London Conference in July—Aug. 1924, he took charge of the discussions with the bankers which ended in the successful flotation of the German loan in Oct. of that year.

Snowden's power, both in the Labour movement and outside, was due as much to gifts of character as of brain. As a speaker, he was equally powerful both as a private member in opposition and as a minister. Most of his life was spent in the service of Socialism; he was also a powerful advocate of the emancipation of women and of temperance. In the promotion of these causes, as in his work for peace and in his opposition to Communism, he was notably assisted by his wife, herself a speaker and writer of wide appeal. He was member of the Liquor Control Board during the War, and served on royal commissions on the civil service, canals and venereal disease.

He is the author of various books, among them *A Socialist Budget* (1907); *A Living Wage* (1912); *Socialism and Syndicalism* (1913); *Wages and Prices* (1920); *Labour and National Finance* (1920); *Labour and the New World* (1921). (M. A. H.)

SOAP: *see* OILS AND FATS.

SOCIAL ANTHROPOLOGY (*see* 2.108c).—Investigation of many peoples by a rigorous linguistic and statistical technique has produced a mass of accurate information that may be quantitatively gauged by comparison of the first and second editions (1910 and 1922–3) of G. Buschan's *Illustrierte Völkerkunde*. There naturally followed co-ordination from both historical and psychological points of view, and, though in reality intertwined, these are best treated under separate heads.

Culture History

As substitutes for the "evolutionary" syntheses of men like E. B. Tylor and Lewis H. Morgan, several "diffusionist" schemes have been elaborated. However, this label, though convenient, fails to define the essential difference, since the earlier writers also used the principle of transmission even to the extent of deriving all clan systems from one centre (Morgan). What really characterises them is the belief in historical laws. Human institutions, Tylor held, follow one another "in series substantially uniform over the globe."(1) Knowing the formula of progress, the anthropologist can predict the future and reconstruct prehistory—as when Morgan infers a matrilineal stage of Hellenic society.

The notion of laws of sequence is amenable to the direct test of pre-history, and stands refuted by it. While in Europe stone tools are succeeded, first by copper (bronze), and then by iron tools, the African negroes passed directly from the Stone to the Iron Age. Similarly, in Italy the Solutrean period of the Palaeolithic is lacking, and so forth. Thus, Tylor's "substantial uniformity" is not demonstrated: if laws exist, they are masked by incalculable disturbances that render them metaphysical rather than scientifically useful concepts.

Modern Diffusionists.—The "diffusionist" reconstructions, then, spurn formulae of sequence and view cultural phenomena as historical, *i.e.*, individual events. One school, fathered by the late W. H. R. Rivers, is headed by G. Elliot Smith and W. J. Perry; a rival system outlined by F. Graebner has latterly been amplified by Father W. Schmidt. Both schemes ignore the possibility of independent duplication. Similarities are *ipso facto* evidence of transmission, and the proof is perfect when not merely single traits but complexes recur—megalithic monuments *and* a suncult, conical roofs *and* a solar mythology, rectangular huts *and* a division into matrilineal moieties.(2)

Apart from their antipathy to independent invention, the two schools differ profoundly. The British diffusionists are pan-Egyptians,(3) an "archaic civilisation" evolved in Egypt prior to 2600 B.C. and then spread to the four quarters of the globe, reappearing elsewhere in varying degrees of decay; the ruder cultures are not "primitive," but degenerate. Before contact with "the archaic civilisation," the Australians lacked magico-religious beliefs and practices, and a dual organisation, "when discovered in some outlying part of the world, would be sufficient witness of the existence of Egyptian influence(4)."

In contrast to this monism, Graebner and Schmidt are pluralists. To follow Schmidt(4a), a primeval culture corresponded to the hunting type of life of recent Pygmies and Pygmoids. From this there branched off at different times and localities three "primary" cultures. One was based on woman's invention of tillage, with consequent development of a matriarchal polity, female deities and a lunar mythology. Another culture evolved from the perfection of primeval hunting methods, the rise of masculine crafts, patrilineal descent—associated with totemism, male deities and a solar mythology. A third group of hunters domesticated livestock and became pastoral nomads. The subsequent course of history consists in the spread and interaction of these three *Kulturkreisen*. By fusion of the first two there arose

village life, with its combination of husbandry and craftsmanship; while the impact of nomadism upon this joint product laid the foundation of the Near Oriental proto-civilisations.

Solid achievement must be credited to both diffusionist schools. While the complexity of culture had been discovered before Graebner and Rivers, their insistence has made historical analysis a commonplace of anthropological research. Again, Elliot Smith's denial of laws due to the " psychic unity " of mankind has exposed the impotence of that principle so long as it is impossible to explain why a *constant* factor does not yield uniform results. Above all, diffusionists have envisaged all culture as a connected whole.

Nevertheless, fatal defects of method make acceptance of either scheme impossible. The pan-Egyptian view implies a complete passivity of all non-Egyptian peoples, yet many ingenious devices current in ruder cultures and rooted in local conditions disprove this corollary. Indeed, the irreversible flow of cultural elements from the more complex to the ruder cultures is refuted in history. The Caucasians borrowed maize and other cultivated plants from the American aborigines, and B. Laufer's studies show that the Chinese repeatedly profited by contact with peoples of inferior level(5).

Again, the procedure of both schools in segregating a selected number of features as an historical unit is arbitrary. Thus, Graebner and Schmidt have it that totemism was originally joined with paternal descent. What, then, of the matrilineal totemic tribes in northwestern America and the Pueblos of Arizona and New Mexico? Schmidt assumes that in either case matrilineal descent was introduced by Athabascan neighbours. But since most Athabascans lack definite rules of descent, his logic is radically unsound; for by inventing auxiliary hypotheses *ad hoc*, it is manifestly easy to prove anything and everything. An equally vital defect lies in the vagueness of the concepts used. To say that two peoples share a sun-cult or a solar mythology is to hide possible diversity under a label of merely descriptive utility. Proof of transmission depends on the comparison of phenomena, the sharpness of whose definition guarantees identity.

Independent Origins.—Still more unfortunate is the denial of independent origin, though this is demonstrable for the dual organisation that plays so prominent a part in both schemes. Thus, the probably once exogamous Pezoma and Pepfüma moieties of the Angami of Assam are no longer so, hence in one village all the people were marrying among themselves if of different clans; and since these numbered only two, they correspond exactly to the classical form of dual organisation(6). But in the Hopi village of Shipaulovi the same result was achieved by the extinction of one of three clans. The dual division accordingly cannot figure as the invention of one people, but is a recurring institution that may have arisen five hundred times in the course of human history—now by a reduction of clans, now by the fusion of two intermarrying groups into one tribe and again by other processes.

Convergence.—We have here a perfect example of convergence, a process which F. Boas(7) and A. A. Goldenweiser(8) have powerfully argued to establish as a reality. They have shown that in many situations confronting man the possible number of solutions is so small that any particular one has a high degree of probability and is likely to be duplicated.

Independent origin is also demonstrated by linguistic phenomena, which are merely a specialised department of culture. If the dual number could develop independently in Greek and in Shoshoni (Idaho), if the use of reduplication in Takelma (Oregon) is not derived from contact with ancient Greece(9)—then, too, stories about the moon or the conquest of monsters cannot be offered as evidence of cultural connection.

A sense for historical reality must, then, reject as equally dogmatic the assertion of uniform sequences and the derivation of all similarities from a single invention. Historical realism will rigidly exclude as useless for comparison any but sharply individualised features; it will trace distributions over continuous areas, will appeal to the ascertained facts of linguistics and other sciences; and, above all, will use the findings of archaeological stratigraphy as the surest point of departure and ultimate arbiter in questions of chronology.

Auxiliary tests of relative antiquity are not lacking(10). The most important of these is the assumption that the range of distribution is proportionate to age. Though challenged and liable to correction in specific cases, the general utility of this criterion is guaranteed by supplementary checks. Thus, Kroeber argues for the antiquity of girls' adolescence rites in California(11), not merely because of their universal distribution but from the concomitant fact of local differentiation. In general the appeal to pre-history supports the correlation of age with range: a universal trait, such as the use of fire, dates back to Mousterian times. The dog is at once the most general and most ancient of domesticated animals. The bow, at least of Azilian antiquity, has (barring Australia) a comparable range. In ancient Egypt the plough is seen as a newcomer crowding out the hoe; and the hoe remains, until recent times, the most common implement of husbandry. Since Europe remains the only major area systematically explored by stratigraphic methods, historical reconstruction must remain tentative.

Facts of Distribution.—The facts of distribution themselves may suffice for chronological inferences. The sinew-backed bow, which in Egypt goes back to the second millennium B.C., is characteristic of many Asiatic peoples, and occurs in the New World only north of Mexico and west of the Missouri. It may, therefore, be interpreted as a comparatively recent acquisition from Asia that failed to establish itself beyond the far west of the United States. From the same angle, systematic comparison of North and South American ethnography is bound to yield interesting results. The absence of the tambourine from South America indicates that it can hardly belong to the oldest "proto-American" layer of culture. On the other hand, E. Nordenskiöld's discovery of Gran Chaco games that almost exactly duplicate North American forms(12) places these traits as definitely older, even though we are unable to give a precise definition in chronological terms. Still more remarkable are the implications of Gusinde's and Koppers'(13) researches in Tierra del Fuego: the Yahgan at the extreme tip of the continent are found to share with the Indians of British Columbia initiation rites during which the novice is obliged to drink through a tube and to scratch his head with a special " head-scratcher." The specific character of these features and the arbitrariness of the association leave little doubt as to the identity of the phenomena; and it is reasonable to ascribe to them a very great antiquity.

Established facts as to the history of domesticated animals and cultivated plants are rightly reckoned among the most valuable aids in the tracing of cultural connections. Thus, the cultivated banana is invariably propagated from side-shoots and has long ago become seedless; hence its range over a wide area in southern Asia and Polynesia is incontrovertible evidence of diffusion. Moreover, the cultivated banana of Africa cannot possibly have been derived from the botanically distinct wild banana of Africa, which produces no side-shoots; its importation from Asia is accordingly demonstrated(14). Apart from the historical evidence that the banana was indigenous in America, fossil banana seeds have been found in Tertiary—perhaps Oligocene—beds in Colombia. This does not necessarily prove that South America was the region of origin(14a). Similarly, the humped variety of cattle found in parts of Africa has been identified with the zebu of India, while the long-horned breed can be traced with practical certainty to Egypt, if not beyond. Whenever a route of migration has thus been ascertained by objective methods, it is proper to inquire for additional traits that may have travelled along the same path. If we are sure that the zebu came from India we shall be on the lookout for other elements of culture from that source, such as cotton and the loom; while the affinity of South African with Egyptian cattle enables us to trace the history of Bantu head-rests as well.

Use of Linguistics.—An unquestionable linguistic relationship likewise serves as a secure starting-point for ethnographic comparison. As Tylor showed long ago, the Malagasy share

with their fellow-Malayans a type of bellows utterly distinct from any on the neighbouring mainland, hence the invention must have spread to Madagascar from a Malaysian centre. In the case of so specialised a device as this "piston-bellows," mere recurrence in the same general part of the world is adequate proof of transmission; accordingly, the Nagas of Assam appear as cultural kindred of the Indonesians, and this conclusion is corroborated by other points of community, such as the equally distinctive terraced irrigation system of the Angami Nagas and the Malay-speaking Ifugao of the Philippines.[15] By concentrating upon points of unmistakable identity Miss Laura Watson Benedict[16] has succeeded in demonstrating the generically Indonesian substratum in the religion of Mindanao natives, has separated later Hindu accessions and rendered probable an infiltration of Indo-Iranian ideas. Modern methods of divination in Indonesia have been identified with Babylonian hepatoscopy of about 2000 B.C.,[17] and R. Andree[18] follows the distribution of shoulder-blade divination from Bering Strait to northwestern Europe.

The cultural bond of western and eastern Asia, of Asia and Africa, of easternmost Siberia and Europe, is thus definitely established, and the sinew-backed bow has been cited as evidence of connection between the two hemispheres. Indeed, the joint study of the Old and the New World has already produced positive results of considerable importance. The Lapp's tambourine is not only widely spread in both Siberia and North America but appears with curious frequency in association with the shamanistic office, a combination not easily explained except by contact of the cultures in question. Over a large part of the same territory hunters exhibit a characteristically apologetic attitude toward a slain bear, and practice similar rites of propitiation. Above all, the systematic investigation of hundreds of myths has led to some astonishing conclusions. The Koryak of Siberia, whose material life is very much like that of the Eskimo, are mythologically much more closely allied to the Indians of southern British Columbia. An ancient contact of these now widely separated populations is thus demonstrated, the connection being broken by a possibly retrograde movement of the Eskimo.[19] In the case of one story shared by European, Siberian and American folk-lore—that of the Magic Flight—even so stout-hearted a champion of independent origin as Andrew Lang admitted dispersal from a single centre.

The Deluge Myth.—Among the stories discussed by Jochelson[20] the deluge myth is one of the most interesting. It is not merely a narrative of a general flood, which would be devoid of historical cogency, but contains the specific detail of animals diving for mud to be used in the rehabilitation of the earth. This characteristic episode occurs in North America from the Atlantic to the Pacific, and also among the Chukchi, Yukaghir, Buryat, Turkic and Finnic tribes. It is now possible to add two Bodo tribes of the Tibetto-Burman family—the Garos and the Kacharis.[21] Moreover, Mr. Hutton has mentioned Naga parallels to tales recorded among the Lapps, whose original home lies in or near Siberia.[22]

As corroboratory testimony from another field may be cited the religious sanction of homosexual inversion in North America, Siberia and Indonesia, and the striking resemblance between the priestly activities of the inverts in Borneo and among the Chukchi.[23] Considering the historic migration of Buddhism from India to Mongolia, a cultural bond between Siberia and southern Asia cannot be waved aside as inherently improbable. But if we admit the possibility, an alternative is supplied for the speculative attempts to interpret mythological and other coincidences between Asia or Oceania and America by contact through a direct water route. It is then possible to proceed on the orthodox principle of tracing continuously distributed traits over demonstrated paths of dissemination.

Orthodox principles of comparison, then, suffice to span continental distances and to co-ordinate the ethnographic and archaeological data of the globe; and if the chronological results lack a spurious completeness, they have a compensatory solidity.

In one respect historical realism enjoys a definite superiority over the extremist schools. Diffusionism, in asserting the absolute singularity of cultural events, bars causal explanation. If, say, agriculture and pottery arose jointly only once in the history of mankind, their association may be a chance occurrence; and their joint diffusion is due to chance contacts. On the other hand, if like features arise independently and linked with the same concomitants, a functional relationship may be demonstrable.

Thus, there are tribes in Assam, California, Nebraska and South Africa[24] who, in their kinship terminology, fail to distinguish the maternal uncle from his son; while in Arizona, Montana, California and Melanesia others class the paternal aunt with her daughter. The former peoples are patrilineal, the others matrilineal: the kindred included under one head are in both cases in the same clan. This is not a *law* for we cannot predict that a given patrilineal or matrilineal tribe will so fuse distinct generations; but we can predicate a correlation between types of fusion and rule of descent. Similarly, Tylor's correlation between moieties and unilateral merging of lineal and collateral kin holds if, with Rivers,[25] we substitute clans for moieties. In the statistical determination of such correlations lies one of the most fruitful lines of future research.

Psychological Problems

A decade ago anthropology seemed to have few points of contact. It had become clear that racial differences, even if ascertainable by unequivocal tests, could not explain the history of a people's culture, which varies too rapidly to be correlated with hereditary changes. The uncertainty of the psychological interpretations offered bred an aversion from psychology, which was enhanced by the desire of a new science to assert its individuality. Hence, such declarations of independence as A. M. Hocart's "Psychology and Sociology"[26] and A. L. Kroeber's "The Superorganic."[27] Rivers went a step further, maintaining that only through the study of cultures could the psychologist understand the workings of the human mind.[28] Today psychologists admit that culture co-determines the individual's mental life;[29] while anthropologists have fallen back from their intransigeant position. Even Kroeber[30] finds a non-psychological treatment of society sterile.

This is not surprising; for the very phenomena formerly envisaged from a purely historical angle harbour a host of psychological questions.[31] Why do peoples adopt alien features? Why are some traits accepted while their concomitants are spurned? Can the mere idea of, say, pottery be transmitted without instruction in the technique? Such are among the problems that beset the historian, who, consciously or unconsciously, must turn psychologist.

The late Dr. Rivers furnished partial solutions: primitive peoples, he contended, would readily adopt foreign elements, even when introduced by small bodies of immigrants, provided these possessed a material culture that powerfully impressed the aborigines. Since, however, transmission is by no means regularly the result of movements of population, this theory has at best limited applicability. More damaging still is the adherence to custom by the American natives, swamped, not merely visited, as they are by possessors of a superior technology.

Culture Contacts.—Boas has indicated the selective character of borrowing, and suggests that people are receptive toward elements more or less prefigured in their culture. This, however, is avowedly rather a formula defining a programme of observation than a causal explanation. What is required is the careful analysis of concrete instances. Pioneer service has been rendered by P. Radin, whose "Sketch of the Peyote Cult of the Winnebago"[32] illustrates how a borrowed culture may be levelled to a cultural pattern of long standing.

But contact may prove a creative factor. "The introduction of new ideas," says Boas, "must by no means be considered as resulting purely mechanically in additions to the cultural pattern but also as an important stimulus to new inner developments."[33] Thus, the fusion of diverse types of social organisation on the west coast of Canada has led to novel arrangements. Similarly Rivers[34] shows how certain art styles originate from

the mingling of two Melanesian trends. In East Africa the subjection of one people by another has repeatedly created a caste system unparalleled in the previous polity of either conqueror or vanquished. Re-valuations ensuing upon the borrowing of ceremonial traits have been illustrated by L. Spier.(35) In the domain of technology the Chinese derived glazing from western Asia; but centuries of experimentation culminated in a creative synthesis—the invention of porcelain.(36) In the North American Plains area the introduction of the horse proved at least a potent factor in the spread of cultural features.(37)

Human Invention

To turn to another aspect of the subject, anthropologists must take cognisance of the differences in outlook between participants of the lowlier and the higher cultures. If these are not to be correlated with inborn differences, how shall we appraise them? L. Lévy-Bruhl(38) assumes that ruder peoples are possessed of a pre-logical mentality. R. R. Marett(39) and Goldenweiser,(40) however, have shown that primitive man displays in everyday life precisely the same sort of thinking as ourselves, while his irrational speculations are paralleled by equivalent phenomena in the highest civilisations. In short, there is at best a difference in degree, not in kind. Even our advanced technology establishes no basic group difference, for its psychological correlates are confined to narrow bodies of specialists.

Apart from the effects of intensive specialisation, human invention does not seem to differ in principle throughout the course of history. There is certainly no inexhaustible reservoir of ideas for effective adaptation to environment: the Fuegian shivers without manufacturing adequate dress; the Navaho fails to utilise stone material for masonry; European peasants do not automatically conceive advanced sanitary regulations. Between maximum exploitation of the environment and that minimum prerequisite to continued existence there lies a vast scale of cultural values. Mankind is certainly prone to muddle along with traditional devices, and in so far Graebner and Elliot Smith are right in challenging the assumption of an indefinite inventiveness.

Nevertheless, the fact remains that most peoples are not merely passive recipients of foreign culture; everywhere we encounter adaptations that could only have originated on the spot. Snow-goggles were not invented in Egypt for export to the Arctic. In South America the poisonous manioc becomes, through an elaborate treatment, the staple diet. In Brazil and the Chaco lack of stone leads to the perfection of wooden tools. Even where foreign influence is certain; the re-working of the received elements, as in the case of porcelain, may involve a creative synthesis. This conclusion must re-act upon our interpretation of similarities: if primitive tribes have sometimes ingeniously solved their problems, why insist that certain solutions were beyond them simply because they had already been achieved elsewhere?

Psycho-analysis.—Naturally the progress of psychological science itself has reacted upon anthropological interpretation. Religion is hardly intelligible without the concepts of suggestion and hypnotism, and with the rise of psycho-analysis came new explanatory principles. Unfortunately the ethnographic naïveté of psycho-analysts has discredited their interpretations of culture, while Rivers achieved little more than to paraphrase cultural phenomena in the new phraseology.(41) Genuine illumination is, however, afforded by B. Malinowski,(42) who shows that the results of repression and conflict must vary with sociological differences, and suggests comparative analysis of patrilineal and matrilineal communities.

To the impetus of psycho-analytic thinking must also be credited C. G. Seligman's attempt to record primitive dreams—an undertaking of first-rate significance in view of the part dreams play in aboriginal life.(43) Finally, one cardinal doctrine of psycho-analysis is amply corroborated by anthropological data. Decorative designs, rituals, tales that have been diffused from one centre become secondarily linked with new symbolism, cosmic or biological explanation.(44) Thus, "rationalisation" merges in Boas' still wider principle of secondary association.

The orthodox psychology of a past generation is still capable of stimulating anthropological inquiry. Quite recently Gustav Theodor Fechner's work in experimental aesthetics has suggested measurements and detailed comparison of the decorative patterns found in Plains Indian rawhide cases. Thus, there has been secured a more exact definition of local styles and a clearer conception of the subjectively significant elements of decoration.(45) Similarly, Galton's descriptions of colour and number associations in his *Inquiries into Human Faculty* have an obvious bearing on relevant ethnographic data.

The Value of the Individual.—Of deeper import is the Galtonian theory of individual differences that so largely dominates psychology to-day. Thanks to Father Schmidt, Marett, Boas and others, the dogma that on primitive cultural levels the individual is completely submerged in the group is definitely shattered. Boas has stressed the skilled craftsman's influence on the development of art.(46) Radin has studied individual literary endowment through distinct versions of the same tale,(47) and has propounded the theory that monotheistic beliefs are correlated with a definite temperament, and accordingly may be expected to occur with a certain frequency, irrespective of cultural plane.(48) R. Thurnwald(49) accepts the varying capacities of, say, Papuans as an established proposition; and R. H. Lowie(50) systematically surveys individual variability as to sensory type, suggestibility, intellect, idiosyncrasies and leadership. In short, modern anthropology accepts personality as one of its irreducible phenomena and recognises in the interaction of individuals and the social tradition they confront, combat, succumb to or dominate, one of its perennial problems.

These attempts to saturate ethnography with psychological points of view are as yet merely inchoate gropings toward a fuller comprehension of the subject. They are far from affording an insight into the spirit of other cultures. No wonder that those of little faith have grown restive and are blaming anthropological technique: a liberation from methodological bondage is their recipe for "a proportionate rise in creative ideas."(51) This hope is a delusion and a snare. There is no royal road to an alien people's true inwardness. Only by piecemeal labour on the elements of culture and their concrete psychic correlates can we rise above the impressionist's pseudo-synthesis, and by reliving aboriginal experience with its affective tinge attain that union of intellectual and imaginative enlightenment which must be our goal.

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SOCIALISM (*see* 25.301).—Throughout the world the War of 1914–18 and its aftermath have profoundly altered the position of Socialism in national and international affairs; and its doctrines and policies, already in rapid change before the War, have been correspondingly modified in the light of post-War conditions. Above all, the Bolshevik revolution of 1917 has deeply affected every Socialist movement and party, and has caused in many countries a re-grouping of Socialist forces of which the full effects are still impossible to predict.

In the years immediately before the War, the outstanding changes in Socialist policy were due mainly to two causes—the growth of Socialism as a parliamentary force, and the rise of new ideas of industrial organisation and action. Not only in Great Britain, but also in Germany, France, Italy and other countries, the Socialist movement, either directly or through a Labour party, had become a powerful force in national politics, and had accordingly begun to shape its policy to suit parliamentary requirements. This had led on the one hand to the rise of "revisionist" doctrines, modifying the militant Marxism of earlier days, and on the other to revolts and criticisms from the Left Wing, directed against the compromising tactics of the official Socialist parties. Thus in Great Britain the Labour party which had first become an important party after the election of 1906, was accused of allying itself with Liberalism and so betraying the Socialist cause. There were similar divisions of opinion in every developed European country.

Industrial Unionism and Syndicalism.—Of more importance, however, in the years before the War, was the growth of new industrial movements and theories. During the first decade of the 20th century, prices had risen, without an equivalent rise in wages. This led to a wave of reaction against parliamentary methods, which, it was urged, could not really protect the workers' standard of life. Industrial unrest became widespread. The theories of Industrial Unionism and Syndicalism exerted a wide influence on working-class opinion. The former, arising in America, largely among the immigrant workers, proposed a mass organisation of the whole working class, without distinction of craft, sex or grade, for the revolutionary overthrow of capitalism by direct industrial action, with or without parliamentary action as an auxiliary. The latter, arising in France, largely under Anarchist-Communist influence, was a definite attempt to replace parliamentary by industrial methods, and to bring about revolution by mass trade union action leading to working class control of industry and the reconstruction of society on the basis of purely working class institutions. In Great Britain, a small Syndicalist movement grew up during the period of great strike activity between 1911 and 1914; but far more important was the widespread influence of the new ideas on the trade union movement. Guild Socialism, which developed rapidly from 1912 onwards, was an expression of this same tendency, stated in terms better adjusted to British conditions, and aiming at a reconciliation of Socialism and Syndicalism by combining the Socialist plan of public ownership of the means of production with the Syndicalist plan of workers' control in industry and society.

Socialist Parties Split by the War.—The outbreak of the War altered the entire situation. It checked the movement of industrial unrest, and acutely divided the Socialist forces. In every belligerent country some Socialists supported and some opposed the participation of their countries in the War; In Germany, France and Great Britain and in most of the smaller States the majority of the Socialist supported the War; but in each case a powerful and growing minority opposed it. In Great Britain the Labour party supported the War, and after a time entered into Coalition Governments for its prosecution; but the Independent Labour party, largest and most influential of the Socialist bodies, took the opposite view, though it remained throughout an affiliated section of the Labour party. In Germany the Social Democratic party broke eventually into two sections—the majority, which backed the Government, and the Independent Socialists, who refused their support. These cleavages became more pronounced as the War continued, and the growing losses and hardships steadily swelled the volume of anti-War opinion in all countries, and especially in Germany.

In 1917, under the strain of war, the old régime in Russia hopelessly broke down. A political revolution placed first a body of liberal reformers and then the moderate Labour groups under Kerensky in nominal power. But the attempt, in face of complete national exhaustion, to carry on the War brought on a further revolution, by which power passed to the Bolsheviks, the Left Wing Socialist party which later adopted the name of Communist party. The Bolsheviks established a "proletarian dictatorship," made peace with Germany at Brest-Litovsk, and set out to work among the war-weary peoples of the belligerent countries for a world-wide Socialist revolution.

Bolshevism.—The Bolshevik revolution, by which for the first time a Socialist Govt. assumed complete political and economic power in a great country, everywhere profoundly affected Socialist thought and policy. At first its influence was mainly in the direction of "pacifism," and it certainly helped to undermine the war morale of the German people. But when, in the autumn of 1918, the resistance of Germany at length gave way, the revolution which followed did not result in the triumph of Socialism. For a while the Socialists appeared to be the leading power in the new German Republic; but, subjected to the victorious Allies and fearing starvation by blockade, the German Socialists, still disunited, did not attempt to force their power home, and gradually, after a series of disturbances, Germany assumed the shape of a constitutional Republic in which industry and property remained on a capitalist basis.

The Post-War Reconstruction of Socialist Parties

Meanwhile, the conclusion of the War had led in other countries to a great increase in the strength of the Socialist movement. Every Government had made lavish promises of reconstruction after the War, and great hopes had been aroused. A great mass of recruits from all classes flocked into the Labour and Socialist parties. Everywhere there were great industrial as well as political movements. In Great Britain, the Labour party reconstructed itself in 1919 as the party of the "workers by hand and brain," and the trade unions showed, in 1919, great activity in presenting and pressing their demands for improved conditions. Idealism was in the air; plans of drastic social and economic reconstruction got widespread attention; and Governments went some distance towards compromise with the new forces whose development they feared. Constitutional Labourism gained the most converts; but Communism, spreading from

Russia, made its appearance in every country as an organised revolutionary movement, preaching the class war and denouncing moderate Socialism as a middle-class doctrine designed to mislead the workers and divert them from the task of revolutionary action.

For two years after the War, trade prospered and wealth appeared to abound. But then came everywhere a pronounced industrial slump, causing widespread unemployment and a severe fall in both wages and profits. Plans of social reconstruction were hastily jettisoned; great strikes or lock-outs, such as the British miners' lock-out in 1921, broke the power of the trade unions; a wave of reaction swept across the world. The European governments attempted to break the power of Communism by the ostracism and blockade of Russia, which had offended against capitalist standards by wholesale confiscation of property and repudiation of debts, as well as by propaganda in other countries; and, while the Socialists everywhere opposed these measures, the deep cleavages between Communists and orthodox Socialists in the European countries helped to undermine their influence, and added to the fundamental weakness caused by the decline in the demand for labour.

From the end of 1920 to the end of 1925, to which this article extends, the slump remained in being, especially in Great Britain, and everywhere trade union membership declined and there was a fall in the working-class standard of life. This, however, did not necessarily involve a decline in the voting strength of the Socialists in parliamentary elections. Thus the British Labour party which in 1910 (Dec.) secured 370,802 votes and 42 seats in the House of Commons, and in 1918 (on the new franchise) 2,244,945 votes and 57 seats, got 4,348,375 votes and 191 seats in 1923, and, despite adverse electional conditions, 5,551,549 votes and 151 seats in 1924. Moreover, after the 1923 election a Labour Govt. for the first time in British history assumed office, albeit as a minority administration dependent on Liberal support. Under these conditions, however, it was unable, like the Socialist governments which have held office in Sweden, Denmark and other countries, to take any important step towards a distinctively Socialist policy.

British Parties.—The cleavage between orthodox Socialism and Communism has, for certain definite reasons, been far less pronounced in Great Britain than in most of the continental countries. The British Labour party is based directly on the trade unions, which control the overwhelming majority of votes at its conferences. The affiliated Socialist Societies, among which the only body of real importance is the Independent Labour party, with about 50,000 members, are only a tiny fraction of it, and owe their position to energy and readiness to accommodate themselves to circumstances rather than to numbers. The trade unions are not greatly interested in the theoretical disputes of Communists and Social Democrats, and realise the importance of preserving unity for their own practical work. Whereas, therefore, continental Socialist movements have been riven in twain according to the conflicting theories of their individual supporters it has been very hard for Communism to strike root in Great Britain. The Communist party, which has sought but been refused affiliation to the Labour party, has only a few thousand members; and though these conduct, through a so-called " Minority Movement," active propaganda inside the trade unions, they produce relatively little effect. In France, on the other hand, the majority of the pre-War Socialist party went over to Communism, leaving the minority to re-form the Socialist party as a separate body, while in Germany, though the Social Democratic party remains the largest party in the country, the Communists have a really powerful and substantial following.

The International Movement

The rival tendencies in post-War Socialism find expression in two rival Internationals—the Labour and Socialist International, dominated by the continental Right Wing parties and the British Labour party, and the Third, or Communist, International, the organisation of which centres upon the Russian Communist party. Similarly, there are two trade union Internationals—the Amsterdam International Federation of Trade Unions, to which the British and the majority of the unions in most of the continental countries belong, and the Red International of Labour Unions, which includes the Russians and the " minority movements " of a number of other countries. The Italian movement, almost crushed out by Fascism, and the American, still pursuing a policy of national isolation, stand outside both camps. There have been repeated attempts to promote working-class unity in both the political and the economic sphere; but the conflicts of politics and personalities have so far outweighed the tendencies making for common action, of which the chief is the growing pressure in all capitalist countries, under stress of bad trade and international competition, to lengthen again the working day reduced after the War, and to press down the working-class standard of life.

Socialism and Politics.—Socialism everywhere came into effective activity as a movement of working-class revolt, at a time when the impracticability of securing results by parliamentary action and the frequent repression of Socialist propaganda left Socialists no alternative to the adoption of a revolutionary attitude. But gradually these early Socialist bodies won their way to toleration and, commanding a wider influence, took shape as political parties returning a substantial body of members to the various national parliaments. This change led to a marked development of evolutionary Socialist doctrines, in which the achievement of Socialism was envisaged, not catastrophically, but as a gradual transformation of the social order by legislative reforms and as the result of a progressive Socialist conquest of political power. Always there were Socialist groups which repudiated this view (the Syndicalists in France, the Socialist Labour party in America, the Bolsheviks in Russia, the Industrial Unionists in Great Britain); but up to 1914 it appeared to be definitely the growing conception of Socialist policy. It resulted in a placing of the main stress on parliamentary action and on the nationalisation of industry as the means to socialisation of the economic system.

As we have seen, the earlier revolts against this doctrine were mainly industrial movements, designed to turn trade unionism into a revolutionary instrument for the conquest of power and the achievement of workers' control in industry. But after the Russian revolution the Left Wing in the various working-class movements tended to re-cast its policy, and to think in terms, not of a general strike (Syndicalism) or a trade-union advance towards the control of Industry (Guild Socialism), but of a decisive proletarian revolution establishing the dictatorship of a disciplined Communist party. The State and Parliament, which the moderate " Collectivist " Socialists had looked upon as the instruments of social transformation, were denounced as purely capitalist institutions, to be forcibly overthrown and replaced by an exclusively proletarian State as in Russia. This doctrine, clearly enunciated in Marx's Communist Manifesto of 1848, has been most decisively developed by Lenin, the leader of the Russian Bolsheviks (see his *The State and Revolution* and other writings). This tendency to look to revolution, rather than to evolutionary development, as the means of establishing Socialism, has been greatly fostered by the world-wide unloosing of force during the World War, by the apparent success of the method in Russia as compared with the doubtful fortunes of moderate Socialism in Germany and elsewhere, by its employment on the capitalist side in Italy and Spain, and on both sides in Ireland, suggesting that parliamentary decisions will not be obeyed when they cut beyond a certain depth; and by the unsettled condition and uncertain economic prospects of the post-War world. For, whereas before the War it seemed as if the condition of the workers was gradually improving with the general increase in the world's wealth, nowadays the whole economic system is in serious difficulties and the standards of labour appear to be seriously threatened in nearly every country, with only the outstanding exception of the United States.

Yet it would be a profound mistake to regard post-War Socialism as a movement sharply divided into two opposing

factions—revolutionary Communists and parliamentary Collectivists upholding a pacific and constitutional policy. This is indeed the outward form which the struggle often seems to assume. But in every country there are very large groups, far less distinctly organised, which stand at points between the two extremes. Far more important than Communism itself, except in Russia, is the influence on general Socialist thought and policy which not only Communism but also such doctrines as Guild Socialism have undoubtedly exercised. The ordinary trade-union or Socialist party member nowadays, even if he is no Communist, is far less inclined than he was to make constitutionalism a matter of principle, and far more inclined to resort to direct action on a broad basis for the achievement of Socialist, as well as purely immediate economic, ends. This is the result in part of Communism and the Russian revolution, but still more of war experience and changed economic conditions, especially the lessened belief in the stability of the capitalist system and the sincerity of its parliamentary constitutionalism.

Changes in the Socialist Programmes

Again it may be said that, largely owing to Guild Socialist and Syndicalist influence, the practical Socialist programme has undergone great changes. All schools of Socialists still stand for the transference of large scale industry from private to public ownership; but mere State Socialism, or nationalisation, is no longer a satisfying conception to Socialists of any school. In greater or less degree, all now stand for some form of "workers' control" in socialised industry, and repudiate the idea that industry can be bureaucratically run on any existing civil service model. For example, the British miners, who before the War merely demanded State ownership, now demand as well a substantial share in the control of their industry under public ownership. The French have their plan of "industrial nationalisation," and workers' control appeared prominently in German schemes of socialisation after the War.

Political Co-operation with non-Socialist Parties.—It remains to be seen how these changes in doctrine will, in the long run, work out in Socialist political practice. For, while the tendency of Socialist thought and working-class opinion has been on the whole distinctly leftward ever since 1911, there are powerful forces pulling Socialist practice the other way. Especially as, in one country after another, the Socialist parties by constitutional means reach the threshold of political power and increase their parliamentary following, there are strong inducements to disarm opposition and facilitate the assumption of office by the adoption of pacific courses and by compromise or coalition with other parties. In France for example, the Socialists have for some years been in alliance with the Radical parties in a *cartel des gauches*, while in Germany they have taken part in Coalition governments with the middle-class parties, and in Great Britain a Labour Govt. held office for nearly a year with Liberal support. These groupings have arisen in all cases out of difficult political situations; and the tendency may well be for such situations to arise even more often in the future. But there is no doubt that the Socialist parties, if under these impulsions they moved far to the "Right" into alliance with the "Liberal" groups, would forfeit a substantial part of their working-class support, which would either go over to Communism, or form new political groupings of the "Left" on a more definitely Socialist basis and programme.

Solidifying Force of Trade Unionism.—Socialism, then, in 1925, is far nearer than it was in 1911 to the tests of practical experience and responsibility. Naturally, under these conditions, difficulties are more clearly seen, and differences previously latent become more pronounced. But, especially in Great Britain, trade unionism, which is doomed to impotence unless it can transcend these differences and maintain working-class unity, acts as a great solidifying force, and prevents the pushing of quarrels to the point of a split in the political field. And it may be that, elsewhere as well, this need for unity in pursuit of common economic ends will, in the long run, re-unite the warring factions of European Socialism, and achieve a new basis of political agreement. It would take a bold man to prophesy what the outcome will be. But the tendencies at least are clear enough, and are manifested in every country in which the movement exists at all. And the underlying basis is also clear; for, despite all its transformations and developments, Socialism remains essentially not so much a theoretical plan of social reorganisation as a class movement arising directly out of the economic divisions in society determined by the rise of capitalism and the Industrial Revolution. It is an attempt to formulate for the proletariat a policy designed to promote a more equal distribution and also a larger production of wealth, and to abolish class distinctions based on inequalities of wealth and social opportunity, or on property laws and relations which encourage the accumulation of the means of production in private hands. Its forms and its actual policies may change with the movement of events, thoughts and economic forces; but through all its changes it retains this underlying and essential character, proclaimed by Marx in the Communist Manifesto of 1848,[1] to which formulation the great majority of Socialists still trace the impetus of the movement as a creative social force. By no means all Socialists, especially in Great Britain, call themselves Marxists; but to this extent at any rate the movement as a whole is based firmly on Marx's diagnosis of the social problem (*see also* Communism; Second International; Third International).

Bibliography.—General. There is no really good account of Socialism as a whole. The handiest text-books in English are W. Sombart, *Socialism and the Social Movement*, tr. by M. Epstein (1909); T. Kirkup, *History of Socialism*, 5th ed., revised by E. A. Pease (1913); The best post-War books, S. and B. Webb, *A Constitution for the Socialist Commonwealth of Great Britain* (1920); J. Ramsay MacDonald, *Socialism, Critical and Constructive* (1921); H. N. Brailsford, *Socialism for To-Day* (1925). R. C. K. Ensor's *Modern Socialism* (1910) is a useful pre-War collection of extracts from the writings of Socialists of all countries. Max Beer's *History of British Socialism*, 2 vol. (1919–20) is indispensable. For the growth of the movement in foreign countries, see the *Labour International Handbook* (1921) and *Supplement* (1923). Other useful books are H. G. Wells, *New Worlds for Old*, rev. ed. (1914); Bertrand Russell, *Roads to Freedom* (1918); G. D. H. Cole, *Guild Socialism Re-stated* (1920).

See also N. Lenin, *The State and Revolution*, Eng. tr. (1919); N. I. Bucharin and E. Preobrazhensky, *The A. B. C. of Communism*, Eng. tr. (1922). The *Communist Manifesto* of K. Marx and E. Engels (1848) should be compared with the new *Communist Manifesto* of the Third International (1919) and with the British Labour Party's *Labour and the New Social Order* (1918). Marxism. K. Marx, *Capital*, Eng. tr. (1907–9), etc. Max Beer, *The Life and Teaching of Karl Marx* (1921); A. D. Lindsay, *Karl Marx's Capital* (1925). There is, of course, a large literature on Socialism in nearly every European language.[2]

(G. D. H. C.)

SOCIALISM: PRINCIPLES AND OUTLOOK, (*see* 25.301).—Socialism, reduced to its simplest legal and practical expression, means the complete discarding of the institution of private property by transforming it into public property, and the division of the resultant public income equally and indiscriminately among the entire population. Thus it reverses the policy of Capitalism, which means establishing private or "real" property to the utmost physically possible extent, and then leaving distribution of income to take care of itself. The change involves a complete moral *volte-face*. In Socialism private property is anathema, and equal distribution of income the first consideration. In capitalism private property is cardinal, and distribution left to ensue from the play of free contract and selfish interest on that basis, no matter what anomalies it may present.

I.

Socialism never arises in the earlier phases of capitalism, as, for instance, among the pioneers of civilisation in a country where there is plenty of land available for private appropriation by the last comer. The distribution which results under such circumstances presents no wider departures from a rough equality than those made morally plausible by their association with exceptional energy and ability at the one extreme, and

[1] Drafted in 1847; published in 1848.

[2] For the contrary case Capitalism the article should be consulted.

with obvious defects of mind and character or accidental hard luck, at the other. This phase, however, does not last long under modern conditions. All the more favourable sites are soon privately appropriated; and the later comers (provided by immigration or the natural growth of the population), finding no eligible land to appropriate, are obliged to live by hiring it at a rent from its owners, transforming the latter into a *rentier* class enjoying unearned incomes which increase continually with the growth of the population until the landed class becomes a money-lending or capitalist class also, capital being the name given to spare money. The resource of hiring land and spare money is open to those only who are sufficiently educated to keep accounts and manage businesses, most of whom spring from the proprietary class as younger sons. The rest have to live by being hired as labourers and artisans at weekly or daily wages; so that a rough division of society into an upper or proprietary class, a middle or employing and managing class, and a wage proletariat is produced. In this division the proprietary class is purely parasitic, consuming without producing. As the inexorable operation of the economic law of rent makes this class richer and richer as the population increases, its demand for domestic servants and for luxuries of all kinds creates parasitic enterprise and employment for the middle class and the proletariat, not only withdrawing masses of them from productive industry, but also fortifying itself politically by a great body of workers and employers who vote with the owners because they are as dependent on the owners' unearned incomes as the owners themselves.

Meanwhile the competition of employers for custom, which leads to the production of a dozen articles to satisfy the demand for one, leads to disastrous crises of feverish overproduction alternated with periods of bad trade (" booms " and " slumps"), making continuous employment of the proletariat impossible. When wages fall to a point at which saving also is impossible, the unemployed have no means of subsistence except public relief during the slumps.

It is in this phase of capitalistic development, attained in Great Britain in the 19th century, that socialism arises as a revolt against a distribution of wealth that has lost all its moral plausibility. Colossal wealth is associated with unproductiveness, and sometimes with conspicuous worthlessness of character; and lifetimes of excessive toil beginning in early childhood leave the toiler so miserably poor that the only refuge left for old age is a general workhouse, purposely made repulsive to deter proletarians from resorting to it as long as they have strength enough left for the most poorly paid job in the labour market. The inequalities become monstrous: hardworking men get four or five shillings a day (post-War rates) in full view of persons who get several thousands a day without any obligation to work at all, and even consider industrial work degrading. Such variations in income defy all attempts to relate them to variations in personal merit. Governments are forced to intervene and readjust distribution to some extent by confiscating larger and larger percentages of incomes derived from property (income tax, supertax, and estate duties) and applying the proceeds to unemployment insurance and extensions of communal services, besides protecting the proletariat against the worst extremities of oppression by an elaborate factory code which takes the control of workshops and factories largely out of the hands of their proprietors, and makes it impossible for them to exact grossly excessive hours of labour from their employees or to neglect their health, physical safety, and moral welfare with complete selfishness.

This confiscation of private property incomes for public purposes without any pretence of compensation, which is now proceeding on a scale inconceivable by Victorian ministers, has destroyed the integrity of private property and inheritance; and the success with which the confiscated capital has been applied to communal industries by the municipalities and the central Government, contrasted with the many failures and comparative costliness of capitalist industrial adventure, has shaken superstition that private commercial management is always more effective and less corrupt than public management. In particular, the British attempt to depend on private industry for munitions during the War of 1914–8 nearly led to defeat; and the substitution of national factories was so sensationally successful, and the post-War resumption of private enterprise, after a brief burst of illusory prosperity, was followed by so distressing a slump, that the reversal of the relative efficiency prestige of socialism and capitalism was vigorously accelerated, leaving capitalism unpopular and on the defensive, whilst confiscation of private capital, communal enterprise, and nationalisation of the big industries, grew steadily in popularity in and out of Parliament.

This change in public opinion had already deeply penetrated the middle class, because of the change for the worse in the position of the ordinary employer. He, in the 19th century, was admittedly master of the industrial, and, after the Reform of 1832, of the political situation. He dealt directly and even domineeringly with the proprietary class, from which he hired his land and capital either directly or through agents who were his servants and not his masters. But the sums required to set on foot and develop modern industrial schemes grew until they were out of reach of ordinary employers. The collection of money to be used as capital became a special business, conducted by professional promoters and financiers. These experts, though they had no direct contact with industry, became so indispensable to it that they are now virtually the masters of the ordinary routine employers. Meanwhile the growth of joint-stock enterprise was substituting the employee-manager for the employer, and thus converting the old independent middle class into a proletariat, and pressing it politically to the left.

With every increase in the magnitude of the capital sums required for starting or extending large industrial concerns comes the need for an increase in the ability demanded by their management; and this the financiers cannot supply: indeed they bleed industry of middle class ability by attracting it into their own profession. Matters reach a point at which industrial management by the old-fashioned tradesman must be replaced by a professionally trained and educated bureaucracy; and as Capitalism does not provide such a bureaucracy, the industries tend to get into difficulties as they grow by combination (amalgamation), and thus outgrow the capacity of the managers who were able to handle them as separate units. This difficulty is increased by the hereditary element in business.

An employer may bequeath the control of an industry involving the subsistence of thousands of workers, and requiring from its chief either great natural ability and energy or considerable scientific and political culture, to his eldest son without being challenged to prove his son's qualifications, whilst if he proposes to make his second son a doctor or a naval officer he is peremptorily informed by the Government that only by undergoing an elaborate and prolonged training, and obtaining official certificates of qualification, can his son be permitted to assume such responsibilities. Under these circumstances, much of the management and control of industry gets divided between routine employers who do not really understand their own businesses, and financiers, who, having never entered a factory nor descended a mine shaft, do not understand any business except the business of collecting money to be used as capital, and forcing it into industrial adventures at all hazards, the result being too often reckless and senseless over-capitalisation, leading to bankruptcies (disguised as reconstructions) which reveal the most astonishing technical ignorance and economic blindness on the part of men in high repute as directors of huge industrial combinations, who draw large fees as the remuneration of a mystical ability which exists only in the imagination of the shareholders.

II.

All this steadily saps the moral plausibility of capitalism. The loss of popular faith in it has gone much further than the gain of any widespread or intelligent faith in socialism. Consequently the end of the first quarter of the 20th century finds the political

situation in Europe confused and threatening: all the political parties diagnosing dangerous social disease, and most of them proposing disastrous remedies. National governments, no matter what ancient party slogans they raise, find themselves controlled by financiers who follow the slot of gigantic international usuries without any public aims, and without any technical qualifications except their familiarity with a rule-of-thumb city routine quite inapplicable to public affairs, because it deals exclusively with stock exchange and banking categories of capital and credit. These, though valid in the money market when conducting exchanges of future incomes for spare ready money by the small minority of persons who have these luxuries to deal in, would vanish under pressure of any general political measure like—to take a perilously popular and plausible example—a levy on capital. Such a levy would produce a money market in which there were all sellers and no buyers, sending the Bank Rate up to infinity, breaking the banks, and bringing industry to a standstill by the transfer of all the cash available for wages to the national treasury. Unfortunately the parliamentary proletarian parties understand this as little as their capitalist opponents. They clamour for taxation of capital; and the capitalists, instead of frankly admitting that capital as they reckon it is a phantom, and that the assumption that a person with an income of £5 a year represents to the state an immediately available asset of £100 ready money, though it may work well enough as between a handful of investors and spendthrifts in a stockbroker's office, is pure fiction when applied to a whole nation, ignorantly defend their imaginary resources as if they really existed, and thus confirm the proletariat in its delusion instead of educating it.

The financiers have their own *ignis fatuus*, which is that they can double the capital of the country, and thus give an immense stimulus to industrial development and production, by inflating the currency until prices rise to a point at which goods formerly marked £50 are marked £100, a measure which does nothing nationally but enable every debtor to cheat his creditor, and every insurance company and pension fund to reduce by half the provision for which it has been paid. The history of inflation in Europe since the War of 1914–8, and the resultant impoverishment of pensioners and officials with small fixed incomes, forces the middle classes to realise the appalling consequences of abandoning finance and industry direction to the unskilled, politically ignorant, unpatriotic "practical business men."

Meanwhile, the nobility of capital leads to struggles for the possession of exploitable foreign territories ("places in the sun") produces war on a scale which threatens not only civilisation but human existence; for the old field combats between bodies of soldiers, from which women were shielded, are now replaced by attacks from the air on the civil population, in which women and men are slaughtered indiscriminately, making replacement of the killed impossible. The emotional reaction after such wars takes the form of acute disillusion, which further accelerates the moral revolt against capitalism, without unfortunately, producing any workable conception of an alternative. The proletarians are cynically sulky, no longer believing in the disinterestedness of those who appeal to them to make additional efforts and sacrifices to repair the waste of war. The moral mainspring of the private property system is broken; and it is the confiscations of unearned income, the extensions of municipal and national communism, above all, the new subsidies in aid of wages extorted from governments by threats of nationally disastrous lock-outs and strikes, which induce the proletariat to continue operating the capitalist system now that the old compulsion to work by imposing starvation as the alternative, fundamental in capitalism, has had to be discarded in its primitive ruthlessness. The worker who refuses to work can now quarter himself on public relief (which means finally on confiscated property income) to an extent formerly impossible.

Democracy, or votes for everybody, does not produce constructive solutions of social problems; nor does compulsory schooling help much. Unbounded hopes were based on each successive extension of the electoral franchise, culminating in the enfranchisement of women. These hopes have been disappointed, because the voters, male and female, being politically untrained and uneducated, have (*a*) no grasp of constructive measures, (*b*) loathe taxation as such, (*c*) dislike being governed at all, and (*d*) dread and resent any extension of official interference as an encroachment on their personal liberty. Compulsory schooling, far from enlightening them, inculcates the sacredness of private property, and stigmatises a distributive state as criminal and disastrous, thereby continually renewing the old public opinion against socialism, and making impossible a national education dogmatically inculcating as first principles the iniquity of private property the paramount social importance of equality of income and the criminality of idleness.

Consequently, in spite of disillusion with capitalism, and the growing menace of failing trade and falling currencies, our democratic parliamentary Oppositions, faced with the fact that the only real remedy involves increased taxation, compulsory reorganisation or frank nationalisation of the bankrupt industries, and compulsory national service in civil as in military life for all classes, dare not confront their constituents with such proposals, knowing that on increased taxation alone they would lose their seats. To escape responsibility, they look to the suppression of parliamentary institutions by *coups d'état* and dictatorships, as in Italy, Spain and Russia. This despair of parliamentary institutions is a striking novelty in the present century; but it has failed to awaken the democratic electorates to the fact that, having after a long struggle gained the power to govern, they have neither the knowledge nor the will to exercise it, and are in fact using their votes to keep Government parochial when civilisation is bursting the dikes of nationality in all directions.

A more effective resistance to property arises from the organisation of the proletariat in trade unions to resist the effect of increase of population in cheapening labour and increasing its duration and severity. But trade unionism is itself a phase of capitalism, inasmuch as it applies to labour as a commodity that principle of selling in the dearest market, and giving as little as possible for the price, which was formerly applied only to land, capital and merchandise. Its method is that of a civil war between labour and capital in which the decisive battles are lock-outs and strikes, with intervals of minor adjustment by industrial diplomacy. Trade unionism now maintains a Labour party in the British Parliament. The most popular members and leaders are socialists in theory; so that there is always a paper programme of nationalisation of industries and of banking, taxation of unearned incomes to extinction, and other incidentals of a transition to socialism; but the trade union driving force aims at nothing more than capitalism with labour taking the lion's share, and energetically repudiates compulsory national service, which would deprive it of its power to strike. In this it is heartily seconded by the proprietary parties, which, though willing enough to make strikes illegal and proletarian labour compulsory, will not pay the price of surrendering its own power to idle. Compulsory national service being essential in socialism, it is thus deadlocked equally by organised labour and by capitalism.

It is a historic fact, recurrent enough to be called an economic law, that capitalism, which builds up great civilisations, also wrecks them if persisted in beyond a certain point. It is easy to demonstrate on paper that civilisation can be saved and immensely developed by, at the right moment, discarding capitalism and changing the private property profiteering state into the common property distributive state. But though the moment for the change has come again and again it has never been effected, because capitalism has never produced the necessary enlightenment among the masses, nor admitted to a controlling share in public affairs the order of intellect and character outside which Socialism, or indeed politics, as distinguished from mere party electioneering, is incomprehensible. Not until the two main tenets of socialism: abolition of private property (which must not be confused with personal property), and equality of income, have taken hold of the people as religious dogmas, as to which no controversy is regarded as sane, will a stable socialist state

be possible. It should be observed, however, that of the two tenets, the need for equality of income is not the more difficult to demonstrate, because no other method of distribution is or ever has been possible. Omitting the few conspicuous instances in which actual earners of money make extraordinary fortunes by exceptional personal gifts or strokes of luck, the existing differences of income among workers are not individual but corporate differences. Within the corporation no discrimination between individuals is possible; all common labourers, like all upper division civil servants, are equally paid. The argument for equalising the class incomes are that unequal distribution of purchasing power upsets the proper order of economic production, causing luxuries to be produced on an extravagant scale whilst the primitive vital needs of the people are left unsatisfied; that its effect on marriage, by limiting and corrupting sexual selection, is highly dysgenic; that it reduces religion, legislation, education and the administration of justice to absurdity as between rich and poor; and that it creates an idolatry of riches and idleness which inverts all sane social morality.

Unfortunately, these are essentially public considerations. The private individual, with the odds overwhelmingly against him as a social climber, dreams even in the deepest poverty of some bequest or freak of fortune by which he may become a capitalist, and dreads that the little he has may be snatched from him by that terrible and unintelligible thing, state policy. Thus the private person's vote is the vote of Ananias and Sapphira; and democracy becomes a more effective bar to socialism than the pliant and bewildered conservatism of the plutocracy. Under such conditions the future is unpredictable. Empires end in ruins: commonwealths have hitherto been beyond the civic capacity of mankind. But there is always the possibility that mankind will this time weather the cape on which all the old civilisations have been wrecked. It is this possiblity that gives intense interest to the present historic moment, and keeps the Socialist movement alive and militant. (G. B. S.*)

SOCIAL SERVICE (*see* CHARITIES, 5.860).—In the modern state many social services are maintained by statutory authorities, and in Great Britain the term public social services has become a current phrase in official reports; nevertheless social service is still commonly understood as referring to voluntary work, and in this sense is employed in the present article.

Public Health.—In the field of public health voluntary agencies have done and are doing much to stimulate and support the work of public health authorities by the creation of enlightened public opinion through propaganda and the organisation of health exhibitions, demonstrations, etc. In Great Britain bodies like the National Council for Combating Venereal Disease and the National League for Health, Maternity and Child Welfare are largely responsible for the growth of public opinion which has made possible the recent expansion of statutory services (*see* VENEREAL DISEASES).

In the United States voluntary bodies such as the American National Red Cross, American Public Health Assn., American Social Hygiene Assn. and National Child Health Council, National Committee for Mental Hygiene and the National Organisation for Public Health Nursing (*see* NURSING) are having a similar educative effect on public opinion. In connection with housing and town-planning and other public health services, pioneer work and the formation of public opinion are characteristic tasks for voluntary initiative. Much modern social legislation presupposes for its effectiveness the willing co-operation of the individual citizen, and an extension of the voluntary spirit of service can alone secure this.

Education.—The task of voluntary agencies in education is narrowed by the development of public systems of compulsory education, but an extension of adult education (*q.v.*) is particularly the field of voluntary effort. Not the least remarkable development of adult education in recent years is the rapid growth of a system of voluntary education in British prisons, which owes its achievement to a large band of men and women who undertake the work of teaching in their spare time. There are other fields in which a similar activity is shown.

Industry.—The growth of the industrial welfare movement is opening up new opportunities for co-operation between employers and employed in the development of better social facilities, and offers a new career for those who desire to take up social work as a profession. Systems of vocational selection for young people leaving school and schemes for their after-care, which are being evolved particularly in Great Britain and the United States, owe much to the pioneer experiments of voluntary societies, and even as they become stereotyped as state services they are likely to depend for their effectiveness on the voluntary workers associated with the public authority in their administration.

Recreation.—Provision for recreation and opportunities for a good use of leisure are being recognised as of increasing importance, in view of the movement to reduce working hours. A strong public opinion on such matters as the need for open spaces and playing fields has still to be created in many countries. The formation of the National Playing Fields Assn. in Great Britain is evidence of progress, but the United States is ahead of any other country in this matter, development there being due largely to the pioneer work of the Playground and Recreation Assn. and other voluntary associations with similar aims. The work of juvenile organisations such as the Boys Brigade, Church Lads Brigade, Boy Scouts (*q.v.*), Girl Guides (*q.v.*), Camp Fire Girls and of Boys' and Girls' Clubs is profoundly important in this connection, for they provide training in the use of leisure at a time when, the discipline of school being lately removed, it is most needful. Such bodies as the English Folk Dance Society in Great Britain and the Music School Settlements in the United States and others promoting choral singing, dramatics and the practice of arts and crafts perform social services which are of great value, for the line between education and recreation cannot be drawn clearly.

THE TREND OF RECENT DEVELOPMENTS

Unlike services provided under statute and administered under regulations, voluntary social service is essentially dynamic. It derives not from authority but from personal conviction, and while particular societies may stagnate and fail even to keep pace with the progress of knowledge, it is nevertheless generally true that progress in social provision is mainly due to voluntary effort which is the pioneer force, constantly experimenting with new methods and breaking fresh ground.

The modern interest in prevention rather than cure is very noticeable, and is coupled with a new sense of "community." The younger generation of those who are prepared to work for social betterment are inclined to think in terms of the community rather than of the individual; they are anxious to improve the conditions and quality of the social life in the community of which they are members; they want to work not *for*, but *with* their neighbours; they are less interested in "mopping up social messes" than in preventing them.

The quickened sense of community which resulted from concentration on "national" needs during the World War has given new impetus to the movement for voluntary social service with society rather than the individual as its objective. The attention given to "community organisation" in the United States is an outstanding illustration of the new spirit. The 100,000 voluntary workers for the National Savings Movement in Great Britain are one example of the new forces which it is enlisting.

This change of emphasis which is closely allied with current tendencies in the development of political ideals, is impressing itself on the institutions of voluntary social service. Already two distinct types of voluntary agency are clearly distinguishable, although a great many occupy a middle position. There is, first, the older type of social service typified by relief societies and orphanages, established to meet the special needs of particular individuals in distress. Secondly there is a newer type of association aiming at the corporate self-development of a membership which is united by common interests and is selective only in that sense. Eligibility for membership is not dependent on need, but on the desire to join in a common endeavour and a willingness to accept a common rule.

Ex-service Societies.—Every former war produced voluntary societies to care for the needs of ex-service men in distress and the recent war is no exception: but whereas in former wars such societies have been of the older type, this time it is the ex-service men and women who have banded themselves together to help themselves. The British Legion had in Jan. 1926 a membership of approximately 1,000,000. Its work is, broadly speaking, twofold. On the one hand it raises vast sums by public appeal and other means for the relief of distress among ex-service men and women, and it provides them with a powerful advocate where their claim to public provision is in question. On the other hand the legion also aims at securing for its members the facilities for a good social life, through the organisation of clubs and institutions, provision for education, etc. Here is a case in which (1) the old philanthropic work is carried on by a body which is organised on democratic lines and which combines with it (2) the positive task of providing social amenities for its members. Similar bodies of ex-service men are to be found in practically every other belligerent country, and all have a wider social purpose than the mere protection of self interest.

Rotary Clubs and Women's Institutes.—There are an increasing number of voluntary organisations, doing work of great value, which are not specifically, or at least primarily, formed for that end. The Rotary movement which is rapidly developing throughout the English-speaking world is a case in point, but an even more effective illustration is provided by the growth of post-War organisation among rural women. Starting in Canada, the Women's Institute movement under various names has grown with remarkable pace in Great Britain since the War. It is a banding together of women to secure the conditions for a better social life, not for themselves only, but for the whole rural community. The institutes are not only concerned with their own education, etc., but are increasingly interesting themselves in the social services of the villages. In this case the movement makes no appeal to philanthropy; in its early days its organisation was subsidised from state funds, but less has been needed each year as the movement grew and it is now (Dec. 1925) very nearly self-supporting, with a membership of some 206,000 representing every class of countrywomen.

Finance.—In the past voluntary work was financed entirely from the gifts of the charitable—donations, subscriptions or endowments, and much is still financed in this way; but two other possible sources of income are now available and both are attributable to the developments which have been noted. They are (*a*) membership fees and money raised by the corporate efforts of members—the more completely democratic is the organisation the larger will be the proportion of total income from this source—and (*b*) grants-in-aid from public funds. In Great Britain and in some other countries, co-operation between public authorities and voluntary agencies is not only personal but financial. It is difficult to estimate the ultimate effect of this development. Acceptance of grant-aid must involve the acceptance of some measure at least of regulation, and freedom is the very life of voluntary enterprise—dependence on public aid may prove as damaging to the morale of an association as it is to an individual. There is great social value in the enthusiasm, faith and self-sacrifice which are expressed in the accounts of voluntary associations, where every shilling represents a voluntary contribution of someone whose interest and sympathy have been enlisted.

Nevertheless provisions in social legislation for the grant-aid of voluntary work marks a growing recognition of its importance to the community and a growing sense of community responsibility. Two significant developments are (1) the adoption of what are known as "contributory schemes of finance" by the voluntary hospitals of Great Britain, and (2) the growth of systems of "central financing" in the United States.

Hospital Schemes.—The hospital scheme expresses a voluntary assumption of financial responsibility for hospital finance by a large proportion of the community of potential beneficiaries and others interested in their social welfare; it involves a widespread organisation of local representative committees and is resulting in a co-ordination of hospital and allied services in districts where the scheme is well developed. For as soon as community responsibility is accepted the isolated and completely independent position of a voluntary association ceases to be allowable; co-ordination with other bodies and other services becomes an obvious necessity (*see* HOSPITALS).

Central Financing.—In the American schemes for "central financing" this need for co-ordination is fully recognised, and advocates of the system attach great importance to the co-operative programme- and budget-making which are involved. All the voluntary agencies in a town draw up their programmes and budgets for the coming year. These are then carefully co-ordinated by a central, representative organisation. After this has been done, one organised appeal is made for the total sum required (popularly known as the "chest")—the appeal being based on the whole programme of social effort for the community which is expressed in the combined programmes of the several participating agencies. It is demonstrable that in the first few years that followed the adoption of the system substantial increases were secured in (1) the amount raised and (2) the number of individual contributors. The new plan is making headway in spite of much criticism and some hostility. Clearly it may save a waste of time and valueless competition between agencies, it may result in a better understanding of a community's needs and a wider acceptance of responsibility; but it may also tend to impair the freedom of purpose and of action of the constituent agencies. The constitution of the co-ordinating body is vitally important. Representatives of the participating agencies on one hand and of the contributors on the other, each claim a voice in the programme-shaping; at present there is considerable variety in the local organisation of the system and the "balance of power" varies in different cities. The trend of the movement is, however, unmistakably towards safeguarding the initiative and responsibility of the participating agencies. "The basic motive of central financing," say its advocates "is not the mere establishment of a better financial method, but the promotion of a definite community purpose."

Thus the effect of a new outlook on the older type of voluntary agency is reflected in their acceptance of public grants in aid and of the "regulation" which goes with these, in the organisation of a contributory membership (in the case of British hospitals) and their increased willingness to combine in co-operative organisation and to co-ordinate their work with that of other bodies.

THE COMMUNITY SPIRIT

The movement to develop co-operation between social service agencies reflects the same growth of a community spirit. It is beginning to be recognised in the United States and in Great Britain that a council of social agencies, a council of social service, or of social welfare—the name is immaterial— is essential to effective work. Statutory authorities and voluntary agencies cover much ground but in the absence of any provision for systematic collaboration or "team work" they often ignore each other's activities and their efforts overlap or leave gaps unfilled. To secure the pooling and exchange of knowledge and concerted action a body representative of all agencies at work in a single locality is required, and it is to meet this need that these councils are being established. They are in the main consultative and advisory, but there are certain tasks which they are specially qualified to undertake on behalf of all their constituent bodies. The representative character of a council of social service ensures ready access to information in possession of all its constituent bodies, and its office is therefore a centre where reliable information is easily obtainable by every inquirer. The maintenance of a careful survey of social need and social provision is, further, a distinctive task which is best undertaken by a body qualified by its constitution to survey the whole field.

In Great Britain this movement is not confined to towns, but is expressed in the community councils which are being formed in country areas. Its extension is the task of a national council of social service (Incorporated) on which the principal government departments and voluntary organisations of a national scope are represented. In the United States the National Social Work

Council and other important bodies are working for similar ends, and the annual meetings of the National Conference of Social Work have done much, during the past 50 years, to spread co-operation and breadth of outlook among social service workers in the States and in Canada. In this connection reference must be made to the work of an increasing number of Trusts established by private benefactors for the promotion of social welfare. With a wide vision of their opportunities such bodies as the Russell Sage Foundation in the United States and the Carnegie United Kingdom Trust in Great Britain (to mention only two) are doing much to emphasise the inter-relation of different branches of work, both by direct action and by the assistance which they give to other voluntary bodies as agents in a carefully evolved programme.

Training of Social Workers.—The standard of technical equipment required of social workers has greatly increased as social services have grown and become more elaborate and as the sense of community responsibility supersedes satisfaction with haphazard and comparatively uninformed tinkering. A demand for scientific method in social work has led to the establishment of special training schools and of special departments in connection with universities, in Great Britain, United States, Belgium, Chile, Czechoslovakia, Finland, France, Germany, Italy, Netherlands, South Africa, Sweden and Switzerland.

In these a study of the social sciences is usually combined with that of particular problems and some practical work in connection with local agencies and institutions. Allied to this demand for training is the increased attention that is being given to research and the study of social problems—a work in which several of the Trusts referred to above are playing a valuable part.

International Co-operation.—Not only does the number of international conferences on social questions increase year by year, but several voluntary movements now function on an international scale. The ex-service men's organisations referred to above have their international federation—both the Y.M.C.A. and the Y.W.C.A. have an international organisation and work in many lands. The same is true of the Red Cross societies. In this international work national prejudices are forgotten in a common desire to learn all that may help from the experience of others. A quickening of the social conscience in hitherto backward countries owes much to such international contacts.

The limits of social service are not easy to define. The time is coming when the social purpose of industry and other pursuits will be more generally recognised, and clearly many of the problems with which social service is concerned cannot be solved independently of these. It is of vital importance to any nation that the search for solutions should be resolutely pursued and in that search the voluntary spirit is the most powerful agent. If this be so the tendencies which have been noted are encouraging. (*See* also BLIND; BOY SCOUTS; CHILD WELFARE; GIRL GUIDES; HOSPITALS; MATERNITY; WHITE SLAVE TRAFFIC; etc.)

(L. F. E.)

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SOCIOLOGY (*see* 25.322).—No comprehensive presentment of social science having, as yet, obtained general recognition, a detached survey of the sociological field must needs follow the lines of the leading schools, and of individual writers most widely influential or significant.

THE SEVERAL SCHOOLS OF THOUGHT

Up to 1914 the two most representative schools were (*a*) of Durkheim, essentially following the tradition of Auguste Comte, who founded sociology by the publication of his *Philosophie Positive* during the years 1830–42; and (*b*) of De Tourville and Demolins, following the tradition of Frédéric Le Play, who, independently of Comte, and without reference to his work, founded the more concrete and observational side of sociology, especially by monographic publication of his *Les Ouvriers Européens*, from 1855 onwards.

Durkheim.—Both these schools suffered an arrest during the World War; but the organ of the Durkheim school, *L'Année Sociologique* recommenced publication in 1925, and on the same plan as previously, but edited by Marcel Mauss in place of Durkheim, who died in 1917. The scheme of the *Année* is to publish each year a series of studies by members of the school, and also an analysis and epitome of the more important writings produced in general sociology and in each of the main specialisms within the sociological field. The *Année* selects and epitomises relevant advances in economics, political philosophy, ethics, jurisprudence, criminology, social geography, anthropology, social psychology, demography, comparative religion, aesthetics, etc. This comprehensive survey and abstract makes a file of the *Année* an invaluable requisite of the serious student, whether of general or specialised interest.

Le Play.—The organ of the Le Play school (*La Science sociale*) had a different purpose. While the approach of Comte was primarily logico-mathematical, biological, historical and interpretative, that of Le Play was from physical science and industry, with direct observation, especially through travel, first of representative working-class families, by means of family budgets, and next of their actual living communities: and especially of the fundamental nature occupations; all studied at first hand in their environment, and in their resulting social organisation, with its characteristic ideas and ideals. Hence have been published in *La Science sociale* a long series of social monographs, in contribution to the geographico-social study of communities as they develop from their simple origins and isolated situations towards complex cultures interacting to form our historic civilisations. This line of treatment has been more akin to the naturalistic and descriptive attitude of Balzac and later realist French literature than to the abstractly philosophic, or the strictly anthropological, historical, or psychologic treatments of other schools, and so has elicited, as yet, too little appreciation in the run of current sociology.

A third group of active sociologists in France is that associated with the Institut International de Sociologie, with its periodic congresses and its *Revue internationale de sociologie*, ably edited by René Worms until his death in 1926.

The two formative French schools, continuing and developing the initial impulses of their respective founders, are manifestly complementary. But owing to the sharp division in France between the traditions of the revolution and of the counter-revolution, to which the doctrines of Comte and of Le Play respectively first appealed, these have, unfortunately for the progress of science, run independent courses, with little or no inter-penetration. Except for a book by Paul Bureau (*Introduction à la Méthode sociologique*, Paris, 1923), no serious attempt seems as yet to have been made in France to integrate their respective methods and products.

The Work of Geddes.—But a third school, initiated in Edinburgh about 1890 by Patrick Geddes has laboured continuously towards uniting and developing both these main French traditions, view-points and methods; more especially by applying the characteristic methods of each towards studying the evolution of cities and their regions. For this school it is living cities and their regions which most fully offer to the scientific student, as well as to the plain man, the directly observable aspects of civilisation. And if, along with direct observation, there is afforded, as by this synthetic school, a historic and contemporary interpretation which utilises the available specialised knowledge, then does the student of cities attain towards that complex unity of presentment which sociology demands. To this end has been developed, and largely in harmony with the Le Play school, the characteristic method now widely known as regional and civic survey; such surveys emanating from this group, with their pragmatic motto of " vivendo discimus," have been experimentally applied in Great Britain, France, India, Palestine, etc., towards regional improvement and in city and university design. With these

practical endeavours should also be appreciated the advances made by social workers in almost all countries, for their labours contribute, if not always immediately, yet indirectly, to the progress of social science.

This survey method is being increasingly applied as the preliminary inquiry requisite for town-planning, in its later developments known as regional. It is also being adopted in schools as an introduction to social studies made by direct observation in the open air along with nature studies, or as sequels to these. But these educational and civic applications alike too often lack the systematic and synthetic character essential to a scientific handling of sociological issues.[1]

Importance of Interconnection.—From the unified standpoint of the preceding schools the most generalised conception for the upbuilding of a science of sociology is that of the essential interconnection of all main aspects of any given community and its civilisation. Its situation in place, its actual industries and everyday work, and its people of all classes, with their common sense and experience, their ordinary feelings of selves and family, are all intimately connected with their ideas, social and political, with their scientific interests and aesthetic preferences and even with the religion and the philosophy of their own times as well as of earlier phases. But this view of social interaction is not to be confused with the too simple "economic determination of history" so emphasised by and since Marx; for the economic processes of each place and age are seen by the sociologist to be deeply influenced, often even determined, by preceding as well as current ideas and ideals; so that constant interaction is ever going on between the "temporal and spiritual" forces in every society. The actions and reactions of all these social factors in functional interplay thus produce the general and working "consensus" essential to each given community, in its characteristic phase and main level of civilisation; with its current and predominant "representation of life" accordingly.

The Social Heritage.—Changes in all these aspects of a civilisation, however, arise, even from generation to generation (especially when stimulated by great events), and still more from age to age, with their correspondingly fresh phases, and with variations, both objective and subjective, each modifying the other. Yet despite all such changes of the social consensus in its functionings and institutions and of representation of life accordingly, there is always traceable a definite continuity, even of "filiation," with the preceding phases, however great the seeming contrast. The outcome of these complex interactions is an unmistakable social inheritance. Above and beyond biological heredity there exists therefore a characteristic social heritage (and its associated burden of evil) which, by differentiating human from animal societies, constitutes the essential subject matter of sociology. And of this heritage, cities and their regions are more than the repositories. They are essentially concerned in transmitting it from generation to generation, and in modifying, for better or worse, its volume, character and purpose. It follows that the regional and civic survey, as a means of scientific advance, must develop a technique for study, at once observational and systematic, of the social heritage, in its past, present and incipient phases.[2]

[1] For the principles requisite to a systematic presentation see papers by Geddes, in *Sociological Papers*, vol. 1, 2, 3 and in *The Sociological Review* of 1925 (Le Play House Press, 65 Belgrave Road, London). For an elementary account, prepared for social workers and studious citizens, see *Introduction to Regional Surveys*, by Sybella Branford and Alexander Farquharson (Le Play House Press). Later developments of the method, and many applications to theoretical studies and practical questions, will be found in *The Sociological Review*, the organ of the (British) Sociological Society. Amongst characteristic books of the same school, but of more general treatment, may be mentioned *The Coming Polity* (revised edition 1919), and our *Social Inheritance* (1919), both by V. Branford and P. Geddes, and *Cities in Evolution* (1915), by P. Geddes and *Science and Sanctity* (1923), by V. Branford. For the relation of sociology to biology, as viewed by this school, see *Biology* by P. Geddes and J. A. Thomson in the Home University Library, London.

[2] For a set of formulae adjusted to this purpose see, in addition to the papers by Geddes already mentioned, *Our Social Inheritance* by Branford and Geddes, Part I.

The preceding outline indicates the needed and practical utilisation alike of Le Play's teaching and Comte's, along with that of other writers, respectively observant and interpretative, concrete or abstract. All are needed, and all require fuller coordination; and for this purpose, no doubt, revision. Thus Comte's classification of the sciences as essentially physical, biological and social, and his famous "law of the three states" (as successively theological and military, metaphysical and political, positive and industrial; or, as John Stuart Mill summed them, volitional, abstractional and scientific), have been absorbed into the body of social thought more fully than is commonly realised; yet each of these master concepts demands fuller inquiry, with consequent restatement.

So too Le Play's essential formula of "place, work and folk," though necessary for the correlation of geographic, economic, anthropological and social inquiries, calls for elaboration. The other basal contribution of Le Play and his continuators comes from their insistence on, and treatment of, the primary occupations. Gathering and hunting, herding and cultivating, mining, woodcraft and fishing—all these are viewed as elemental types of adaptation between man and nature, each definitely related to given environments, and together in their unity composing a rich rural matrix, from which urban civilisations have issued, and are perennially renewed, developed, arrested or degraded, according as, under more or less urbanised conditions, the characteristic traits and dispositions of the original rural types persist and undergo modifications towards progress, reversion or perversion.

From this presentment of elemental social types and their interplay for good and evil, arises a "natural history" of civilisations, which goes far beyond the superficial handling of the fundamental occupations by early economists and anthropologists. Yet, mainly perhaps by lack of detailed reference and specific instance, this Le Play doctrine of social evolution and regression has, so far, failed to win recognition from the specialised investigators of current economics and anthropology.

Place, Work, Folk.—The three primary social factors of place, work, folk, so insisted on by the Le Play school, correspond, term for term, with the primary biological concepts of environment, function, organism. Hence the possibility of a sociology concentrated on the social heritage and its progress, arrest or perversion, in social life, yet definitely correlated with biology and presenting the social process as not only continuous with the organic and individual life-processes, but increasingly transcending these. In all human communities, progress is thus seen to consist essentially in an orderly and rational modification and even transformation, of environment, through those kinds of work, *i.e.*, occupation up to its widest sense, which give expression to composite ideals at once social and individual, rural and urban.

Amongst various endeavours towards such a sociology, *i.e.*, continuous with biology but utilising as fully as may be the resources of philosophy, of psychology, history and all other relevant specialisms, that of Geddes and his fellow-workers starts from the more naturalistic and geographical approach; and that of L. T. Hobhouse sets out from a more strictly humanistic standpoint, psychologic and philosophic. Hobhouse's main works are *Mind in Evolution* (1915); *Morals in Evolution* (1923); and the following four books, together constituting the author's *Principles of Sociology, viz.: Metaphysical Theory of the State* (1918); *The Rational Good* (1921); *The Elements of Social Justice* (1921); and *Social Development* (1923).

Specialised Approaches.—As a notable instance of the many contributions towards a general sociology, at once naturalistic and humanistic, starting from anthropology, may be especially mentioned the works of Professor Westermarck. His classic *History of Human Marriage*, many times revised, was followed by *Origin and Development of Moral Ideas* (2nd ed., 1917), and other works. Amongst other advances in England from anthropology towards sociology may be cited those of Rivers, Haddon, Marett, Myers, Peake, Fleure, Seligman, Crawford, Elliot Smith, Perry and Malinowski. A similar list could be compiled, for other countries, of anthropologists moving, deliberately or uncon-

sciously, towards a general sociology. And the same, in less degree, is true of psychologists, economists, historians, geographers and other specialised groups. But all these regiments of sociologists, actual or would-be, are too inclined to march independently of each other, and without guidance from the synthetic concepts and co-ordinating methods grown up in the central tradition of the main science.

Work in Various Countries

United States.—In contrast to the surviving indifference to sociology on the part of British universities (with the conspicuous exception of London), those of the United States have mostly established chairs, sometimes even departments. From this American source issues a copious stream of literature, mainly text books for students, but also more considerable works, both methodological and of comprehensive range. Lester Ward, the American pioneer of sociology before its academic adoption, Giddings, Albion Small, E. A. Ross, Ellwood, Vincent, Cooley, Barnes and many younger writers have produced notable works.

Yet American sociology suffers from inadequate relation to the twofold French beginnings of the science and to the developments which have grown up out of these historic initiatives. This lack of continuity makes difficult the correlation of the American output with the main European lines of thought and research. Indeed, an increasing tendency has shown itself in American sociology to abandon the traditional endeavour to unify the whole body of relevant social studies, specialised and general, and to organise their essential product into an integrated doctrine in line with biology and the other "preliminary" sciences. This tendency, narrowing, yet in a sense progressive, has been stimulated by the remarkable advance of psychology in America, and also more or less by Le Bon and his many successors in the study of the group mind. Its main effort has been towards the psychology of groups and their interaction. In other words, American sociology has been especially concentrating on social psychology. *The American Journal of Sociology*, founded by Albion Small in 1895 markedly reflects this specialising tendency in its later issues. Two companion periodicals (*Social Forces* and *The Journal of Applied Sociology*) attest the abundance and vitality of American sociology.

Germany.—A notable post-war movement in sociology has arisen in Germany, where, before the World War the subject as such was hardly recognised in the universities, notwithstanding the sustained efforts of Simmel, Ratzenhofer, Barth, Tönnies and others. But an inquiry made in 1925 by Leopold von Wiese showed that in nearly every university of the German-speaking world the study of sociology was being more or less organised. Institutes and societies have been established for promoting sociological studies and research, whence emerges a growing output of periodical and other literature. In addition to the older *Archiv für Sozialwissenschaft und Sozial politik* there are now many periodicals in this field. First after the War came the *Kölner Vierteljahrschrift für Soziologie* (started in 1920 by von Wiese), which gives admirable surveys of current literature in addition to original articles. The *Jahrbuch für Soziologie; Ethos: Vierteljahrschrift für Soziologie, Geschichte und Kultur-philosophie;* and the *Zeitschrift für Völkerpsychologie und Soziologie*, all began publication in 1925. There has also been a considerable output of books on sociology in Germany since the War, but these, like most teaching in German universities, appear to emanate either from some single and specialised field or from a general philosophy of social life; and so in either case are inadequately related or in comprehensive indifference to the originative and fundamental traditions.

Other Countries.—In Italy, Belgium, Spain, Holland, Switzerland and the Scandinavian countries, few signs of progress are discernible in general sociology, apart from sporadic advances of the specialisms within the sociological field. True, the Institut de Sociologie in Brussels has enlarged and improved its journal (*Revue de l'institut de sociologie*) since the War; but in Italy the *Rivista italiana sociologica* has ceased publication. In Czechoslovakia and Poland a definitely sociological movement, with institutes and prospect of publications, has arisen. Also in Japan there was launched in 1925 a sociological society which publishes a monthly journal.

The Future of Sociology.—New growths in general sociology are seriously handicapped by the obstacles that have impeded, or even arrested, the progress of the science during the past two generations. These obstacles, indicated above, need candid recognition and discussion if they are to be overcome, and so make way for that ever-developing inheritance of systematised knowledge which, essential to the continuing growth of every science, is supremely required for the complex issues of sociology. That neglect of the two originative French traditions, which was so marked in Herbert Spencer's *Principles of Sociology* and in his systematic *Tables*, has been too much continued by most later sociologists, and has become well nigh a *damnosa haereditas*.

But a prior obstacle lies at the very foundation of the science. The failure of both Comte and Le Play adequately to organise their respective doctrines and incorporate therein the relevant specialisms of their day, has been aggravated by the unsystematised progress of those detailed advances and by the multiplication of new minor specialisms taken up in disregard of their place in general sociology. And the few synthetic workers, who have laboured to unite and develop the two initiative French traditions into a body of doctrine incorporating the relevant specialisms, have so far, achieved but little success in the leavening of academic institutes and official organisations. Yet, in spite of these many disabilities under which the synthetic movement labours, its progress towards unity and clearness is none the less advancing. (*See* Anthropology; Biology; Human Geography.)

(V. B.)

SODA FOUNTAIN: *see* Food Service.

SODDY, FREDERICK (1877–), British scientist, was born at Eastbourne, Sussex, on Sept. 2 1877, and was educated at Eastbourne College, the University College of Wales, Aberystwyth and Merton College, Oxford. From 1900–2 he held the post of demonstrator of chemistry at the McGill University, Montreal, where he carried out research work on radioactivity with Sir E. Rutherford, and for the next two years he worked under Ramsay at University College, London, becoming in 1904 lecturer in physical chemistry and radioactivity at the university of Glasgow. Ten years later he went to Aberdeen University as professor of chemistry, but he left there in 1919 to become Lee's professor of inorganic and physical chemistry in the university of Oxford. He made many valuable contributions to the science of radioactivity, and will be particularly remembered for his work on the nature of isotopes, for which he was awarded the Nobel Prize for chemistry in 1921. He was elected F.R.S. in 1910 and was a member of many British and foreign scientific societies, being president of the Röntgen Society 1905–6. (*See* Rays.)

His numerous scientific publications, chiefly on radioactivity, include *Radioactivity* (1904), *The Interpretation of Radium* (1909, revised and enlarged by a section on the "Structure of the Atom" (1920). *Chemistry of the Radioactive Elements* (Part I., 1920; Part II., 1914); *Matter and Energy* (1912); *Science and Life* (1920); *Cartesian Economics* (1922), *Inversion of Science* (1924).

SÖDEN, HERMANN, Freiherr von (1852–1914), German biblical scholar (*see* 25.339), died in Berlin Jan. 15 1914.

SÖDERBLOM, NATHAN (1866–), Swedish ecclesiastic, was born in Trönö Jan. 15 1866 and educated at the University of Upsala. In 1894 he became chaplain to the Swedish Legation in Paris and in 1901 took a theological degree at the Sorbonne for his thesis *La vie future d'après le Mazdéisme*. He was professor of the history of religion at the University of Upsala from 1901–4 and also at Leipzig from 1912–4 and gained a wide reputation as one of the foremost contemporary investigators in this field and also for his studies of Persian religion and theocracy. In 1914 he became Archbishop of Upsala. In the negotiations after the Lambeth Conference in 1908, which led to an official understanding between the Swedish and English churches, he took an enthusiastic part. Having extensive international relations, Söderblom worked with success for an approach to "evangelical catholicity" among various Christian societies, and played an important part in the preparations for

the universal Christian Conference on Life and Work held at Stockholm in Aug. 1925, in which he was one of the leaders.

SOISSONS-REIMS, BATTLE OF: *see* GERMAN OFFENSIVE.

SOKOLNIKOV, GREGORY YAKOVLEVICH (1888–) Russian communist and financial expert, was the son of a doctor. He studied in Moscow and at the University of Paris. He lived in exile until the revolution of Feb. 1917, when he returned to Russia and entered politics and journalism. After the Nov. Revolution, Sokolnikov at first worked in the Soviet finance department (for nationalisation of banks), but later took part in the civil war, holding the highest military commands in the revolutionary army in Turkistan. At the end of 1921, immediately after the proclamation of the New Economic Policy, Sokolnikov was appointed to the Committee of the People's Commissariat of Finance; at the beginning of 1922 he held the post of deputy people's commissar of finance, becoming commissar soon after.

At this time the finances of Soviet Russia were completely disorganised. Only 10% of the Government expenditure was covered by taxation, if one excepts the taxes in kind on natural products which formed the whole basis of the Government's finances. The daily expenditure could practically only be covered by continual issues of worthless currency. In the course of four years (1922–5) the system of taxes was restored to order, the Government undertakings began to yield a profit, the budget was put in order, the deficit being reduced to negligible quantities; the most important reform being the reform of the currency. This was begun at the end of 1922 and the new State bank was given the right of issuing notes; it was completed in 1924 with the reorganisation of the treasury bills and the stabilisation of the Soviet currency. In 1923–5, which period comprised the chief reforms, the financial department played the most important part in the Government of Soviet Russia, and Sokolnikov enjoyed great political influence. He succeeded in collecting in the finance commissariat a considerable number of energetic young members of the Communist party and talented non-party specialists. At the end of 1925, when great dissensions arose in the Communist party on the economic-political question, Sokolnikov went over to the opposition, joining the group which included Zinoviev, Kamenev, etc. After the 14th congress of the Communist party in Jan. 1926 he was removed from the post of commissar of finance and appointed deputy president of the " Gosplan," or state-planning commission.

(L. N. Y.)

SOLAR ENERGY.—The sun radiates out energy at a rate which varies at most only slightly from day to day or from year to year. So far as is known, the rate of radiation is approximately the same for all directions in space. Only a tiny fraction of this radiation, less than one part in two thousand millions, falls on our earth, but from observations on the amount of this it is possible to estimate the total output of solar energy. The solar constant is defined as the quantity of radiation which would fall per minute on an area of one square centimetre at the earth's surface, placed so as to face directly toward the sun, if the earth's atmosphere were absent, the earth being at its mean distance from the sun. The best determination of the solar constant, that of Abbot and Fowle, gives its value as 1·93 calories.

The mean distance of the earth from the sun, 92,800,000 m., is approximately 215 times the sun's radius, so that the energy emitted per minute by a square centimetre of the sun's surface must be $(215)^2 \times 1{\cdot}93$ calories, or about 89,000 calories. In terms of energy each square centimetre of the sun's surface has an output of energy equal to that of an engine of 8·4 H.P.

This represents a more concentrated output of radiation than can be produced in the laboratory. The output of energy from the carbons of an electric arc is something under two horse-power per square centimetre, so that the sun's surface must be at a temperature substantially higher than that of the electric arc, which is about 3,700°. The energy emitted from a perfect radiator at absolute temperature T is σT^4 per sq. centimetre, where σ is Stefan's constant. On the supposition that the sun's surface behaves like a perfect radiator, calculation shows that T the " effective temperature " of the sun's surface is about 5,740° absolute, or 5,470° Centigrade.

Knowing the area of the sun's surface ($5{\cdot}9 \times 10^{22}$ sq. cm.) and the output of radiation per sq. centimetre, we can calculate that the sun's total radiation must be about $5{\cdot}4 \times 10^{27}$ calories per minute, the equivalent in energy to the output of an engine of 5×10^{23} horse-power. Even this colossal figure represents a rather low output of energy for a star; the star V Puppis is known to be radiating at fully 10,000 times this rate, while the giant star BD 6° 1309 recently studied by Plaskett is probably emitting some 30,000 times as much energy as the sun.

From quite early times scientific curiosity has, naturally enough, been concerned as to the source of this treme dous outpouring of energy. Early speculations that the sun was merely radiating away an unreplenished store of heat, like a red-hot cannonball suspended in space, were soon found to allot it an inadequate span of life. The further conjecture that the sun's heat might be maintained by a sort of combustion of its whole mass did not meet with much better success; it was calculated that if the sun's whole mass were solid coal, and if this coal were burned in pure oxygen, the resulting heat would only suffice to maintain the sun's radiation at its present rate for about 6,000 years.

Mayer's Hypothesis.—The first hypothesis to provide anything in the least approaching to an adequate supply of heat was that of Robert Mayer. According to his hypothesis, the energy of the sun's radiation was provided by a continuous fall of meteorites and other small bodies into the sun. A meteorite starting with a small velocity at the confines of the solar system and falling under the sun's gravitational attraction would have acquired a velocity of about 400 km. a second by the time it reached the sun's surface. As the meteorite was brought to rest the energy of its motion would be transformed into heat, precisely as the energy of a bullet is transformed into heat when it strikes the target. Mayer calculated that a shower of meteorites of total mass equal to that of the earth would provide heat equal to that radiated away by the sun in rather over 95 years. Thus the sun's radiation could be accounted for if we were free to suppose that meteors of total mass rather less than that of our moon fell into the sun every year.

The hypothesis required the sun to be continually increasing in mass at a rate equal to about one moon per annum, so that the present mass of the sun fixed a limit to the total amount of radiation that could have been emitted by the sun. It was found that the infall of meteorites could not have provided radiation at the present rate for more than 18,000,000 years. There is in any case no reason for thinking that meteorites are distributed in space as freely as is required by this hypothesis, and indeed every reason for thinking the contrary, for, if meteorites were distributed to the extent required, so many would fall on our earth as to keep its temperature at a point at which it would be uninhabitable (*cf.* GEOLOGY).

Helmholtz' Hypothesis.—In 1853 Helmholtz propounded an alternative hypothesis which provided for the same total radiation as the hypothesis of Mayer, without its objections. Helmholtz supposed the sun's radiation to be provided, not by the spasmodic infall of meteorites, but by a gradual and regular infall of the sun's mass as he contracted in consequence of his radiation. The loss of energy resultant on radiation caused the sun to shrink; as this shrinkage took place each particle of the sun's mass moved to positions ever nearer to his centre; the energy set free by this gradual fall provided for more radiation, more shrinkage and so on. On this hypothesis the total heat radiated by the sun since his birth was equal to the total loss of potential energy in the sun's present configuration minus a certain allowance for the heat at present imprisoned in his mass. It was also equal to the heat which would have been radiated if the sun had been formed entirely by an agglomeration of infalling meteorites. Thus the limit set to the sun's total past radiation by this hypothesis was the same as that set by the meteoric theory of Mayer, namely a total past radiation equal to about 18,000,000 years of radiation at the present rate.

Discovery of Radioactivity.—Until quite recently no theory of the origin of the sun's heat allotted him a longer life than this. It is true that, in the excitement which first followed the discovery of radioactivity (*q. v.*), it was thought that the properties of radioactive substances permitted of an almost unlimited extension to the sun's past age and future life, but the various conjectures then made speedily proved to be false. A gramme of radium emits heat at the rate of about 138 calories per hour or, measured as energy, at the rate of about 1,600,000 ergs a second, whereas the sun's radiation represents an emission of only about two ergs a second from each gramme of his mass. It would at first sight appear that the supposition that even a small fraction of the sun's mass is radium would amply account for the sun's radiation, past, present and future. This view is fallacious on account of the fact that radium (*q.v.*) does not last for anything like the time throughout which the sun's radiation must be supposed to have lasted; it is reduced to half strength, in about 1,760 years. To allot the maximum possible life to the sun we should have to suppose his whole mass to have consisted originally of pure uranium, the parent radioactive substance out of which all others are formed. Rutherford has, however, calculated that this supposition would add at most 5,000,000 years to the sun's life, radiation being assumed to be at the present rate. Thus all the sources of energy which have so far been mentioned, acting in conjunction, could at most provide for radiation for about 23,000,000 years at the present rate of radiation.

Geological Estimates of Earth.—Even before Helmholtz propounded his contraction hypothesis, geologists had estimated the earth's age in hundreds of millions of years, basing their figures on the observed rates of denudation and sedimentation. The discovery of radioactivity provided a better and simpler means of judging this age. A special kind of lead, characterised by having atomic weight 206·0, is produced by the breaking up of atoms of uranium. Now the process of breaking up is a purely spontaneous one proceeding always at the same rate whatever the physical condition of the uranium may be. The constant rate is such that one out of every seven thousand million atoms of uranium breaks up each year. Hence in a mixture of uranium and lead a comparison of the relative amounts of the two substances enables us to estimate the time which has elapsed since the lead first commenced to form. Using this method, geologists are convinced that certain Canadian rocks are at least 1,400 million years old, and as it is generally accepted that the earth originally formed part of the sun it follows that the sun must be older still. (*See* GEOLOGY.)

Astronomical Arguments.—As will be explained later, astronomical arguments indicate that the period of 1,400 million years, which geologists assign as a lower limit to the age of the earth, is at most only a tiny fraction of the age of the sun. While the geologist has been increasing his estimate of the earth's age up to 1,400 million years or more, astronomical research has been moving in the direction of asking for at least 1,000 times this period for the sun and the stars in general.

No doubt a distinction must be drawn between the age of a star and the period during which it has been emitting radiation, but the difference between the two periods is less than might at first be thought. The observed velocities of the stars give some indication as to the intensity of the gravitational field in which they move, and hence of the density of gravitating matter in the universe. It is found that the visible stars account for something like a quarter of this density, and probably for more. Thus it is fairly safe to state that a quarter of the whole matter in the universe, or at least in our part of the universe, is shining, and so to conclude that the period of a star's radiation must be comparable with his total age. Further than this, modern theories of stellar evolution suppose that a star shines most brightly in his early days, then less brightly, and finally ends his days in darkness. Thus if astronomy indicates an age of millions of millions of years for our sun, we are safe in supposing that his total radiation since birth has been greater than the same number of millions of millions of years of radiation at his present rate. It is in any case abundantly clear, and with a very wide margin to spare, that our sun, and consequently the other stars also, must have some source of energy beyond those already mentioned.

Theory of Relativity.—In 1905 Einstein propounded his theory of relativity (*q.v.*), which requires that any increase in the energy of a body is necessarily accompanied by an increase in its mass, and vice versa. The standard illustration is provided by the changes which are observed to occur in the mass of a rapidly moving electron as its velocity varies. Under more usual conditions the change in a body's mass is so slight as to escape detection; thus the " Mauretania " when at full speed increased her mass by only ·00004 grammes.

It is at once evident that if the actual matter in any body could be annihilated, an enormous amount of energy would be set free. In 1904, before the appearance of Einstein's theory of relativity, the annihilation of matter had been suggested as a possible source of energy by J. H. Jeans, who further calculated in 1917 that the annihilation of 1% of the sun's mass would set free sufficient energy to maintain the sun's radiation at its present rate for 150,000 million years. This calculation is wholly independent of any conjectures or assumptions as to the mechanism by which mass is transformed into radiation. Perhaps the most plausible conjecture is that the positive and negative charges of which matter is made fall into one another and mutually annihilate one another in so doing. But, quite apart from this or any other conjectures, the theory of relativity provides the quite general theorem that the annihilation of a mass m in any way whatsoever sets free an amount of energy mC^2, where C is the velocity of light; this is all that is essential to the calculation.

The Life of a Star.—Obviously the suggestion underlying this calculation provided a quite simple source of energy for the sun's radiation; the only outstanding question was whether the radiation was in actual fact provided from this source or from some other still unconjectured source. According to generally accepted schemes of stellar evolution a star begins its life as a " giant " star—a sphere of gas of enormous size, low density and very high luminosity. Gradually it changes into a " dwarf " of comparatively small size, high density and low luminosity. Our sun, now a fairly typical dwarf, must have passed through a giant stage in which it radiated far more energy than now, and subsequently experienced a gradual diminution in size and luminosity. It has gradually emerged that the giant stars are of greater mass than the dwarfs, and that, in general, lower luminosity is associated with smaller mass. The close correlation between luminosity and mass was investigated by Hertzsprung, by Adams and Joy, and others, the most noteworthy contribution being made by Eddington, who showed in 1924 that visible stars of a given mass all lay within a comparatively small range of luminosities, the luminosity varying with the mass according to an assigned law. It at once became clear that if our sun had followed the normal evolutionary course, its mass in the past must have been far greater than its present mass. Also, since the rate of radiation corresponding to each mass was known, it became possible to calculate the time interval between any two assigned masses on the supposition that the energy of radiation was derived from loss of mass alone.

In this way Jeans calculated in 1924 that the time since our sun was a giant star must be of the order of seven million million years. It is hardly necessary to specify exactly what precise point in the giant state is taken as the starting point in this calculation, for, on account of their very high rate of radiation of energy in the giant state, stars run through this stage of their careers with extreme rapidity. Now the various astronomical arguments to which reference has already been made agree in indicating a period of just about this magnitude as the most probable age of stars in the condition of our sun.

Binary Stars.—Perhaps the most satisfactory estimates are those obtained from a study of binary stars which have broken up by fission. The two constituents of such a system commence life by describing about one another orbits of almost circular shape and of dimensions so small that the two stars are almost in contact. With advancing age both the dimensions and the

eccentricities of their orbits increase, and a purely dynamical calculation indicates that binaries whose constituents are in about the stage of development of our sun must have lived for millions of millions of years. An interesting check is provided by a study of the ratios of the masses of the two constituents of binary stars. The radiation from a massive star is not only absolutely greater than that from a less massive star, but is also relatively greater; the more massive a star, the more radiation it emits per unit mass. As a consequence of this, the masses of the two constituents of a binary must continually approximate to equality as the star grows older, and it is possible to calculate the rate at which this equalisation of mass should take place. Observations collected by R. G. Aitken show that the predicted approach to equality of mass actually occurs, and also make it possible to estimate the ages of binaries of various types.

Calculations based on these data give an age of 4·5 million million years for binaries of spectral types F to G, a figure which is in quite good agreement with the estimate of seven million million years for our somewhat older sun, which is obtained on the hypothesis that the sun's radiation is due entirely to annihilation of its mass.

Source of Solar Energy.—These and similar considerations indicate that our sun's loss of mass in the last seven million million years is just about represented by the total radiation which it is believed to have emitted in that time. If so, there would seem to be little room for doubt that a solution has been obtained to the long-standing problem of the origin of solar energy and of stellar energy in general. The answer to the puzzle proves to be the quite simple one that the sun's energy is derived by annihilation of the sun's mass. The electrons and protons which form this mass constitute bottled up stores of energy; the breaking of these bottles of energy and the setting free of the imprisoned energy as radiation is at present proceeding at a rate of rather over 4,000,000 tons a second, and has been proceeding at this or a greater rate for the past seven million million years.

In the same way in which it has proved possible to trace the sun's history back into the past, we can look forward into the future and watch the sun continually decreasing in mass and luminosity. All normal stars appear to follow a single clearly defined evolutionary sequence, and just as any normal star of greater mass than our sun provides us with a picture of what he must have been at some past time, so any normal star of mass less than that of our sun gives a picture of some epoch of his future. To peer further and further into the future of our sun we must look at stars of smaller and smaller mass and so of ever lower luminosity. The faintest known star, Proxima Centauri, which happens to be also the nearest, has a luminosity only one twelve-thousandth of that of our sun, but there is some room for doubt whether this is a normal star, and its mass is at present unknown. Of the stars whose masses are known with fair certainty, the smallest masses must be attributed to the two components of 60 Kruger. Aitken's determination (1925) assigns to them masses of approximately one-fourth and one-fifth of our sun, their luminosities being about a hundredth and a two-hundredth of that of our sun. These stars enable us to visualise what will be the state of our sun after an interval of about a hundred million million years.

Rates of Radiation.—While our sun emits energy at the rate of two ergs a second per gramme of his mass, Plaskett's star (B.D. 6°, 1309) already mentioned is radiating about 1,000 ergs a second per gramme. At the other end of the chain the fainter component of 60 Kruger radiates only a twentieth of an erg a second per gramme. As a general rule the farther advanced a star is the less its radiation per gramme. This suggests that a newly born star consists largely of types of matter which transform themselves fairly rapidly into radiation; as the star ages, these easily transformable types soon get used up, so that the older stars consist solely of less transformable types. It is likely that there must finally remain a residuum of mass consisting of types of matter which either do not transform into radiation at all or at best transform themselves with extreme slowness. If the earth is at present transforming any of its mass into radiation, this must be at most at the rate of a ten-thousandth of an erg a second per gramme of its mass, since any higher rate would be inconsistent with the actual temperature of the earth's surface. Thus the various chemical elements known on earth are probably of the non-transformable type. If so, the sun and the younger stars must be supposed to consist, in part at least, of chemical elements unknown to us on earth, which have the capacity of transforming their mass fairly rapidly into radiation. These unknown elements are probably of higher atomic weight than our terrestrial elements, although possibly our radioactive elements (uranium, radium, etc.) represent a last vestige, appearing even now only in infinitesimal quantities and destined ere long to disappear altogether. (*See* also RADIATION.) (J. H. JE)

SOLOGUB, FEDOR, pen name of Fedor Kuzmich Teternikov (1863–), Russian man of letters, was born Feb. 17 1863 in St. Petersburg (Leningrad), the son of a tailor. On the latter's death, his mother became a domestic servant and the son was brought up by her employers. He studied at the Teacher's Institute in St. Petersburg and was a schoolmaster for 25 years, retiring in 1907. In 1897 he published his first volume of poetry and also some short stories. He is considered the greatest figure of the Symbolists in prose and poetry. His best novel is *The Little Demon* (1907), in which he has created a universal type of evil in the central figure, the schoolmaster, Peredonov. He also wrote several plays.

His other works include *The Sorcery of Death* (a series composed of *The Created Legend, Drops of Blood, Queen Ortruda,* and *Smoke and Ashes*). *The Little Demon, The Created Legend, The Old House and other Tales* have been translated into English.

SOMALILAND (*see* 25.378).—The country continues to be divided between Abyssinia, Great Britain, Italy and France. The frontier between the Italian and Abyssinian regions was delimitated in 1911, when, in the north, it was fixed at 48° E. instead of 47° E. as provided in the 1908 agreement. This placed all the Ogaden tribal lands under Abyssinian authority.

I. BRITISH SOMALILAND

This district has an area of 68,000 sq. m., and a population (1921) of 346,908, including 2,205 foreigners (European Arabs and Indians.) Berbera, the capital and chief port, has, in the trading season, some 30,000 inhabitants. The policy of "strict coast concentration" adopted in 1910 in consequence of the costly and ineffective campaigns against Mohammed bin Abdullah, the "Mad Mullah," broke down. Efforts to restore order were inevitable; they began inauspiciously. In Aug. 1913 a camel constabulary party under R. C. Corfield was cut up, Corfield being killed. In March 1914 dervish raiders reached the coast and fired into Berbera. In May 1914 Mr. (later Sir) Geoffrey Archer became Commissioner (a title changed in 1919 to that of Governor), and on his representations further operations were authorised. Major T. A. Cubitt inflicted severe punishment on the dervishes in Nov. 1914–Feb. 1915, but the Mullah, who had retired to the border of the Mijertin country, subsequently again overran a large part of the protectorate. An end was, however, put to his activities in 1920, when by operations planned by Archer and carried out by Lt.-Col. (later Sir) Gerald Summers almost the whole dervish force was destroyed. The success of these operations was primarily and mainly due to the Royal Air Force. The dervishes, good fighting men, were demoralised by the attacks from the air. The Mullah himself escaped, fleeing into Abyssinian Somaliland, where, at the town of Imi, he died in Jan. 1921.

The overthrow of the Mullah marked the deliverance of the country from 21 years of dervish oppression. In 1922 Sir Geoffrey Archer, who had brought about this deliverance, was transferred to Uganda. He was succeeded by Sir Gerald Summers, who worked hard and with satisfactory results to improve the moral and material conditions of the Somalis. Sir Gerald died in Nov. 1925, and in Jan. 1926 Mr. H. B. Kittermaster, secretary to the administration since 1921, was appointed Governor.

A considerable number of sheep and goats and a smaller number of cattle are exported, but by far the most valuable export is

that of skins, the Somali sheep and goat skins being of very high quality. Ghee, gum and salt (the last named to Abyssinia) are other exports. Sheeting and longcloth, dates, rice and sugar are the chief imports. The growth of Japanese imports of grey sheeting, as opposed to American cloth, which had had a practical monopoly, was very noticeable in 1923 and 1924. In 1910–1 the value of imports was £267,000, of exports £247,000. In 1924 the value of seaborne trade was: imports £333,000, exports £228,000. The transit trade with Abyssinia, via Zeyla, was valued at £33,400. Revenue, mainly from customs, was but £30,000 in 1910–1, when expenditure was £99,000. For 1924–5 revenue was £82,000 and expenditure £150,000. Deficits are met by grants from the British Exchequer.

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II. FRENCH SOMALILAND

The value of this small, largely arid and sparsely populated colony lies in its port, Jibuti, the only French port on the Suez Canal route and the main artery of trade with Abyssinia. The railway to Addis Ababa, owned by a French company, was, after many delays, completed in 1917. Four-fifths of the trade of Jibuti is in the conveyance of goods to or from Abyssinia. It serves also as a coaling station, the coal being previously imported. The chief local industries are shark and mother-of-pearl fisheries and the collection of salt from the Bahr' Asal; since 1912 the salt exports have risen from 4,000 to some 14,000 tons a year. In 1914, when the railway was open only as far as Dire Daisa (30 m. short of Harrav), the value of exports was 43,600,000 fr. and of imports 28,700,000 francs. In 1922 exports were valued at 170,800,000 fr. and imports at 160,400,000 francs. Jibuti had (1921) 8,366 inhabitants, of whom 354 were Europeans. The population of the colony is said to be about 200,000 —apparently an overestimate—and consists of Denakil, Somali and Galla, who, on the grassland of the higher ground, rear camels, goats and black-faced sheep.

In 1919 the local budget balanced at 2,370,000 fr., in 1924 at 5,015,000 francs. The colony is administered by a governor, assisted by a nominated council composed of official and unofficial members. Apart from occasional raids by the nomads, who, away from the railway zone, are left much to their own devices, the colony has been peaceful. Lej Yasu, the deposed Emperor of Abyssinia, was in the Donakil country in 1917–8, but his efforts to raise the tribes against the French failed.

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III. ITALIAN SOMALILAND

Revised estimates give the area at some 154,000 square miles. The population is probably overestimated at 650,000. There were in 1921 664 Europeans (almost all Italians). These figures are exclusive of Trans-Juba, transferred to Italy by Great Britain in 1925 (*see* JUBALAND). The country is divided into Southern and Northern Italian Somaliland. In the southern division, a Crown Colony, under a civil governor since July 1910, energy was shown in the development of the somewhat scanty natural resources of the land and in the valleys of the Webi Shebeli, and the Juba cotton and rice were cultivated. The chief exports continue, however, to be durra, sesame, ghee, gum, myrrh and hides. From Mogadishu, the capital (population, in 1923, 20,700) a railway was built to Afgoi, 18 m., as the first section of a line to the Abyssinian frontier at Lugh. By 1924 some 2,000 m. of roads had also been built. The effect of the transfer of Jubaland remained to be seen in 1926; by giving the Italians possession of Kismayu it placed at their disposal a port superior to any on the Benadir coast. The colony had required constant subventions from Italy; thus, in 1924, colonial revenue was but 2,857,000 lire, while expenditure totalled 24,000,000 lire. Exports were far below imports in value; the figures for 1922 were: imports 51,000,000 lire, exports 11,000,000 lire. In part, the exports consist of goods from Abyssinia.

Northern Italian Somaliland was divided into the Sultanate of the Mijertin, whose territory included the coast facing the Gulf of Aden, the Nogal Territory (in the centre) and the Sultanate of Obbia. The economic value of these regions is not great, but they are famed for the abundance of plants which furnish frankincense and myrrh and also gum arabic. The Nogal Territory was for some years occupied by the "Mad Mullah," but he failed to agree with Mohammed Osman, the Mijertin sultan, and there were intermittent hostilities between them from 1908 to 1919. The overthrow of the Mullah by the British left the Somalis free to quarrel among themselves. In pursuance of the forward colonial policy adopted by the Fascist Govt., the Italians in 1925 decided to bring the sultanates under direct control. Military operations followed, and in Oct. 1925 it was announced that Sultan Ali Jusuf of Obbia had come to terms. The submission of the Mijertins was reported in April 1926. A campaign followed in the Nogal Territory, where the Somalis opposed the Italians with some stubbornness.

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SOMBART, WERNER (1863–), German economist, was born at Ermsleben in the Harz Jan. 19 1863; he studied in Pisa and Berlin, and in 1888 became secretary of the chamber of commerce in Bremen. He taught at the University of Breslau from 1890, at the Berlin commercial high school from 1906, and in 1917 was appointed professor at the University of Berlin. Sombart wrote prolifically on economic, historical and social problems. His best known work is *Der Moderne Kapitalismus* (1902, revised and enlarged ed. 1916). His books are stimulating and fertile in ideas, but many of his views conflict with those of others, and have given rise to a great deal of controversy.

Sombart's published works include *Sozialismus und soziale Bewegung im 19. Jahrhundert;* the 10th revised edition of this treatise, published in 1924, bears the title: *Der proletarische Sozialismus. Wirtschaft und Mode* (1902), *Die deutsche Volkswirtschaft im 19. Jahrhundert* (1903, 5th ed. 1921), *Das Proletariat* (1906), *Das Lebenswerk von Karl Marx* (1909), *Die Juden und das Wirtschaftsleben* (1911), *Luxus und Kapitalismus* (1912), *Die Ordnung des Wirtschaftslebens* (1925). Sombart is the editor of *Grundlagen und Kritik des Sozialismus* (1919).

SOMME, BATTLE OF THE.—This engagement, an offensive on the part of the British armies, with some assistance from the French, opened on July 1 1916. Between Ham and Arras the river Somme runs first from south to north as far as Péronne and then bends sharply to the west, in which general course it continues to the sea. From Péronne a low range of hills runs somewhat to the north of west, forming the watershed between the Somme and the basins of the Scarpe and the Schelde.

This ridge had fallen into German hands in Oct. 1914 in the course of the operations usually described as "the race to the sea" and the line in this quarter, indeed on the whole front from Arras southward to the Oise, had remained substantially unaltered during 1915, the chief change being that in July 1915 a British III. Army had been formed which relieved the French between the Ancre and the Somme. Subsequently a IV. Army was also formed, and early in 1916 the British had relieved the French X. Army on the Arras front, making their line continuous from Ypres southward. The right boundary between the British and French had varied considerably and in June 1916 was near

Maricourt, about 3,000 yd. north of the Somme. Here the Allied line, which southward of this point ran north and south, turned sharply and following the lower slopes of the watershed already described ran west for another 7,000 yd. to make another sharp turn at Fricourt, whence it ran north for 10,000 yd. to the Ancre, which pierces the ridge between Thiepval and Beaumont Hamel, continuing definitely in a northerly direction north of that river.

Reasons for the British Offensive.—When the German attack on Verdun opened in Feb. 1916, neither the artillery and ammunition situation of the British nor the training of many of the more recently arrived "New Army" divisions was such as to permit of their giving relief to their allies by taking the offensive on a big scale. Their help had consisted in the taking over of a long stretch of the French line, but as the spring turned into summer it had become evident that more than this would be necessary, for the French defence, though determined and resourceful to a high degree, was being very severely tried and the position was frequently critical. Sir Douglas Haig therefore agreed to set on foot plans for an offensive on a very large scale, although from the purely British standpoint it was doubtful whether such an effort was not still somewhat premature, neither the ammunition output nor the supply of guns being as yet equal to starting a serious offensive at more than one point, so that once the point of attack had been declared the advantages of surprise and the initiative would be largely discounted.

German Positions.—The German positions on the frontage to be attacked, a distance of some 25 m. in all, were extremely formidable. Their defenders had been in undisturbed possession for over a year and a half, they had had ample time therefore to turn to advantage the natural features of the ground and to supplement them by artificial means. Woods and villages had become fortresses, two elaborate trench systems had been constructed about two to three miles apart, each containing several lines and connected up by intermediate lines or "switches" which greatly complicated the task of the attacker who should penetrate any part of the front. Deep "dug-outs," easy to construct in a chalk country, protected the trench garrisons against the heaviest bombardments, broad belts of barbed wire obstructed the approaches, the lines bristled with well-placed and protected machine-guns, and every point of tactical importance had been specially fortified. The advantage of the ground as regards facilities for observation lay with the Germans, although south of the Somme where the French were to attack on a frontage of nine miles, conditions were less in their favour and their defences less formidable.

For an attack on such positions the most elaborate preparations were necessary, both tactical and administrative. Roads and railways had to be made, vast dumps of ammunition and stores collected and protected, gun positions selected and dug, bivouacking and encamping grounds prepared, the water supply expanded. It was not till the end of June that the offensive could be started; and it had been practically impossible to conceal from the Germans the scale and nature of the preparations or the intended extent of the attack, although such precautions as were possible had been taken.

I. THE FIRST ATTACK

After a week's preliminary bombardment of unparalleled intensity the Allied attack was delivered on the morning of July 1. On the British left north of the Ancre the VIII. Corps attacked from Serre to Beaumont Hamel, but though its centre penetrated some way into the German lines north of Beaumont Hamel the flanks were checked and the central division was finally dislodged. Equal ill-success attended the X. Corps south of the Ancre and the left of the III. Corps on its right, in their attacks on the formidable defences of Thiepval and Ovillers. However, on the right centre just north of La Boisselle and between La Boisselle and Fricourt lodgements were not only made but maintained by the right of the III. Corps and the left of the XVII. East of Fricourt, again, the three British divisions attacking in a northerly direction were all successful, Mametz and Montauban were taken and all the objectives secured, while beyond them the French astride the Somme fared brilliantly, reaching Hardecourt and Curlu north of the river, while south of it they actually penetrated to and captured six miles of the German second line.

The Germans had apparently not expected a French attack and were less well prepared on the Fricourt-Montauban front than on the line running north from Fricourt, where both their positions and their fortifications were strongest, and the substantial success achieved by the British right and by the French went some way towards compensating for failure elsewhere. Sir Douglas Haig, realising the formidable nature of the frontage astride the Ancre, concentrated his attention on exploiting the success of the right and in the course of 10 days of hard fighting in which some six fresh divisions were thrown into the struggle important gains were made: Fricourt, La Boisselle and Contalmaison were reduced, several woods were cleared and the line was advanced on a front of over six miles to within reach of the enemy's second system of defences on the southern crest of the main ridge.

Second Line of Defence Assaulted.—This system, less strong than that stormed on July 1, was formidable enough and the stubborn resistance of the Germans in their front system and intermediate lines had allowed large reserves of men and guns to be brought up and the defence to be reorganised. However, the attack on the second system, delivered at dawn on July 14, established the British on the Bazentin Ridge on a 6,000 yd. frontage, cleared the Bazentins and Longueval, penetrated into Delville Wood on the right and to High Wood in the centre and compelled the surrender of Ovillers, already isolated. But though at one time it looked as if prompt exploitation of the success might yield far-reaching results, reserves could not be thrown in quickly enough to make good and retain High Wood and before long the Germans started counter-attacking in great force and with much determination. Several weeks of hard fighting elapsed during which the British were unable to make more than very gradual progress at disproportionate cost.

These weeks, the second half of July, all Aug. and the beginning of Sept., saw desperate contests for Delville Wood at the salient angle on the British right, for High Wood in the centre, for Pozières and Mouquet Farm further to the left in the Thiepval direction. The lodgement gained on the main ridge needed to be extended, especially on the flanks, but the Germans had brought up large reserves, were employing a great weight of artillery and still enjoyed great advantages in position.

The British progress was slow, especially on the right, where Ginchy, Guillemont and Falfemont Farm formed a barrier against which many attacks were shattered even after Delville Wood had been won. It was important to extend on this side to get touch with the French who were gaining ground north of the Somme: Pozières equally was a stumbling-block to the advance of the British centre and behind Pozières were all the formidable defences of which Thiepval was the centre. Division after division was thrown into the fight, fought desperately, lost heavily and apparently achieved little, though Pozières was taken by the Australians before the end of July and other gains were made beyond its ruins. But the strain was telling heavily on the Germans: they checked the Allied progress but their resources in men, guns and ammunition were, by Ludendorff's own admission, taxed to the utmost to do so, while they had to relinquish entirely their attacks on Verdun, the cessation of which was ordered almost immediately after the supersession as chief of the staff (Aug. 27) of Falkenhayn by Hindenburg.

II. THE SECOND AND THIRD STAGES

With Sept. the Allies began to reap the fruits of their struggles. On Sept. 3 a renewed attack astride the Ancre by the V. Army, recently formed out of Rawlinson's IV. Army and placed under Sir H. Gough, was unsuccessful, and the centre made little progress. However, the right at last mastered Guillemont and in the next few days added Falfemont Farm, Ginchy (Sept. 9), Leuze Wood and Bouleaux Wood to its gains, while the French made substantial progress north of the Somme and gained a big success south of it, taking 7,000 prisoners and storming three m. of the old German front line as far as Chaulnes. These successes removed the main obstacles to the advance of the British centre, freeing it from the menace—the Falfemont Farm—of being enfiladed from Ginchy line. The British were now well established on the forward crest of the main ridge and could prepare to attack the villages on the northern slopes of the watershed.

The third phase in the offensive was ushered in on Sept. 15, by an attack on a broad front in which 10 divisions took part. The special feature of this attack was the employment for the first time of "tanks," (*q.v.*) the reply to the problem of the machine-gun behind barbed wire. The new weapon achieved a modified success, not all that had been hoped by its designers but enough to encourage the Allies and to shake the morale of the Germans, besides yielding valuable lessons for its future development and use. On the left and centre the attack did well, Courcelette, Martinpuich, High Wood and Flers were all taken with many prisoners. On the right, however, Lesboeufs and Morval were not reached and only after sharp fighting was the line straightened by the capture of the Quadrilateral (Sept. 18.), which had held up this wing. This obstacle at last disposed of, a fresh attack on Sept. 25, swept over Morval, Lesboeufs and Gueudecourt and by joining up with the French who had again secured substantial successes both north and south of the Somme, compelled the Germans to evacuate Combles (Sept. 26).

Success of the V. Army.—Simultaneously with this success operations on a big scale were resumed by the V. Army on the British left and Thiepval was at last taken (Sept. 26) with the Zollern, Stuff and Schwaben redoubts behind it. This important success left the Germans with only the scantiest foothold on the main ridge and was followed by further gains by the left of the IV. Army astride the Albert-Bapaume road. Thus by the beginning of Oct. the enemy has been driven back to his last completed line of defences, which ran from Sailly-Saillisel on the right, past Le Transloy and in front of Bapaume: he was busily engaged on fresh lines further in rear but as yet these were far from ready or formidable.

It really seemed therefore as if Oct. might see the Allies reaping full harvest of their earlier efforts. The rearward German defences could not be compared with those already penetrated and there had been some indications that the German morale was beginning to decline: there had been less stubbornness in the resistance encountered, less vigour in the counter-strokes. Unluckily an exceptionally wet Oct. robbed the Allies of the spoils which seemed in their grasp. Continuous and heavy rain combined with the effects of the bombardments to make the ground a sea of mud, across which guns and transport could hardly be moved, and even lightly equipped men could only struggle slowly forward. Attacks under such conditions were terribly handicapped; that most of them failed was not remarkable, for when a trench was taken the difficulties of consolidating it were greater than ever. What was more remarkable and a great tribute to the valour and determination of the troops engaged was that some progress was made, despite all obstacles. On the right the British established themselves on a spur running north-west between Gueudecourt and Le Transloy, in the centre Eaucourt l'Abbaye (Oct. 3) and Le Sars (Oct. 7) were taken, though

repeated attacks on the Butte de Warlencourt were foiled by the mud. On the left Regina Trench was taken, the western portion on Oct. 21, the eastern three weeks later, but the weather was becoming very bad and further operations were more difficult to carry out.

III. THE LAST OFFENSIVE

By about the middle of Nov. the British had secured almost the whole of the main ridge and had advanced quite far enough to make the German defences north of the Ancre into a pronounced salient with its apex at Beaumont Hamel. Had Oct. 1916 been as fine as Oct. 1914 or Oct. 1918, it is probable that the Allies might not only have pierced the Le Transloy line but by advancing on a wide front to the north and northeast they might have outflanked the Beaumont Hamel position and the whole German frontage as far as Arras. The rains had prevented this, but with the Allies in possession of Thiepval it was possible when at last the weather improved a little to renew the attack on Beaumont Hamel with better chances of success. The last important operation in the Somme offensive took the shape, therefore, of an attack by seven divisions on Nov. 13, which proved most successful on the right and centre, clearing the Germans off their last foothold between Thiepval and the Ancre and taking St. Pierre Division, Beaumont Hamel itself and Beaucourt-sur-Ancre with 7,000 prisoners.

On the left, however, Serre again proved impregnable; but by Ludendorff's own admission the loss of Beaumont Hamel was a severe blow. However, before the success could be much further expanded the return of bad weather again put a stop to active operations, which were not resumed on any considerable scale until well after the New Year. In the two months which preceded the German retreat to the Hindenburg line (March 1917) much was achieved which the bad weather of the autumn had then rendered impracticable and these operations, which had brought the British within striking distance of the last line covering Bapaume and Péronne before the Germans anticipated an enforced evacuation by retreating, may really be regarded as the belated culmination of "the Somme." Unluckily in March 1917, the Germans had a Hindenburg line to fall back to—there would have been none in existence had Oct. 1916 been dry.

Results of the Somme Battles.—The Allied offensive on the Somme may not have yielded all the immediate results that had been hoped for. Progress had been slower, casualties infinitely heavier, gains of ground far smaller than were anticipated. Nevertheless the three main objects had been achieved: the pressure on Verdun had been relieved, the enemy's main forces had been pinned down to the Western Front, his powers of resistance had been substantially reduced. Ludendorff himself has testified to the effect of the long struggle on the German morale and it is only necessary to compare the general strategical situation on Dec. 31 1916 with that of July 1, to see what a change had come over the War. It had been effected in the stubborn and apparently disproportionately costly struggle for the watershed between the Ancre and the Somme, and not outside France where the Russian offensive had been checked, Rumania had collapsed, the Italians had been held up and the capture of Monastir had been a mere flash in the pan, powerless even to help Rumania. Kut was still untaken, the British had not yet reached Palestine. It was the Somme which had wrought the change, even if bad weather had prevented the immediate exploitation of the success earned between July 1 and Oct. 1, and even though early in 1917 changes of command and of plan were to throw away much that the campaign on the Somme had placed within reach of the Allies. For the fighting sometimes known as the second battle of the Somme, *see* GERMAN OFFENSIVE and VICTORY, ADVANCE TO.

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(C. T. A.)

SOMOV, KONSTANTIN ANDREEVICH (1869–), Russian painter, was born in St. Petersburg (Leningrad), Nov. 30 1869, his father being director of the Hermitage Museum. Early in his career he worked under Ilia Repine, the realist painter and professor of the Academy of Arts. The spirit of the 18th century attracted him strongly and he was greatly influenced by the masters of the "Fêtes Galantes" and by the modern art of Aubrey Beardsley and Charles Conder. The retrospective qualities of his style are well illustrated in "Rainbows" and "fireworks," which were his favourite subjects; while his portrayals of Italian comedy in rococo environment show a sympathetic understanding of the subject. Somov was one of the founders of the group known as "The Artistic World." In 1919 he issued *The Book of the Marquise*, which he illustrated with a number of characteristic drawings. His best portraits, which are drawn in coloured crayon, show remarkable delicacy of execution and masterly delineation of character and bear comparison with the work of Clouet and Ingres. Somov, who was a connoisseur of ceramics, also produced a number of groups painted on china. See Oscar Bie, *Constantin Somoff* (1907).

SONIC DEPTH FINDER: *see* SOUND RANGING.

SONNINO, SIDNEY, BARON (1847–1922), Italian statesman (*see* 25.416). During the debates on Giolitti's Steamship Subsidies Bill in the spring of 1909, it was Baron Sonnino who conducted the most vigorous attacks against the Government, exposing the radical defects of the measure, and when Giolitti resigned on Dec. 2 it was Sonnino who was called upon to form a ministry, for the second time. But he did not enjoy the favour of the still Giolittian Chamber, and his Cabinet was defeated over the new shipping bill. On March 21 1910 he resigned, again after 100 days of office. He continued to take an active part in the debates in the Chamber, and was a stern but just critic of Giolittian political methods, although during the Libyan war he generally abstained from opposition for patriotic motives.

In the autumn of 1914, after the death of the Marquis di San Giuliano, the Premier, Salandra, assumed the Foreign Office for a short time, but when he reconstituted his Cabinet on Nov. 5 he offered that portfolio to Sonnino, who accepted it. His conduct of the Foreign Office was characterised by sincerity of purpose, high principles, unswerving patriotism and a wide knowledge of international politics. He had not, however, a free hand. He was still Foreign Minister, under Orlando's premiership, during the Peace Conference, which he attended as second Italian delegate from Jan. 18 to June 19 1919. On the fall of the Orlando Cabinet (June 19 1919) Sonnino retired into private life. He died Nov. 24 1922.

The irritation of the whole of Italy against the policy of the Allies towards Italy at the Peace Conference reacted to some extent against the nation's representatives at Paris, and Sonnino himself came in for a large share of unpopularity also, on account of a certain caustic hardness of manner and his strong objection to compromise in any form, although the more intelligent and better informed part of public opinion realised the great difficulty of his task and the inadequate support afforded him by Orlando, as well as the value of his actual achievements. He did not stand for Parliament at the elections in Nov. 1919, but was subsequently made a senator in 1920. In spite of what was regarded as his failure to overcome the obstacles of the Peace Conference, he enjoyed the reputation of being the greatest Minister for Foreign Affairs that Italy had had since Cavour, with the possible exception of Crispi, while as a financier he ranked very high. As early as June 1922 he realised that if Italy was to be saved from catastrophe some form of *coup d'état* was necessary. When the Fascists seized power in Oct. following, he viewed the movement with sympathy, although he was no longer in active politics. He was also a man of wide reading and culture, and a distinguished Dante scholar and bibliophile.

SOPWITH, THOMAS OCTAVE MURDOCH (1888–), British airman and inventor, was educated at Cottesmore and at Seafield Engineering College. Having won the Baron de Forest Prize of £4,000 for a flight from England to the Continent in 1910, in 1912 he founded the Sopwith Aviation Co., Ltd., at Kingston-on-Thames. During the World War this firm designed

and produced large numbers of aeroplanes and seaplanes for the British Government. Sopwith also became joint managing director of the H. G. Hawker Engineering Co., Ltd., Kingston-on-Thames. In 1918 he was made a C.B.E. He married in 1914 Beatrix, daughter of the 8th Baron Ruthven.

SORABJI, CORNELIA (1866–), Indian author and publicist, born at Nasik, was the fifth daughter of the Rev. Sorabji Kharsedji, an agent of the Church Missionary Society at Poona converted from Zoroastrianism, and of Francina Sorabji, a Hindu convert and educational pioneer. The first girl student of the Deccan College, Poona, Cornelia graduated in 1887, went to Somerville Hall, Oxford, in 1888 as a scholar, and in 1893, received the B.C.L. of Oxford. In 1904 she was appointed a legal adviser to the court of wards, Bengal, and later held the same position in Bihar and Orissa, and Assam. In these and other provinces she rendered very effective service to female landowners who suffered from the handicap of the *purdah* system. Miss Sorabji was awarded the Kaisar-i-Hind gold medal in 1909 and received the bar of the first class in 1922. She was enrolled in 1921 as a vakil of the Allahabad High Court. In 1923, soon after the removal of the sex disqualification she was called to the Bar by Lincoln's Inn, and returned to India to practise in the High Court, Calcutta. Both in her writings and her speeches, she showed a remarkable gift for graphic and sympathetic depiction of widely varied types of Indian life, with full appreciation of the value of the British connection.

Her best known books were *Love and Life Behind the Purdah* (1901) and *Sun-Babies* (1904), of which there was a second series in 1920. She also published *Between the Twilights* (1908), *Indian Tales of the Great Ones* (1916), the *Purdahnashin* (1917) and *Therefore* (1924).

SOROLLA Y BASTIDA, JOAQUIN (1863–1923), Spanish painter (*see* 25.434), was engaged for practically the whole of the decade 1910–20 on work for the Hispanic Society of America. It includes a series of portraits of Spanish writers and a "Panorama of the Forty-nine Provinces of Spain," consisting of 49 immense compositions, each representing views, costumes and customs of a different province. This great undertaking was completed before paralysis brought the artist's painting to an end. Important exhibitions of his work were held at the Grafton Galleries, London, 1908; in New York, 1909; in Chicago, 1913; and he was represented by two typical works in the 1920–1 exhibition of Spanish paintings at Burlington House. He died at Madrid Aug. 10 1923.

See Hispanic Society of America, *Eight Essays on Joaquin Sorolla y Bastida*, 1909; A. de Beruete y Moret, *Sorolla y Bastida*, 1920.

SOUND (*see* 25.437).—The increase in our knowledge of the subject of acoustics (the science of sound) during recent years has been largely associated with the War conditions which prevailed from 1914 to 1918. As a consequence of the War the development of this science has been abnormal, and research has been directed towards the rapid realisation of practical acoustic devices and methods for immediate use in warfare, both on land and sea. Some aspects of the investigations have received continued though less urgent attention since the War, with important results. A general survey of the work done shows that the advances consist of applications of well-established principles rather than the discovery of new phenomena. Generally, the observations made have proved to be in accordance with previous theoretical investigations, mainly due to the first Lord Rayleigh.[1] The work falls naturally under two headings, viz.: (1) the detection and perception of direction of sounds in air, and (2) the detection and perception of direction of sounds in water. Theoretically these two problems have much in common, but practically there are important differences which make it desirable to treat them in separate sections. A special section (3) is devoted to the important advances in auditorium acoustics, and the remaining section (4) deals briefly with miscellaneous outstanding features of modern work on sound.

[1] Lord Rayleigh's work is contained in his *Collected Papers* (No. 6, 1920). His contributions were numerous between 1911 and 1919, when he died.

I. DETECTION AND PERCEPTION OF DIRECTION OF SOUNDS IN AIR[2]

Detection.—The human ear itself is a remarkably sensitive detector of the air vibrations which constitute sound. It is still much superior in this respect to any mechanical device which has yet been produced for recording the vibrations visually. Thus the perception of feeble sounds of necessity depends upon the limitations of audibility, either indirect listening, or with the ear aided by the intervention of an electrical device such as a microphone. The audibility of a feeble sound can be very largely augmented by making use of the principle of resonance, provided that the sound itself approximates to a pure tone. This can be secured, for example, by the use of a Helmholtz resonator applied to the ear in the case of direct listening, and in addition by tuning the diaphragm receiver when microphonic listening is adopted. It has happened fortuitously that some of the chief sounds in air which it is important to be able to detect, viz.: those emitted by aircraft, does contain predominant notes, apparently due to engine exhaust, which enable the application of resonance, as above indicated, to increase largely the range of audibility.

The operation of the *Döppler effect*, arising from the relative motion between the aircraft and the observer, prevents the possibility of the identification of the machine by means of the observed frequency, this being liable to change by as much as 20%, according to the speed and direction of flight. An interesting observation which has been constantly made is that the notes of low pitch continue to be heard at ranges where those of high pitch have ceased to be audible. This is in accordance with the theoretical expectation that damping increases with frequency.

The determination of the direction whence a sound arrives is theoretically possible by a variety of methods dealt with below, several of which have been tried in aircraft localisation.

(*a*) *Binaural Listening.*[3]—Lord Rayleigh's experiments (*Collected Papers*, vol. 5, p. 347) have shown that low-pitched sounds are determined in direction by the observation of the phase difference between the vibrations arriving at the two ears. This principle has been applied in direction-finding, and the effect has been exaggerated by increasing the distance between the two points of reception. The sound is received by two equal trumpets or horns rigidly connected together and capable of rotation about axes perpendicular to the line joining them. Separate and exactly equal tubes lead from the trumpets to the two ears respectively, and the apparatus is rotated until the sound under observation appears to come from directly in front. The line joining the sound receivers is then perpendicular to the incident sound stream. An alternative method which dispenses with the necessity of rotating the apparatus is to use a *compensator* or *phase-measurer*, which consists of tubes, adjustable in length, inserted between the sound receivers and the appropriate ears, so as to provide a path difference equal to that between the distant source of sound and the two receivers. Adjustment of the tube lengths is made until the impression received is that the sound is neither to the right nor to the left, and the determination of direction is then a matter of simple geometry. In practice the compensator is graduated to give direct angular readings.

The practice of binaural listening has verified theoretical conclusions in several important respects. It has been found that it is easier to perceive the direction of a mixed sound, or noise, than a pure note. Apparently it is necessary that the wave train should contain more or less isolated special characteristics whereby the

[2] The information contained in this section is largely drawn from a manual entitled *Development of Sounds*, kindly placed at the writer's disposal by the British Munitions Inventions Department.

[3] This method of perception of direction has been largely used also in a connection which scarcely justifies treatment in a separate section. The *geophone* is an instrument for direction-finding of sounds proceeding through the earth, and its particular use during the War was for localising the sounds of picks, etc., used in tunnelling and land mining. It consists of two hollow boxes connected by equal tubes to a stethoscope arranged so that the sounds proceed from the two boxes to separate ears. The boxes are laid upon the ground a few feet apart, and moved about until the sounds of the pick appear to come from straight ahead. It is then known that the sound source is on a line perpendicular to that joining the two geophone receivers, since the sounds arrive through the earth in synchronism. By combining several pairs of geophones separated by considerable distances, the actual position of the pick can be estimated, for it lies at the intersection of the several perpendiculars above specified.

phase difference can be readily appreciated. In the regular sine wave corresponding to a pure tone each vibration is exactly like those which immediately precede and follow it, and the ears are unable to identify corresponding displacements. It is apparently also necessary for successful binaural listening that the two portions of the incident wave which enter the two receivers should be free from subsequent distortion; in particular, that the sound receivers should be as nearly as possible non-resonant for the vibrations in question. Any amplification of the sound which depends upon resonance, therefore, such as the use of Helmholtz resonators already referred to, is incompatible with efficient direction-finding by observations of phase difference.

The method is subject to many errors, chiefly those arising from the motion of the sound source, refraction due to temperature inequalities in the air, and the effect of winds. The necessary corrections are tabulated for use in practice.

(*b*) *Sound Mirrors.*—Some success has been attained in direction-finding by means of concave sound reflectors. The chief limitations have arisen from the question of size, and, consequently, of portability. In optics the size of mirrors commonly in use is very great in comparison with the wave-lengths of the light; in the corresponding problem in acoustics it is almost impossible to make them so; and yet this is a necessary condition for the geometrical laws of reflection to apply with accuracy. In the largest sound mirrors—perhaps 20 ft. in diameter—the size is at most only a few wave-lengths for the aircraft sounds under investigation with the result that the image of a distant sound obtained at the focus proves to be an area much larger than that corresponding to optical calculations. There is therefore no advantage secured by making the mirror paraboloidal instead of spherical, and considerable roughness of the surface is not detrimental. The mirrors were usually made of concrete, and listening was effected either by means of a small horn receiver placed in the focal plane and connected by a tube to the ears, or by means of a microphone placed in a similar position. If, as was more usual, the mirror was fixed, the direction of the sound source could be found by determining the position of maximum intensity in the focal plane. It may be noted that in this method of direction-finding amplification is obtained on account of the area of the mirror, and that further augmentation is attainable by using resonators, to which the same objections do not apply as in binaural listening. The accuracy of the determinations varies very much with frequency, being much greater for notes of high pitch than for low, as would be anticipated from considerations of wave-length.

(*c*) *Interference and Diffraction Methods.*—There have been many attempts to apply the principle of interference as a substitute for binaural listening, *i.e.*, by ultimately mixing the sounds entering the two receivers, instead of leading them to different ears and adjusting the compensator until the total sound heard is as loud as possible. Theoretically this will occur when there has been provided in the compensator a difference of path equal to the path difference outside the receivers. The method has not proved very successful, for a variety of reasons, some of which are obscure.

On the other hand, remarkable results have been obtained by the application to sound waves of a phenomenon well known in the *diffraction* of light. A small distant source of light gives in the middle of the shadow of a small circular obstacle a luminous region, called the "white spot," arising from the diffraction of light round the edges of the obstacle. The same phenomenon is observable in sound under suitable conditions. Thus a large horizontal disk, at least 20 ft. in diameter, and made of material which either reflects or absorbs sound, will give below itself a sound shadow of a sound source, such as an aeroplane, above it. Near the centre of the shadow, in a position depending on that of the source, there is a region where the sound heard on a suitable microphone placed there is comparatively loud—in many cases much louder than it would be if the disk were absent. The relation between the direction of incidence of the sound and the position of maximum intensity has been calculated, and the method provides, perhaps, the most reliable means of perceiving the direction of air-borne sounds.

(*d*) *Sound Ranging.*—This special military aspect of the localisation of sound sources, viz., those arising from gun-fire and shell bursts, is dealt with in the article SOUND RANGING.

II. DETECTION AND PERCEPTION OF DIRECTION OF SOUNDS IN WATER[1]

Of all the methods practised for the detection of submarines, that depending on the sounds which they emit has been of the widest application. The question of detection has been, of course, of nearly equal importance in the opposite sense, viz.: the hearing of surface ships by the crew of a submerged submarine. The sounds created in the sea by a screw-propelled ship are of a very complicated character, arising partly from the interaction between the propeller and the water, and partly from the vibrations of the machinery which are transmitted through the walls of the ship into the sea. They vary greatly from ship to ship, even of the same class; and, in the later stages of the War, submarines had been constructed which, when cruising submerged at certain slow speeds, emitted practically no noise at all. In many ways the detection of submarines in the sea is more difficult than that of aircraft in air. Normally, listening in air takes place at stations which are fixed; in submarine listening the stations were most frequently ships which, for tactical reasons connected with their safety, had to be constantly on the move. Their own machinery noise and the acoustic disturbances arising from their motion through the water were very apt to drown the noises proceeding from more distant sources. The noise of the sea, too, even in weather not at all stormy, interfered greatly, and the range at which a submarine could be heard varied much from day to day. A serious additional limitation was that recourse could not normally be had to the reflection of ordinary sounds (as is possible in air) chiefly by reason of the great size of the necessary reflectors. For the speed of sound in sea water is more than four times that in air, so that the wave-lengths are larger in the same ratio. This necessitates a corresponding increase in the linear dimensions of the sound mirror, if equal efficiency is to be obtained.

Hydrophones.—Hydrophones, or under-water sound detectors, were already in use before the War for signalling purposes, being carried by ships for listening to submarine bells operated by Trinity House as warnings in foggy weather. They consisted of small, metal, water-tight cases of which one face was a metallic diaphragm operating an enclosed microphone. The electrical disturbances of the microphone caused by any vibration of the diaphragm arising from sound pressure waves in the sea were conveyed to telephone receivers on the ship, where listening took place. It was usual to suspend the hydrophones in water-filled tanks attached inboard to the outer shell of the ship, which, owing to the fact that steel in water transmits sound almost completely, does not diminish appreciably the intensity. Normally the hydrophone diaphragm was tuned so that its natural frequency in water[2] approximated to that of the signalling bell, and so that increased range could be secured by depending on resonance.

The earlier hydrophones used for naval purposes were of much the same type, although the resonant diaphragm proved to be by no means an unmixed advantage. All sounds containing a component corresponding to the diaphragm frequency were distorted in reproduction, and what was gained in sensitivity was liable to be lost in the difficulty of recognition, or, in other words, failure in discrimination between genuine noises due to a submarine and other noises inevitably present in the sea. Appeal to resonance is only really advantageous when the sound under observation has a predominant note, as in the case of an aeroplane; and submarines do not display this characteristic. Ultimately hydrophones of a non-resonant character came to be preferred, and were frequently used in practice. These consisted most usually of enclosures made of rubber, sufficiently thick to withstand the pressure of the sea at the usual depth (about 15 ft.), and having natural frequencies *below* the limit of audition.

An alternative type of hydrophone consisted merely of a hollow enclosure without a microphone, sometimes with a metallic diaphragm, and sometimes simply a rubber tube, filled with air and connected by long tubes to stethoscopes applied to the ears. These are operated by the transference of the pressure vibrations from the sea to the air cavity and thence to the ears. Electrical hydrophones have the advantage over non-electrical ones that their sensitivity can be readily augmented by various means, *e.g.*, by the use of thermionic amplifiers (*see* AMPLIFIERS).

In cases where the hydrophones had to be used by ships in motion, they were sometimes fitted into the hull of the ship; or themselves consisted of fish-shaped bodies towed at a considerable distance behind the ship. The former precaution, *i.e.*, making the shape stream-like, aimed at diminishing the vibrations created by the passage of the hydrophone through the water; the latter had in view the partial elimination of the disturbances arising from noises in the towing ship. Even so, it frequently became necessary to stop the engines temporarily, and listen with the towed hydrophones while the momentum of the ship continued to carry it forward. This proved to be feasible only at comparatively slow speeds.

Directional Hydrophones.—All the hydrophones so far described are of a non-directional character, *i.e.*, the intensity of the sound heard in them is practically independent of the orientation of the sensitive receiving diaphragm with respect to the position of the source of sound. The limitations of dimensions necessitated by con-

[1] The following publications should be consulted, although they form by no means adequate references: H. C. Hayes, *Engineer*, p. 491 (1920); C. V. Drysdale (Kelvin Lecture), *Journ. I. E. E.* (1920); W. H. Bragg, "Submarine Acoustics," *Nature*, July 1919; F. L. Hopwood, "Submarine Acoustics," *Nature*, Aug. 1919.

[2] This is considerably lower than the natural frequency in air, on account of the additional loading by the water.

siderations of portability, etc., are such as to render the instruments much too small to give an effective "sound shadow." The reason for this has already been mentioned, viz., the great wave-lengths corresponding to audible sounds. At a frequency of 500 per second, for example, the wave-length in water is nearly 10 feet.

Differential Hydrophones.—Curiously enough, however, one type of directional hydrophone, here called for distinguishing purposes a *differential* hydrophone, did, in fact, depend upon the small differences of pressure operating upon its two sides; and it met with considerable success. It was made in various forms, the simplest of which consisted of a circular metal diaphragm, bearing at its centre a water-tight box containing a microphone, and clamped round its rim to a heavy metal ring. When placed in the sea so that the plane of the diaphragm passed through the position of the sound source, the pressure variations on the two sides are the same both in amplitude and phase, with the result that the diaphragm, and therefore the microphone, has no motion imparted to it, and the sound heard is a minimum. If, however, the diaphragm faces the sound source, there are, apparently, differences in the pressures on the two sides (probably in both amplitude and phase), and a small differential vibration takes place, with consequent sound in the receiving telephones. Actually, as the hydrophone is rotated through 360° about a vertical axis, two maxima and two minima of sound intensity are observed. In this form, therefore, the instrument is what is called, *bi-directional, i.e.*, it is unable to distinguish between sources in *front* and *behind*. The desirability of obtaining a *uni-directional* instrument led to the introduction of the so-called *baffle-plate*, the behaviour of which has not yet been explained satisfactorily in terms of orthodox theory. The essential characteristics of a baffle appear to be that it should be made of non-resonant material and have air cavities within it. Such a plate, fixed at a small distance (which has to be determined by trial) from one face of a bi-directional hydrophone, transforms it into a uni-directional instrument. A single sound maximum is now obtained upon rotation, occurring when the sound source and the baffle plate are on opposite sides of the diaphragm; and a single minimum—this when the baffle lies between the sound source and the diaphragm. The "edge-on" minima, observed when the baffle is absent, now disappear.

Binaural Listening.—The principles underlying this method of direction-finding have been described already. In the present case the main difference is that the sound receivers have to be submerged hydrophones. It has been found to be equally necessary for success that these should be as completely as possible non-resonant. The simplest arrangement used in practice was two rubber cavities placed several feet apart horizontally, and joined by separate equal tubes to the two ears. The device could be rotated about a vertical axis, usually passing through the hull of the operating ship. As in the case of air listening, compensators were often used in order to avoid the necessity of rotating heavy apparatus. An arrangement much preferred was to tow two or more fish-shaped hydrophones in known positions (about 12 ft. apart) behind the ship. Here electrical transference of the acoustic disturbances had to be adopted, and this necessitated great care in the choice of the microphones and telephone receivers so as to avoid selective resonance. (The behaviour of microphones in this respect was often unsatisfactory, and telephone earpieces, or magnetophones, were frequently substituted for them. This results in diminished sensitivity, but the binaural effects are much improved.) The telephone receivers delivered the sound into the compensator, and the phase difference was measured in the usual way; allowing, of course, for the difference of speed of sound in the sea and in the air channels of the compensator. In using a compensator with two sound-receiving units only, there remains an ambiguity of estimated direction, *i.e.*, one cannot distinguish between the angles θ and $\pi+\theta$. The introduction of a third unit, so that the three form a triangle of known dimensions—the units being used in pairs with the compensator—ensures the correct choice between the alternative angles.

Other Methods of Direction Finding.—Several other methods of perception of direction, not easy to classify, have found application in practice. One of these consisted in fitting in the shell of a ship, on opposite sides, two diaphragms with microphones attached, arranged so that the hydrophones thus formed were of as nearly as possible equal sensitivity. These were listened to alternately by means of a reversing switch. The ship, on account of its considerable size, was capable of giving a marked sound shadow. Thus the starboard hydrophone would give greater response than that on the port side if the sound source were to starboard, and vice versa. By steering the ship so that the responses were equal, it could be inferred that the course was directed towards the cause of the sound. The limitations of the method were mainly those arising from local noises; and the speed had to be small while listening took place.

In other cases large numbers of sound receivers, usually simple diaphragms whose function was to transfer the vibrations from the sea to the air inside, were inserted in the ship's hull. Good results were obtained by an arrangement of this kind, called the Walser gear, in which the sound receivers were disposed at regular intervals on a large bulge, in the shape of a spherical segment, incorporated in the hull on either side towards the bows. The system acted as a sound lens, a sound focus occurring at a point where the "sound paths" by alternative routes were equal. Application of the laws of geometrical optics enabled the relation between the position of the focus and the direction of incidence of the sound wave on the ship's side to be determined.

Sea Sound Ranging.—The methods hitherto mentioned for perceiving sound direction would all fail when the sounds are abrupt in character, because they all require an appreciable time for carrying out the necessary tests. To determine the position of an exploding submarine mine or torpedo we require, therefore, a different device. A suitable method is one identical in principle with that practised on land. The main variations in applying the device to the sea are that the microphones must be in submerged hydrophones, and that a correct knowledge of the velocity of sound in sea water must form the basis of the calculations. Ordinary non-directional hydrophones of the type first mentioned have proved to be quite sufficiently sensitive, but specially constructed hydrophones, sensitive to shocks and irresponsive to general sea noises, are superior. Indeed, the greatness of the distances at which explosions in the sea have given unmistakable impressions on the recording film has been surprising. Small detonators serve at distances of several miles, while the explosion of 40 lb. of guncotton is operative more than 100 m. from the receiving hydrophones. Many experiments have been carried out by the British Admiralty with hydrophones disposed in suitable positions on the east coast of Britain, and the installations promise to be useful, not only for locating mine and torpedo explosions in circumstances of war, but also for navigational and surveying purposes. A ship in fog, for example, could ascertain its position by exploding (with due notification by wireless to the sound ranging station) a small charge near itself in the sea; the station could within a few minutes inform the ship—again by wireless—of its position. (*See* SURVEYING).

An important additional method, the so-called R–A or radio-acoustic device for locating positions at sea, has been developed since the War by A. B. Wood and H. E. Browne, working for the British Admiralty (see *Proc. Phys. Soc. Lond.*, vol. 35, p. 183, 1923). It consists of measuring the difference of time of reception at shore stations of ordinary wireless signals (which travel practically instantaneously) and sound signals in the sea (explosions) sent out simultaneously from a ship. Both incoming signals are recorded on the same moving photographic film, and such great precision of measurement has been attained that the method has served to check, and sometimes to correct, hydrographic surveys made in the orthodox manner.

Sea sound ranging has necessitated the accurate redetermination of the velocity of sound in sea water. This has been accomplished by the inverse of the processes just mentioned, making use of explosions in accurately known positions.

This velocity and its variations due to temperature and salinity are now known with great precision. For example, the velocity in sea water at 15° C. containing 35 parts of salt per 1,000 is 4,935 ft. per second.

Echo Sounding.—The accurate knowledge of such velocities has led to another remarkable device being designed and used successfully by the British Admiralty. This measures the depth of the sea at any point, and provides a means of survey of the sea bottom far more rapid than is possible by ordinary sounding lines. A description of the method has been given by F. E. Smith, Admiralty Director of Research, in a Royal Institution lecture on "Modern Navigational Devices" (*Proc. Roy. Inst.*, vol. 24, p. 342, 1924). In principle it consists of measuring the time taken for an abrupt sound to travel to the sea bottom and return as an echo after being reflected there. The sounds are made by an electrically operated hammer striking at regular intervals a diaphragm fixed in the hull of the ship; the sound receiver is a non-resonant hydrophone, also suitably immersed in the sea. The timing mechanism, which is of ingenious construction too elaborate to describe here, measures the time of the double sound journey in terms of the angular separation of two disks rotating synchronously on the same shaft. This permits of calculating the sea depth, the velocity being known. An indicator in connection with the mechanism performs the necessary calculation automatically so that the depth can be read off. A most important advantage of the method, in addition to its accuracy, is that the ship carrying out soundings need not stop to do so (*see* SOUNDING).

III. AUDITORIUM ACOUSTICS

The acoustics of public buildings have been put on what approximates to an exact scientific basis largely as a result of the work of W. C. Sabine (*J. Frank. Inst.*, 179, p. 1, 1915). For good hearing three conditions are necessary and sufficient. The sound heard must be *loud enough*; the simultaneous constituents of a mixed sound must preserve their *relative intensities*; and the successive sounds must *remain distinct and in the correct order*, and be free from extraneous noises. The extent to which these conditions are fulfilled depends on the construction of the auditorium, its shape, its dimensions and the materials of which it is composed. In already finished buildings radical alterations of the first two are not often feasible, but great improvements can be secured solely by suitable changes in the internal features.

The main difficulty arises from what has been called *reverberation*, due to the multiple reflection of sound at different parts of the room. If the reverberation is prolonged, it means that the rate of absorption of the sound is slow. Thus, in a lecture room at Harvard, where these experiments were commenced, the rate of absorption was so small that a single spoken word continued to be audible for $5\frac{1}{2}$ seconds. Successive syllables thus had to be heard and appreciated through a loud mixed sound due to the reverberation of many previous syllables, and the conditions of hearing were intolerable. Great reduction of the multiple echoes constituting reverberation can be made by increasing the rate of absorption of sound. It is apparent that, in the space of several seconds, the sounds travelling at 1,100 ft. per sec. will have suffered many successive reflections, and will, therefore, have penetrated to practically all parts of the room. The sound will have become diffuse radiation, and absorbing material introduced almost anywhere will be equally effective in reducing reverberation. An open window proves to be a complete absorber, in the sense that it permits the egress of the maximum possible quantity of sound radiation (*cf.* the properties of a small aperture in an isothermal enclosure in heat radiation). The introduction of cushions, carpets, wall hangings and people also largely diminishes reverberation, because of their considerable absorbing powers. Sabine has made a systematic study of the coefficients of sound absorption of various materials by the inverse method of measuring their effect in reducing the duration of reverberation. Measurements, for example, indicated that an audience gave an absorption equal to 44% of that due to an equal area of complete absorber, thus accounting for the improved hearing conditions that are very often found in well-filled buildings.

The absorption of sound can thus be adjusted with precision, but it must not be carried too far, otherwise the *sound intensity* is too much diminished. The ear is able to disregard, or even to take advantage of, reverberation which is not too prolonged, and the extent of absorption has to be adjusted to the appropriate amount. Too many apertures such as open windows or doors must be avoided.

Sabine has also made examination of the exact manner in which sound is reflected in an auditorium by constructing scale models of the latter, and photographing the sound waves at various instants after creation, using the beautiful method due to Toepler (*Annalen der Physik*, v. 127, p. 556) and elaborated by R. W. Wood (*Physical Optics*, 2nd ed., 1911, p. 94). By this means the positions of the sound waves, both incident and reflected, are capable of observation at all instants and at all points in the model room, and they provide data upon which can be based correct architectural construction from the acoustic point of view.

IV. MISCELLANEOUS ADVANCES

Absolute Measurement of Sound.—A. G. Webster (Nat. Acad. Sci., *Proc.*, 5, p. 173, 1919) has advanced to a considerable extent the methods of absolute measurement. For this purpose it is impossible to rely upon audition, handicapped as it is by the vagaries of the ear. What is required is a reliable mechanical device, the performance of which is constant, to record the sound vibrations with sufficient magnification. Webster has made an exhaustive study of the properties of various materials, and has constructed from those most suitable for the purpose two instruments which he has called the *phone* and *phonometer* respectively. The "phone" provides a means of creating a simple tone of intensity and frequency which are under control and capable of exact measurement. The phonometer is an instrument for measuring absolutely the vibrations received by it. It consists of the combination of a diaphragm and a resonator, both of which are adjustable in frequency. The motion of the diaphragm is observed by making it a reflector and part of a Michelson interferometer, so that the amplitude is measured in terms of the wave-length of suitable monochromatic light. In practice the interference fringes are photographed on a moving film upon which they appear as wavy lines. Against this instrument, which is regarded as a standard, other portable phonometers can be calibrated, these depending on the simpler process of the deflection of a beam of light set into angular oscillation by the receiving diaphragm. With such instruments and also with D. C. Miller's *phonodeik* (referred to later), L. V. King has carried out an elaborate investigation on the propagation of sound in air and fog-signal efficiency (*Phil. Trans.*, v. 218, p. 211, 1919) in the region near Father Point, Quebec. King, in this paper, also describes a modification of the siren called the *diaphone*, used as a standard source of sound in his research.

Analysis of Sound.—Webster's phonometer described above is a resonant instrument, and, therefore, unsuitable for the analysis of mixed sounds. Much progress has been made, however, in the analysis of such sounds, using non-resonant recorders—for example, D. C. Miller's *phonodeik*. This instrument, which depends on the motion imparted to a tiny mirror by the operation of a vibrating diaphragm, is described in Miller's *Science of Musical Sounds* (1916), where also will be found the results of the analysis of various sounds. In such instruments the sound record is of the ordinary type, and consists of the trace on a moving photographic film of a spot of light vibrating at right angles to the motion of the film, thus forming a transverse wave. Records of a different type have been obtained by A. O. Rankine (*Proc. Phys. Soc. Lond.*, v. 32, p. 78, 1919 and *Nature*, v. 108, p. 276, 1921), in which the sounds are caused to vary the *intensity* of a narrow beam of light, which gives on a moving film a line image perpendicular to the motion. The record thus consists of a negative film of varying transparency along its length. It is not so suitable as transverse records for direct analysis of the component frequencies, but it has the advantage that it admits of *reproduction* of the sound by means of a selenium or other photoelectric cell, such as is used in photophony. This arrangement constitutes a novel type of phonograph operated by light, first invented by Ernst Ruhmer in 1900, but hitherto little known.

Mainly owing to the demands of wireless broadcasting (*q.v.*), the question of the composition of sounds, particularly speech sounds, has become acute, and many investigations on this subject in relation to more perfect telephonic reproduction have been carried out since 1922. There has been besides a remarkable advance in our knowledge of the structure of speech due to the work of Sir Richard Paget (*Proc. Roy. Soc.*, *A.*, v. 102, 1923, and 106, 1924), who has examined systematically by direct listening the component characteristic frequencies of vowel sounds in particular and, to some extent, consonants also (*see* VOICE SOUNDS). The accuracy of these observations is established by the fact that speech sounds have been imitated artificially by employing the appropriate frequencies, and a speaking machine, consisting of the hands, a reed and bellows, called the *cheirophone*, has been evolved.

Speaking Films.—Progress has also been made in the application of photographic sound records, in conjunction with photoelectric cells, as mentioned above, to the synchronous reproduction of pictures and sounds (see *Nature*, v. 108, p. 276, 1921). Bergland in Sweden, Masolle, Vogt and Engl in Germany and De Forest in America appear to have been the principal experimenters, and De Forest *phonofilms* are now (in 1926) to be seen and heard in certain British picture theatres. In this particular phonofilm the sound record, which is of the varying transparency type, occupies a strip about $\frac{1}{16}$ in. wide on one side of the picture series. It is made by sounds acting microphonically on the luminosity of a special lamp to which the moving film is exposed through a slit. For reproduction a photoelectric cell, under the influence of the fluctuations of light caused by the developed film record, operates loud-speaking telephones, the necessary intensity being secured by sufficient valve amplification. The pictures and the corresponding sound record being on the same film, synchronism is perfect, even after the fracture and repair of the film which frequently occurs in practice. What one sees and hears are, of course, but imitations of the original appearances and associated sounds, but the double deception of the eye and ear is in fact almost, if not quite, complete. The phonofilm reproduction *lives* more nearly than the silent moving picture.

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SOUNDING (*see* 25.460).—From the year 1911 until the commencement of the World War there was no improvement in the methods of deep-sea sounding; but certain advances were made in connection with sounding in shoal water, the best known British systems being called after their originators, "Douglas-Schäfer" and "Somerville"; these two appliances are now fitted in all British surveying vessels, and enable accurate and rapid soundings up to 30 fathoms to be obtained easily when the vessel is steaming at the rate of about four knots. Both methods use a wire traveller carrying a lead between the stern of the vessel and a spar projecting from the bows, and entirely prevent the entry of the lead into the water until it is disengaged at its greatest distance forward, thus enabling a vertical sounding to be obtained as it passes the stern.

Effect of the War.—During the five years of the War original methods of sounding were not improved upon, this being largely due to the lack of time for experimental work in this direction, and also because after the War, and even now (1926), certain nations still treat certain war inventions, to some extent, as confidential. Perhaps the non-circulation of such information may be due to the aversion to publication of imperfect data, as well as to the necessity for safeguarding commercial rights to entirely novel appliances.

Although not directly applicable to the subject of ocean sounding, reference must now be made to subaqueous sound-ranging, a form of the utilisation of sound-waves which proved eventually to have such a remarkable effect upon the former. Subaqueous sound-ranging is of distinctly higher accuracy than that through air, owing to the velocity of sound through water being considerably greater and comparatively unaffected by extraneous causes; in water, sound travels at about 4,900 ft. per sec., which is more than four times its rate through air.

This method of obtaining a distance by sound was used largely in connection with the detection of submarines, and was invaluable in accurately fixing a position which could not have been ascertained otherwise. Sound waves were also utilised for locating the explosion of mines and for fixing any positions at which a small explosive charge was fired intentionally. After such an explosion the sound travelled through the water to two or more sets of suitably placed hydrophones whose positions were accurately known and which were connected to organised shore stations; after the reception of the sound of the explosion by the hydrophones, not only was its approximate distance obtained, but, by mathematical calculation, a line of direction was also given. Thus the combination of these distances and lines of direction from two or more hydrophone stations gave the position of the explosion with considerable accuracy. In practice when used in the North Sea the results were obtained without difficulty up to about 200 miles. The greatest distance for which this method was utilised was in the case of obtaining the position of vessels sunk during the battle of Jutland, which was nearly 300 m. from the English coast.

The value of this method in obtaining accurate and rapid positions for sounding purposes in connection with the numerous minefields in the North Sea cannot be overestimated, and its enormous utility is especially realised when the thick weather which is so prevalent there prevents the taking of all astronomical observations, and, further, when most of the positions were out of sight of land.

Utilisation of War Methods for Purposes of Peace.—On the termination of the War, inventions which had been utilised during its progress were turned, when possible, to the purposes of peace, and a large amount of material and knowledge gathered together in connection with subaqueous sound-ranging were gradually utilised in the direction of sounding, and in this special field the utilisation of acoustic sounding in substitution for the direct measurement of oceanic depth is its practical result.

Echo Sounding.—This new method is known as echo sounding, and depends upon the principle that any sound originating at or near the surface travels through the water at a known speed, and after striking any large object or the bottom of the sea is reflected back to the surface, the time between the emission of the sound and its reception back again being a matter for accurate measurement.

While the value of 4,900 ft. per sec. may be taken as the average velocity of sound in water, it is obvious that the question of an exact value of this measurement is a most important item in this connection. Experiments are being carried out by several nations on this subject, which involves questions of depth, density, temperature, salinity, etc., all of which play a vital part in these investigations.

The perfection of some means of obtaining an accurate measurement of the time from the moment when the sound is first produced until its echo is received back is therefore the practical problem to be solved satisfactorily, and if a form of apparatus carrying out the above requirement is produced, a succession of measurements, *i.e.*, soundings, can be obtained easily.

Experimental Work.—Several nations are known to have carried out much experimental work in the perfecting of such an apparatus as is required—France, the U.S.A., Germany and Great Britain are those especially prominent in this direction, and each nation's investigations have resulted in evolving its own special form of apparatus for carrying out echo sounding; in this article, no attempt has been made to describe the devices of the various nations; the whole subject is at this date in an experimental stage, and it appears more than doubtful if any of the existing appliances will survive the test of time in their present form.

Use of System by French.—The French hydrographic service was the first known to have made practical use of echo sounding, and in April 1922 one of its surveying vessels ran a line of echo soundings across the Mediterranean from Marseilles to Philippeville in Algeria, these soundings being required in connection with a projected submarine cable. The existing recorded depths were found to be very similar to those obtained, and the result generally was most successful; the majority of the depths were slightly under 3,000 metres (about 1,000 fathoms). The acoustic apparatus employed by the French was invented by Monsieur Marti, a hydrographic engineer of the French Navy. All the surveying vessels of the French Navy are fitted with some form of sonic sounding apparatus, and the apparatus is also supplied to some of the larger vessels of the Navy itself.

Utilisation by U.S.A.—In June 1922 the U.S.S. "Stewart" ran a line of echo soundings from American waters to Gibraltar; the voyage occupied about nine days, during which about 900 soundings were taken, the depths varying up to 3,200 fathoms, and the time between the soundings usually being about 20 min.; no difficulty whatsoever was experienced in taking these soundings, and the speed at no time was reduced for this purpose; the average speed was 15 knots. The apparatus used on this occasion is called the "Navy Sonic Depth Finder," and was developed by Dr. Hayes at the Engineering Experimental School at Annapolis, Maryland.

At the latter end of 1922, two American vessels were fitted with a similar form of apparatus for echo sounding, and carried out an extensive bathymetrical survey off the west coast of North America, at the request of the Carnegie Institution of Washington. About 5,000 soundings were obtained during the survey, and the resulting chart has proved of great value in connection with those disturbances which have been unfortunately so prevalent on this coast. In those regions in which land changes occur frequently, their study will be immensely advanced by a greater knowledge of the off-lying ocean depths, now rendered feasible by this new form of sounding. In the year 1923 an American cruiser was fitted with the sonic depth finder and crossed the South Atlantic to the Cape, and thence proceeded up the East Coast of Africa. The apparatus was in constant use during the whole voyage, its results being found in close agreement with the existing soundings on the chart; and from a

navigational point of view it proved of great value, especially in the dangerous vicinity of Cape Guardafui, which was rounded by its means during thick weather which entirely prevented land being sighted. A sonic depth finder is now fitted in several ships of the American Navy for navigational purposes, and in all surveying vessels.

German Apparatus.—Mention must now be made of a German apparatus, invented for the purpose of obtaining sonic depth soundings, by Dr. Behm. A study of the question of submarine explosions and their reflection from the bottom of the sea was commenced for this purpose by him about the year 1912, but further improvements are required before the invention can be described as being a practical success.

Use by British Navy.—The British Navy have now perfected an apparatus which carries out all the necessary purposes of the sonic depth finder; it is comparatively simple in character; no calculations are required, the actual depth being read directly on a dial. This apparatus is produced in two patterns, the first being for use in comparatively shoal water and a second for obtaining deep-water soundings; the first is quite sufficient for the purposes of ordinary navigation, while the second is suitable for hydrographic, oceanic investigation and for submarine cable requirements. All British surveying vessels in home and foreign waters are now fitted with the latter apparatus.

Reference must be made to the utilisation of ultra-sonic waves by Professor Langevin, of the Paris University, in connection with deep-sea sounding. This method makes use of sounds in water which are comparable with the Hertzian waves of the air. There appears to be a great deal to be said in favour of this apparatus, but more experiments with it are required before it can be said to be a complete success. In spite of the undoubted success of echo sounding in obtaining deep-sea measurements, the old apparatus for wire sounding will be required for oceanographic investigations, as specimens of the bottom temperatures and salinity will still be necessary, but the number of such observations will be very small compared with those required for deep-sea sounding.

Since 1874 the method of sounding by wire as described in Vol. 25, 461, has been in practice, and was, in its turn, an immense step over the former clumsy method of utilising hemp, but the advantage of echo sounding as compared with that by wire is so enormous that practically there is no comparison. In the present case the apparatus is unlikely to be damaged in any way, whereas under old conditions not only was it extremely likely that the apparatus itself might be injured, but the loss of both wire and lead was unfortunately not infrequent. The time necessary for obtaining a sounding is almost infinitesimal, the sounding in extreme depths taking little more time than one in the shallowest water. The speed of the vessel is maintained throughout the soundings, and the soundings themselves may be accurately taken at extremely short intervals. Bad weather does not affect the work, the complete apparatus is of moderate cost, and if even this were gradually lessened could be fitted in all ocean going vessels, and become therefore as useful for general navigation purposes as in the special fields of hydrography and oceanic research. *See* also SURVEYING, NAUTICAL. (J. P.)

See *The Hydrographical Review*, vol. 1, 2 and 3, published by the International Hydrographical Bureau, Monaco.

SOUND RANGING.—The method of locating hostile guns by the sound, or sounds, consequent on their discharge was introduced on the British front in France during 1916. It works as well at night or when, owing to fog, mist or smoke, the visibility is poor as on clear days; it can detect batteries so well hidden as to be invisible from the air or on air photographs; it is always ready when once the apparatus has been installed; and a location can be obtained, under favourable conditions, within a minute or two of the arrival of the report of the piece. The chief disadvantages of the method as used in the World War were that the installation necessitated the laying and maintenance of several miles of wire; that the method would not work well during a heavy bombardment; and that certain weather conditions, to be specified later, rendered location almost impossible.

The two latter difficulties seem insuperable. The wiring trouble can be minimised in two ways: either by devising a method of wireless transmission of the signals from the instruments to the central station, which is quite feasible, whatever the practical difficulties in reducing the weight and cost of the apparatus to reasonable limits may be; or by modifying the method of time recording so that much shorter bases can be employed. Considerable progress has been made in this direction. The method has been elaborated to permit the directing of fire on a hostile piece by comparing the record of the sound of discharge of the piece with that of the burst of the shell directed against it. With 12-in. and 9·2-in. howitzers destructive shots have been directed very successfully by sound ranging.

Principles.—The method generally adopted in the British, French and American armies is to record the instant of the arrival of the sound made by the hostile piece at certain fixed and carefully surveyed posts, spaced at intervals varying from 1,000 to 2,000 yards. If it be assumed that the sound spreads out from the source with a known velocity, the same in all directions, then a known interval between the arrival of the sound at two fixed posts will determine a curve on which the source must lie. This curve is a hyperbola with two posts P_1 and P_2 as foci, for the determining condition is that the difference of the radii vectors SP_1 and SP_2 be constant. If, in addition, the time of arrival at a third post be known, then the interval between this and the time of arrival at either P_1 or P_2 will fix a second hyperbola on which the source must lie, and so determine the position of the source. In practice three posts are not sufficient, since any uncertainty caused by the recording of a spurious sound at a post would falsify the location. In general six posts are used, which, taken consecutively in pairs, give five lines which should all intersect at one point. Any accidental selection of the record of a spurious sound at one or more of the posts is then at once detected by the non-intersection of the curves. Records of the sound at five, or indeed four, of the posts are generally sufficient for the experienced sound ranger, even when several guns are being recorded at short intervals, so that the use of six posts allows for the sound not being successfully recorded at one or two of the posts.

Instruments.—The instruments comprise: (*a*) detectors, placed at each of the six surveyed posts, which give an electrical response to the arrival of the sound, and (*b*) a recording instrument, placed at a central station and connected by a separate circuit to each detector, which registers the exact time at which each detector responds.

(*a*) The method described assumes that the sound travels out from the source in all directions with the same velocity, which is true of the sound of discharge of the piece. The passage of a projectile through the air with a velocity greater than that of sound gives rise, however, to the so-called "shell-wave," which travels with a velocity above the normal in the forward direction, the velocity being greatest along the line of fire. (This "convection" of sound by the shell, if it may be so named, was explained by Mach and others as long ago as 1889.) The ear and the ordinary carbon microphone, if situated some distance in front of the piece, usually hear the shell-wave better than the sound of discharge. For sound-ranging a special type of microphone, particularly sensitive to the low frequency disturbance of the sound of discharge, was invented by Maj. W. S. Tucker.

It depends on the principle utilised in the hot-wire anemometer, *i.e.*, the change of electrical resistance consequent on the change of temperature of a heated wire which ensues when the air round it is set in motion. A very fine wire of platinum, whose resistance at atmospheric temperature approaches 100 ohms, is mounted in the form of a grid over a circular hole some seven mm. in diameter. It is included in one arm of a bridge circuit, and sufficient current passed through the network to heat the wire to a dull red. The bridge is balanced so that when the air round the wire is undisturbed no current passes through the galvanometer. Motion of the air causes the resistance of the wire to decrease, upsets the balance, and so causes a current to pass through the galvanometer.

The microphone wire is mounted in front of an air container of some 16 litres capacity. The instrument so completed is insensitive to all sounds of speech, musical sounds, traffic or even rifle fire. It responds readily, however, to gun sounds (which are low frequency disturbances) even when they are inaudible, and records also the shell-wave. Its reaction is very rapid, and the small lag which does occur appears to be the same for all similarly constructed instruments.

(*b*) The recording instrument used is the Einthoven galvanometer, in which the moving part is a very fine wire (through which flows the current to be detected) mounted in a magnetic field. The wire moves in a direction normal to its length and to the direction of the field. Six wires, insulated from one another, and provided with separate terminals, can be mounted side by side in the field produced by a single small electromagnet. This provides in a small space what is essentially six independent galvanometers, one of which is included in the bridge belonging to each microphone. As the sound reaches successively different microphone posts the corresponding galvanometer wires move in rapid response.

The instant at which each wire begins to move is registered on a moving photographic film or sensitive paper strip. The camera in which the film runs vertically is furnished with a horizontal slit, a cylindrical lens in front of the slit reducing its effective breadth. Shadows of the perpendicular galvanometer wires, cast by means of an electric lamp and an optical system mounted in the pierced poles of the galvanometer magnet, fall on the slit, and are focused on the film, appearing there as six points of shadow on a horizontal line of light. As long as the wires are still each point leaves on the running film a straight line; the movement of a wire registers itself as a break in this trace. A special device, by which a tuning-fork effects a periodic interruption of the light beam, records a time scale on the film itself, so that the distance between parallel lines on the film corresponds to a given time interval whatever be the rate at which the film is running.

Originally the film was cut off after the required record had been taken, and developed in a small dark room adjacent to the instrument. Later a method of automatic development was devised, by which the film passed successively through developer and fixer while running, and emerged ready for interpretation.

Influence of Weather Conditions.—The method in use demands that to every time interval shall correspond an exact distance, a standard velocity of sound being assumed which corresponds to some standard temperature, and still air. The intervals measured have, therefore, to be corrected for the prevailing temperature and wind; the velocity of sound is independent of the pressure. It is found that the temperature and wind which are concerned in these corrections are not those prevailing at ground level, but at a height of between 250 and 500 ft. up.

Owing to the refraction of sound by wind the record of a given sound at ground level is greatly influenced by the variations of wind velocity at different heights above the ground. This wind gradient determines largely whether the conditions are favourable or unfavourable for the detection of sounds. In the case of a wind increasing in velocity with height, a following wind, besides increasing the velocity of the sound, tilts the wave front so that the sound converges on the listener or instrument on the ground, and is well heard. An opposing wind causes the sound to tend to pass upward and leave the ground. Hence a wind blowing from the instruments toward the hostile piece often renders sound-ranging almost impossible if it be of any strength. The temperature gradient also affects the refraction of sound.

Work in the Field.—It is not feasible to have the film running continuously during any period when records are expected. It should be started a second or two before the sound reaches the first microphone. In the field this is effected by having two forward observers in front of the line of microphones, so placed, one to each flank, that either the one or the other of them must hear the sound of the hostile piece a few seconds before it reaches any of the microphones. These observers are provided with keys, the depression of which starts the film running.

The microphones may be placed anywhere where the hearing is good: the only obstacles which seem to cast sufficient sound shadow to affect them are high hills just in front of them. They may be put in shallow depressions dug for them, and should be protected from splinters, and also from wind and draughts. Canvas and hurdles may be used for this latter purpose without appreciably affecting the sensitiveness of the instruments.

Ranging on Hostile Pieces.—A heavy burst near a hostile gun position will furnish a sound record of its position just as does the gun itself. Fire may be directed on a piece which is in action by comparing the records which it supplies with those of the bursts of one's own answering shell. Since both gun and burst are located by the same method all uncertainties introduced in an ordinary location by ignorance of the precise atmospheric conditions are eliminated.

A differential method is adopted, the difference of times of arrival of the sound of the hostile gun and of the friendly burst at each microphone being plotted as ordinates against a certain simple function of the relative positions of the microphones and the hostile gun as abscissae. A horizontal line then corresponds to a direct hit; a straight line sloping to left or to right to an error of line to one side or the other; a curve (approximately an elliptical arc) convex or concave downwards to an error of range. The magnitude of the corrections neccessary is easily estimated from curves previously prepared (*see* ARTILLERY).

(E. N. DA C. A.)

SOUSA, JOHN PHILIP (1854–), American bandmaster and composer, was born at Washington, D.C., Nov. 6 1854. Studying the violin from an early age, he appeared at the age of 11 as a solo violinist, and played in various orchestras, also acting as conductor. In 1880 he was appointed leader of the band of the U. S. Marine Corps, serving in this capacity till 1892, when he resigned in order to organise Sousa's Band. Under his directorship this band rapidly acquired a foremost position in the United States, and made several successful tours of the world. On May 31 1917 he was appointed lieutenant-commander in the U.S. Naval Reserve Force and assigned as musical director to the naval training station, Great Lakes, Illinois. As a composer of marches he acquired an international reputation, among his greatest successes being *The Washington Post, Stars and Stripes Forever, Under the Double Eagle, Thunderer* and *King Cotton.* He also composed the music for a number of comic operas, including *El Capitan* (1896), *The Charlatan* (1897) and the *Bride Elect* (1898). In 1890 he published *A Compilation of the National Patriotic and Typical Airs of all Countries.*

SOUTH AFRICA, UNION OF (*see* 25.463).—Since the conquest of German Southwest Africa by Union forces in 1915, the whole of South Africa, except for the Portuguese territory on the East Coast south of the Zambezi, has been under British administration. Including Northern Rhodesia, which is, however, geographically in East Central Africa, the total area is approximately 473,954 square miles. The population in 1921 was a little over 11,000,000, and of this total the whites numbered about 1,600,000. Apart from the Portuguese territory the political divisions are (1) the Union of South Africa, established in 1910 and consisting of the former colonies of the Cape, Natal, Orange River (Free State) and Transvaal; (2) the colony of Southern Rhodesia; (3) the territory of Southwest Africa, governed under mandate by the Union; (4) the native territories or protectorates of Basutoland, Swaziland, Bechuanaland, and Northern Rhodesia, governed by the Colonial Office. All the regions named are noticed separately; the present article deals specially with the Union of South Africa as an entity. The Union is a self-governing dominion of the British Crown (for details of constitution *see* 25.467–468). The population in the census years 1911 and 1921 was as follows:—

Year	European	Native	Asiatic	Mixed & others	Total
1911	1,276,242	4,019,006	152,309	525,837	5,973,394
1921	1,519,488	4,699,433	163,896	545,548	6,928,580

In 1921 the whites formed 21·9% and the natives 67·8% of the total population. Of the Asiatics 161,339 were Indians and of the Indians 141,336 lived in Natal. Of those classed as "mixed and others," the majority were the class of mixed European and native descent, known as coloured persons (or Cape boys). The great majority of them live in the Cape Province. The returns of religions in 1921 gave the Dutch churches 693,898 European members, equal to 54.37% of the white population, an indication that Afrikanders of Dutch descent outnumber the British descended Afrikanders. (F. R. C.)

I. POLITICAL HISTORY

The year 1910 saw the attainment of what for half a century had been the recognised goal of South African statesmanship, both British and Dutch: the union of the Colonies and (former) Republics under a common administration. With this achieved, it was confidently hoped that a country vexed throughout the 19 century with the frequently recurring wars which culminated in the desolating conflict of 1899–1902 would at last enter upon an era of racial reconciliation and assured material progress. These natural expectations have not been altogether fulfilled. Rather it would seem that under the Union the course of South African history has remained true to type: alternately stagnant and tumultuous, diversified by strange and unexpected events, but always replete with interest and instruction for the statesman and the student of human affairs.

The 15 years (1910–25) under review fall into three well-defined periods. Of these the first (1910–14) is distinguished by the activities appropriate to the substitution of a single central administration for the four Colonial Governments which it replaced; the second (1914–9) by the World War; and the third (1919–25) by the new conditions to which the War gave rise.

The Transition

With the opening of the first Union Parliament (Nov. 4 1910), the administration of the new Dominion passed to a predominantly Dutch ministry. The party candidates elected to the House of Assembly, and the composition of the ministry, must be recalled; since they provide the necessary starting point from which the subsequent formation of parties can be traced. The 121 constituencies returned (Sept. 15 1910): South African party (Het Volk, Orangie Unie and Afrikander Bond), 67; Progressives (mainly British), 40; Natal Independents, 10; Labour, four. The Executive Council (or Cabinet) consisted of: Gen. Botha (Prime Minister and Minister of Agriculture); Mr. J. W. Sauer (Railways and Harbours); Gen. J. C. Smuts (the Interior, Mines and Defence); Gen. J. B. M. Hertzog (Justice); Mr. H. C. Hull (Finance); and six others. Of the 11 Ministers four were British. The Opposition, on the retirement of Sir Starr Jameson,[1] was led by Sir Thomas Smartt. The Labour party was led, then as now, by Col. F. H. P. Creswell, the strenuous advocate of the extended employment of white labour in the mining industry.

Administrative Readjustments.—Certain of the administrative readjustments involved in the union of the four Colonies had been made in the interval between the coming into force of the Constitution Act (May 31 1910) and the meeting of the first Union Parliament. The assets and revenues of the constituent Colonies and the administration of native affairs passed at once to the (provisional) Union Executive; and a common Judiciary, with common Courts of Justice, was set up. The adoption of the new electoral system, with provision for the quinquennial redistribution of seats, necessarily preceded the Union and provincial elections; and the provincial councils and executive committees had come into being *pari passu* with the Union Parliament and Ministry. But the Act had left the task of completing the administrative machinery of the Union to the central Government which it created. In particular it remained for Gen. Botha's Ministry to carry out the great economic reform of eliminating the practice, hitherto necessary, of using the State railways as agencies of taxation; to amalgamate and reorganise the four existing civil services; and to apportion the revenues of the (former) Colonies—other than their railway and harbour revenues—as between the provincial and central administrations of the Union. As, moreover, the readjustments necessary for these purposes had been the subject of discussion and ultimately of agreement between the respective delegacies of the four Colonies at the national convention (1908–9), both the nature of the readjustments and the principles and methods to be pursued in bringing them about had been laid down in the Act. It remained also for Gen. Smuts in the second year of the Union to amalgamate the existing colonial militia and volunteer forces, and reorganise and expand them into a system of national defence. In preparing the South Africa Defence Act, 1912, by which the new Dominion was provided with a citizen army, the Union Defence Minister was assisted actively by Lord Methuen, whose command of the Imperial forces in South Africa was extended for the purpose, and by Rear-Adml. Bush, the commander of the South African naval station.

Apart from the avoidance of a ruinous railway and tariff war between the inland and coastal colonies, the great material gain expected from the Union was the reduction of taxation to be effected through the substitution of one for four administrations. The Transvaal, in addition, looked to the fall in the cost of living on the Rand which was to come from the management of the railways and harbours on "business principles" by a Board independent of political interference,[2] as a *quid pro quo* for the surplus millions it had brought to the Union Exchequer. In view of these expectations, it is not surprising that the first serious criticism of the Government, and the first division in the Ministerial ranks, were occasioned by these administrative readjustments.

On the whole, the reorganisation of the civil service, and the adjustment of the financial relations of the Union and the provinces, were effected without impairing the good results of the co-operation of the British and Dutch leaders in the national convention, or challenging the political convictions of the Progressives. On the other hand, the reorganisation of the railways led to dissension in the Ministry itself. The Finance Minister, Mr. Hull, who was familiar with the conditions of the Rand (the great industrial and importing centre of the Union), being dissatisfied with the policy of Mr. Sauer, the Minister of Railways and Harbours, resigned, and in June 1912 the Ministry was reconstructed. Mr. Sauer, transferred to the Ministry of Agriculture, was replaced by Mr. Burton, a Natal Englishman; Gen. Smuts became Finance, as well as Defence, Minister; and by these and other changes the Cabinet was reduced from 11 to nine.

During the recess a more fundamental dissension appeared. Speaking in the Transvaal early in Dec., Gen. Hertzog declared that "when the proper time came South Africa would look after its own interests first and those of the Empire afterwards." This speech was held by Gen. Botha to be incompatible with the Government's policy of racial reconciliation and offensive to the British-minded South Africans who supported it. As, however, Hertzog denied this and declined to resign, Botha himself resigned (Dec. 14 1912). On Feb. 5 1913, at a full meeting of the Government's supporters, Botha's leadership was confirmed by a large majority while Hertzog became the head of the dissentient minority of "pure Afrikanders." Before the end of the session the resultant Nationalist party, on a motion of "no confidence," moved in the Assembly by a Labour member (June 16), commanded 42 votes as against the Government's 68.

Disturbance on the Rand.—The efficiency, as well as the consistency, of Botha's rule was tested in the same year by two considerable civil disturbances. A trivial industrial dispute between the managers and the white employees of a Rand mine on May 20 developed into a revolutionary movement so threatening that, on June 29, the Government requested and obtained from the Governor-General (Lord Gladstone) the assistance of the British regulars. On July 4, at Johannesburg, the Park railway station and the offices of the *Star* were set on fire with incendiary bombs, and on the next day, after due warning, the troops fired upon, and dispersed, the rioters. The Witwatersrand Disturbances

[1] He died during the War.

[2] In the almost total absence of navigable waterways, cheap and convenient carriage by rail is of exceptional importance.

commission (constituted July 14) found that the trade union leaders had been dominated by revolutionary socialists. It was a Syndicalist movement. A compromise, in which all that the (white) miners demanded was not conceded, was followed by the threat, and postponement, of a general strike; by two further commissions; and by the promise to remove valid grievances by remedial legislation. But the smouldering discontent which this compromise left on the Rand was kindled afresh by a strike among the coal miners in Natal, and when in Pretoria, on Jan. 7 1914, a strike of all workers under the Railway and Harbour Board was ordered, the Trades Federation at Johannesburg decided to take "sympathetic action" and ordered a general strike of the white workmen throughout the Union. By this time, however, Botha's Govt. had completed their preparations. Martial law was proclaimed. Smuts swiftly mobilised his new citizen army. Everywhere the call was obeyed; and the Minister of Defence was not found wanting. All necessary equipment was ready for the British townsmen at the depôts, and the burghers rode "with new rifles and belts full of cartridges" to their rendezvous. The red flag flown over the trades hall in Johannesburg was lowered at the sight of a field gun in position; and the executive of the trades federation were lodged in gaol. At a cost of two lives (lost accidentally) the Government had won; and the ease and completeness of their victory brought the Syndicalists into ridicule and contempt.

Then a step was taken which aroused public criticism and provoked resentment among the (white) workmen in the Transvaal. Nine of the Syndicalist leaders were removed from the custody of the law, placed on board the "Umgeni" in Durban harbour, and sent back to England. The justification for this action was given by Smuts. Syndicalism was a new offence, for which the law of treason, derived from past centuries, provided no appropriate punishment. The Government, therefore, had to go outside the law and itself devise a penalty to meet the changed conditions of to-day. The plea was accepted. The Indemnity Bill, in which also the deported men were declared "prohibited immigrants," was passed in the Assembly by 70 to 12 votes, and received the Governor-General's assent on March 19. Two results of this disturbance must be noticed. (*a*) In conformity with the Government's pledge, before the session ended (July 7 1914) Workmen's Compensation, Protection of Workmen's Wages, Miners Phthisis (strengthening the Act of 1912), and Law of Riot Acts were passed. (*b*) The failure of revolutionary methods, and the resentment aroused by the deportations, fostered the growth of the Constitutional Labour party. From 1914–7 Labour was in power, though declining office, in the Transvaal Provincial Council; and in the general election of 1920 it secured 21 seats in the Assembly.

Racial Questions.—The second disturbance involved a problem which still (1926) awaits solution. In the Union, where the white population is outnumbered by the "other than white" in the proportion of one to four, there is a general conviction among Europeans that all livelihoods suitable for them should be protected from the encroachment of the non-European races; and in 1913 the Government passed an Immigrants' Regulation Act prohibiting all further Asiatic immigration. Although the Act did not discriminate against Indians as such, their interests were directly affected. The status of British Indians was no new question in South Africa. So impossible was it to reconcile the self-preserving dictates of the European community with the claims of Empire citizenship, that the Crown Administration of the Transvaal had done little more than President Kruger to give effect to the unassailable equity of the Colonial Secretary's dispatches on the treatment of British Indians in that colony. In 1907–8 legislation restricting Asiatic immigration evoked a campaign of passive resistance. Under the new Act not only immigration from India, but the inter-provincial migration of Indians then in the Union, was prohibited. Its enactment was followed by a march of Natal Indians to the Transvaal, in the course of which many Indians were arrested, and Mr. Gandhi and other leaders were put in prison. Strikes of Indian workers on the plantations and mines of Natal led to rioting in which Indian lives were lost. The India Office and the Government of India protested: and, as in the case of the Rand disturbances, a Commission of Inquiry was set up. The report (March 17 1914) recommended the removal of certain administrative grievances and of some specific disabilities imposed by the Act,[1] and these recommendations were accepted by the Viceroy. Subsequently an Indian Relief Bill was passed; and before prorogation (July 7) an agreement between Smuts and Gandhi, in which further administrative concessions were granted, was made public. The Relief Act and the Smuts-Gandhi agreement together constituted the "settlement" of 1914. "In South Africa," said Lord Gladstone, "the bill was an act of justice. But in the Imperial interest it was an urgent necessity."

The World War

The military operations carried out by South African troops in the World War (Aug. 4 1914–Nov. 11 1918) are related elsewhere. The campaigns in which South Africans were especially interested are treated under Southwest Africa and East Africa, while for the part played by South Africans on other fronts reference must be made to Western Front and other War articles. But certain aspects of the period must be noticed here. To the majority of both Dutch and British the issues of the conflict were quite clear. The Union campaign against German Southwest Africa, said Botha (July 24 1915) was undertaken "for the same reasons as hostilities were entered upon by the Imperial Govt. against Germany—to maintain the principles of truth and justice, and the honour once pledged by a nation." But there was a minority among the Dutch Nationalists who, although they had no great liking for Germany, were encouraged by her early success in France to seize what they regarded as an opportunity of liberating South Africa from British rule by her assistance.

The Maritz Rebellion.—The rebellion (Sept.–Dec. 1914) was the culmination of efforts pursued by Germany since her occupation of the southwest coast in 1884, the purpose of which was to convert Africa south of the Zambezi into a "Greater Germany." S. G. Maritz, an officer in the Active Citizen Force, and the instigator of the rebellion, had begun to negotiate with the Governor of Southwest Africa in 1913, and before war was declared he had learnt what arms and ammunition would be placed at his disposal. It was the German offensive, and but for the "miracle of Botha" it might have plunged South Africa into a second internecine conflict even more disastrous than that of 1899–1902. As it was, the energies of the Government were absorbed for three or four months in crushing the rebels and foiling the German plans for concerted action with them; and thus the rebellion, besides causing considerable bloodshed and an additional expenditure of some millions of pounds, postponed the active prosecution of the campaign against German Southwest Africa until Feb. 3 1915, and the conquest of the colony until July 9.

But although the Union was the only State within the Empire in which British subjects took up arms on behalf of Germany, its Ministers were to be at least as closely associated with the United Kingdom Govt. in the conduct of the War as those of any other self-governing Dominion. Botha and Smuts, in common with other oversea Ministers of the Crown, were members of the Imperial War Cabinet constituted in 1917. Smuts, however, not only commanded the British forces in German East Africa (Feb. 19 1916–June 20 1917), but alone of Dominion statesmen was a member of the British War Cabinet of six. He was there, no doubt, in part as a representative of the Dominions in general, but chiefly because he offered a rare combination of statesman and soldier which recalled the personality of his great compatriot, William of Orange.

Economic Assistance to the Allies.—Apart from the campaigns against German Southwest and East Africa, which involved the

[1] The most substantial of the grievances removed was the annual £3 poll tax, or licence paid by time-expired coolies who had remained in South Africa; and the refusal of the Courts to recognise the validity of Indian (polygamous) marriages. The effect of this latter was to prevent the children in India of locally-domiciled Indians from entering the Union under their father's status.

service of 43,000 and 67,000 men respectively, and the subsequent dispatch of over 30,000 troops to Europe the Union gave economic assistance to the Allied cause. The importance of maintaining the output of gold was recognised at once, and the highly organised mining companies rose to the occasion. At the request of the Imperial Govt. and to relieve the United Kingdom workshops, the companies themselves undertook to repair the machinery and make the spare parts required by the mines, the railways, and the local industries of the Union. The equipment of the forces which reduced German Southwest Africa was provided, almost entirely, by South Africa herself. In spite of the use of substitutes for the explosives required for military purposes, and an all-round economy of mining materials, and in spite, too, of the release of white employees for the fighting forces of the Empire and of natives for the Labour battalions in France (25,090) the output of copper was maintained, that of coal was appreciably increased, and in 1916 more gold was produced in the Transvaal (nearly £40,000,000) than in any previous year. In certain respects war conditions led to directly beneficial effects. With the diminution of merchant shipping, the Union Govt., apart from emergency measures for increasing essential food supplies and checking the rise in the cost of living, took action to remove the century-old reproach of the backwardness of Boer farming, and to effect a permanent advance in the agriculture and industries (other than mining) of the country.

The Post-War Years

Aftermath of the War.—The Union emerged from the World War with less material loss probably than any other Dominion. Against a considerable, but not oppressive, war debt (£30,000,000 of which £21,245,000, representing a capital liability of £22,019,567, was advanced by the Imperial Govt.)[1] she could place the administration of Southwest Africa under the mandate of the League of Nations, and the prospect of an increase both of revenue and white population from the introduction of more scientific methods of agriculture and the establishment of new industries. Her Ministers had participated on equal terms with those of Great Britain, Canada, Australia and New Zealand in the work of the Imperial War Cabinet and the British Delegation at Versailles, and had separately signed the Peace Treaties. She had become a member of the Assembly of the League of Nations, and in common with the other self-governing Dominions had acquired the status of a nation within the British Empire. On the other hand administrative difficulties had been augmented in two respects. The relations between the Nationalists and the South African party had been embittered by the suppression of the rebellion and the almost complete identification of Botha's Ministry with the policy of the Imperial Government. Aspirations and ambitions analogous to those which in Asia impelled the peoples of India, China and Japan to challenge the superiority of the European, had been fostered among the non-European subjects of the Union by the levelling influence of World War exigencies. In particular the growth of a race consciousness among the Bantu millions emphasised the dangers inherent in the paucity of the white population and increased the urgency of a question which was engaging the attention of the Government when the outbreak of the War had caused it to be postponed—the need for a new adjustment of the relations subsisting between the European and non-European populations of the Union.

Nationalist Agitation.—The five years' life of the first Union Parliament had expired in 1915. The composition of the new House of Assembly, enlarged by the quinquennial redistribution from 121 to 130 seats—South African Party, 53; Unionists (formerly Progressives), 38; Nationalists, 27; Labour, 6; and Independents, 6—showed a weakening of the South African party; and, although there was no coalition, the Government had been kept in office by the support of the (mainly British) Unionist party. The extent of the dissension among the Dutch which (as related above) led to the formation of the Nationalist party in 1913, was evidenced by Gen. Hertzog's action at the close of the War. In 1919 a congress of this party resolved to petition the Peace Conference for the independence of the Union. That the proposal was contrary to the general sentiment was shown by the repudiation of the movement by 78 to 24 votes in the Assembly. In the event, when the Nationalist deputation was received by Mr. Lloyd George in Paris (June 5 1919), Hertzog did not press the demand for the independence of the Union, but concentrated upon a claim for the restoration of the independence of the Transvaal and Orange Free State on the ground that the annexation of these Boer Republics was a violation of the right of small nations to exist. To this Lloyd George replied that the British Govt. could not intervene to re-open the settlement of 1909. "The constitution of the new Union was the free act of the whole people of South Africa representing both white races and all the Colonies." And in answer to Hertzog's contention, that so long as the issues of peace and war remained with the British Govt., the self-government of the Union was merely fictitious, he said: "The status of South Africa, as one of the Dominions of the British Commonwealth, is . . . one which enables the South African people to control their own national destiny in the fullest sense . . . and participate in Imperial policy on a basis of perfect equality."

General Smuts becomes Prime Minister.—Scarcely three months later Botha's great career was ended by his unexpected death, on his return from the Peace Conference, at the age of 57 (Aug. 28). He was succeeded by his intimate friend and colleague, Gen. Smuts, upon whom devolved the duty of moving the ratification of the Peace Treaty. In doing so (Sept. 8) the new Prime Minister took occasion to expound the constitutional implications of the separate ratification, emphasising the rights inherent in the national status acquired by the Union, and the work of the British Empire as a civilising agency and chief factor in the League of Nations. The fact that his speech was, and was intended to be, a formal reply to the contentions of the Nationalist party, gave point to the voting; which resulted in the motion being carried by 84 to 19 votes in the Assembly, and by 30 to 5 in the Senate.

But although Gen. Smuts was now a statesman of international standing, the loss of Botha's personal influence over the backveldt Boers became apparent in the succeeding general election (1920). In it there were returned to the Assembly (again enlarged from 130 to 134 seats): South African party, 41; Unionist, 25; Nationalist, 44; Labour, 21; and Independents, 3. This result left the Smuts Govt., even counting on the support of the Unionists, with only a slender margin of votes. And, at the same time, important measures, among which was the Native Affairs Administration Bill, postponed by the War, awaited attention. This legislation Smuts felt unable to undertake without more assured parliamentary support. Before the election he had appealed (Sept. 17 1919) to the country for unity on a basis of (1) the British connection; (2) the co-operation of the Dutch and British; and (3) industrial development.

The appeal had failed; but, in spite of this discouragement, he resolved to repeat it. The re-union (hereeniging) of the two sections of the Dutch had been mooted in 1919, and in this year (1920), after speeches by Smuts in the Free State a conference of the Nationalist and South African parties met at Bloemfontein. On all but one point agreement was reached. The Nationalists insisted upon the retention of "independence" in the (combined) party programme: the South African party refused. Smuts then (Sept. 29) appealed to the electorate on the single question which has kept the Dutch apart—secession. On this issue the Unionists were at one with the South African party, and before the end of the year, by the amalgamation of the two, the Unionist party ceased to exist. Parliament was dissolved on Dec. 31 and the general election (Feb. 8. 1921) gave the (enlarged) South African party a sufficient majority (22) over all other parties in the Assembly. The Labour representation had dropped from 21 to 13. For the time being the Union was rid of secession, and Smuts was free to attend the first post-War Imperial Conference which met in June.

[1] Of the amount advanced by the Imperial Govt. £11,884,000, converted into bonds with fixed rates of redemption, remained a liability of the Government of the Union in 1926.

Strike on the Rand.—Not long after his return an emergency arose which, for the moment, united both sections of the Dutch with the British in a common determination to uphold the authority of the Government and the existing order of society. On Dec. 9 1921, the Chamber of Mines decided that the ratio of coloured to white labour must be raised; since, if the price of gold (as seemed likely) fell to 85 s. the ounce, 24 out of the 29 producing companies would be working at a loss. This necessary economy in the cost of production led to a strike of the (white) miners on Jan. 10 1922. A collision between the strikers' organisation (which had rigidly enforced the stoppage of work) and the police on Feb. 27 developed on Monday March 6, into a revolutionary outbreak; and by the end of the week, in the Prime Minister's words, with the exception of Boksburg and the central district of Johannesburg "practically the whole of the Witwatersrand was in possession of the revolutionaries." Then the Government, which had watched and prepared, mobilised all its available forces (nearly 20,000), and on Friday (10th) martial law was proclaimed. On Saturday Smuts left Cape Town to direct in person the suppression of the strike. Leaving the railroad, he passed through the lines of strikers by car in the darkness and reached the central area of Johannesburg at midnight (March 11–12). On Tuesday the strikers surrendered and on Wednesday suppression of the strike was officially announced. The Miners' Union repudiated the disorders, and directly the fighting was over the white labourers, freed from terrorism, went back eagerly to work. This affair aggravated Communist propaganda acting upon the considerable anarchist element which had clung to Johannesburg from the time it was a mining camp and was costly in human life. The casualties of the Union forces were 61 killed and 199 wounded; those of the insurgents 138 killed and 287 wounded; and of the non-European population 31 were killed and 67 wounded.

There followed two years of comparative calm in which the high cost of living and other dislocating effects of the War were gradually surmounted. In them Gen. Smuts pursued his high aim of uniting the citizens of all parties in an endeavour to find a larger prosperity in the development of the natural resources of the Union, and in mutual goodwill. On the other hand questions of native administration were left in abeyance. Apprehension had been aroused by the census of 1921, which showed that, in addition to the great absolute increase, the non-European population of the Union was increasing relatively at a higher rate than the European. In response to the somewhat unreasonable alarm created by these figures, Gen. Hertzog let it be known that the Nationalist party were prepared to introduce changes in the system of native administration, which would erect a permanent barrier against the encroachments of the non-European races upon the industrial sphere of the whites. To the hopes thus aroused, and to an illogical resentment against Gen. Smuts over the part he played in the suppression of the disorders of 1914 and 1922, and to a certain lassitude—the natural effect of a long and exacting period of office—apparent in the work of the administrative departments must be ascribed the defeat of the South African party in 1924.

The Nationalist Government.—The new Assembly (135 seats), elected June 17, was composed of: Nationalists, 63; South African party, 53; Labour, 18; and one Independent. As in 1920, Labour held the balance of power, but prior to the election a "Pact" had been made between the Nationalist and Labour parties to avoid three-cornered contests and to vote for each other's candidates. The Pact was to end with the election, but when in the event the Nationalists failed to gain a majority over all other parties, it was converted into a coalition Government in which at first two, and subsequently three portfolios were assigned to Labour. The new ministry was, however, so predominantly Nationalist that there was considerable apprehension both in South Africa and in England as to what might happen if the demand for independence, with all its implications, were maintained. In particular it was feared that the visit of the Prince of Wales, previously arranged, might no longer be acceptable after this verdict of the polls. These apprehensions have not been justified. It is true that the next year's budget (April 8 1925) included a reduction of the preference given since 1903 to United Kingdom goods.

But in the matter of secession, Gen. Hertzog, as Prime Minister, modified essentially the pronouncements which he had made in opposition. While, on Oct. 20 1920 he had said that "if there was a majority of even one for a Republic the others would have to give in," on April 28 1925, he told the Assembly that, while any Dominion had the right to secede, it would be for the Union "a flagrant mistake and a national disaster, should it (a secession) be brought about in circumstances causing either the English or the Dutch section as a whole to feel that the change had been caused by the imposition of the will of the one section on the other." It must be added, however, that a statement in a precisely opposite sense was issued simultaneously by the Secretary of the Transvaal Nationalist party with the approval of its leader, Mr. Tielman Roos, the Minister of Justice and Deputy Prime Minister. And these discordant utterances were repeated by Hertzog and Roos after the session had ended. Obviously this sharp division of the Nationalist party on secession would facilitate a *hereeniging* between the moderate Nationalists under Hertzog and the South African party; and this, together with the loosening of party ties to be expected from the discussion of the Government's native policy, makes a re-grouping of the electorate in the near future not improbable. Two days after the Prime Minister's reassuring statement in Parliament, the Prince of Wales landed at Cape Town. So far from his visit (April 30–July 29) giving rise to any untoward incidents, it was productive of a renewed friendliness between the Dutch and British.

Changes in Native Administration.—In the recess (Nov. 13) Gen. Hertzog stated his native policy thus:

1. The "Coloured people" to be treated as Europeans; being released from all industrial restrictions and, except that a higher electoral qualification would be required of them than of Europeans, admitted to the parliamentary franchise;
2. The whole Native population of the Union to have direct[1] representation in Parliament. This representation to consist of seven additional members of the Assembly (one for the Free State, and two for each of the three remaining provinces), such members to be Europeans elected by natives only, voting in separate electoral areas;
3. Local self-government on the Glen Grey principle to be extended to all natives by the constitution of district and general councils and a Union council meeting annually; these councils to have only advisory or other limited powers;
4. Since, under the Constitution Act, natives as well as coloured people, are admitted in the Cape Province to the franchise on the same (low) qualification as Europeans, these measures would involve the disfranchisement of the natives, and the raising of the qualification for coloured people, in this province. (Such legislation can only be enacted under the Act by a two-thirds majority of the members of both Houses in joint session.)

It is understood that this political segregation of the natives is to be accompanied by an industrial and territorial segregation; and it is somewhat disconcerting that Gen. Hertzog should have omitted to deal with this aspect of the subject, since it is here that, in the opinion both of supporters and critics, the main obstacle to his proposals is to be found. The total population of the Union, 6,928,580 (according to the census of 1921), is made up of 1,519,488 whites, 545,548 "coloured people" (*i.e.*, mixed European and other races, with the Malays of the Cape Province), 165,731 Asiatics, and 4,697,811 Native Africans. The whites are, therefore, in a minority of one to four; and the significance of the relative paucity of the European population within the Union is emphasized by the neighbourhood of the 750,000 natives living in the Territories of the High Commission. Of the natives within the Union, 1,017,448 live in the Native Territories of the Trauskei, Glen Grey and Herschel subject to the control of Union officials, on lands reserved for them from which Europeans are excluded; while the rest live in the rural areas occupied by the European population or in urban areas. It is to the 3,700,000 natives living generally, but not entirely, under European employment in these otherwise European areas, that industrial and territorial, as well as political, segregation is to be applied.

[1] Under the Constitution Act they are represented *indirectly* through the nominated members of the Senate.

But while all natives living in European areas are to be prohibited from pursuing avocations which afford a livelihood to Europeans, for those among them who are unwilling to accept the position of unskilled and menial workers, separate areas are to be provided. In these areas (but not outside them) it will be lawful for a native to purchase or lease land, to practise any skilled handicraft, and to pursue any trade or profession. Thus, without injury to the progress of the detribalised native in civilisation, a more rapid increase of European population would be assured by protecting the European in European areas from the competition of trained and educated natives. To accomplish this object, however, without grave injustice, with the probable sequel of insubordination, the areas to be reserved must be sufficiently extensive and fertile to provide the displaced natives with the means of existence within them. Otherwise segregation would become merely an agency for imposing conditions of life upon all non-tribal natives, which would compel them to continue to serve the Europeans upon terms definitely excluding any opportunity of rising to positions for which their skill or professional ability might qualify them. And as evidence of the difficulty of finding these self-sufficing areas, critics of the policy recall the Commission appointed to delimit such areas under the Native Land Act of 1913; and the subsequent withdrawal of the Native Affairs Administration Bill which was to have given effect to the findings of the Commission. With every desire to do justice to the claims of both parties the commissioners were able to assign only a bare 13% of the soil of the Union to the 4,500,000 natives as against 87% to the (then) 1,250,000 Europeans.

Although the four Bills embodying this policy were merely Fabled in the Assembly (June 2, 1926) with a view to subsequent consideration within and without Parliament, two measures inspired by the fear of non-European encroachment upon the industrial sphere of the Europeans were dealt with in the session of 1926. The first, the Mines and Works Act, 1911 (Amendment) Bill, legalises the Transvaal Mining Colour Bar clause which (in effect) prevents any "coloured person," however competent in fact, from being deemed competent for employment in mines, factories or industries using mechanical propulsion; such legalisation having been made necessary by a judicial decision pronouncing the clause in question to be *ultra vires*. But since it also permits the Transvaal practice to be applied throughout the Union, it was opposed by the South African party and twice rejected by the Senate. In the event this "Stowe Bar" Bill was passed on May 13 in a joint session of the two lower Chambers by 83 to 67 votes.

The second, the Areas Reservation (Asiatic) Bill, applies the segregation principle of the Native Land Act, 1913, to Asiatics domiciled in the Union, and would prohibit the Indians in Natal and the Transvaal from acquiring or leasing land except in specified areas. In answer to the protests of the Indian community in South Africa and the Press and Government of India, the Union Govt. made the very same proposal which, early in the century, the Crown Administration of the Transvaal in the like circumstances had made (unsuccessfully) to the Colonial Secretary; viz.; that representatives of the protesting Government should visit South Africa and study the question on the spot. As the result of the visit of the official deputation sent from India for the purpose, and of subsequent negotiations, Dr. Malan (Minister of the Interior) announced on April 23, 1926, that a conference of representatives of the two governments would be held to seek a solution of the Indian problem on the basis of a recognition of the need of safeguarding in South Africa "Western Standards of Life by just, legitimate means." He added that the Government had decided not to proceed with the Bill until the results of this conference were available.

Later in the session a Bill to provide the Union with a National flag from which the Union Jack was to be excluded aroused so much opposition among the British, that the measure was temporarily withdrawn. But, as we have seen, in 1926 the Native Question dominated the field of South African politics. And in view of the difficulties of the segregation policy as a means of increasing the European population of the Union, the success of a recent effort to promote the same object by the settlement of British farmers must be put on record. In commemoration of the centennial anniversary of the Albany Settlement, the "1820 Memorial Settlers Association" was founded in 1920 for the purpose of introducing men and women of the right type into South Africa by judicious and soundly conducted migration and land settlement. Up to 1926 2,077 settlers and their dependents had been permanently established, with a total capital of £3,500,000. In 1925 the association was so encouraged with the success achieved that it acquired three farms and established them as training centres.[1] See the *Yearbook of the Union of South Africa*, annual, and the various official publications and parliamentary papers. (W. B. W.)

II. DEFENCE

The establishment of the Union in South Africa in 1910 involved a fusion of the different military systems then obtaining in the four colonies which became original constituent provinces of the Union. The Cape Colony and Natal, and that part of the Transvaal (chiefly the Witwatersrand) with a large British population, maintained volunteer forces which differed only slightly, if at all, in their essential features from the old volunteer force of Great Britain. In each of the three colonies there was also a cadet organisation. In the greater part of the Transvaal and in the Orange River Colony, renamed in the Union the Orange Free State, the Burghers, organised on the lines of the old republican forces, constituted the military forces of the State. In all the colonies the liability of every able-bodied male to be called upon to render military service to the State in time of peril was accepted and recorded in the law. A small permanent force was kept in the Cape Colony, and on even a smaller scale (being confined to staff) in Natal and the Transvaal.

On June 14 1912 the South Africa Defence Act 1912 became law, and in that Act were reaffirmed the general principles which characterised the different colonial military systems. The Act provided for a permanent force, divided into Staff and Mounted Rifles, of which latter there were five regiments. The South Africa Defence Amendment Act 1922, an amending Act framed in the light of experience gained in the World War, effected radical changes in the composition of the permanent force, which was so altered as to provide a nucleus of trained and permanently serving units of every arm essential to a modern army and capable of combining with the bulk of the military force of the State, the Citizen Force. The permanent force now consists of the South African staff corps, instructional corps, naval service, field artillery, mounted riflemen (one regiment), garrison artillery, engineers, air force, service, medical, ordnance and veterinary corps and an administrative, pay and clerical corps. In other respects the Act of 1912 practically stands.

Every citizen of the Union between the ages of 17 and 60 (both included) is liable to render personal service in time of war in defence of the Union in any part of South Africa, and the National Reserve is composed of all citizens so liable who do not belong to any other portion of the forces. The Citizen Force is the real military force of the State, and consists of units of the Active Citizen Force, the successor of the volunteer forces already mentioned, and of rifle associations which may be regarded as carrying on the commando system of the old republican burgher forces.

Every citizen is liable to undergo, beginning in his 21st year, four years' "peace training" in the Active Citizen Force, but may enter for the training voluntarily in any year from his 17th to his 21st year (both included). The number to be trained is placed in the Act at 50% of the total number liable, but Parliament may increase this number. A ballot is provided for in case of shortage of entries. After "peace training" has been completed the trained man goes to class "A" of the Citizen Force Reserve, where he remains until his 45th year. "Peace training" may also be performed in the Coast Garrison Force or the Royal Naval Volunteer Reserve. The latter unit may be placed at the disposal of the Royal Naval

[1] The importance of this effort cannot be realised without reference to the past history of South Africa. "The mere presence of the natives, in addition to furnishing a chronic source of contention between the British and the Dutch, by providing a cheap supply of manual labour blocked the way against British emigration on a large scale; since the labouring class emigrant, who was the chief means of peopling Australia and Canada, could find no market for his manual labour in South Africa. And so, by a strange irony of fate, justice to the natives deprived the British Administration of the readiest and most satisfactory agency for the solution of the nationality difficulty — a rapid introduction of a British population large enough to have converted the Dutch into an appreciable, but politically impotent, minority."—Worsfold, *Union of South Africa* (All Red Series), 1912.

authorities in time of war, and is part of the Royal Naval Reserve constituted under the Naval Forces Act 1903 (Great Britain and Ireland).

A citizen who at the age of 21 has not entered the Active Citizen Force is compelled to serve for four years in a rifle association, where he is taught the use of military weapons of precision. On completion of this service the rifle association member is transferred to class "B" of the Citizen Force Reserve, where he too remains until he reaches his 45th year. In addition to the Reserves already mentioned, provision is made for a Veteran Reserve. Cadet Service (13 to 17) is compulsory, but exemption is procurable at the request of a parent or guardian. (J. J. C.)

III. EDUCATION

Under the Union, control of education "other than higher," a definition interpreted as all education below university standard, was left to the provincial councils, with the result that each province has a different system. They have, however, features in common. Each province provides elementary, secondary and high schools for white children and training colleges for teachers. Technical, art and other vocational schools were also provided, but in April 1925 the Union Education Department took over responsibility for vocational education. Education for white children is compulsory between the ages of seven and 15 (16 in the Cape and Free State provinces). Primary education is everywhere free; in the Transvaal secondary education is also free. Religious instruction is allowed and, in certain conditions, may be in the Cape Province of a sectarian character. The bilingual difficulty, acute at first in the Orange Free State, has been overcome in all the provinces by the use of the home-language, English or Dutch, as the medium of instruction in the lower standards. The Dutch taught is Afrikaans, not Netherlands Dutch. The education given is in general sound, and the provincial councils have adopted ingenious methods for securing instruction for the white children scattered in small numbers in remote areas. For non-Europeans the facilities afforded for schooling varied considerably, but tended to increase, notably in the Cape Province. The education of natives is largely in the hands of religious bodies who in the Cape also maintain training schools for native and coloured teachers. State expenditure on education in the four provinces combined rose from £1,500,000 in 1910 to £6,490,000 in 1922, when 331,000 European and 251,000 non-European children were attending school. About one-twelfth of State expenditure was for non-European schools. In 1924 the Union Parliament made provision for a uniform scale of salaries for teachers.

University Education.—When the Union was established the only university in South Africa was that of the Cape of Good Hope, an examining body with affiliated colleges, of which the oldest and best known was the South African College at Cape Town. The demand for greater facilities was insistent, while rival claims provoked much heated controversy. A solution was found in 1916 in the passing of an Act to establish three universities, namely, the University of South Africa, the University of Cape Town and the University of Stellenbosch. The University of South Africa, which was formally established in April 1918, is the legal successor of the University of the Cape of Good Hope. Its headquarters are at Pretoria, and it at first embraced the following constituent colleges: Grey (Bloemfontein), Huguenot (Wellington), Natal (Pietermaritzburg and, for certain subjects, Durban), Rhodes (Grahamstown) University (Potchefstroom), Transvaal (Pretoria) and the South Africa School of Mines and Technology (Johannesburg). The University of Cape Town was formed by the incorporation in 1916 of the South African College, and under the act of incorporation new buildings for the university were to be erected on the Rhodes estate above Groote Schuur, probably the most beautiful site for a university in the world.

The building began in 1922, in which year the S.A. College of Music was amalgamated with Cape Town University. Besides the usual facilities, the university has a school of African life and languages. A large hospital close to the Groote Schuur buildings will serve as a clinic for the medical school. Stellenbosch University, created in 1918 by the incorporation of the Victoria College of that town, is attended very largely by Dutch-speaking students. Its special features are its agricultural and theological faculties. The desire of the Rand for a separate university led in 1922 to the incorporation of University College, Johannesburg, (as the school of mines and technology had been renamed) as the university of the Witwatersrand. It has all the usual faculties, but is specially noted for original work in metallurgy, geology and allied sciences. The joint matriculation board and the joint committee for professional examinations are bodies representative of all the universities.

The Union maintains five agricultural schools and experimental farms, and in connection with them awards scholarships and provides for laboratory research. There is an institute for medical research at Johannesburg, to which is attached the miners' phthisis medical bureau. There is, further, a research grant board. The South African public library, Cape Town, is a national institution. It has over 140,000 volumes, contains the Grey and other valuable collections and is the largest and oldest library in the Union, having been founded in 1818.

Several large sums were given or bequeathed by private citizens for university purposes—mostly for capital expenditure. State outgoings on higher education rose from £104,000 in 1912 to £253,000 in 1923. In the same period the number of university students increased from 1,285 to 4,166. (See *The Official Year Book of the Union of S.A.*, *Reports* of the Education Administration Commission, 1923 and 1924; also the *Reports* of the Phelps-Stokes Commissions on African education, published in New York.) (F. R. C.)

IV. ECONOMIC HISTORY

General Conditions.—In the decision to establish the Union the advantages to be derived from a single authority to control financial, commercial and other economic relations played an important part. Unity assured internal free trade and a common tariff for external trade. Special customs agreements regulated the relations of the Union with neighbouring British possessions (Rhodesia and the native protectorates), while South-West Africa, on coming under Union mandate, was included in the free trade area. The Union Govt. assumed responsibility for the Transvaal-Mozambique convention of 1909, which provided for free trade in the products of the soil of Mozambique and the Transvaal, for the recruitment of natives of Portuguese territory for the Rand mines, and for the regulation of trade with Lourenço Marques, the one port in foreign possession serving the Union (*see* LOURENÇO MARQUES).

The provinces retained their administrative identity, but had no power of taxation or other means of raising revenues except such as were given them by the Union Parliament. The Financial Relations Act of 1913 specified these powers and provided for a subsidy from Union funds of one-half of the ordinary annual expenditure of the provinces. The Baxter Commission on Provincial Finances in 1923 recommended the termination of this arrangement, and in 1925 the £ for £ subsidy was replaced by a *per caput* grant for education and a new scheme of provincial taxation, calculated to lessen provincial autonomy.

The Act of Union placed harbours and railways—nearly all State owned—under the control of a single Ministry, with the provision that they were to be worked on strictly business lines. Among the first measures taken by the Ministry were extensions to assist trade and especially agriculture by building branch lines and by improving port facilities. As large areas of the country are subject to droughts and irregular and, at times, excessive rainfall, farming has not the stable conditions which prevail in most countries; hence the greater need for scientific methods and for aid to the farmers. A Union Land Bank was established in 1912 which gave liberal advances to the farmers and pastoralists. By this means, by its agricultural colleges, and in other ways the Union Govt. did much to increase efficiency. Large irrigation works were also carried through, costing between 1910 and 1926, over £12,000,000 in capital expenditure.

While the permanent well-being of South Africa depends probably upon agriculture, the mining industry occupies a unique position. South Africa is the chief source of the world's supply of

diamonds, and produces half the world's gold output. In no other country does so large a proportion of the people depend for a livelihood upon gold mining, which from its essential nature is a wasting asset. Other branches of mining, however, may be expected to develop as gold mining declines. Coal is of great actual, and greater potential, importance. It is mainly due to the existence of cheap coal that the large output of gold and diamonds has been made possible. In addition, considerable quantities are used for ships' bunkers and there is a growing export.

All economic developments in South Africa are conditioned by a labour situation which is unique. The direction and organisation of all important industries is in the hands of Europeans; but the great bulk of the labour is supplied by natives, Asiatics, and other non-Europeans. In the Cape province the "coloured" people, while they engage in semi-skilled and skilled labour, supply the great bulk of the unskilled labour force; the sugar plantations in Natal are worked mainly by natives, though some Indians are still employed; the mines are entirely dependent upon an adequate supply of native labour. Throughout the Union farmers depend almost entirely on natives (or, in the western province, coloured workers) for manual labour. Thus the European has been restricted almost entirely to the work of supervision and the skilled crafts; and white workers who fall out of these classes, especially white men and their families who lose their footing on the land in some period of agricultural distress, have a difficulty in finding employment, and constitute the intractable "poor white" problem.

The Pre-War Situation

Trade.—The first five years, 1910–4, of the Union were marked by steady progress. Both agriculture and mining were in a healthy condition. There was little unemployment, and industrial unrest was confined to the Rand. The average annual imports were £37,935,000, average annual exports £56,022,000. The excess of exports was a constant feature, representing interest on British and foreign capital invested in South Africa. The whole of the gold output was shipped to London, where all foreign trade accounts were adjusted. Some 60% of the imports were supplied by Great Britain, which took 88% of the exports. Of British dominions there was a considerable trade with India and Australia, while foreign countries, headed by Germany and the United States, supplied 29% of the imports, but took little over 6% of the exports. The imports were of a very general nature; the chief exports were gold, diamonds, coal, wool and sheepskins, mohair, maize and ostrich feathers. The value of the gold output had increased from £31,900,000 in 1910 to £35,600,000 in 1914; diamonds exported reached their highest value, just over £12,000,000, in 1913. At this period, considerably more than half the capital in these industries was still held by investors dwelling abroad.

Production.—Of at least equal importance to the well-being of the people are the industries in which the capital is South African. Of these, the chief is the breeding of woolled sheep with the subsidiary but valuable trade in sheepskins. In 1913 there were over 28,000,000 woolled sheep in the Union, mostly in the Cape and Orange Free State. The mohair industry continued to flourish in this period, but the Angora goat is more dependent on good seasons than is the sheep; severe droughts were mainly responsible for the decrease in the number of Angora goats from 4,395,000 in 1912 to 2,844,000 in 1916. Ostrich farming, almost confined to the Cape province, attained its highest degree of success in 1913, when 1,023,000 lb. of feathers, valued at £2,953,000, were exported. Subsequently the War and the change of fashion made the trade very uncertain, and the tendency has been to substitute dairy or other forms of farming for ostriches.

Of cereals, only maize was grown for export. This export trade had started in 1904; by 1914 it was firmly established and had begun to occupy the position in farming in the Union that wheat occupies in Canadian and Australian farming. But the uncertainty of the seasons renders maize a very unequal crop, abundance one year being followed by dearth in the next. Next to maize, oats and wheat are the chief cereals; with the aid of a protective tariff, enough is usually grown to supply most of the home requirements. Owing to the sparse population and, in large areas, to the defective quality of the soil, the cultivated area is still small—in 1921 only 13,000,000 ac. out of a total farm area of 261,000,000 acres. With better means for the prevention and control of stock diseases cattle breeding had become more profitable; in 1914 the export of beef for the first time reached notable figures. Dairying, too, had ceased to be regarded as a "side line" by farmers, and in 1914 five-sevenths of the butter consumed in the Union was home produce.

Of other products, tobacco, grown mostly in the Transvaal, was developed and became better known. Sugar production in Natal and Zululand largely increased and tea maintained its position. Besides supplying the bulk of the protected home market there was beginning to be a surplus of sugar for export. The Union Govt. from its establishment made efforts to promote cotton cultivation, but in 1914 the industry, though promising, was still in its infancy. Attention was also paid to better means of dealing with fresh fruit for export. It may be added here that in 1922 the Union Govt. denounced the Mozambique convention, which lapsed in 1923. Thereafter the imposition of a tariff on Mozambique sugar gave additional protection to Natal sugar.

Industry.—Manufacturing industries were encouraged by the Union legislation; but the chief development was in factories engaged in the preparation of food and drink for the local market and in the production of heat, light and power (specially for the Rand mines). While manufactures were still on a comparatively small scale, the value of the gross output was estimated at over £17,000,000 in 1911, when 21,000 Europeans and 44,000 non-Europeans were returned as engaged in factories.

The War Period

The World War had, in South Africa as elsewhere, a marked effect on economic conditions. Some industries, such as gold mining, sheep farming, beef production and manufactures, it stimulated; others, such as the trade in diamonds and ostrich feathers, it depressed. The general rise in the prices of commodities in 1916 and following years render comparisons in terms of sterling of limited value; the rise in the average annual value of imports in the five years by less than £4,500,000 shows a restriction of imports, while the rise of £27,000,000 in the average value of exports reflected higher prices rather than increased production. As an example, in 1915, before prices had begun to soar, the 170,000,000 lb. of wool exported fetched £5,380,000; in 1919 the 184,937,000 lb. of wool exported fetched £17,919,000.

Trade.—The direction of trade in the War period showed important changes. British manufacturers, engaged intensively in meeting War demands and in supplying goods previously obtained from Germany, lost ground in South Africa, and German trade ceased. The United States and Japanese trade in consequence gained; they also became large purchasers of South African goods.

Gold.—To the general rule of increased prices there was one exception; throughout the War the system by which all the gold produced in South Africa was pledged to the Bank of England at a fixed sale value (a little under 85s. an ounce) was maintained. But the cost of production had risen some 25%, and this, together with a stationary price for the metal and the low grade of ore in many mines, threatened a crisis. Some mines ceased working and the closing of about 20 more mines was contemplated. But the continued and instant demand for more gold from all countries had its effect; when war ended, the arrangement for a fixed sale price was terminated, and from July 1919 gold fetched its market value. This so-called "premium on gold," the additional price it fetched in sterling, not only saved the low-grade mines, but had an important effect on industry in general. Gold reached its highest price, 130s. an ounce, in Feb. 1920. From this point deflation began, and as sterling approached parity with the United States dollar the premium decreased and finally disappeared with the resumption of the gold standard after May 18 1925.

The Return to Normal Conditions

The year 1919 had been a disappointing year to the general community in South Africa. The inability of British traders at once to supply the goods required for re-equipping works was noticeable. Merchants in the Union who had heavy stocks realised very high prices. There was a brief spurt in the ostrich feather trade and a recovery in the diamond trade, but general conditions were unfavourable and agriculture and pastoral pursuits suffered from severe drought, followed early in 1920 by excessive rains—which cause almost as much damage as drought. The year was marked by much industrial unrest, which would have been much worse but for the increased price obtained for gold in the latter half of the year.

If 1919 had proved a difficult year 1920 was even more abnormal. It began with a great and unhealthy boom in trade and ended in depression. For the first time imports exceeded exports in realised prices, the figures being, imports £105,927,000, exports £98,997,000; of the imports over £75,000,000 was spent on manufactured articles and £10,600,000 on raw materials and articles used in agriculture. Of the exports over £64,000,000 represented the products of mines, while £25,600,000 represented the sale of agricultural and pastoral produce. The sums realised by exports rarely indicated increased production. Much of the trade was speculative, and with the collapse of the " boom" a period of financial stringency followed. This condition continued throughout 1921. Owing to the premium the gold industry was least affected. The output had been decreasing since 1916, when the gold exported was valued at £38,100,000, but in 1920 the effect of the premium was that £42,273,000 was realised for a smaller output; in 1921 the gold fetched £41,191,000. Other industries were severely hit. The diamond and ostrich feather trade collapsed, and while the maize crop exported exceeded all previous amounts and there was a large increase in the exports of wool and mohair, most commodities, including wool, had to be sold for little more than half the prices realised in 1920. There was indeed much difficulty in selling the wool and mohair at all; eventually the British Govt. bought the unsold portion of the wool crop at about 1914 prices.

The period of deflation was painful but inevitable. It was hastened, and the consequent suffering rendered much more acute, by the disturbances which stopped gold-mining on the Rand, an account of which is given above in the first three months of 1922. The gold industry was put on a paying basis again, with benefit to the whole country. Working costs, which had reached 25s.8d. per ton milled in 1920, had fallen by 1924 to 19s.7d.

Railways.—Apart from the Rand disturbances, 1922 was a year of reconstruction. This was seen, for instance, in the scheme for railway extension and harbour improvements sanctioned by the Union Parliament in July 1922, in which year the railways of South-West Africa were incorporated in the Union system. The two systems had been joined physically in 1915 by the building of a railway (primarily for military purposes) from Prieska to Kalkfontein. Between 1910 and 1916 over 2,000 m. of new railways had been built in the Union. Construction had then practically stopped, but in 1922 the building of 853 m. of new lines at an estimated cost of over £4,000,000 was sanctioned. There were 23 separate schemes, mostly agricultural railways—the shortest but 2 m., the longest 71 miles. Two of these lines (in the Transvaal) were built with " poor white " labour instead of by natives. In 1922 also power was taken for the electrification of railways—the first section to be electrified was the Natal main line from Maritzburg to Glencoe.

Harbours.—Harbour improvements, hindered by the War, were again taken in hand, the expert services of Sir George Buchanan being engaged to examine the existing harbour facilities and to suggest future developments. The Union Castle mail service to and from England was regularly maintained, while there were direct services to India, Australia and America. The number and tonnage of ships entering Union harbours was almost the same in 1913 and 1923—4,106 vessels of 12,205,000 tonnage in 1913 and 4,377 vessels of 12,092,000 tonnage in 1923. Over 75% of the shipping is British.

Recovery in Production.—Notwithstanding the loss occasioned by the Rand disturbances and a bad maize season, the year 1922 closed with more hopeful prospects and 1923 is regarded as representing the return to normal. The gold export, which, owing to the strike, had fallen to £30,000,000 in 1922, rose to over £39,000,000; and in maize the exports reached 1,128 million lb. (a higher total than previously recorded) and realised over £3,000,000. There was also a record export of coal. Excluding gold, the volume of exports was equal to the pre-War average, but at an average increased price of 65%; the volume of imports was about 15% less than before the War, at an average increased price of 85%. Normal conditions in South Africa include, unfortunately, drought, excessive rain and locust plagues; 1924 experienced a partial failure of the maize crops and witnessed the most severe locust plague known. It was, however, a good wool and mohair season, and the general trade figures for 1924—imports £65,800,000, exports £78,000,000 reflected a real advance.

There had been a considerable after-the-war expansion of business by the Union with Rhodesia and Kenya Colony; in other respects the direction of trade from 1922 had reverted to pre-War channels. The United Kingdom largely recovered its losses, taking some 70% of the exports and supplying about 55% of the imports. Germany again became the Union's best foreign customer, the United States falling to second place. The year 1924 saw the first substantial results of the careful nursing of the cotton industry in Natal and the Transvaal, some 3,300,000 lb. of cotton being exported. In 1924, too, a platinum reef was discovered in the Lyndenburg district of the Transvaal, which gave promise of becoming the world's chief source of platinum supply, though the production stage had not been reached up to 1926. The year 1925 was marked by another record maize crop, the maize exported realising £6,000,000. It was also noted for the highest output of gold from the Transvaal mines—9,599,702 oz.; and for an interruption of exports by a strike of British seamen in the month of September. The increased volume of manufactures, due to natural growth of population and the War-time restriction of imports, has been well maintained in the post-War period. At the same time, agriculture has become more intensive, the development of fruit and citrus farming, both in volume and quantity, being especially marked.

Finance.—Among the financial measures taken by the Union in the period of reconstruction was the establishment of a branch of the Royal Mint at Pretoria, which began operations on Jan. 1 1923. At the same time, the gold mining industry established co-operatively a refinery at Germiston. Meanwhile, an Act passed in 1920 had established the South African Reserve Bank to co-ordinate credit facilities and exercise the exclusive right to issue bank notes. Specie had thus no longer to be imported—in fact, in 1925 Pretoria was exporting gold coins to India—and when exchange rates on London were unfavourable the mines found it more profitable to sell gold to the South African Reserve Bank than to export it. The embargo on the export of specie, which had been imposed in 1914 as a War measure, was removed at the end of June 1922, at which date also the right of private banks to issue notes ceased. In 1926 the National Bank, one of the two most important private banks, was amalgamated with Barclays Bank (Dominion, Colonial and Overseas).

Labour.—Inquiries into industrial conditions, especially that following the Rand disturbances of 1922, had led to renewed interest in conciliation machinery for disputes between employers and employed, and a Conciliation Act destined to encourage collective bargaining was passed in 1924. In 1925 a Wage Act was passed setting up a permanent Wage Board to fix legal minimum wages in trades where wages were low and to impose binding decisions in other trades when voluntary negotiations had failed to effect a settlement of a dispute. As a preliminary for the new Wage Board's activities, an Economic and Wage Commission was appointed to investigate conditions, the chairman of which was Mr. Stephen Mills, C.M.G., an Australian civil servant and Prof. Henry Clay, an English economist, one of the members.

The commission's report, issued in March 1926, contained an extensive survey of South African economic conditions. The

two overseas members and one of the local representatives condemned as unnecessary and impracticable the policy of attempting to substitute white for native labour in unskilled employment and reported against any restriction of the native's economic opportunities. The majority recommended that the Wage Board should concentrate its efforts on the lower-wage and unorganised occupations. They held that if regulations were applied to force higher the rates of the more highly paid workers those of unskilled workers were likely to be still further depressed. The leading recommendation in the minority report urged the Government to stop the importation of native labourers. The Government had already refused to allow any increase in the importation of the only native labour which counted, namely, that of Africans from Mozambique for work in the Transvaal mines. It may be added that the overseas members of the Commission came away convinced that the economic condition of the country was very healthy and much impressed by the agricultural development.

Public Finance.—The economic burdens of Government and the taxable resources of the country had been unevenly distributed while the four colonies retained their autonomy. The Union effected a great improvement, and the new Government found its financial task relatively easy. In the first full year, Customs brought in £4,500,000, mining revenue over £2,000,000, the railways paid interest and sinking fund as their debt and in addition made a contribution of over £1,000,000 to the general revenue. In the first five years the average total expenditure of the Union and provinces was £16,322,427 and revenue £16,975,507. The War led to a great increase. Expenditure reached its maximum in 1921–2 at £34,228,307, revenue a year earlier at £33,272,952. The net Public Debt of the Union increased from £119,366,000 in 1914 to £196,843,000 in 1924; a large part of the increase was due, however, not to War expenses, but to public works (the increase after 1918 being £45,000,000), and of the total two-thirds may be regarded as productive. Provincial expenditure grew in even greater proportion, from an average figure of £3,205,000 in the first years of the Union to £8,819,000 in 1921–2. The increased expense of the Government was met by a general increase in taxation and by the introduction of a graduated income tax in 1914, which yielded nearly £7,000,000 in 1921–2.

The collapse of trade in 1920 and the following years led to a succession of deficits, which in turn led to a check to the growth of expenditure. In the railway administration in particular drastic economies were effected, which reduced working expenditure by over £3,000,000 between 1920–1 and 1922–3, and, with the revival of traffic in 1924, converted a heavy deficit into a surplus. Until 1925 the Customs tariff, though productive in its effect, had been designed primarily to raise revenue. The Government that came into power in 1924, on the advice of a reconstituted Board of Trade and Industries, revised it in such a way as definitely to make it protective, and at the same time included provisions for extending, raising or withdrawing a duty by administrative action with a view to encouraging a new industry or checking an unsatisfactory industry. The general preference on British goods was removed and a limited list of items substituted. The United Kingdom was also promised "most favoured nation" conditions.

BIBLIOGRAPHY.—*The Official Year Book of the Union of South Africa*, published by the office of the Census (No. 7, 1925, 5s.), contains a remarkably comprehensive account of every aspect of economic life with full bibliographies; *The South and East African Year Book and Guide* (Union Castle Steamship Co. Ltd., 5s.) contains useful chapters in less detail. Among official reports the most useful are *Report of the Economic Commission* (1914); *Low Grade Mines Commission* (1919); *Drought Commission* (1922); and *Economic and Wage Commission* (1926). The British Department of Overseas Trade publishes periodical reports on South Africa. R. A. Lehfeldt's *National Resources of South Africa* is the most valuable brief survey of the country in its economic aspects. (F. R. C.; H. Cl.*)

SOUTH AFRICAN LITERATURE: AFRIKAANS.—The rapid rise of the South African form of Dutch, known as Afrikaans, as a literary and official language has forced Dutch (Nederlands) into the background; and since 1910 there has been singularly little literary activity in the older form of the language. In the prose anthology of Kockstra and Viljoen (*Zuidafrikaanse Prozabundel*) about a dozen well-known South African writers in Dutch are represented; but the popular form of the language, spoken throughout the Union, has now practically captured the literary field, and has in a comparatively short time produced more than 50 writers, some of them of outstanding merit.

As with all young languages, Afrikaans began its literary life with poetry. J. F. Celliers, who in 1906 had been a pioneer with his *Die Vlakte*, has produced *Die Rivier, Unie Kantate, Die Saaier* (1923), *Liefdelewe* (1924), *Topie Tourie, en ander nuwe Gedigte* (1920), and *Martjie* (1912), besides a few prose works. J. D. du Toit (Totius), who was the second in the field in 1908 with *By die Monument*, has since published *Potgieters Trek, Wilgerboom-Bogies, Rachel and Trekkerswee*. C. L. Leipoldt has followed up *Oom Gert Vertel* of 1911 by *Dingaansdag, Uit Drie Werelddele* and *Die Heks*, a tragedy. Celliers and Totius may be regarded as typifying the conservative element in Afrikaans literature; they are largely subjective and introspective, essentially patriotic, and intensely religious, with a rigid Calvinistic bias that colours their idealism. In local colouring and in lyrical expression the poems of Leipoldt seem more native that those of his contemporaries. D. F. Malherbe has written *Karroo Blommetjies* (1909), *Vergeet Nie, Klokgrassies*, and *Vir Vrijheid* (1919); while H. H. Joubert has published *Verse oor Piet Retief, Dageraad en Sonneskyn en andere gedigte* (1918). These two, with A. D. Keet (*Gedigte*), A. G. Visser (*Gedigte* 1925), and possibly F. van den Heever, are poets whose output and technical capability ensure them a place in the catalogue of Afrikaans writers. The number of minor poets is large and growing. Of the older generation, in purely humourous verse the work of Melt Brink and of F. W. Reitz must be cited.

In prose the productions of permanent merit are not numerous. Afrikaans has not yet evolved a prose style comparable with Dutch prose. C. J. Langenhoven has written on a great variety of subjects in prose and in rhymed and unrhymed verse, and his works have attained a measure of popularity. Probably his best books are *Die Lig van Verre Dae* and *Ons Weg deur die Wereld* (1919), a volume of didactic essays.

In biography F. S. Malan's *Mevrou Koopman de Wet*, J. D. Kestell's *Christiaan de Wet* (1920) and G. Preller's *Piet Retief* are the only works that can lay claim to consideration.

In fiction Afrikaans has been less fortunate. Its novels show little originality, and some of them make an appeal chiefly because of their intense national sympathy. Stories with decided literary merit are Sadie Bosman's *Onder Bevoorregte Mense* (1925) and *Langs Kronkelende Wegen* (1916); Leon Maré's *Die Nuwejaarsfees* (1919); E. Marais' *Margriet van Laastelust* (1922); R. J. van Reenen's *Die Lokaas;* J. van Bruggen's *Teleurgestel* (1918) and *Mit Anysie* (1923); J. Lub's *Oom Frikkie* (1918) and N. Hofmeyr's *Fanie* (1925). Good work has been done in natural history by A. A. Pienaar (Sangiro), whose *Oerwoud en Vlakte* has been translated into English and German; in native, especially Bushman, sociology by G. R. von Wielligh; and in the study of language by S. P. Boshoff and D. B. Bosman. Some 25 dramas have been published in Afrikaans; of those that deal with specific South African subjects or situations none has sufficient artistic or literary merit to attract an audience that has outgrown early Victorianism on the stage.

SOUTH AFRICAN LITERATURE: ENGLISH.—The great poetical activity of the years 1910–26 in England had its parallel in South Africa. A recent anthology, *The Centenary Book of South African Verse* (1925), edited by Francis Cary Slater, contains poems by 68 writers, most of whom were still living in 1926. Mr. Slater's own poetry is saturated with the feeling of the country to which he belongs. His later works include *Settlers and Sunbirds* (1919), and *The Karroo, and other Poems* (1924). Arthur Shearly Cripps, a missionary in Mashonaland, wrote poetry in which the influence of Oxford is blended in a surprisingly beautiful way with that of the country of his adoption. *Pilgrimage of Grace* (1912) and *Lake and War* (1917) are two of his later volumes. He also wrote stories of life in those remote parts, including *Faerylands Forlorn* (1910) and *Cinderella in the South* (1918). Cullen Gouldsbury, for several years a native commissioner in

Rhodesia, showed poetical gifts of a high order in his *Songs out of Exile* (1912) and *From the Outposts* (1914). Mary Rosalie Boyd, in her poem *The Veld*, which won the Capetown Bardic Chair in 1921, has finely expressed the fascination exercised by South Africa upon those who come to make it their home. Charles Murray, for many years chief of the Union Govt. public works dept., has written poetry mainly in a Scots dialect. *A Sough o' War* (1917) and *In the Country Places* (1920) are his latest volumes. *The Flaming Terrapin* (1924), by Roy Campbell, one of the youngest of South Africa's poets, is a somewhat chaotic work, containing, nevertheless, passages of remarkable force and beauty.

Of the fiction produced in South Africa some few works reached a high level. *Margaret Harding* (1911), by Perceval Gibbon, and *God's Step-Children* (1924), by Sarah Gertrude Millin, deal with the difficult problems arising out of the contact of the white races with the black. Pauline Smith, a young writer born in the district of Oudtshoorn, published some short stories under the title of *The Little Karroo* (1925) marked by a fine sympathy and sincerity. Among many other writers of South African stories may be mentioned Gertrude Page, Ethelreda Lewis, F. Horace Rose, and William Westrup.

Some valuable work was done in history and biography. Sir George Cory's *Rise of South Africa* (1910, etc.) deals mainly with the development of the eastern part of Cape Colony, and gives the results of many years of patient research. Another work of outstanding importance is *Lord de Villiers and His Times* (1925), by Eric A. Walker, professor of history in the University of Capetown. An extensive literature has gathered round the name of Cecil John Rhodes, including lives by Sir Lewis Michell and Sir Thomas Fuller. Ian Colvin's *Life of Jameson* (1922); Earl Buxton's *General Botha* (1924); and Dorothea Fairbridge's *Lady Anne Barnard at the Cape of Good Hope* (1924) are also of importance. Frederick Charles Kolbe (Monsignor Kolbe), a poet and critic of distinction, also wrote a delightful autobiography entitled *Up the Slopes of Mount Zion* (1924). *Education in South Africa 1652 to 1922*, by Ernst G. Malherbe, is a useful survey of an important subject. Among many works dealing with the difficult and complex problems involved in the relations between the Europeans and the natives may be mentioned *Black and White in South East Africa* (1911) by Maurice Smethurst Evans; *The Education of the South African Native* (1917) by C. T. Loram; and *The History of Native Policy in South Africa from 1830 to the Present Day* (1924) by Edgar H. Brookes. The views of the natives themselves have found expression in *The Black Problem*, by D. D. Tengo Jabavu, and in other works. *A History of Christian Missions in South Africa* (1911) and *Thrice through the Dark Continent* (a record of missionary travel), by Prof. J. du Plessis (1917), deal with another aspect of the same subject. (H. C. N.)

SOUTHAMPTON, England (*see* 25.491), has included South Stoneham, part of North Stoneham, Swaythling, Bitterne, Sholing, Itchen and Woolston, and Weston and Newtown within its boundaries since 1920, and has now an area of 9,192 ac. (exclusive of tidal water and foreshore); the population was 160,994 in 1921. In 1912, seven civil parishes were united as the civil parish of Southampton; the area of the parliamentary borough, which includes Itchen and returns two members, is 8,032 acres. Woolston, with large shipbuilding and engineering works, is growing rapidly. A museum was opened in 1912, a Roman Catholic church in Portswood road in 1910, a large sailors' home in Oxford street in 1910, Hollybrook cemetery in 1913 and new offices for the harbour board in 1925. The corporation have acquired Tudor house, a fine old mansion, and proposed in 1925 to erect a town hall in West Marlands. A memorial to the Pilgrim Fathers, a column surmounted by a cupola, was unveiled on the west quay in 1913, a memorial of the wreck of the Titanic in the East Park in 1914 and a War memorial, 150 ft. high, in the West Park in 1920. Southampton University college removed to new buildings at Highfield in 1914. During the War they were used as a military hospital, and were not reoccupied by the college till 1919. Lord Swaythling presented South Stoneham house, in grounds of 110 ac., as a university college hostel.

The Port.—There has been a great increase in both goods and passenger traffic through the port of Southampton, which is now a port of call for the P. and O. Far Eastern service and the chief Transatlantic lines. Recent improvements in the harbour include the extension of the quays in the Itchen and the Test to 4,132 ft. and 4,420 ft. respectively, to provide better accommodation for liners; the enlargement and deepening of the turning area off the Ocean dock; and the widening of the Old Extension quay. In 1925 powers were obtained to reclaim about 460 ac. in the Test between the town pier and Southampton West railway station for the construction of docks and five jetties, each 1,000 ft. long and 260 ft. wide, with 45 ft. of water alongside at low tide, and a deepwater channel, 600 ft. wide, to give access to them. Two of these jetties are to be taken in hand first, and will add four deepwater berths to the five which the port possesses. Part of the reclaimed land will be utilised for industrial establishments. The West station has been rebuilt, and the line to Milbrook is to be altered to give further traffic facilities. It is proposed to dredge the harbour to provide a minimum depth of 35 ft. between the docks and Farley. A floating dock, with a lifting capacity of 60,000 tons, was finished in 1924. Southampton has an air service which operates from Woolston aerodrome to the Channel Islands. The harbour was taken over by the naval and military authorities on the outbreak of the World War. A train ferry to Dieppe, which conveyed great quantities of heavy guns, tanks, etc., was opened in 1917.

SOUTH AUSTRALIA (*see* 25.492), a state of the Australian Commonwealth. Its area is 380,070 sq. miles. The population in 1925 was 543,122. Adelaide, the capital, is a well-planned town with a population, at Dec. 31 1924, of 289,914. Other towns of importance are Port Adelaide, the principal overseas port, and Port Pirie, the port for the Broken Hill mines and the centre of the Broken Hill smelting industry. On Jan. 1 1911, the Northern Territory, which had from 1863 been incorporated in the state of South Australia, was transferred to the Commonwealth. South Australia was the first State to enfranchise women (Constitution Amendment Act, 1894), and much of the "social reform" legislation in Australia originated there.

Production and Industry.—A large portion of the state lies within the "dry belt," where wheat growing has been found to be possible with a low average rainfall. The area under wheat in 1911 was 2,104,719 ac., and in 1925, 2,499,852 ac., with a yield of 30,528,625 bushels. South Australia is the principal wine producing state in the Commonwealth, and great progress has been made in this industry as the result of irrigation along the valley of the Murray river. The area under vines in 1911 was 22,952 acres. In 1924 it was 49,303 ac., and the production 10,756,538 gallons. The dried-fruit industry has also made considerable progress in the irrigation areas, where large numbers of ex-soldiers were settled after the War. In 1924, 125,000 cwt. of raisins and 131,000 cwt. of currants were produced, as against 58,503 and 80,400 cwt. respectively in 1920.

Extensive deposits of iron ore exist: the reserves of ore in the Iron Knob and Iron Monarch deposits are estimated at 133,000,000 tons, with an average content of 63 to 64% iron. The Broken Hill Co. utilises ore from these deposits at its iron works in Newcastle, New South Wales. In 1921, 506,993 tons were raised. Large quantities of salt are obtained from the shallow salt lakes, chiefly on Yorke Peninsula. Over 50,000 tons of crude salt, valued at £113,000, were produced in 1923. Lake Hart, 60 sq. m. in area, situated about 120 m. northwest from Port Augusta, contains immense supplies of salt of good quality, but owing to distance from market it has no economic value. The total value of the output of factories in 1924 was £29,650,995. Metal works and machinery accounted for £8,919,965 and food and drink £7,116,910 (*see* AUSTRALIA).

SOUTH CAROLINA (*see* 25.499), a State of the United States of America. The population in 1920 was 1,683,724, an increase of 11·1% in the decade, as compared with 13·1% and 16·4% in the two preceding decades. The estimated population in 1925 was

1,779,084. In the decade 1910–20 the whites increased from 679,161 to 818,538, or from 44·8% of the total population to 48·6 per cent. The density in 1920 was 55·2 per square mile. The urban population was 17·5% of the whole, as compared with 14·8% in 1910. The population of Charleston in 1920 was 67,957, and the decennial increase 15·5%, the white increase being 28·3% and the negro 4 per cent. The white population, increased by war industries, was 52·4% of the whole, constituting a majority for the first time in about 200 years. The population and decennial increase for the other leading cities were as follows: Columbia, 37,524 (42·6%); Greenville, 23,127 (46·9%); Spartanburg, 22,638 (29·2%); Florence, 10,968 (55·7%); Anderson, 10,579 (9·5%); Sumter, 9,508 (17·3%).

Manufactures.—Textile mills paid very large dividends in 1917–20, and in addition doubled or trebled their capitalisation. Wages rose greatly, but fell 30 to 50% in the depression of 1920–1. The number of spindles in 1924 was 5,272,481; of operatives, 64,780. The bales of cotton consumed increased from 765,966 in 1908 to 1,003,375 in 1924. Cotton textiles constitute over 71% of the value of all manufactures. Timber, cotton seed oil and fertilisers are important. The capital invested in industry in 1924 was $179,000,000, and the value of products $217,000,000. Over half the motive power was hydroelectric; in 1920 out of an estimated potential development of 1,260,000 H.P., 450,000 H.P. had been developed. The State Board of Conciliation, created in 1916, arbitrates labour disputes on invitation, or investigates them on its own motion or by order of the governor. Women are forbidden to work in stores after 10 P.M. or over 12 hr. in one day. Children under 14 may not work in any mine or factory. No labourer may work in a textile mill more than 55 hr. a week.

Agriculture.—The war-time rise in prices of cotton was succeeded by a decline from about 40 cents to 10 or 11 cents a lb. in six months (1920–1). Legislation (1912) sought to stabilise agricultural prices by a system of State warehouses for holding products for a favourable market. Co-operative marketing has made considerable progress. The boll weevil became a serious menace in 1920 in the southwestern counties, from whence it soon spread over the whole state, with most serious damage in the southern and eastern sections. Under the law of 1920 extensive drainage projects were undertaken. Agricultural methods have improved and banks now finance the farmer directly at greatly lower rates than formerly charged by the "lien merchant." South Carolina led all the states in 1917 in crop values per ac. with a value of $63. The value in 1919 was $78.79, exceeded by three states only.

According to state government estimate, cotton covered in 1920 45% of the cultivated acreage, and represented 50% of the value of the 13 leading crops. In 1924, 831,000 bales of cotton were raised, not much over half the highest record before the advent of the boll weevil. Other crops in 1924 were: corn (maize), 21,862,000 bu., tobacco, 45,600,000 lb., oats 7,704,000 bu., sweet potatoes 6,230,000 bu., Irish potatoes 3,885,000 bushels. The figures for corn and tobacco are hardly two-thirds of the maximum. In 1920 average monthly wages for adult male farm labour without board were $41.80. During 1910–20 the number of farms increased from 176,434 to 192,693; improved land from 6,097,999 ac. to 6,184,159 ac., average value per farm from $2,223 to $4,946; average value per acre from $29.02 to $76.70. By 1925 the number of farms had decreased to 172,766.

Education.—In 1919 an Act was passed making four months' school attendance each year compulsory throughout the state. Among other improvements were night schools for adults; an increased number of high schools; special teachers and inspectors in rural and textile districts; enlarged facilities for agricultural, vocational and home economics training; state standard certification of teachers; and more effective state supervision. The expenditure for common schools in the year 1923–4 was $12,962,000, in addition to which there remained almost $2,000,000 in hand to be expended on buildings. Enrolment in common schools in 1923–4 for whites was 238,909 and for negroes 228,516; in 1924–5, 245,619 for whites, 234,977 for negroes. In 1923–4 over 13,000 students, of whom 28% were negroes, were enrolled in the 36 colleges in the state.

The religious denominations added materially during 1910–20 to their extensive work in college education. All but 11 of the 36 institutions for higher education in the state were under church control in 1920, and these institutions contained several hundred more students than all state and other non-sectarian institutions combined.

Social Legislation.—In 1912 race-track gambling was forbidden. In 1913 the penitentiary hosiery mill was abolished as harmful to the health of the prisoners. The State Board of Charities and Corrections, created in 1915, was reorganised in 1920 as the board of public welfare. The State Hospital for Insane was entirely remade, materially and administratively, during 1915–9. The placing of orphan and homeless children was taken over by the state in 1920. In 1918 a reformatory institution for white girls was established, and the reformatory for negro boys was reorganised. The probate judge in each county is constituted a juvenile court. Penal and charitable institutions (including church and private charitable institutions) have been under state inspection since 1915. The age of consent was raised in 1921 to 16 years. No city had, by 1926, acted on the permission granted in 1915 to segregate whites and negroes by city blocks.

Finance.—The budget system, adopted in 1919, tended to economy and system. The State Tax Commission, created in 1915, improved the administration of the tax laws. The assessed taxable value of all property in 1924 was $428,601,274, being a fourth, or perhaps less, of the market value. In 1925 the receipts were $24,491,562; the disbursements $22,333,208. The bonded debt was $5,384,125.

Political History.—The class feeling that has so frequently been strong in South Carolina politics found violent manifestation during the governorship of Coleman L. Blease (1911–5). The Legislature was at all times controlled by his opponents and passed many measures over his veto. Resigning without giving an explanation, he was succeeded for five days by Lieut.-Gov. C. A. Smith. In 1918 Mr. Blease ran for the Senate, opposing the country's participation in the World War. He was overwhelmingly defeated, but was elected Senator in 1924. Richard I. Manning was elected governor in 1914. Gov. Manning's two administrations were marked by constructive legislation and effective co-operation with the national government. Gov. Robert A. Cooper was elected in 1918 on a platform that made education its chief plank, and announced that as a result of progressive legislation taxes would be higher. He was re-elected without opposition in 1920, but resigned in May 1922 to accept a Federal appointment, and was succeeded by Lieut.-Gov. W. G. Harvey. Cooper's chief policies were the strengthening of the public schools, the creation of a budget system and the consolidation of the management of charitable and correctional institutions.

The Australian form of ballot was put into force (1921) in primaries but not in general elections, the latter being merely ratification of the former, as the Democratic nomination is equivalent to election. Thomas G. McLeod was elected governor in 1922 and again in 1924. His principal policies consisted of liberal appropriations for education, the consolidation and systematising of state administrative offices, the improvement of prison conditions and the promotion of tax equalisation. Renewed efforts for changing from annual to biennial sessions of the Legislature failed in 1925 because of unforeseen technical difficulties. Constitutional amendments changed the terms of the governor and other state officials from two to four years, beginning with those elected in 1926. The governor is not eligible to re-election. An extensive system of improved highways was under construction for about 10 years, and was still far from complete in 1926.

See Yates Snowden (editor), *History of South Carolina* (5 vols., two of history and three of biographies); W. G. Simms, *The History of South Carolina*, ed. M. C. S. Oliphant (1918); *Public Documents of South Carolina.*

(D. D. W.)

SOUTH DAKOTA (*see* 25.506), a State of the United States of America. The population in 1925 was 681,560 (South Dakota State Census), as compared with 636,547 in 1920 and 583,888 in 1910. The average density in 1925 was nine per square mile. The rural population in 1925 was 561,870, and the urban 119,690, as against 534,675 and 101,872 in 1920. From 1910 to 1920 the rural population increased 5·4% and the urban nearly 33%. The chief towns and their populations in 1925 were Sioux Falls 30,127; Aberdeen 15,035; Watertown 10,319; Huron, 10,204; and Mitchell 10,119. The foregn-born population, consisting very largely of Scandinavians, Germans and Russians, decreased until in 1925 it constituted less than one-eighth of the total.

Communications.—There are 4,486 m. of steam railways; the road mileage is 115,390, which is maintained by direct and indirect taxation. More than $15,000,000 has been expended through federal, state and county aid and by private individuals, in the construction of good roads, bridges and culverts. Four large bridges have been built across the Missouri river, and two others were in progress of construction in 1925. The first and best of the six bridges was built at Yankton, connecting South Dakota with Nebraska; it is on the Meridian Highway, which crosses the State and extends from Winnipeg, Canada, to the Gulf of Mexico. The State Legislature of 1921 provided for a tenth of a mill tax for the purpose of creating a Bridge Fund. Five bridges were built as a result—the Wheeler (or Rosebud), Pierre, Mobridge, Chamberlain and Forest City. They are on the main highways crossing the State from east to west. In the first nine months of 1925 licences were issued for 149,370 automobiles, 13,300 trucks and 320 motor cycles.

Education.—The total expenditure on education in 1923–4 was $18,425,309. In that educational year the 5,305 elementary schools contained 137,460 pupils and 7,046 teachers; 624 secondary schools had 1,348 teachers and 25,128 pupils. Between the ages of 8 and 16 attendance at a public day school is compulsory on all not otherwise taught.

Agriculture.—The farm acreage in 1925 was 34,636,491 of which 24,101,202 ac. were improved land. In 1925 there were 76,174 farmers, of whom 41,751 were owners and 34,423 renters. Farms have become more numerous and, on the average, somewhat smaller: more are now worked by renters. The table below shows the principal agricultural products of the State and their values in 1920 and 1925.

	Year	Production	Value
Corn (maize)	1925	83,405,000 bu.	$50,043,000
	1920	105,600,000 bu.	46,494,000
Wheat	1925	32,378,000 bu.	41,429,000
	1920	29,790,000 bu.	38,727,000
Oats	1925	100,198,000 bu.	28,055,000
	1920	75,446,000 bu.	26,406,000
Barley	1925	23,608,000 bu.	11,096,000
	1920	22,825,000 bu.	13,695,000
Potatoes	1925	3,965,000 bu.	7,137,000
	1920	8,904,000 bu.	8,637,000
Flax Seed	1925	3,801,000 bu.	8,552,000
	1920	2,220,000 bu.	3,630,000
Hay	1925	3,268,000 tons	30,704,000
	1920	1,750,000 tons	14,875,000

The receipts from dairy produce in 1925 were estimated at $31,000,000. There were 745,000 horses, 14,000 mules, 682,000 sheep, 2,400,000 swine, 461,864 dairy cows, and 1,246,000 other cattle in the State on Jan. 1 1925.

Manufactures.—The principal industries in 1925 were packing and canning goods, flourmill and gristmill products, bread and other bakery products, printing and publishing, automobile and truck repairing, cars and general shop construction and repairs by steam railway companies, lumber and timber products.

Finance.—The bank deposits were $219,594,314 in 1922; $233,804,397 in 1923; $177,806,995 in 1924, and $189,841,520 in 1925. The total assessed valuation of all taxable property was $1,977,127,560 in 1922; $1,940,998,027 in 1923, and $1,876,112,764 in 1924. The tax levied in 1921, 1922 and 1923 was $33,006,021; $32,724,800, and $32,568,923. The expenditure for the State Govt. educational, charitable and penal institutions was $9,711,964 in 1920; $18,389,586 in 1924. The State's bonded indebtedness in 1924 was $62,350,000, $47,500,000 of which was loaned by the Rural Credit Board to farmers; $2,000,000 was invested in cement plant; $5,950,000 was used for construction of highways; $6,000,000 for soldiers' bonus and $900,000 for soldiers' land settlement. The debt had been reduced to $61,500,000 by 1925.

Political History.—The Republican party remained in control of the State Govt. from 1909 to 1926. The governors were Robert S. Vessey, 1909–13; Frank M. Byrne, 1913–7; Peter Norbeck, 1917–21; William McMaster, 1921–5; Carl Gunderson, 1925. Norbeck was elected to the United States Senate in 1920, and McMaster in 1924. (C. C.*)

SOUTHEND-ON-SEA, England (*see* 25.510), with a population of 106,010 in 1921, estimated in 1925 at 117,000, and an area of 7,082 ac., has grown with great rapidity. It was created a country borough in 1914, Leigh and part of Eastwood having been included in 1913. The parishes of Leigh, Prittlewell, Southchurch, and part of Eastchurch, have been constituted one parish with that of Southend, so that the boundaries of the parish and the borough are now conterminous. Southend has returned one member to Parliament since 1918. Practically the whole of the cliffs from the Alexandra yacht club to Sharefields are in the hands of the corporation, and a scheme of improvements is being carried out: there are nearly seven miles of esplanades. Eleven acres of land off Sutton road were given to the town in 1914 and opened as a recreation ground in 1920, and the Victory sports ground was given in 1921. The Belfairs estate of 270 ac., to the northwest of Leigh, was acquired by the corporation in 1919; Prittlewell Priory, presented to the borough in 1917, has been restored, and now houses a museum removed from the public library; Southchurch Hall, a medieval house, and its grounds were acquired in 1925. A War memorial on the cliffs was unveiled in 1921. In 1925 a new arterial road to London was opened. There were a number of air raids over Southend during the World War, and 32 people were killed in one which took place in 1917.

SOUTH SEA ISLANDS: *see* OCEANIA.

SOUTH SHIELDS, England (*see* 25.516), a thriving port and the chief outlet for the collieries of Northumberland and Durham, had a population of 116,635 in 1921, and an area of 2,339 ac. of land and inland water (not including the area added in that year). In 1918 Cleadon Park of 196 ac., with a mansion since made into a tuberculosis sanatorium, to the south of Harton, was bought for a housing scheme. An isolation hospital was built on part of the estate, and a light railway of 1½ m. has been laid. In 1921 the new suburb and Harton village were added to the borough; the number of aldermen was increased to 15, and of councillors to 45. Twenty ac. of land were acquired for a cemetery in 1917, and Readhead Park of 7½ ac. in 1922. New municipal buildings were opened in Westoe Road in 1910, and a statue of Queen Victoria unveiled in front of the main entrance in 1913; the old town hall is used by a branch of the Imperial Merchants' Service Guild. A cenotaph in memory of men from the western end of the town was erected at Tyne dock in 1921. Constant dredging is carried on to maintain a depth of 30 ft. in the channel of the Tyne as far as the Northumberland dock.

SOUTHWEST AFRICA (*see* 11.800c), a mandated territory in South Africa, formerly German Southwest Africa. The administration of the country is vested in the Government of the Union of South Africa, under a mandate conferred by "the Allied and Associated Powers," which took effect from Dec. 17 1920. No change has been made in the area of the territory, which covers 322,393 sq. miles. The administration of the northwestern extension towards the Zambesi, known as the "Caprivi Zipfel" (10,573 sq. m. in area) has been delegated to the High Commissioner for South Africa, and attached to the Bechuanaland Protectorate, while Walvis Bay (374 sq. m.) is included in the mandated territory. The area of the territory administered by the mandatory is therefore 312,194 sq. miles. Population

(census of May 3 1921) 227,739, of whom 19,500 were whites and 5,000 of mixed native and European descent.

I. POLITICAL HISTORY

After the conquest of German Southwest Africa in July, 1915, the administration was carried on under martial law to the end of 1920. By the Treaty of Versailles (Article 119) Germany ceded her colonies to the Allies, and Article 22 indicated Southwest Africa as a territory which should in future be administered under the laws of the mandatory, as an integral part of its own territory. Accordingly, on Dec. 17 1920, a mandate was conferred on His Britannic Majesty "for and on behalf of the Government of the Union of South Africa," that Government having already (Sept. 1919) been authorised by its Parliament to accept it (Act 49 of 1919).

The mandate conferred full powers of administration and legislation, subject to the mandate, which prescribed the prohibition of the slave trade and of forced labour for any purpose other than essential public works and services; the control of the traffic in arms and ammunition; prohibition of the supply of intoxicating liquor to natives; prohibition of military training of natives except for police and internal defence, and of military and naval bases in the territory; freedom of conscience and worship; and finally that an annual report on the administration should be submitted to the Council of the League of Nations. The Union Govt. by Act No. 49, acquired parliamentary sanction to delegate its authority, but all laws were to be submitted to Parliament, and specific authority was required before the administrator could grant State lands or minerals, or any trading or other concessions, or alienate native reserves.

In Jan. 1921, by proclamation of the Governor-General, martial law was replaced by a civil administration under an administrator, to whom his powers of legislation were delegated. In accordance with the recommendations of a parliamentary commission set up in 1920, an Advisory Council of eight unofficial, and one official member, representing the native interests, was appointed by the administrator to advise on general policy, on the raising and expending of revenue, and on any other matter on which its advice might be asked.

Law.—The law of the territory consists in part of Acts by the Union Parliament, and in part of ordinances enacted by the administrator and approved by Parliament. The more important of the former are Act 12 of 1920, which constituted the supreme court of the Union as an appellate court for the territory; Act 35 of 1921, which included it in the Customs Union; Act 20 of 1922, which vested the railways and harbours in the Union Government and placed them under its management; Act 27 of 1923, which amalgamated the civil services; and Act 30 of 1924, relative to the status of Germans. This last demands a word of explanation.

It was the declared policy of the Union to accept the Germans "as part of the people with the same privileges and the same responsibilities as the others." German immigrants had been welcomed, and 1,361 had arrived from overseas by the end of 1922. The question of their status was the first and most pressing problem. It was decided, with the consent of the League Council, to enact a law by which every German should automatically acquire the status of a British subject *in the Union*, unless he declined it before a given date. The proposal was opposed by the Germans at Windhoek, though welcomed by others, and it was not till Oct. 1923, that an agreement was reached between General Smuts and two representatives of the German Government. The mandatory pledged itself to allow German to be an official language and used in German schools; it accepted liability for the pensions of German ex-civil servants, and agreed that Germans should not be liable for military service against Germany for 30 years. The agreement was given legal sanction by Act. 30 of 1924.

Form of Government.—The settlement of this question enabled the mandatory to turn its attention to the form of government which should replace the transitional rule of the administrator. In 1924 the Premier, General Hertzog, toured the country, and declared that the demand of the Europeans for some form of self-government ought to be satisfied. An Act, No. 42 of 1925, was passed the next year. The territory was divided into 12 constituencies, each electing a member for the Legislative Assembly, to which six more were nominated by the Union Government. Certain subjects were absolutely reserved to the Cape Parliament. These were the control of mines and minerals, railways and harbours, the public service, the courts of justice, the posts and telegraphs, defence, immigration, customs tariffs, currency and banking, and native affairs. Education, police, aviation, the disposal of land and the control of land banks, were temporarily reserved.

An executive of five members, under the chairmanship of the administrator, is elected by the Assembly. The administrator also exercises executive functions in respect of reserved subjects, and is then aided by an Advisory Council of four executive councillors and three nominees of his own, including one with knowledge of native affairs. The native population, which outnumbers the Europeans by 10 to one, has neither direct representation nor the right to vote. The total number of the adult male Europeans who exercise that right is 6,500. The Union Govt. retains full powers of legislation and veto, since as mandatory it alone is responsible to the League of Nations.

Revenue and Defence.—The revenue of the territory is about £850,000, nearly half of which is derived from royalties on the diamond mines. The ordinary expenditure has been in the neighbourhood of £650,000, and a considerable surplus has accumulated. The police force consists of about 280 white, and 240 natives. Native farm labour is paid 10 s. to 20 s. per month with food. The administration is endeavouring to create adequate reserves for the natives and coloured people, and large areas of waterless land have been reclaimed for this purpose by well boring.

Native Risings.—The administration has been faced with two native risings. The first, by a small body of Bondelzwarts, who were irritated by certain regulations regarding cattle branding, taxes on dogs, and other matters, was suppressed with considerable loss of life, which gave rise to some adverse criticism. The second, by a small body of "Bastards" (Rehoboths) who claimed complete autonomy, was dispersed without bloodshed.

II. PRODUCTION AND TRADE

Southwest Africa is largely a cattle-raising and sheep-farming country. The absence of water renders large-scale agriculture almost impossible, for the only rivers with a constant flow are the Kunene and Okavango in the extreme north: the territory depends for its permanent supply of water upon subterranean streams, which are tapped by sinking wells and boreholes. Small crops of maize, potatoes, cotton, pumpkins and beans are raised, and with the development of irrigation considerable possibilities should arise for the cultivation of wheat and the extension of cotton. Dairy farming is making progress and several creameries have been established; the production of butter and cheese is increasing. The territory contains extensive mineral deposits. The most valuable product is diamonds, the value of which in 1924 was £1,224,440. Copper and lead (value £571,152), next vanadium (£83,435) and tin (£31,400) are also worked, while silver and other minerals are believed to exist, but are not exploited. The gold exported in 1922 amounted to 147 ounces. Large deposits of guano are found along the coast. The bulk of the trade of the territory is with the Union of South Africa.

The development of agriculture is indicated by the increasing imports of agricultural machinery and implements, fertilisers, power lorries and steam wagons: the increase in the export of cotton from 914,268 lb. in 1921 to 3,299,388 lb. in 1924 shows the steady development in the cultivation of cotton. The larger imports of mining machinery and the increased exports of copper, lead and vanadium also indicate the development of the mineral resources of the territory. The progress made by cattle raising and sheep and dairy farming is shown by the increasing exports of cattle, sheep and butter to the Union of South Africa. The export of diamonds, valued in 1924 at £1,395,846, was entirely to the United Kingdom; copper ore was mainly exported to Belgium, and vanadium ore to Germany and the United Kingdom.

Communications and Finance.—The railway system of the territory, before the occupation by the Union, linked up the ports of Luderitz and Swakopmund with Kalkfontein in the south, Windhoek in the central area, and Tsumeb and Grootfontein in the north. In 1915 a line was completed between Kalkfontein and Prieska, a distance of 315½ m., connecting the system with that of the Union. A short line was also constructed from Walvis Bay to the former German system, thus completing a network of railways which links up Walvis Bay and Luderitz with Cape Town, Port Elizabeth, Durban and other South African ports, and with Lourenço Marques and Beira on the east coast. The chief ports are Walvis Bay and

Lüderitz: Swakopmund has been permanently closed as a port, and the whole of the landing and shipping work transferred to Walvis Bay, which is now the regular port of call for mail steamers. A wireless station has been erected there. Branches of the National Bank of South Africa (now Barclay's Dominion, Colonial and Overseas Bank) and the Standard Bank of South Africa have been established in the chief towns.

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(F. D. L.)

SOUTHWEST AFRICA, CAMPAIGN IN.—For some time before the year 1914 the proximity of the German Protectorate of Southwest Africa, sharing a common frontier on its southern and eastern borders with the Union of South Africa, had been recognised by the Government of the latter country as an important factor in its military arrangements.

On Aug. 6 1914 the Union Govt. undertook to assume all obligations resting upon the British regular garrison in South Africa, and, on Aug. 10, to send a military expedition of its own against German Southwest Africa. The British Govt. accepted both offers, and indicated the enemy seaports and the wireless installation at Windhuk as the first objectives of the military venture. Early action was vital in view of the position of South Africa on the ocean route between Europe and Asia, and the necessity for denying harbours and facility for long range communication to the enemy naval squadron in the South Atlantic.

Arrival of British Troops.—Between Aug. 31 and Sept. 18 a mixed force under Brig. Gen. Lukin was disembarked at Port Nolloth and disposed thence eastwards along the southern enemy border to Steinkopf, the line of observation being continued to Upington by another force under Lt. Col. Maritz. The first Union troops to occupy enemy territory were those commanded by Col. Beves, which landed unopposed at Luderitzbucht on Sept. 18. On Sept. 9 Maritz, with the greater portion of his command deserted to the enemy, actuated by the same motives as induced a small part of the Dutch population of the Union, which had displayed strong antagonism to the war policy of their government, to go into rebellion in October. Though only some 11,000 rebels took the field, 30,000 loyal troops were needed to quell the rebellion, and offensive action against the enemy was delayed for four months. A strong advanced Union detachment with 2 guns was captured in enemy territory at Zandfontein on Sept. 26, a reverse to which the treachery of Maritz was largely contributory.

Meanwhile Louis Botha had assumed command of all the South African forces on the outbreak of the rebellion, and on its conclusion on Feb. 3 1915, left Cape Town to conduct the postponed offensive against the enemy. The leading units of the force which was to operate under his immediate command reached Walvis Bay in Union territory on Dec. 25 under Col. Skinner, who on Jan. 13 occupied the northernmost enemy port of Swakopmund. Gen. Botha reached Swakopmund on Feb. 11.

Disposition of Forces.—The position then was that the northern force (Gen. Botha) held Walvis Bay and Swakopmund, facing the troops of the enemy chief command (Lt. Col. Franke). The central force (Brig. Gen. Sir D. McKenzie) occupied Luderitzbucht with its forward troops at Tshaukaib, 40 m. inland, in touch with the enemy on the railway line to Keetmanshoop. The southern force (Brig. Gen Van. Deventer) watched the German force (Major Ritter) on the southern enemy border. The eastern force (Col. Berrangé), considerably smaller than the rest, was mobilising for an advance along the Kuruman and Molopo rivers against the eastern border of the enemy, whose detachments here lay at Rietfontein and Hasuur. The northern and central forces had strong infantry formations, though mounted troops predominated in the former, while the two other forces were composed of mounted units. Heavy and field artillery were allotted as the nature of the task of each force suggested, and valuable aid was afforded by the presence of officers from the Royal Marine Artillery in the heavy batteries. The Royal Navy conveyed, escorted and disembarked the whole of the forces and their supplies from the base at Cape Town.

The Scene of Operations.—The greater portion of the theatre of the campaign's 322,350 square miles in area is a plateau 3,500 ft. above sea level. A barren waterless tract, 40 to 100 m. broad on the coast side and 200 inland, intervenes between the first rise to the plateau and the border. Water is extremely scarce everywhere, and the water holes were well known and far apart. The country is very sandy and often rough. The climate is dry and healthy for man and beast, though malaria occurs in the wet season in the north. Cattle were plentiful, all other supplies, including fodder, scanty. The scene of operations was thus badly watered, difficult to move in and devoid of supplies, and the interior was protected by a desolate belt of desert. A railway (3 ft. 6-in. gauge) ran from Luderitzbucht to Keetmanshoop in the south, thence north to Windhuk and from there west to Karibib. An extension to Kalkfontein in the south branched from the Luderitzbucht-Keetmanshoop section at Seeheim, a total length of 800 miles. From Swakopmund a 2-ft. gauge line ran to Karibib and thence north to Tsumeb and Grootfontein, a total length of 420 miles. The lines were much damaged by the enemy and the Union engineers repaired 1,040 m. and laid 340 m. of new line during the campaign. The enemy forces consisted of 2,000 soldiers and 140 officers and in addition 7,000 male Europeans, many with military training. Of military material and equipment the German commander had abundance; he enjoyed throughout a substantial advantage in respect of artillery.

Botha's Campaign.—On Feb. 23, Gen. Botha moved from Swakopmund and secured Rössing on the railway line and Husab on the Swakop river. The river route was selected for the main advance, and on March 18, after careful and tedious preparations Gen. Botha again advanced and heavily defeated the enemy at Riet and Pforte in the Swakop valley, capturing 2 guns and 284 prisoners. Sixty miles of the river route were now secured, and, after another period of preparation, a third advance was made on April 26 and Karibib occupied on May 5, after a series of rapid turning movements by mounted troops. The enemy withdrew to the north and Windhuk was occupied on May 12.

The Auxiliary Movements.—Gen. Botha's infantry (Skinner) had meantime advanced along the railway and occupied Usakos. On March 30 the central force occupied Aus, and on April 26 at Gibeon, McKenzie's mounted troops, after rapid sustained marching, overtook and heavily attacked the enemy retiring from the south. The eastern force (Berrangé) left Kuruman on March 6 and joined hands with the southern force on April 20 at Kabus. The southern force (Gen. Smuts) defeated the enemy at Nabas on March 8 and at Kabus on April 20. The capital occupied, all the country to the south fell into Gen. Botha's hands.

A conference between the Union Commander and Gov. Seitz at Giftkuppe on May 21 proved abortive and the final stage of the campaign against the enemy, now concentrated in the north, ensued. After reorganisation and settlement of the occupied territory, Gen. Botha advanced from Karibib on June 18. The main body (mounted troops and infantry) moved in the centre with the commander-in-chief, while strong mounted forces operated to the east and west commanded respectively by Myburgh and Brits. The enemy retired rapidly, and on June 27 Brits was ordered to move widely to the northwest and head the enemy off at Namutoni, while Myburgh was to swing in on Tsumeb from the east. These movements were carried out exactly and the enemy, defeated on July 1 at Otavi by the leading mounted brigade of the centre, forestalled at Namutoni, and having lost Tsumeb, surrendered on July 9 1915.

Conclusion.—The campaign had been won with little loss of life—127 Union soldiers were killed in the rebellion and in German Southwest Africa, but it will repay study as an instance of success in spite of difficulties in climate and terrain, and for the experience which it afforded of the value of fertility of resource and power of adaptation. Some of the obstacles which were surmounted seemed almost impossible to deal with, and the methods adopted in connection with water supply are worthy of close attention. Some magnificent marching was a striking feature of all the operations. Brits's force on the final advance marched 340 m. in 20 days; McKenzie's mounted troops covered

200 m. in 12 days; while the infantry brigade in the centre in the concluding operations in 16 days marched 230 miles. Finally, the campaign reveals the extraordinary mobility of mounted riflemen when good horsemen are directed by a master hand.

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SOVA, ANTONIN (1864–), Czech poet, began his literary career early in the 'nineties with descriptive verse, the subject-matter of which was derived from the streets of Prague and from his native region of Southern Bohemia. His introspective poems, notably those contained in the volumes *Lyrics of Love and Life*, *Mastered Sorrows* and *Once Again Shall We Return*, include some of the finest lyrical poems in the Czech language, and have been compared, not without justification, with Verlaine. The disillusionment caused by the poet's contact with the realities of life drove him to seek escape in a dream-world of his own, and this theme was treated in a series of visionary poems which reveal Sova as a master of symbolism. In 1913 appeared *Harvests*, a volume in which moods of a mature reconciliation predominate. In the succeeding decade Sova exhibited an unusual fecundity. The poems of this later period are written with the crystalline simplicity of folk songs, and there are others in which Sova is shown as one of the most enlightened spokesmen of Czech aspirations. He also wrote a number of novels and short stories.

SOYA BEAN: *see* OILS AND FATS.

SPA, CONFERENCE OF (July 5–16 1920).—This was the first occasion after the War of 1914–8 on which the heads of the German and Allied Governments negotiated on a formal footing of equality. At the same time, at Spa, as at Versailles, the Allies resorted to dictation, and negotiations resulting in an agreed settlement did not take place until the London reparations conference of July and Aug. 1924. The Germans were represented by the chancellor, Herr Fehrenbach; the Foreign Minister Dr. Simons; and the Finance Minister, Dr. Wirth. The crucial questions at issue were the execution of the disarmament clauses and the coal delivery clauses of the Treaty of Versailles, and in both cases the Germans were compelled to sign protocols dictated by the Allies under threat of military sanctions which were set out in the documents and in both cases included an eventual Allied occupation of the Ruhr basin. In the coal negotiations, the Allies were exasperated by the pugnacious tone of Herr Stinnes, who gave evidence on behalf of the German coal-owners, but the protocol afterwards signed was remarkable inasmuch as it provided for partial cash payments by the Allies.

A German proposal for the general settlement of the reparation problem was rejected, but on this occasion no general Allied counter-proposal was put forward. In regard to reparations, the chief permanent achievement at Spa was the inter-Allied agreement regarding the allocation of prospective German payments, an agreement which has since been modified in detail, but which still governs the situation. It was provided that France should receive 52% of sums obtained from Germany, the British Empire 22%, Italy 10% and Belgium 8%, while the remaining 8% was to be divided between the other Allied Powers. By a subsequent agreement among the several members of the British Commonwealth, 86·85% of the British Empire's share was allocated to Great Britain. Another article in the Spa Agreement provided for the allocation of reparation payments from Austria, Bulgaria and Hungary, and "cost of liberation" payments from Italy, Czechoslovakia, Rumania and Yugoslavia.

At the Spa Conference the Supreme Council also came to an agreement with Germany regarding the trial of war criminals, dealt with the Teschen question and rejected the objections of the Constantinople Govt. to the draft Treaty of Sèvres.

(A. J. T.)

SPACE-TIME (*see* 25.525)—All our thoughts and concepts are called up by sense-experiences and have a meaning only in reference to these sense-experiences. On the other hand, however, they are products of the spontaneous activity of our minds; they are thus in no wise logical consequences of the contents of these sense-experiences. If, therefore, we wish to grasp the essence of a complex of abstract notions we must for the one part investigate the mutual relationships between the concepts and the assertions made about them; for the other, we must investigate how they are related to the experiences.

So far as the way is concerned in which concepts are connected with one another and with the experiences there is no difference of principle between the concept-systems of science and those of daily life. The concept-systems of science have grown out of those of daily life and have been modified and completed according to the objects and purposes of the science in question.

The more universal a concept is the more frequently it enters into our thinking; and the more indirect its relation to sense-experience, the more difficult it is for us to comprehend its meaning; this is particularly the case with pre-scientific concepts that we have been accustomed to use since childhood. Consider the concepts referred to in the words "where," "when," "why," "being," to the elucidation of which innumerable volumes of philosophy have been devoted. We fare no better in our speculations than a fish which should strive to become clear as to what is water.

I. SPACE

In the present article we are concerned with the meaning of "where," that is, of space. It appears that there is no quality contained in our individual primitive sense-experiences that may be designated as spatial. Rather, what is spatial appears to be a sort of order of the material objects of experience. The concept "material object" must therefore be available if concepts concerning space are to be possible. It is the logically primary concept. This is easily seen if we analyse the spatial concepts for example, "next to," "touch," and so forth, that is, if we strive to become aware of their equivalents in experience. The concept "object" is a means of taking into account the persistence in time or the continuity, respectively, of certain groups of experience-complexes. The existence of objects is thus of a conceptual nature, and the meaning of the concepts of objects depends wholly on their being connected (intuitively) with groups of elementary sense-experiences. This connection is the basis of the illusion which makes primitive experience appear to inform us directly about the relation of material bodies (which exist, after all, only in so far as they are thought).

In the sense thus indicated we have (the indirect) experience of the contact of two bodies. We need do no more than call attention to this, as we gain nothing for our present purpose by singling out the individual experiences to which this assertion alludes. Many bodies can be brought into permanent contact with one another in manifold ways. We speak in this sense of the position-relationships of bodies (Lagenbeziehungen). The general laws of such position-relationships are essentially the concern of geometry. This holds, at least, if we do not wish to restrict ourselves to regarding the propositions that occur in this branch of knowledge merely as relationships between empty words that have been set up according to certain principles.

Pre-scientific Thought.—Now, what is the meaning of the concept "space" which we also encounter in pre-scientific thought? The concept of space in pre-scientific thought is characterised by the sentence: "we can think away things but not the space which they occupy." It is as if, without having had experience of any sort, we had a concept, nay even a presentation, of space and as if we ordered our sense-experiences with the help of this concept, present *a priori*. On the other hand, space appears as a physical reality, as a thing which exists independently of our thought, like material objects. Under the influence of this view of space the fundamental concepts of geometry: the point, the straight line, the plane, were even regarded as having a self-evident character. The fundamental principles that deal with these configurations were regarded as being necessarily valid and as having at the same time an objective content. No scruples were felt about ascribing an objective meaning to such statements as "three empirically given bodies (practically infinitely small) lie on one straight line," without demanding a physical definition

for such an assertion. This blind faith in evidence and in the immediately real meaning of the concepts and propositions of geometry became uncertain only after non-Euclidean geometry had been introduced.

Reference to the Earth.—If we start from the view that all spatial concepts are related to contact-experiences of solid bodies, it is easy to understand how the concept " space " originated, namely, how a thing independent of bodies and yet embodying their position-possibilities (*Lagerungsmöglichkeiten*) was posited. If we have a system of bodies in contact and at rest relatively to one another, some can be replaced by others. This property of allowing substitution is interpreted as " available space." Space denotes the property in virtue of which rigid bodies can occupy different positions. The view that space is something with a unity of its own is perhaps due to the circumstance that in prescientific thought all positions of bodies were referred to one body (reference body), namely the earth. In scientific thought the earth is represented by the co-ordinate system. The assertion that it would be possible to place an unlimited number of bodies next to one another denotes that space is infinite. In prescientific thought the concepts " space " and " time " and " body of reference " are scarcely differentiated at all. A place or point in space is always taken to mean a material point on a body of reference.

Euclidean Geometry.—If we consider Euclidean geometry we clearly discern that it refers to the laws regulating the positions of rigid bodies. It turns to account the ingenious thought of tracing back all relations concerning bodies and their relative positions to the very simple concept " distance " (*Strecke*). Distance denotes a rigid body on which two material points (marks) have been specified. The concept of the equality of distances (and angles) refers to experiments involving coincidences; the same remarks apply to the theorems on congruence. Now, Euclidean geometry, in the form in which it has been handed down to us from Euclid, uses the fundamental concepts " straight line " and " plane " which do not appear to correspond, or at any rate, not so directly, with experiences concerning the position of rigid bodies. On this it must be remarked that the concept of the straight line may be reduced to that of the distance.[1] Moreover, geometricians were less concerned with bringing out the relation of their fundamental concepts to experience than with deducing logically the geometrical propositions from a few axioms enunciated at the outset.

Let us outline briefly how perhaps the basis of Euclidean geometry may be gained from the concept of distance.

We start from the equality of distances (axiom of the equality of distances). Suppose that of two unequal distances one is always greater than the other. The same axioms are to hold for the inequality of distances as hold for the inequality of numbers.

Three distances $\overline{AB^1}$, $\overline{BC^1}$, $\overline{CA^1}$ may, if $\overline{CA^1}$ be suitably chosen, have their marks BB^1, CC^1, AA^1 superposed on one another in such a way that a triangle ABC results. The distance CA^1 has an upper limit for which this construction is still just possible. The points A, (BB′) and C then lie in a " straight line " (definition). This leads to the concepts: producing a distance by an amount equal to itself; dividing a distance into equal parts; expressing a distance in terms of a number by means of a measuring-rod (definition of the space-interval between two points).

When the concept of the interval between two points or the length of a distance has been gained in this way we require only the following axiom (Pythagoras' theorem) in order to arrive at Euclidean geometry analytically.

To every point of space (body of reference) three numbers (co-ordinates) x, y, z may be assigned—and conversely—in such a way that for each pair of points A $(x_1, y_1, z_1,)$ and B (x_2, y_2, z_2) the theorem holds:

$$\text{measure-number } \overline{AB} = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2+(z_2-z_1)^2}$$

[1] A hint of this is contained in the theorem: " the straight line is the shortest connection between two points." This theorem served well as a definition of the straight line, although the definition played no part in the logical texture of the deductions.

All further concepts and propositions of Euclidean geometry can then be built up purely logically on this basis, in particular also the propositions about the straight line and the plane.

These remarks are not, of course, intended to replace the strictly axiomatic construction of Euclidean geometry. We merely wish to indicate plausibly how all conceptions of geometry may be traced back to that of distance. We might equally well have epitomised the whole basis of Euclidean geometry in the last theorem above. The relation to the foundations of experience would then be furnished by means of a supplementary theorem.

The co-ordinate may and *must* be chosen so that two pairs of points separated by equal intervals, as calculated by the help of Pythagoras' theorem, may be made to coincide with one and the same suitably chosen distance (on a solid).

The concepts and propositions of Euclidean geometry may be derived from Pythagoras' proposition without the introduction of rigid bodies; but these concepts and propositions would not then have contents that could be tested. They are not " true " propositions but only logically correct propositions of purely formal content.

Difficulties.—A serious difficulty is encountered in the above represented interpretation of geometry in that the rigid body of experience does not correspond *exactly* with the geometrical body. In stating this I am thinking less of the fact that there are no absolutely definite marks than that temperature, pressure and other circumstances modify the laws relating to position. It is also to be recollected that the structural constituents of matter (such as atom and electron, *q.v.*) assumed by physics are not in principle commensurate with rigid bodies, but that nevertheless the concepts of geometry are applied to them and to their parts. For this reason consistent thinkers have been disinclined to allow real contents of facts (*reale Tatsachenbestände*) to correspond to geometry alone. They considered it preferable to allow the content of experience (*Erfahrungsbestände*) to correspond to geometry and physics conjointly.

This view is certainly less open to attack than the one represented above; as opposed to the atomic theory it is the only one that can be consistently carried through. Nevertheless, in the opinion of the author it would not be advisable to give up the first view, from which geometry derives its origin. This connection is essentially founded on the belief that the ideal rigid body is an abstraction that is well rooted in the laws of nature.

Foundations of Geometry.—We come now to the question: what is *a priori* certain or necessary, respectively in geometry (doctrine of space) or its foundations? Formerly we thought everything—yes, everything; nowadays we think—nothing. Already the distance-concept is logically arbitrary; there need be no things that correspond to it, even approximately. Something similar may be said of the concepts straight line, plane, of three-dimensionality and of the validity of Pythagoras' theorem. Nay, even the continuum-doctrine is in no wise given with the nature of human thought, so that from the epistomological point of view no greater authority attaches to the purely topological relations than to the others.

Earlier Physical Concepts—We have yet to deal with those modifications in the space-concept, which have accompanied the advent of the theory of relativity. For this purpose we must consider the space-concept of the earlier physics from a point of view different from that above. If we apply the theorem of Pythagoras to infinitely near points, it reads

$$\bar{ds}^2 = dx^2+dy^2+dz^2$$

where $\bar{ds}$ denotes the measurable interval between them. For an empirically-given ds the co-ordinate system is not yet fully determined for every combination of points by this equation. Besides being translated, a co-ordinate system may also be rotated.[2] This signifies analytically: the relations of Euclidean geometry are covariant with respect to linear orthogonal transformations of the co-ordinates.

[2] Change of direction of the co-ordinate axes while their orthogonality is preserved.

In applying Euclidean geometry to pre-relativistic mechanics a further indeterminateness enters through the choice of the co-ordinate system: the state of motion of the co-ordinate system is arbitary to a certain degree, namely, in that substitutions of the co-ordinates of the form $x' = x - vt$

$$y' = y$$
$$z' = z$$

also appear possible. On the other hand, earlier mechanics did not allow co-ordinate systems to be applied of which the states of motion were different from those expressed in these equations. In this sense we speak of "inertial systems." In these favoured-inertial systems we are confronted with a new property of space so far as geometrical relations are concerned. Regarded more accurately, this is not a property of space alone but of the four-dimensional continuum consisting of time and space conjointly.

Appearance of Time.—At this point time enters explicitly into our discussion for the first time. In their applications space (place) and time always occur together. Every event that happens in the world is determined by the space-co-ordinates x, y, z, and the time-co-ordinate t. Thus the physical description was four-dimensional right from the beginning. But this four-dimensional continuum seemed to resolve itself into the three-dimensional continuum of space and the one-dimensional continuum of time. This apparent resolution owed its origin to the illusion that the meaning of the concept "simultaneity" is self-evident, and this illusion arises from the fact that we receive news of near events almost instantaneously owing to the agency of light.

This faith in the absolute significance of simultaneity was destroyed by the law regulating the propagation of light in empty space or, respectively, by the Maxwell-Lorentz electrodynamics. Two infinitely near points can be connected by means of a light-signal if the relation

$$ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2 = 0$$

holds for them. It further follows that ds has a value which, for arbitrarily chosen infinitely near space-time points, is independent of the particular inertial system selected. In agreement with this we find that for passing from one inertial system to another, linear equations of transformation hold which do not in general leave the time-values of the events unchanged. It thus became manifest that the four-dimensional continuum of space cannot be split up into a time-continuum and a space-continuum except in an arbitrary way. This invariant quantity ds may be measured by means of measuring-rods and clocks.

Four Dimensional Geometry.—On the invariant ds a four-dimensional geometry may be built up which is in a large measure analogous to Euclidean geometry in three dimensions. In this way physics becomes a sort of statics in a four-dimensional continuum. Apart from the difference in the number of dimensions the latter continuum is distinguished from that of Euclidean geometry in that ds^2 may be greater or less than zero. Corresponding to this we differentiate between time-like and space-like line-elements. The boundary between them is marked out by the element of the "light-cone" $ds^2 = 0$ which starts out from every point. If we consider only elements which belong to the same time-value, we have

$$-ds^2 = dx^2 + dy^2 + dz^2$$

These elements ds may have real counterparts in distances at rest and, as before, Euclidean geometry holds for these elements.

Effect of Relativity, Special and General.—This is the modification which the doctrine of space and time has undergone through the restricted theory of relativity. The doctrine of space has been still further modified by the general theory of relativity, because this theory denies that the three-dimensional spatial section of the space-time continuum is Euclidean in character. Therefore it asserts that Euclidean geometry does not hold for the relative positions of bodies that are continuously in contact.

For the empirical law of the equality of inertial and gravitational mass led us to interpret the state of the continuum, in so far as it manifests itself with reference to a non-inertial system, as a gravitational field and to treat non-inertial systems as equivalent to inertial systems. Referred to such a system, which is connected with the inertial system by a non-linear transformation of the co-ordinates, the metrical invariant ds^2 assumes the general form:—

$$ds^2 = \sum_{\mu\nu} g_{\mu\nu} dx_\mu dx_\nu$$

where the $g_{\mu\nu}$'s are functions of the co-ordinates and where the sum is to be taken over the indices for all combinations 11, 12, . . . 44. The variability of the $g_{\mu\nu}$'s is equivalent to the existence of a gravitational field. If the gravitational field is sufficiently general it is not possible at all to find an inertial system, that is, a co-ordinate system with reference to which ds^2 may be expressed in the simple form given above:—

$$ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2$$

But in this case, too, there is in the infinitesimal neighbourhood of a space-time point a local system of reference for which the last-mentioned simple form for ds holds.

This state of the facts leads to a type of geometry which Riemann's genius created more than half a century before the advent of the general theory of relativity of which Riemann divined the high importance for physics.

Riemann's Geometry.—Riemann's geometry of an n-dimensional space bears the same relation to Euclidean geometry of an n-dimensional space as the general geometry of curved surfaces bears to the geometry of the plane. For the infinitesimal neighbourhood of a point on a curved surface there is a local co-ordinate system in which the distance ds between two infinitely near points is given by the equation

$$ds^2 = dx^2 + dy^2$$

For any arbitrary (Gaussian) co-ordinate-system, however, an expression of the form

$$ds^2 = g_{11}dx^2 + 2g_{12}dx_1dx_2 + g_{22}dx_2^2$$

holds in a finite region of the curved surface. If the $g_{\mu\nu}$'s are given as functions of x_1 and x_2 the surface is then fully determined geometrically. For from this formula we can calculate for every combination of two infinitely near points on the surface the length ds of the minute rod connecting them; and with the help of this formula all networks that can be constructed on the surface with these little rods can be calculated. In particular, the "curvature" at every point of the surface can be calculated; this is the quantity that expresses to what extent and in what way the laws regulating the positions of the minute rods in the immediate vicinity of the point under consideration deviate from those of the geometry of the plane.

This theory of surfaces by Gauss has been extended by Riemann to continua of any arbitrary number of dimensions and has thus paved the way for the general theory of relativity. For it was shown above that corresponding to two infinitely near space-time points there is a number ds which can be obtained by measurement with rigid measuring-rods and clocks (in the case of time-like elements, indeed, with a clock alone). This quantity occurs in the mathematical theory in place of the length of the minute rods in three-dimensional geometry. The curves for which $\int ds$ has stationary values determine the paths of material points and rays of light in the gravitational field, and the "curvature" of space is dependent on the matter distributed over space.

Just as in Euclidean geometry the space-concept refers to the position-possibilities of rigid bodies, so in the general theory of relativity the space-time-concept refers to the behaviour of rigid bodies and clocks. But the space-time-continuum differs from the space-continuum in that the laws regulating the behaviour of these objects (clocks and measuring-rods) depend on where they happen to be. The continuum (or the quantities that describe it) enters explicitly into the laws of nature, and conversely these properties of the continuum are determined by physical factors. The relations that connect space and time can no longer be kept distinct from physics proper.

Nothing certain is known of what the properties of the space-time-continuum may be as a whole. Through the general theory of relativity, however, the view that the continuum is infinite in its time-like extent but finite in its space-like extent has gained in probability.

TIME

The physical time-concept answers to the time-concept of the extra-scientific mind. Now, the latter has its root in the time-order of the experiences of the individual, and this order we must accept as something primarily given.

I experience the moment "now," or, expressed more accurately, the present sense-experience (*Sinnen-Erlebnis*) combined with the recollection of (earlier) sense-experiences. That is why the sense-experiences seem to form a series, namely the time-series indicated by "earlier" and "later." The experience-series is thought of as a one-dimensional continuum. Experience-series can repeat themselves and can then be recognised. They can also be repeated inexactly, wherein some events are replaced by others without the character of the repetition becoming lost for us. In this way we form the time-concept as a one-dimensional frame which can be filled in by experiences in various ways. The same series of experiences answer to the same subjective time-intervals.

The transition from this "subjective" time (*Ich-Zeit*) to the time-concept of pre-scientific thought is connected with the formation of the idea that there is a real external world independent of the subject. In this sense the (objective) event is made to correspond with the subjective experience. In the same sense there is attributed to the "subjective" time of the experience a "time" of the corresponding "objective" event. In contrast with experiences external events and their order in time claim validity for all subjects.

This process of objectification would encounter no difficulties were the time-order of the experiences corresponding to a series of external events the same for all individuals. In the case of the immediate visual perceptions of our daily lives, this correspondence is exact. That is why the idea that there is an objective time-order became established to an extraordinary extent. In working out the idea of an objective world of external events in greater detail, it was found necessary to make events and experiences depend on each other in a more complicated way. This was at first done by means of rules and modes of thought instinctively gained, in which the conception of space plays a particularly prominent part. This process of refinement leads ultimately to natural science.

The measurement of time is effected by means of clocks. A clock is a thing which automatically passes in succession through a (practically) equal series of events (period). The number of periods (clock-time) elapsed serves as a measure of time. The meaning of this definition is at once clear if the event occurs in the immediate vicinity of the clock in space; for all observers then observe the same clock-time simultaneously with the event (by means of the eye) independently of their position. Until the theory of relativity was propounded it was assumed that the conception of simultaneity had an absolute objective meaning also for events separated in space.

This assumption was demolished by the discovery of the law of propagation of light. For if the velocity of light in empty space is to be a quantity that is independent of the choice (or, respectively, of the state of motion) of the inertial system to which it is referred, no absolute meaning can be assigned to the conception of the simultaneity of events that occur at points separated by a distance in space. Rather, a special time must be allocated to every inertial system. If no co-ordinate system (inertial system) is used as a basis of reference there is no sense in asserting that events at different points in space occur simultaneously. It is in consequence of this that space and time are welded together into a uniform four-dimensional continuum. *See* RELATIVITY. (A. E.)

SPADINI, ARMANDO (1883–1925), Italian painter was born in Florence July 29 1883. He first studied art in his native city but was chiefly inspired by the great Venetian artists, particularly by Giorgione and Paolo Veronese. His painting entitled "Giovani al bagno" secured him the Pensieriato artistico nazionale, in 1910. He developed rapidly an art which was full of grace of line, sunshine and brightness of colour, and specialised in the painting of children. Two important pictures "Figure and Bambini," are in the National Gallery of Modern Art in Rome, "Musica al Pincio" is in the new Mussolini Museum also in Rome, while others are in the Florence Modern Art Gallery, in the Luxembourg, and in the Lima Museum; but his most important paintings are in private collections in Rome. He died in Rome on March 29 1925.

SPAIN (*see* 25.527), a country of southwestern Europe and a member of the League of Nations. Its area is 191,893 sq. m., and the population 21,966,000 (1925 estimate).

I. POLITICAL HISTORY

At the close of the year 1910 Señor Canalejas resigned in order to reconstruct his Cabinet. This second Ministry, during which (Jan. 7–13) the King visited Melilla, lasted till April 3, 1911, when it fell on the occasion of a debate on the Ferrer case, the army officers having resented the half-hearted attitude of Canalejas on the matter. The incident was typical of much that was to come.

The attention of Parliament was diverted towards Moroccan affairs. The French were preparing their advance on Fez, and Spain was forced to an active policy, the first signs of which were received with ill-humour by the French Press. The Government, in the teeth of popular opposition, were sending troops to Morocco, and on June 9 a Spanish force landed at Larache. France was prevented from taking strong action by the Agadir incident (*see* EUROPE, HISTORY), but a certain tension prevailed between France and Spain during the summer. Anti-war meetings took place in Barcelona and Madrid, and a republican rising, plotted by the lower deck of the cruiser "Numancia," anchored off Tangier, though unsuccessful, startled public opinion. A campaign of strikes led to grave disorders in Bilbao, Catalonia and Valencia, notably in Cullera, where a magistrate was mobbed to death. The Government met the situation with coolness and resolution, and towards the end of Sept. the strike fever had abated.

The Moroccan operation prepared as a consequence of the disembarkation in Larache began successfully on Dec. 6, but collapsed a few days later after a gallant attempt to force the passage of the River Kert, not without leaving behind an atmosphere of ill-feeling due to the belief, current in the Spanish Army, that the Moorish troops were provided with French arms and ammunition. Under such unfavourable conditions began the negotiations for a Franco-Spanish agreement following upon the Franco-German Treaty on Morocco. After a reshuffling of his Cabinet (March 11) Canalejas adjourned Parliament until May first. During the interval Don Melquiades Alvarez, a moderate republican, launched the Reformist party, aiming at bringing a certain important portion of republican opinion into the fold of the monarchy. The parliamentary session opened with the discussion of the bill called *de Mancomunidades*, ostensibly allowing "diputaciones" (elected provincial councils) to unite into groups for purposes of common administration, but in reality constituting a sop to Catalonia, which under the bill could set up a kind of local Parliament. With the summer a period of strikes, culminating in a grave railway strike, set in, Canalejas met it by applying Article 221 of the Recruiting Law allowing the drafting into military service of all men of military age working in industries of public importance in cases of danger or abnormal circumstances. On Oct. 14 the autumn session began with a fresh discussion of the bill *de Mancomunidades*, but the session was brought to a close by the murder of Canalejas on Nov. 12 1912.

The Romanones Ministry.—Count Romanones replaced Canalejas, first in a somewhat temporary, then, after the Franco-Spanish Treaty on Morocco had been signed, in a more permanent capacity, having been confirmed in power by the King. This royal decision contributed to weaken the Liberal party by

strengthening the division between the Romanones and García Prieto groups within it, and led to a sensational protest by Señor Maura, who expected to be called to office. Señor Alvarez, on the other hand, took the opportunity to accentuate his evolution towards the monarchy, helped by the King, who, at the moment, was seeking the advice of several prominent men known for their advanced views. Count Romanones took a good share of whatever merit there was in this policy, as well as in the success of the King's official visit to Paris on the conclusion of the Franco-Spanish Treaty (May 6–9). He resigned on May 31, after a strong speech of opposition from Maura who restated his position of "implacable hostility" to a policy of co-operation with the parties of the anti-dynastic Left. The next day the King asked him to return once more, after the crisis caused by a split in the Liberal party on the question of the bill *de Mancomunidades* then before the Senate (June 11). Count Romanones was reinstated by the King, but this time it was generally realised that this step was simply an expedient necessitated by the coming visit of M. Poincaré to Madrid. M. Poincaré, President of the French Republic, arrived in Madrid on Oct. 7. He left Spain by way of Cartagena, where he embarked on the battleship "Diderot," Spain being represented by the battleship "España" and England by H.M.S. "Inflexible." Both the King and the President emphasised the fact that Cartagena had, six years earlier, witnessed the Franco-Anglo-Spanish agreement on Mediterranean policy.

The latent Liberal crisis broke out as soon as M. Poincaré left Spanish soil. On Oct. 25 the Cabinet resigned, and the King, after attempting in vain to reconcile the parties, realised that the Liberal policy which he had constantly followed since 1909 was at an end. He first summoned Maura but found his views on policy so dangerous that he turned to Señor Dato (Oct. 27), a choice which initiated the disintegration of the Conservative party. The new Government granted a decree giving validity of law to the bill *de Mancomunidades*, dissolved the *Cortes* (Dec. 31 1913), and came back after a general election with a sufficient majority in both Houses. It met with considerable opposition owing to several royal decisions which were interpreted as acts of personal power in military matters. But its internal difficulties were soon to be merged into the all-absorbing preoccupation of the World War.

The World War.—The international situation of Spain at the outbreak of war was defined by two sets of circumstances: official, and national or popular. The official situation was ruled by the Cartagena Agreement of 1907, confirmed by the conversations held there in 1913 between M. Poincaré and Count Romanones. These agreements and conversations stipulated that "should new circumstances arise tending to alter the territorial *status quo*" in the Mediterranean or in the European and African coasts of the Atlantic, the three powers concerned (Spain, France and England) would "enter into communication" in order to take any measures that might be necessary. The War was obviously a "circumstance" falling within the limits of the above definition. Yet Spain did not "enter into communication" with France and England, for the two Powers most interested in the matter, France and England, made no sign to set in motion the Cartagena Agreements. Señor Dato promptly declared for an absolute neutrality; Spain was, in fact, the only European nation which had no stake in the War. On the other hand, the nation was divided as to its feelings. The working classes, most of the intellectuals and the trading communities, were pro-Ally. The clergy, most of the army and of the bureaucracy and the "idle rich," were pro-German. Thus, the country was split into a reactionary or conservative pro-German wing and a democratic or "advanced" pro-Ally wing, and, as this division was real, and not fictitious as were the party groups, it cut across the parties. On one definite point everybody agreed. Spain was to keep out of the War.

A "committee of initiative" was created for the study and coordination of efforts to deal with War problems. Parliament resumed its sittings on Oct. 30 1914 and unanimously endorsed the foreign policy of the Government. The country was meanwhile getting used to abnormal conditions. Metals, raw and manufactured, clothes and boots, all kinds of foodstuffs, horses and mules, poured into France, under the "neutral" eye of the Government. The Government introduced and passed a bill which gave them special powers to deal with customs tariffs, railway rates, state purchases of food, shipping and expropriation of foodstuffs. The great increase in exports contributed to the rise in the value of the peseta, which gave the Government an opportunity to repatriate the public debt, by enacting that all Spanish Government stock held by foreigners which was payable in francs or sterling should become payable in pesetas in the Spanish market. Though the Cortes was closed, great political activity was displayed by all parties, stimulated by an active German propaganda, soon to be imitated by similar endeavours on the part of the Allies. But though the excitement produced by several outbursts of partisan feeling did not go very deep, the Government decided to deny all permits for meetings on neutrality and the War.

A crisis was, however, precipitated on the refusal of the business community to co-operate with the Government in the launching of a loan. The main cause of the failure seems to have been a reluctance of business circles to subscribe under conditions which were not considered generous enough for the subscriber. The resignation of the Government (June 22) was quickly followed by a reinstatement of the same Cabinet. The situation of the Treasury was by no means flourishing. At the end of the year revenue remained at 1,202,000,000 pesetas while expenses, not including Government purchases of foodstuffs, rose to 1,556,000,000 pesetas. The Government had to fall back on Treasury Bonds negotiated through the Bank of Spain.

Yet the work of the country was in full swing under the stimulus of war orders. Thus, the shipowners announced to the Government (Aug. 1915) that the premiums granted them by the Shipping Acts as a measure of protection were no longer necessary and would not be cashed. This meant that such premiums were no longer worth the sacrifice which they entailed of the shipowner's liberty to trade as he pleased between foreign ports. Great shipping profits ensued, and torpedoings followed. On Aug. 17 the S.S. "Isidoro" of Bilbao was sunk by a German submarine. On Aug. 20 the S.S. "Peña Castillo" of Santander sank in obscure circumstances.

Several efforts made to reunite the Liberal groups into one party again failed. Count Romanones then prepared a plan of campaign against Señor Dato's Government on the Military Reform Bills which was ultimately successful, and the Government fell on Dec. 6. The crisis ended in the formation of a united Liberal ministry. Count Romanones took the premiership, and in order to counterbalance the effect of his well-known pro-Ally views, assigned the Foreign Office to Señor Villanueva, a notorious pro-German.

In a sense, the inclusion of Señor Urzáiz, the Finance Minister, who, though a Liberal, was a party unto himself, and of Admiral Miranda, a Conservative, initiated the period of mixed ministries, which was about to open as a logical consequence of the gradual weakening of the old parties, and in its turn tended to accelerate the process of their disintegration. Urzáiz came into conflict with his chief, and was dismissed before he had time to resign (Feb. 25). His successor, Señor Alba, with a bill on war profits, aroused the opposition of all the minorities except the socialist. But the Cortes was closed, a general railway strike having suddenly upset all Government plans on July 13. The strike was over one week later, and the autumn session dragged on till Dec. 19. The Government reappeared before the House on Jan. 19, but in the meantime Count Romanones had resigned and accepted office again with the same ministry. This crisis was probably devised by the Prime Minister as a means to recover from the King the moral authority which some thought he had lost at the hands of the pro-German Press, which accused him of drawing great profits as a business man from his foreign policy as a Prime Minister.

Count Romanones wore his neutrality with a difference, and, though the inheritor of Señor Dato's policy, he did little to

conceal his pro-Ally views. By September, 1916, Spain had lost more than 30,000 tons of shipping by torpedoing, and more than 50,000 in circumstances which were, to say the least, obscure. The shipping interests asked for Government help. A period of Government activity set in. On Jan. 31 Germany sent in a note establishing an " absolute blockade " of the Allied coasts. Count Romanones was committed to a policy which implied a firm answer to such a note. He gave it in the note of Feb. 6. But the Prime Minister realised that this firmness meant nothing unless backed with the will to fight if necessary and that public opinion would not follow him so far. He resolved to leave the Government there and then, at the top of the wave of his own policy.

Committees of Defence.—Other considerations of home policy were perhaps not altogether without effect on his decision, notably, the first signs of a military conflict, which was fundamentally to alter Spanish politics for years to come. When on April 19 Count Romanones resigned, he took the easiest path. His fall, however, cost him the leadership of his party. The new Ministry, under the premiership of Señor Garcia Prieto, was frankly neutralist, and Germany, rightly interpreting the position, felt freer to intensify her submarine campaign. But the Government had to concentrate on the situation created by the so-called committees of defence. Towards the middle of 1916, a system of infantry committees of defence appeared, which soon evinced a tendency to interfere with the Government in such a manner that, towards the end of the year, Count Romanones, then in office, insisted on their dissolution. General Aguilera, the War Secretary in Garcia Prieto's administration, ordered the leaders to be arrested.

But meanwhile, probably owing to royal hints, a less disciplinarian line of action was taken, and the arrested men were released. It was known later that an ultimatum had been placed in the hands of General Marina, Captain General of Barcelona, with a time-limit of 12 hours (June 1). Not unnaturally the Government resigned. Dato, called to office, capitulated before the Juntas, and accepted their regulations in full. This victory of a movement which, in its essence, was revolutionary, had an immense effect on immediate events as well as on the political evolution of the country. The revolutionary ferment was stimulated. Political manifestos asking for a renovation in government and constitution followed each other (Socialists June 12, Catalanists June 16, Left-Coalition June 16). All but three of the deputies and senators for Catalonia met on July 5 at Barcelona, and passed a resolution asking for an immediate meeting of the Cortes, and declaring that, should the Government refuse to comply with this request, a meeting of all the deputies and senators composing the Cortes would be called at Barcelona on July 19. The Government allowed it to be known that should the Assembly meet it would be considered as rebellious and treated as such.

The Assembly met, 13 senators and 55 deputies attending, including all the Socialist, Republican and Reformist members of the Cortes, voted resolutions asking for a reform of the constitution, and set up three commissions to prepare reports on reforms to be submitted to a second meeting to take place later. At one moment it looked as if these 68 men would take the lead of the revolutionary spirit which the bold action of the army officers had stirred in the country. But the mass of the Assembly was too dull, and no real leader manifested himself. Thus two attempts, one military, one middle-class, both directed against the evils of the old régime, failed through lack of co-ordination and mutual understanding. A third attempt, and a third failure, was still to come. On Aug. 10 the railwaymen of the Northern Railway went on strike. On the 13th, a general strike, clearly revolutionary, was suddenly launched in the whole country.

The country was declared in a state of war, and the military crushed the rebellion with a ruthless hand. By Aug. 19 the situation was well in hand. The net result was to prove that the only real force in the country was the army committee system. On Aug. 10, the Council of Ministers passed a special credit for military expenses. The committee, conscious of their strength, asserted themselves in the field of civil politics. The scandal became public on the Government lifting the censorship. The committees attempted to deliver a message into the hands of the King. Dato had to resign on a " perfectly constitutional " hint by the King. In point of fact he was expelled by the army committees. The crisis was long and laborious, and in the midst of it, the Parliamentary Assembly met in Madrid (Oct. 30) in its second session. The Cabinet was at last formed by Garcia Prieto. It was a Coalition ministry composed of Maurists, Liberals, and Catalanists, in which, in order to give satisfaction to the new demand for an impartial general election, a non-political judge was given the post of Home Secretary. Señor La Cierva, who took the War Office, was the real head of the Cabinet. His policy consisted of ingratiating himself with the committees of defence, so as to become their leader and representative.

Juntas were soon formed by the civil servants of nearly all Government departments, and on Jan. 12 1918, on the occasion of a difference between the Postmaster-General and his subordinates, an agitation began which was ultimately to cause the downfall of the Government. On Feb. 21 the telegraph officials went on strike—by meticulously carrying out official regulations.

On Feb. 24 the general election took place under these abnormal conditions. For the first time a Coalition Government presided over an election, and great hopes were entertained as to the result. The new Chamber, however, was but an average of the preceding ones, different only in that no party in it had a clear majority. La Cierva began then to act as the self-appointed leader of the committees. After provoking two partial crises, he committed the Government to a policy as firm towards the civil Juntas as it was weak with the military ones. On Feb. 17 the postal services declared a strike. La Cierva's efforts to cope with this by means of military improvisations ended in utter failure and the Government fell, March 18. All possible combinations were tried and failed, until on March 21 at midnight, at a meeting of ex-prime ministers called by the King in his study, after, it is said, having threatened his abdication, King Alfonso succeeded in forming a " ministry of all the talents."

This Government had agreed on a concrete programme: reform of the standing rules of the Cortes, amnesty, military reforms, budget. The Government carried them all but the fourth, Alba having left the Cabinet on their refusal to pass his education plans (Oct. 8), which ultimately brought the Cabinet to its end on Nov. 6. The new Government, presided over by Garcia Prieto, had to be formed amid the sensation caused by the arrival in Madrid of the news of the Kaiser's flight. The world being full of the idea that the triumph of the Allies meant that of democracy, the Government published an " advanced " manifesto, but the ministry fell on Dec. 3 1918, and Count Romanones formed a stop-gap Cabinet so as to pass the budget and leave the King free for a change of policy. The first important act of Count Romanones was his visit to President Wilson, then in Paris.

It is to the credit of the successive Governments which ruled Spain during this period that they succeeded in steering clear of all obstacles, home and foreign, overburdened as they were with home problems and foreign advice not always disinterested. On June 29 1917, a German submarine " UC52 " arrived in Cadiz for repairs. Dato allowed its arrival and departure within 24 hours, and thereupon had a royal decree signed forbidding submarine navigation in Spanish waters. The next incident of the kind was the escape of the " U53," which had been interned in Cadiz under the above royal decree. On the initiative of the Romanones administration a treaty had been negotiated in London between the Marqués de Cortina and the English Government. This agreement was signed on Dec. 6. Its importance lay in the fact that it legalised in the eyes of the pro-Germans all trade with England, which received food and ore in exchange for coal. Torpedoings continued all the same, and the Spanish Government decided to apply to Germany the claim of ton for ton. Germany had agreed to the ton-for-ton indemnity when the end of the War came. The Spanish merchant marine had lost 65 ships representing 140,000 tons. From the material point of view, the neutral attitude adopted by Spain contributed to

accelerate the progress which was observable in her economic development in the pre-War years. This period of exceptional activity comprises two coincident movements. One is a somewhat artificial "inflation" of Spanish industries, due to the demand of the Allies. The other one is the continuation of a development already noticeable before the War. Thus certain industries, really national, such as that of olive oil, succeeded at last in establishing themselves in foreign markets.

Troubles in Barcelona.—Count Romanones did not precisely find in Paris in 1919 the diplomatic triumph which he had expected, but neither did he return wholly disappointed. He found the country astir with a mixture of two political currents, one a democratic, constitutional agitation, born of the Allied victory, another one a revolutionary agitation which could be traced to the unwholesome effect of the Juntas' *pronunciamientos*. The main effect of these two movements was felt in Barcelona and was represented by Catalanist propaganda, a military undercurrent of opposition to it, and lastly syndicalist agitation which made the two former forget their mutual enmity and unite against it. A violent conflict arose between the military and the civil authorities of Barcelona on the occasion of a strike, and when the strike had been settled by the latter, the Government suddenly resigned. It was known afterwards that this resignation was due to the military having expelled the civil authorities from the town. Maura took office on April 15, asked for a decree dissolving the Cortes, and to the consternation of all parties, obtained it. This amounted almost to a *coup d'état* on the part of the King.

After a general election held under a strict censorship, under the protest of all the Left parties (including the Monarchical Liberals), and with the use of electioneering methods which had been long forgotten in Spain, Maura failed to bring to the new Cortes more than about one-eighth of its total membership under his banner. His Government fell under a discussion of his electioneering methods (July 20), and Señor Sanchez de Toca (Dato being ill) formed a Conservative Cabinet, which had to deal with a grave situation in Barcelona, where syndicalist trouble was again brewing. But a new outburst of the Juntas forced the Government to resign, and Señor Allendesalazar (a follower of Maura) took office with a Coalition Cabinet. The change of policy which the change of Cabinet implied aggravated the conflict. Murders continued. A mutiny organised by syndicalist soldiers took place in a barracks in Saragossa. Disorders broke out in Valencia and Santander. Another militarist outburst ended the life of the Cabinet, which, having passed the budget, left office on March 4 1920. The King called Dato to power. But the general election at the end of 1920 showed that the mainspring of the old system—*i.e.*, the docility of the electorate to any kind of government—could no longer be counted upon. Dato failed to obtain a working majority, his supporters numbering 177 members out of 405. All his efforts were accordingly bent towards the reconciliation of the several factions within the Conservative party. While engaged in this task he was assassinated by anarchists on March 8 1921.

Decay of the Party System.—This murder accelerated the disintegration of the system of rotation of the two political parties, which, as arranged by Cánovas and Sagasta at the death of Alfonso XII (Pacto del Pardo), had stood the monarchy in good stead as a substitute for a real constitutional practice on the lines of the English Monarchy. The lack of an objective policy, or even of objective principles, which had all along been a cause of weakness in the two political parties of the Restoration and the Regency, became more and more apparent as death, whether by natural or by criminal means, thinned out the ranks of the leaders and delivered the parties to the intrigues of understudies and second-rate politicians. While the old system deteriorated day by day owing to its own internal weakness, the forces which attacked it from the outside gradually gained strength.

These forces were of three different kinds: first, the anti-dynastic elements, once heaped together under the common name of Republicans, now moving towards Socialism on the one hand and on the other towards different varieties of social revolutionaries such as syndicalists, anarchists and even professional agitators without any particular political or philosophic bias; secondly, the Catalan homerulers, gradually evolving from autonomy to separatism; finally the movement of what might be called *military syndicalism* embodied in the famous *juntas de defensa*, to the intervention of which in active politics many of the political crises of the period have been due. The death of Dato (March 8 1921) was to reveal the interplay of these forces. The Conservative party found itself suddenly deprived of its chief. The King called on Maura, who made it clear from the outset that he would constitute a national coalition or no Government at all and, finding no support in the Liberal party, had to withdraw from the field. A purely Conservative Government took office under the leadership of Allendesalazar, during whose administration some of the symptoms of the crisis through which the very constitution of the country was soon to pass, began to appear on the political horizon. Thus in a famous speech delivered on the occasion of a banquet in Córdoba, May 23 1921, the King referred to the working of the Spanish Parliament in terms of scathing criticism.

The Melilla Withdrawal.—The greatest event of the year was the military disaster which the Spanish troops met in Morocco in July 1921. It entailed the following immediate effects: the withdrawal of the Spanish troops from all the zone previously occupied by the commanding-officer in Melilla; the death of the commanding-officer in Melilla, General Silvestre, a brilliant cavalry officer, who committed suicide at the beginning of the precipitate withdrawal of the Spanish troops effected in most painful conditions at heavy cost of men and material; and finally considerable moral effects both in Spain and in the Rif—in Spain because from that moment onwards the Moroccan problem became the very centre of national politics; in the Rif because the collapse of the Spanish troops in Anoual raised the prestige of Abdel-Krim. The country was suddenly brought to compare these results with the cost of the army which, after the reorganisation effected in 1918, rose to a figure of about 700,000,000 pesetas yearly.

The emotion due to these events swept away the inadequate Government of Allendesalazar. A stronger Conservative Government was constituted under Maura who was enabled, by a public opinion strongly roused by the situation in Morocco, to send to the rescue of the troops there an army of 140,000 men. But at the same time an energetic demand for an inquiry which would ruthlessly bring out the responsibilities for the disaster made itself heard. As a set-off against this current of civilian opinion, the *juntas de defensa* began a campaign of threats and accusations against Parliament, which they considered responsible for the general disorganisation leading to the Moroccan crisis. The gradual revelation of the magnitude of the defeat; the growing number of details published concerning the disorganisation of the auxiliary services in the Moroccan Army, and particularly those of health and commissariat; the inopportune proposals of the War Minister, La Cierva, who, in Nov. 1921, before any adequate inquiry as to the responsibility for the disaster had been decided upon, submitted to Parliament a bill for military rewards; the warm and public welcome given by the King and his Government to General Berenguer, who was commander-in-chief of the military forces in Morocco at the time of the Anual disaster, before any authoritative pronouncement had been made as to the extent of his responsibility in the matter; these and other factors of a similar kind so strengthened the demand for an inquiry that the Government decided to appoint General Picasso as an official investigator to report to the Government on the operations and the responsibility for them. General Picasso carried out his task with a high sense of duty and impartiality, and his report was received by all parties alike as a fine example of patriotic courage.

But this display of energy on the part of the Government increased the opposition of the military *juntas de defensa*. The Cabinet sought a clumsy solution of this problem by a so-called "disbandment" of the *juntas* and their replacement by *juntas*

informativas publicly and legally recognised and placed, at least in theory, under the authority of the War Minister. This solution satisfied nobody. Parliamentary opinion did not fail to see its purely superficial character, while the officers themselves, though in no way deprived of their organised power, resented the humiliation imposed on them by the new measures. The Maura Cabinet resigned on a conflict with them in Jan. 1922, and though it continued in office by express wish of the King, had finally to disappear in the month of March of the same year, leaving office to another Conservative Cabinet under the leadership of Señor Sánchez Guerra.

The Juntas.—The new Prime Minister was known to be an energetic man, strongly opposed to any undue interference of the military in political matters, but he took office at a time when Parliament was exceedingly weak. This fact was not without influence in the movement towards a federation of all the groups into which the Liberal party had split up since the death of Sagasta. In April 1922, these Liberal groups came to an agreement, not only among themselves, but also with the small but influential Reformist group, headed by Alvarez. Meanwhile, the *juntas de defensa* of the infantry officers, authorised by the previous War Minister, met in an assembly which adopted a number of resolutions, two of which may be given here as an indication of their general attitude: (1) Every infantry officer to be bound to affiliate to the *juntas*, or otherwise to be prosecuted before a tribunal of his brother officers; (2) No promotion to be authorised in the army save by seniority.

It became more and more apparent that in the *juntas*, the army officers had set up a form of military syndicalism which, owing to the material strength that it wielded, was a state within the State. The parliamentary debates on Morocco became more and more searching on the publication of the figures relating to the expenses during the fiscal year 1921–2 amounting to 519,-681,839 pesetas as against 173,190,000 in 1920–1. Simultaneously with this revelation, the news of a considerable defalcation in the offices of the commissariat in Larache was made public, while Parliament had at the same time to deal with a deficit in the budget amounting to 1,101 millions. All these facts contributed to give substance to the demand for bringing home political responsibility which up to the moment had met with the obstacles imposed by the traditional co-operation and comradeship prevailing between the two main political parties since the Pact of el Pardo. The report that had been prepared by Picasso was submitted to a parliamentary commission on which all the Parties were represented. The long-drawn debates of this commission led to three different draft reports, and this lack of unanimity increased the difficulties in which Sánchez Guerra's Cabinet was at the time entangled. The Prime Minister had courageously applied to the situation which he found on taking office methods borrowed from the policy of his Liberal opponents. Thus he restored the constitutional guarantees which had been in suspense for over two years and he recalled from the civil governorship of Barcelona General Martinez Anido who had established a certain amount of order in that unhappy city but by methods which had aroused considerable criticism. Sánchez Guerra was also responsible for a decree dissolving the military *juntas*, and prohibiting officers of the army from entering any association whatsoever connected with their profession.

The parliamentary debates on the three reports submitted by the commission on responsibility gradually warmed the political temperature of the Congress of Deputies to such a pitch that men of a conservative turn of mind like Señores Maura and Cambó rose to indict the political system in general and (in the case of Cambó) the Cabinet in office in July 1921. Public opinion outside followed with intense interest the proceedings of Parliament. The more popular part of the campaign was led by the Ateneo de Madrid, an intellectual club which has always played an important part in the literary, artistic and political leadership of the country. But the debate in Parliament degenerated towards its close into a political fight of such violence that the government collapsed and Parliament was dissolved.

Liberals and Morocco.—The Liberal coalition which had been created in April of the same year then took office (Dec. 1922); in its official declaration to Parliament the new government made it clear that it would uphold the parliamentary procedure adopted in regard to the conduct of the Moroccan campaign. Popular feeling did not lag behind and promptly backed this attitude of the new government. A popular procession organised by the Ateneo de Madrid showed the enormous hold that this question had obtained on the people. Señor Lerroux, a well-known Republican leader, in a speech delivered in Seville, in Jan. 1923, went even so far as to involve the King in part of the responsibility for the disaster and a Conservative paper *La Accion*, published in Feb. of the same year a sensational article in which it advised the King to give up all idea of abdication, an intention which, according to this newspaper, the King had more than once expressed in private conversation. *La Accion* took this opportunity of pointing an accusing finger at certain politicians in order to screen the King, and thus the estrangement between the King and the political circle of collaborators who had stood him in good stead from the beginning of his political life, and even from the beginning of his life (for King Alfonso was born a King), began to show itself in the Press.

The new government had to face a crisis on their proposal for the amendment of Article 11 of the Constitution dealing with the toleration accorded to other religions than that of the Roman Catholic Church. The clergy protested, and the government, having withdrawn the proposal, the Minister of Finance, Señor Pedregal, who represented the Reformist group in the Cabinet, left the Ministry, though the Reformist group, realising that the Liberal party had in any case an uphill road before them, continued to give their active help to the administration. The elections held in April 1923, led to a Liberal-Reformist majority, but its sensational feature was the success of five out of eight Socialist candidates in securing election in the capital, attributed by the Socialist party to the strong line which they had taken against the war in Morocco and in favour of a searching inquiry.

After the opening of Parliament the high court for the war and the navy (*Tribunal Supremo de Guerra y Marina*) demanded from the Senate authority to prosecute General Berenguer, ex-high commissioner and commander-in-chief in Morocco, who, as a senator, could not be prosecuted until the Senate withdrew from him his parliamentary immunity. Generals began to appear in the forefront of politics, foreshadowing what was to come. A notorious personal incident, involving General Aguilera, President of the Supreme Military Court, Sánchez Guerra and another ex-Prime Minister and ex-president of the Senate, Señor Sánchez Toca, was the herald of the coming political storm. The difficulties arising out of this phase of the Moroccan question, were considerably increased by other events in the same field. During the summer of 1923 the Liberal Govt. had endeavoured to strengthen civilian and to reduce military action in Morocco. From 1909, when military action was started on a large scale, until 1923, Morocco had consumed more than 2,500,000,000 pesetas and the yearly figures showed a definite tendency to increase; thus the average yearly expense had been from 1909 to 1913 75,000,000, from 1914 to 1918 146,000,000 and from 1919 to 1923 358,000,000 pesetas. The outlook was therefore black for Spanish finance, particularly as the budget for the year 1922–3 showed a net deficit of 920,000,000 and a total of actual expenses estimated at 3,373,000,000. The increase in military and naval expenditure for the period 1915 to 1922–3 had been 167%, while the net revenue of the State had only increased about 100%.

The burden which the Moroccan question imposed on the Treasury was aggravated by other problems which the nation was unable to put aside. The railways were face to face with a severe crisis due to a variety of reasons, industrial and financial. A system of recoverable advances to the companies established in 1920 had resulted in the shifting of part of the financial burden of the railways from the private companies to the State. In three years the Treasury had handed over 173,000,000 to the

companies. Moreover, in April 1920, confronted by a dangerous conflict between the owners and the men, the government had consented to meet any additional expense caused by increases in the wages of all railway servants. As a result of this decree of April 1920, the Treasury had to disburse from the said date until Sept. 13 1923, a sum of 328,000,000 pesetas. The economic situation had somewhat improved since 1920–1, when the tension between owners and men was at its highest, particularly in Catalonia, where professional agitators victimised both owners and men to such an extent that in the year 1921 there were in Catalonia alone 145 attempts on human life causing 90 deaths.

In Sept., 1923, the debates of the parliamentary commission on the disaster of 1921 were drawing to a close and the commission was ready to draft its findings and submit them to Parliament. Several well-known politicians were stated to be deeply involved either for lack of foresight or because they had allowed too much freedom to the military or—and this was perhaps the most dangerous element in the situation—because they had accorded too much unconstitutional initiative to the King. Other difficulties, no less grave, were raised owing to the ill-feeling with which the army received any parliamentary or civilian criticism of its action in Morocco. While the nation was anxiously wondering what was going to be the next development of this long-drawn conflict, a dramatic stroke brought suddenly to an end the system under which the country had lived since 1875.

Primo de Rivera.—The captain-general of Catalonia, Don Miguel Primo de Rivera (Marqués de Estella) rebelled against the government, threatening its members with jail, and seized power first and office afterwards. Don Miguel Primo de Rivera had already once or twice appeared in the limelight owing to declarations on such questions as the giving up of Morocco, on which he held, from the first, courageous if unorthodox views, and on the interchange of Gibraltar and Ceuta. This last expression of opinion had caused his removal from the position of military governor of Cadiz which he then occupied. At the time of the *coup d'état* General Primo de Rivera was captain-general of Catalonia, his headquarters being in Barcelona, where he wielded considerable political influence. There is no doubt that he utilised his office as the jumping-ground for his bold adventure, for his first steps were certainly taken in agreement with, if not with the full concurrence and help of, the conservative homerulers of Catalonian politics.

In the early morning of the 13th, the government published the news that the captain-general of Catalonia had risen in arms against the government, that the government would not leave its post and that the King, who at the moment was in San Sebastian, would arrive in Madrid the same day. The military authorities of Bilbao and Saragossa, it was reported unofficially, had sided with the rebels and in Madrid a council of military commanders of the Madrid garrison were acting for Primo de Rivera. The captain-general of Madrid, General Muñoz Cobos, maintained a cautious, though dubious attitude. A manifesto published the same day by Primo de Rivera declared that it was indispensable to liberate the country "from the professional politicians, the men who, for one reason or another, are responsible for the period of misfortune and corruption which began in 1898 and threatens to bring Spain to a tragic and dishonourable end." The general added that "the wide net of greedy politics has caught in its meshes and imprisoned the royal will itself." He announced the constitution of a military directorate in Madrid which was to find for the problem of Morocco a "quick, dignified and sensible" solution and was to bring home responsibility "promptly and justly" by the formation at an early date of "tribunals of recognised moral authority." He brought accusations of a grave character against the Foreign Secretary, Don Santiago Alba, who had taken a strong stand against military action in Morocco, and announced that Alba would be prosecuted immediately, as well as the Prime Minister himself, Marqués de Alhucemas, for the support he had given to his Foreign Secretary.

Immediately after the King's arrival (delayed 24 hours) the Prime Minister called on His Majesty and proposed strong action against the military rebels, but the King asked for time for reflection and the government resigned. Two hours later a deputation of generals was received at the Palace and, as a result of this visit, the King requested Primo de Rivera, still in Barcelona, to take office, while accepting the authority of the military directorate which had been previously constituted by him. Upon his arrival in Madrid on Sept. 15, Primo de Rivera proceeded to transform the military directorate both in its personnel and in its constitution. The first directorate was confined to the military commanders in Madrid; the one founded by the General represented all the branches and all the garrisons of the army: it contained a brigadier-general from each military district belonging each to a different branch of the service and a representative of the navy, in the person of Admiral Marqués de Magaz, a member of the permanent advisory commission on military, naval and air questions of the League of Nations.

From a constitutional and administrative point of view, the directorate struck an original note. The only Minister was Primo de Rivera himself. As a whole, the directorate was the equivalent of the Council of Ministers, but the directors were not Cabinet Ministers. The various ministerial departments were entrusted to the care of under-secretaries, but final decisions were always taken by the directorate as a whole, after a special report had been received from one of the directors, not necessarily always the same for the same department. The under-secretaries in charge were in some cases genuine permanent officials, in other cases minor political or semi-political figures eager for advancement. The Home Office was entrusted to General Martinez Anido. Public opinion received the change in absolute silence, save for a protest from the Socialist party. The other political parties remained silent, except the followers of Maura who, without the approval of their chief, declared in favour of the new administration because "the Crown had accepted it and the unmistakable majority of the country was behind it."

The Directorate's Policy.—Meanwhile the directorate began to assert itself. It declared the country in a state of war. The Press was put under a strict censorship and all public demonstrations of a political character were forbidden. A government manifesto was addressed to the working-classes foreshadowing, if necessary, the enforcement of compulsory laws in order to fix the hours of work and rate of wages. All provincial governors were dismissed and their authority handed over to the military. The municipalities, which were considered by the new administration as nests of political corruption which the directorate had come to destroy, were the object of systematic scrutiny. No fewer than 115 municipalities were thus closely inspected by the military, who failed however to bring forth proof of any substantial local corruption. Nevertheless, the directorate replaced most of the municipalities of the country by a new personnel chosen amongst local people who happened to be trusted by the military delegates, and appointed officers to take supreme control over local politics and administration. Military men were also appointed to a considerable number of high public offices. In order to forestall possible trouble in the lower ranks of the army, a substantial rise in pay was granted to non-commissioned officers. A heavy budget for public works, amounting to 54,000,000 pesetas, was set aside for Morocco.

On Nov. 13, two months after the *coup d'état*, Count Romanones and Don Melquiades Alvarez, the presidents respectively of the Senate and of the Congress of Deputies, called on the King in order to remind him that the Crown was under a personal constitutional obligation to call the Cortes together within three months of their dissolution. The two presidents drew the attention of the King to the fact that this article of the constitution had always been scrupulously respected during the 47 years it had been in force. The King referred the matter to the directorate, and an official note from the Government was published to the effect that these two statesmen who were deprived of their posts and privileges were the representatives of a decaying parliamentary system and their visit an ingenious move in favour of a political régime which had passed away.

The King and his Premier went on an official visit to the Court of Italy in Nov. 1923. Three sets of facts must be recorded in connection with this visit. First, the public and private expressions of approval from the King and from Primo de Rivera for the success and methods of Fascismo. Thus the King declared to General Italo Balbo: " I admire Fascismo. You are happy here in being so near the end of your labours. We are just beginning." Then the political activity of the King and his Premier in regard to the Vatican. The King read a sensational speech in the presence of the Pope which met with considerable criticism, not only in Vatican circles but also in Spain and South America. Spain was offered to His Holiness in the event of a new crusade being necessary. The answer of the Pope was a discreet, broad-minded pronouncement. Finally, it was widely believed that as a result of this visit a definite political programme of international co-operation between the two Mediterranean peninsulas was being prepared, a view belied by subsequent events. The next important step in the foreign policy of the directorate was the signature of the Tangier Convention in Dec. 1923. This Convention, which was severely criticised in the country, excluded Tangier from the Spanish Zone, establishing for it an international régime. Public opinion in Spain on the other hand had always considered that the alternatives for Spain in Morocco were either giving up the whole adventure or else remaining in Morocco with Tangier as the basis for action. In spite of the strict censorship, the hostility of public opinion became clear and the directorate took great pains to explain away the awkward fact that, although the country was at the moment governed by a strong dictatorship, its strength could not reach beyond the frontiers and indeed seemed in the international sphere to be weaker than the old system which it had replaced.

Home Affairs.—In home politics the government continued to repress all hostile expression of opinion. The agitation for an inquiry into the Moroccan campaign remained active and had for its centre the Ateneo de Madrid. The directorate, after having vainly attempted to obtain from the Ateneo its consent to a curtailment of its liberty of speech, closed the club—the first time since its creation in the second half of the 19th century. Don Miguel de Unamuno (*q.v.*), the famous author and professor of Salamanca University, whose strong stand against the directorate, expressed in indignant and sometimes offensive articles in the Press of South America had greatly incensed the directorate, was exiled to the Canary Islands.

Though the activities of the government were mainly concentrated on Morocco it did not, however, neglect internal matters. Thus in March 1924, the council of national economy was created in order to co-ordinate the activities of numerous economic organisations working under several departments. The council of national economy was divided into six sections: tariffs, valuation of goods for tariff purposes, statistics, commercial information, defence of production, treaties of commerce. The directorate freed itself from any legal restrictions in the matter of accountancy and financial administration and its decrees had the full force of law. It found a treasury heavily burdened with military and Moroccan expenditure and a budget with a regular deficit. In April 1924, it floated an internal loan of 700,000,000 pesetas of four-year-term bonds at 5% and 1% sinking-fund, in order to meet the Treasury Bonds issued by them in Oct. 1923. This loan was covered nearly eight times over. Further in 1923 the directorate organised a national railway council in order to regulate and co-ordinate the administration of the railway companies, the State and the companies sharing in the administration and the State participating in the financial liabilities and assets of the companies. As a result of this step the government launched a railway loan (Oct. 1925) to the amount of 300,000,000 pesetas at 5% free from tax. This loan had but a moderate success in contrast with the success of the loan of Treasury Bonds made in Nov. 1924, mainly owing to the fact that the economic crisis through which the country was passing, due among other reasons to excessive protection and continual deficits, had become graver.

Elated by the success of the loan floated in Nov. 1924, the directorate then began to consider the possibility of perpetuating their régime by the creation of a political party outside the framework of the old ones which they christened the " Patriotic Union Party," while refusing to other political organisations the right to address public meetings. In the old City of Medina del Campo representatives of many civilian municipalities met the president of the directorate and asked him for tariff protection and agricultural credits. A similar movement aiming very much at the same ends, was active in Andalusia, supported largely by the great land-owners anxious to obtain some betterment of the financial and economic conditions of agriculture, but oblivious of what is perhaps the most important factor in the agricultural situation of Spain, namely the conditions under which land is held by the small land-owner and cultivated by the labourer.

New Phase in Morocco.—The problem of Morocco, however, soon monopolised the attention of the president. The expenses continued to increase. The Budget of 1923–4 had to face a deficit of 576,000,000 pesetas, compared with a deficit of 920,000,000 in the budget of 1922–3, and of 1,101,000,000 for 1921–2. The decrease in the deficit in 1923–4 was not due to a reduction in expenses, but to a considerable increase in receipts due to the rise in the assessment of the tax on *utilidades* (a kind of tax on incomes) and to a better assessment of local and urban taxable property. As for the year 1924–5, while financial papers estimate the deficit at 1,000,000,000, the directorate declares that it does not go beyond 600,000,000. There is no doubt, however, that the figures show a considerable and continuous increase in the military and Moroccan expenses of the country. General Primo de Rivera tackled the problem of Morocco with characteristic courage. In the summer of 1924 he decided to carry out what had always been his plan, namely, a considerable withdrawal and a curtailment of military liabilities. Two obstacles lay across his path. The first was that in taking this decision he was but following in the wake of the Foreign Secretary whom he had violently expelled from power, since the policy of an agreement with the Rifian leaders and of withdrawal from the more inaccessible parts of the Spanish zone, as well as the transformation of a military occupation into a civil administration, had all along been advocated by Alba.

The second obstacle was that the Spanish Army in Morocco did not consider that it had sufficiently avenged the disaster of Anual and would not hear of any proposals for withdrawal. In the face of these two obstacles, Primo de Rivera resolved to carry out his policy and he deserves all credit for having succeeded first, in imposing his views on the Spanish Army in the field at the risk, not only of his popularity, but even sometimes of his life, and also for having most skilfully conducted a difficult military retreat covering all the zone between Tetuan and Xauen. Later events, however, obliged General Primo de Rivera considerably to modify his policy in Morocco. In the summer of 1925 a sudden attack launched by Abdel-Krim against the French forces in the French Protectorate, led to the combined action of the two countries interested in Morocco. The French Govt. sent to Spain M. Malvy, who negotiated with General Primo de Rivera an agreement for military and political co-operation which led to the recovery of the French territory lost during the first onslaught of the Rifian troops, and to the occupation of Abdel-Krim's headquarters, after a brilliant landing in Alhucemas Bay by the Spanish troops. (For later developments *see* MOROCCO.)

From the political point of view, this episode in the Moroccan War may be considered as one of the many instances of Spanish co-operation in international politics with France and England. Since the War the foreign policy of the Spanish Govt. has followed the lines of this co-operation. The first neutral State to join the League of Nations, Spain has occupied since an elective seat in the Council and, partly owing to its neutrality in Europe, and partly owing to the ability of its representative in the Council, Señor Quiñones de León, has often played in the League the rôle of " honest broker " in questions in which there was a difference of opinion between the Great Powers. This was

so in the question of Upper Silesia, in the case known as the "Corfu case," and in others of smaller importance.

Municipal Reform.—During 1925 the directorate embarked on a thorough-going reorganisation of the provincial and municipal administration of the country. The government promulgated two decrees. The first deals with municipal reform and aims at establishing a system of municipal autonomy, delegating to municipalities the right to levy certain rates, thus enabling them to set up their municipal treasuries; and establishing female and proportional suffrage in municipal stations. A similar decree has been promulgated concerning provincial administration, the most important effect of which was the abolition of the *Mancomunidad*, a kind of Catalonian local parliament. In its Catalonian policy the directorate soon reversed the pro-home rule orientation which had inspired the first utterances of Primo de Rivera. The Conservative home-rule elements of Catalonia, in supporting the first steps of Primo de Rivera, had undoubtedly hoped that the president of the directorate would facilitate a policy of devolution. He, however, found considerable opposition to such a course amongst the military forces which surrounded him for, gradually, the sympathies of the directorate towards the Catalonian autonomist movement disappeared and made way for a régime which was described in Catalonia itself as one of systematic persecution.

The country owes to the directorate a fuller measure of internal peace than it had enjoyed under the old system, and this fact certainly helps to facilitate its task. Nevertheless the military government, though with the best intentions, is inflicting on the country grave harm in depriving it for such a long time of the normal channels for the expression of public opinion. With the Press gagged, and political leaders of the country deprived of their right to address the public, public opinion cannot exist, let alone express itself. Rumours are astir all over the country, as is always the case when news is controlled by official means. Local risings such as that of Vera in 1924 which, though a purely local affray between civil guards and obscure men, ended in the execution of three misguided individuals, and widely spread military conspiracies such as that discovered in Nov. 1925, which led to the imprisonment of several generals in Madrid and of a few professors in Barcelona, revealed an unhealthy state of affairs. Though the president of the directorate often describes the system for which he is responsible as the first phase in a new order of things, it would be more accurate perhaps to describe it as the last phase of the old order.

Nor is this observation in any way weakened by the choice of his collaborators in the recent transformation of the directorate into a Ministry or Cabinet. On Dec. 3, Primo de Rivera parted from his military team and formed a Ministry of which, apart from himself and the Ministers of War and Marine, a fourth soldier was a member in the person of Martinez Anido, who became Home Secretary and vice-president of the council. The other Members of the Cabinet were for the most part young and unknown men drawn from the extreme right of the old party system. Primo de Rivera, in becoming president of the council, made it perfectly clear that he meant to retain full powers as dictator, and he emphasised, in particular, that the Press should remain under the same system of strict censorship. During 1926 the censorship, both of the press and of persons, was vigorously used, especially in Catalonia, one eminent professor being exiled.

It seems obvious that the country must pass through more dangerous waters before coming to calm seas again. But, one of the hopeful signs is the calmness and apparent indifferences with which Spain is accepting its present trials, for it shows that the nation, after a long period of agitation, has at last come to realise that political progress is a matter of silent and daily work rather than of dramatic action and violent enterprise.

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II. EDUCATION

From the beginning of the 20th century there has been marked educational activity in all parts of Spain. A large number of students and teachers are sent abroad to study every year, and they constitute a reserve from whom teachers and research workers are being recruited. With the help of the "Committee for the Extension of Scientific Study and Research" (an autonomous but official body), departments for the study of mathematics, biology, physics, chemistry, botany, philosophy, philology, history, archaeology, palaeontology and law are being founded. The same committee was responsible for the founding of the *Instituto-Escuela* in 1917—an establishment for secondary education which, attended by hundreds of girls, is rapidly transforming old educational methods, particularly as it exercises considerable influence over other secondary education centres.

Primary education is also improving in respect of the numbers, salaries and training of teachers. The number of teachers in 1917 was 26,253; in 1920, 28,202; in 1924, 30,180; and in 1925, 31,180. Illiteracy is decreasing, but only slowly, owing to the lack of sufficient schools and the number of poor families who are compelled to send their children of school age out to work. The statistics for illiteracy, which is of course most marked in the rural centres, are as follows:—in 1887, 68·01%; in 1900, 63·78%; in 1910, 59·35%, and in 1920, 52·23%.

The *Junta de pensiones para Ingenieros y Obreros* gives assistance for technical and professional training and sends the most suitable engineers and the most intelligent and industrious workmen, including those who are engaged in agriculture and its subsidiary industries, to the best industrial centres for purposes of study and training. The 11 existing universities have, according to the last complete census, that of 1923, 25,690 students, recording a steady increase since 1914–5, when the number was 20,497. The normal schools for male teachers, numbering 42, have passed through a critical period owing to the poor pay of the teachers, but since the increase in their commencing salaries—3,000 pesetas and residence—in 1923, the number of entries has increased, exceeding 5,700 in 1922, and 7,000 in 1925. The 48 normal schools for women teachers had 12,100 pupils in 1922, and over 14,000 in 1925. All these schools are recruited from all classes of the community, and a considerable number of the pupils come from good upper-middle-class families. Secondary education also has its difficulties, and as the 60 existing *institutos* or state secondary schools are unable to provide for more than 32 to 35% of the scholars available (54,602 in the last census), many have to take their educational courses in private schools.

The 37 schools of art and industry, which teach some 40,000 pupils, are unable to absorb the large number of applicants from the working classes. There are 23 commercial schools, two schools for the training of industrial engineers and one each for the following:—mines, forests, roads, canals and ports, and agriculture. It is interesting to note that there is a revival in the study of the old Spanish industrial arts—ironwork, artistic textiles, leatherwork, embroideries, lace, carpets, ceramics, etc.

III. ECONOMIC HISTORY

Population.—According to the census of 1910 the population of Spain was 19,995,686. By 1920 it had grown to 21,389,842, and according to an estimate of 1925 it was 21,966,000.

The principal centres of population are:—

	Inhabitants		Inhabitants
Madrid	750,896	Barcelona	710,335
Valencia	251,258	Seville	205,529
Malaga	150,584	Saragossa	141,350
Murcia	141,175	Granada	103,368

These are the only cities whose population exceeds 100,000. The population of the large towns is increasing, and whereas in 1900 to 1910 the provincial capitals accounted for 16% of the total population of the peninsula, in 1920 this percentage had increased to 18·8 and it was calculated that in 1925 it would have approximated to 20%. The population is most dense in the province of Biscay, with 189 inhabitants per sq. kilometre; Barcelona, 175; Guipuzcoa, 137; Madrid, 133, and Pontevedra,

121. It must be remembered, however, that it is Barcelona and Madrid that are responsible for the density of the population in two of these provinces, and that in the same way Biscay contains Bilbao and Guipuzcoa contains San Sebastian.

Pontevedra is the province with the greatest actual density of population per kilometre, followed by La Coruña, while those with the lowest density are Soria with 14, Guadalajara, Cuenca and Huesca with 16, Albacete with 19 and Cáceras with 20. The average birth-rate for the period 1918–22 was 29·2 per 1,000 inhabitants, and the mortality 24·4—a high rate which is leading to a demand for hygienic reform among the more enlightened sections of the community.

Agriculture.—The abnormal profits made during the War led to an extension of the areas under cultivation, some of them unsuitable, and also to the uneconomic exploitation of forests, with the following three results: (*a*) the extensive purchase and use of agricultural machinery; (*b*) the introduction of better methods of cultivation; (*c*) hygienic improvements on the farms, and the provision of water for irrigation purposes. Much benefit is expected when the following irrigation works are completed:—

(1) The central canal of Aragon, with its smaller offshoots, which, with the Ebro, will water 300,000 hectares of Upper Aragon.

(2) The irrigation works of Alicante and Murcia, now almost completed, which are turning the steppes of those provinces into orchards.

(3) The series of reservoirs and canals, some of them completed, like that at Jerez and others under construction, which will irrigate 100,000 hectares in the fertile valley of Guadalquivir.

(4) The works already begun for making the Guadalquivir navigable up to Córdoba, the construction of weirs to regulate the course of the river and reservoirs from the springs feeding the Guadalquivir which will provide electrical power and also help navigation.

The works under (1) and (3) are State; (2) and (4) are private enterprises.

In Old Castile and in the " Reino " de León the experimental farms of Palencia, Valladolid and Zamora are introducing new arable methods, and there is noticeable progress in all parts, though in the north and northeast, with their small holdings and lack of credits, the advance is not so rapid.

The average production of wheat was:—

In 1910–4	34,119,556 metric quintals
In 1915–9	38,061,869 metric quintals
In 1919–24	35,437,831 metric quintals

an increase that has made Spain self-supporting in cereals apart from bad harvest years like those of 1922 and 1924.

Spain has now attained first place in the world production of olive oil, with marked effects on its trade balance. The average production of oil in metric quintals was:—

1905–9	1,961,985	1915–9	3,105,313
1910–4	2,132,960	1920–4	3,034,761

The olive cultivation areas were: 1914, 1,453,000 hectares; 1917 over 1,504,273 hectares; 1924 over 1,624,233 hectares.

Andalusia alone produces two-thirds of Spain's output of an average of 300,000 metric tons per annum, which is more than 45% of the world's production.

The valuable wine trade suffered from the same crisis which affected both France and Italy, but production is increasing, the average figures (incomplete) being: for 1915–9, 20,072,703 hectolitres; for 1920–4, 23,882,000 hectolitres.

The production of beet sugar is increasing, and in the valley of the Guadalquivir is very profitable, owing to the high sugar content. This success reacts on the industry throughout Spain, because of the cheapness of the arid land on which beet cultivation was first started. The average value of agricultural products was estimated at 3,824,394,425 pesetas for 1903–07, at 7,975,623,025 in 1916 and at 9,201,476,000 in 1923.

Commerce.—The character of Spain's foreign trade changed during the War, for the balance hitherto always unfavourable save at exceptional periods, as for example, when the French vines were attacked by phylloxera, became favourable.

Average imports in pesetas		Average exports in pesetas	
1910–4	1,868,446,602	1910–4	1,092,129,014
1915–9	1,110,239,020	1915–9	1,263,546,180
1920–4	2,573,522,339	1920–4	1,306,689,864

It must be remembered, however, that the imports for 1915–9 include the large remittances of gold which the bank of Spain amassed during the War. The commercial landslide from which the country suffered after the War can be gauged from the fact that whereas in 1919 the balance of exports over imports rose to 235,000,000 pesetas, the imports in 1920 exceeded exports by 420,000,000 and in 1924 by 1,199,000,000. Spain met this unfavourable balance by invisible imports such as the freights earned by her mercantile marine, and by the large remittances sent by its emigrants in America, to the value of over 200,000,000 of pesetas for the northwest region alone. This latter source of revenue is continually increasing owing to the growing custom of the emigrants of leaving their families in Spain for the first few years, and also owing to the increasing economic importance of definitely Spanish centres in certain countries such as Cuba, Mexico and Argentina. The following figures (pesetas) are for the last year available, 1924:—

Imports	Pesetas
Livestock	14,803,260
Raw materials	955,841,063
Manufactured articles	1,497,589,893
Foodstuffs	476,652,218
Gold in bullion and coin	2,146,090
Silver in bullion and coin	123,380
Total	2,947,155,804

Exports	Pesetas
Livestock	3,639,220
Raw materials	350,465,603
Manufactured articles	401,245,505
Foodstuffs	992,234,967
Gold in bullion and coin	2,442
Silver in bullion and coin	262,380
Total	1,747,850,177

Thus, agriculture alone supplied in foodstuffs 56% of the total exports, whereas manufactures contributed only 22%.

Of the imports in 1924 Great Britain contributed 17·16%, the United States 16·55, France 13·74, Germany 5·90 and Argentina 4·70. Of the exports, Great Britain absorbed 21·80%, France 19·79, the United States 10·01, Cuba 6·03, Argentina 5·71 and Germany 5·66. Spain has had considerable tariff difficulties with other countries. An Anglo-Spanish commercial treaty was ratified in April 1924, and remains in force for three years from the date of ratification.

Industry.—Since the War Spain has tended to become self-supporting, and there is a general tendency to substitute goods of Spanish origin for foreign imports. Many industries however have been passing through periods of severe depression due to some extent to the poor purchasing power of the middle and working classes. The textile industries of Catalonia more particularly have been suffering from an inadequate home demand and also from a reduction in exports, leading to a strong demand for protection. The equipment of this industry is not sufficiently up-to-date, as only a small proportion of the spindles in use are of recent construction. Moreover Spanish textiles are not concentrated in large concerns, but divided among small firms. The War, however, gave the textile industry a period of prosperity hitherto unknown. Taking the 1913 index as 100, the following table shows imports and exports:—

	1914	1915	1916	1917	1918	1919	1920
Cotton textiles:							
Imports	92·2	150·4	111·5	107·5	68·4	80·3	101·3
Exports	93·5	316·8	246·9	258·2	233·3	239·2	137·8
Woollen textiles:							
Imports	67·7	93	102·7	66·1	169·9	73·7	103·8
Exports	188·9	583·5	411·1	342·1	283·5	337·7	184·5

In the years 1922–4, cotton manufactured goods were exported to the value of 54, 56 and 54 millions of pesetas, and woollen to the value of 33, 37 and 43. The sugar industry continues to grow, the average annual production of sugar for the period 1915–9 being 121,789 and in 1920–4, 174,215 metric tons. The iron and steel industry benefits from the high tariff, and has been erecting more factories, but the latest statistics, those for 1922,

do not include the new plant installed in the northeast and in Biscay, and make no mention of the extensions rendered possible in Biscay and Barcelona by the construction of new locomotives for the railways, or of the huge electrical plant erected in Córdoba.

Mining.—The output of minerals in 1923 was 1,900,000 tons in excess of that in 1922. The following are the values for 1922 and 1923:—

	1922	1923
	Pesetas	Pesetas
Minerals	290,391,411	389,370,340
Metals	460,708,518	730,021,550
	751,099,929	1,119,391,890

This apparent increase of 368,000,000 ought to be reduced to 140,000,000, owing to the inclusion in the 1923 figures of certain items which did not appear in those for 1922. The production of coal represents 50% of the total mineral production of the country, but the coal industry whose output, including lignite, was 1,600,000 tons more than that in 1922, began to experience difficulties in 1924, owing to a variety of causes, such as the resumption of imports which tended to close the poor pits exploited during the War, the gradual re-adaptation of industry to peace conditions, and the general causes which depressed the industry throughout the world. Consequently some mines were closed down, there was a decrease in employment, followed by an increase of production per head of labour employed. Thus in 1920, when the highest price per ton was reached, namely 70 pesetas, the production of Asturias—the district accounting for 50% of the national production—was 2,900,000 tons for 39,000 miners; and in 1924 the production was 3,900,000 tons for 30,000 miners, while the price per ton fell from 70 pesetas in 1920 to 27 in 1924. National production, which was 4,200,000 tons in 1914, rose to 6,200,000 in 1924, but does not meet the national consumption, which is increasing, for, whereas in 1920 it was 5,800,000 tons, in 1924 it rose to 7,600,000, the difference being mainly imported from England. Apart from coal, the principal minerals are pyrites, zinc, iron ore, copper and lead.

Communications.—The network of main roads maintained by the State, which at the beginning of the War totalled 51,634 km., rose in 1919 to 58,022, and at the end of 1925 exceeded 60,000. The railway lines according to the 1923 statistics covered 15,300 km., excluding the construction of the double line which is well on its way. The average annual number of passengers carried from 1915–9 was 72,045,742, rising in 1920–4 to 103,583,881 and the tonnage of goods carried, which was for 1915–9 34,345,773, rose in 1920–4 to 35,262,932 (figures incomplete), despite the rise in tariffs and the industrial crisis of 1920–1. Revenue per kilometre has risen from 27,602 pesetas to 51,828 and expenditure from 14,850 to 37,550. The outstanding feature of railway administration in 1925 was the Railway Statute passed by the Military Directorate which provides for the participation of the State in the financing and management of the railways. In connection with the first issue of railway bonds by the State in Oct. 1925, the Government was able to vote 300,000,000 pesetas for improvements in the transport service, which is still inadequate for the industrial necessities of the country.

Shipping.—Spanish shipping is still in a backward state, the percentage of ships over 20 years old being 52·27, compared with 21·72%, the average calculated for the rest of the world. Consequently, though the Spanish merchant marine is absorbing the coastal trade, in the ocean-going trade there is an increase in the number of vessels under foreign flags which enter and leave Spanish ports with cargoes of Spanish imports and even with a considerable portion of the exports. The result is that the shipping interests are insisting more and more on protection.

	Sailing Ships		Steamships	
	Number	Tonnage	Number	Tonnage
1914	237	32,974	633	747,022
1925	554	95,775	687	1,141,529

Banking.—The Bank of Spain which in 1913 held 472,000,000 gold pesetas, held in 1920 over 2,448,000,000 and at the beginning of 1925 2,558,000,000, representing a reserve of over 58% of the 4,352,000,000 pesetas in note circulation at the same date. The guarantee credits which in 1915 were 166,000,000 rose to 1,830,000,000 at the beginning of 1925, and the current credit accounts rose from 689,000,000 to 1,209,000,000. The dividends since 1900 have never fallen below 19%, and were 44% in 1921, and despite the rise in the shares, they continued to pay 28% in 1922 and 1923. The fall in the prestige of Spanish private banks, due to more than one failure, and the large number of bankruptcies since 1922, have compelled the directorate to take steps for exercising closer supervision over private banks. Savings bank returns show an increase from 525,372,000 pesetas in 1915 to 756,000,000 in 1918, 1,456,000,000 in 1922 and, it is calculated, over 2,000,000,000 in 1925.

Towards the close of 1923, and up to the end of March 1924, the peseta gradually weakened, but in April there was a sharp recovery, due to government measures to regulate speculation in exchanges, which was followed, however, by a gradual depression. The peseta, whose par of exchange in sterling is 25·22½, fluctuates from about 33·50 to about 34·50, and in view of the strong position of the Bank of Spain and the improvement in the trade and budget deficits, it is difficult to explain its depreciation. (F. DE LOS R.)

SPANISH LITERATURE (*see* 25.578).—The dominant feature of Spanish contemporary literature in 1910–26 may be found in a more conscious realisation of the creative element of the race by its critical element and, therefore, in a tendency towards the fusion of both these elements into a complete whole. With the death of Galdos, the sceptre of Spanish literature passes to Miguel de Unamuno, who represents the modern version of the Spanish mystic writer. His main concern is the relation of man to creation. It is the subject of his masterpiece *Del Sentimiento Trágico de la Vida* (1913), a book of passionate meditation (of which an excellent translation exists in English, *The Tragic Sense of Life*, 1921), and as an attitude of mind it dominates his criticism; *En torno al Casticismo* (1902), *Ensayos* (1916), *La Agonía del Cristianismo* (1926); his novels: *Niebla* (1914), *Abel Sánchez* (1917), *Tres Novelas Ejemplares y un Prólogo* (1920) and his play: *Fedra*. In these works Unamuno appears as the apostle of an ideal of life more closely connected with spiritual Easternism than with the intellectual and social tenets of the West. He thus fulfils in Spain much the same function as Dostoievsky did in Russia, for Spain like Russia is a transition between East and West. He aims at intensity rather than extension. His style is not unlike the style of Carlyle in that it is written with the whole being of the man, body and soul.

If, in order to complete the parallel with Russia, a Spanish western type of mind had to be opposed to Unamuno, as Turgeniev could be opposed to Dostoievsky, a younger man, José Ortega y Gasset, might be selected for this purpose. Ortega y Gasset is a refined humanist, strongly influenced by German contemporary Neo-Kantian schools of thought. His main work is in the field of criticism and psychology—*Meditaciones del Quijote* (1911), *El Espectador* (1917). In more recent books he has endeavoured to draw philosophical and psychological conclusions from current events; for instance, in the field of politics with his *España Invertebrada* (1922) and in that of philosophy and science with *El Tema de nuestro tiempo* (1923), a masterly commentary on the new vistas opened out to thought by the discoveries of Einstein. In this same school may be included José Martínez Ruíz (b.1876), better known under his literary name of Azorín, whose art has all the finish and exquisiteness, all the smallness also, of miniature painting. He has had the rarer merit of applying these gifts to the interpretation of national scenes and places, as in his *Castilla* (1920); *Los Pueblos* (1905); *La Ruta de Don Quijote* (1905), and has thus contributed in no small measure to the movement for national self-knowledge which is noticeable in contemporary Spain.

Fiction.—In fiction, though belonging to an older generation, Vicente Blasco Ibáñez must be mentioned. His war novel

Los Cuatro Jinetes del Apocalipsis (1916, Eng. trans. 1918) has made him famous with the English-speaking public. Older novels (and better ones) have been translated, such as *La Barraca* (1899); *The Cabin* (1919); *Sangre y Arena* (1908) and *The Matador* (1918). Blasco Ibáñez represents an art which is Spanish only in its subject but not in its spirit, manner or style.

Of a younger generation, Pío Baroja (b. 1872) is perhaps the most widely read. A Basque, with all the acuity of mind of his race and not a little of its rustic independence and antagonism to civilisation, Baroja writes abundantly and carelessly with more spirit than art. His best work is perhaps *Idilios Vascos*, in which he has rendered the quaint charm of his own country. Many of his works have been translated into English by American publishers. To this generation belongs also Ricardo León, who writes in a more consciously traditional vein and pays considerable attention to matters of style. His main work is *Casta de Hidalgos* (1908). Concha Espina, a brilliant woman novelist, has distinguished herself by novels of psychological insight and easy style, such as *El Metal de los Muertos* (1920).

Ramón Pérez de Ayala (b. 1881) is perhaps the best novelist of the younger generation. A critic of great talent and a poet, he has written several novels, the best of which are *Novelas Poemáticas de la Vida Española* (1916) (translated into English under the title of *Prometheus*) and *Belarmino y Apolonio* (1921). He is a typical exponent of the fusion of the traditional Spanish spirit with the conscious knowledge of its resources referred to above, as characteristic of contemporary literature in Spain. The same may be said of Gabriel Miró, whose delicate sensibility and deep knowledge of the language make him one of the most richly endowed authors of contemporary Spain. Among his works are *El Humo Dormido* (1920); *El Libro de Sigüenza* (1921); *Figuras de la Pasión del Señor* (1916) (this last translated into English 1924). Of recent years several authors have cultivated the utopian and satirical variety of novel-writing. To this kind belong *El Archipiélago Maravilloso* (1923) by Luis Araquistain, and *La Girafa Sagrada* by S. de Madariaga (originally written in English and published 1925). Among newcomers in novel-writing Claudio de la Torre and Felix Urabayen, *El Barrio Maldito* (1925) must be singled out.

Drama.—Jacinto Benavente still dominated the Spanish theatre during this period. His most famous play, *Los Intereses Creados* (1907), is not representative, for it illustrates but one phase of the talent of this many-sided author. A more powerful tragedy, *La Noche del Sábado* (1903), is of the same period. In more recent times he has given an intense drama of life in *La Malquerida* (1913). There is, however, a type of play in which Benavente must yield the prize to the brothers Álvarez Quintero (Serafín, b. 1871; Joaquín, b. 1873). As authors of Comedias de Costumbres these two writers, who always work together, are unsurpassed. The list of their comedies is long, and includes *Las de Caín* and *Puebla de las Mujeres* (1912). Other playwrights of note are Linares Rivas (b. 1866), remarkable for his skill in the handling of dialogue; Martínez Sierra, a name which stands for the collaboration of Don Gregorio Martínez Sierra (b. 1881) and his wife, resulting in a happy blend of dramatic skill and delicate psychology; and Pinillos (Parmeno) (1875–1923), a vigorous painter of social conflicts. The poetical theatre still lives in Spain, maintained by Valle-Inclán (b. 1870), Marquina Cata and Ardavín. In recent years a writer of unusual power, Jacinto Grau, has conquered the foreign stage, particularly with his *El Conde Alarcos* (1917), *El Hijo Pródigo* (1918). But drama and comedy are only one, and that not the most important, aspect of the Spanish theatre. Still more typical of the nation is what is modestly known in Spain as *Género chico* (small genre), a type of theatrical production consisting in plays generally short and accompanied by music and ranging from variety pieces akin to operettas to little masterpieces of musical drama. Its best-known exponents are the brothers Quintero and Carlos Arniches (b. Alicante, 1866).

Poetry.—The two main influences acting on Spanish poetry towards the close of the 19th century, *i.e.*, national tradition and the example of foreign poetry, particularly that of the symbolist school of France, which reaches Spain through South-American poets, such as Rubén Darío, are still at work. Though the first is the more vigorous and conscious, the second widens so as to include all influences: D'Annunzio, Maeterlinck, Tagore. More typically national are Unamuno, *Rosario de Sonetos Líricos* (1911), *El Cristo de Velázquez* (1920); Antonio Machado (b. 1875), whose pessimistic serenity is in keeping with the landscape of central Spain (*Soledades*, *Campos de Castilla*) and Salvador de Madariaga (b. 1886), whose *Romances de Ciego* (1922) re-state in a new form the old Spanish theme of Jorge Manrique. Other poets produce under more complex influences. Thus Manuel Machado (b. 1874), whose main inspiration is popular and southern has, nevertheless, written excellent verse in which the influence of French elegant sensibility is discernible; Juan Ramón Jiménez (b. 1881), remarkable rather for exquisite sensitiveness than for power (*Arias Tristes* and *Elegías*, 1908–10), is led by his melancholy moods towards fluid rhythms which, though more settled, are reminiscent of Maeterlinck and, through him, of Rossetti. Ramón del Valle-Inclán (1870), perhaps the most skilful musician among modern Spanish poets, has given in *La Marquesa Rosalinda* (1913) an admirable example of the adaptability of the Spanish language to the most exquisite and complicated rhythms. Ramón Pérez de Ayala in his three volumes, *La Paz del Sendero* (1916); *El Sendero Innumerable* (1916); *and El Sendero Andante* (1921), effects a happy wedding of thought with harmonious poetry in a work not wholly uninfluenced by Francis Jammes, D'Annunzio and Walt Whitman. Among the rising generation may be mentioned Pedro Salinas, Jorge Guillén, García Loria and Rafael Alberti.

Miscellaneous.—In the field of erudition and literary history the task of Menéndez y Pelayo is continued by Don Ramón Menéndez Pidal, whose works on the poem "Mio Cid" (1911, 1913, etc.) and on the Spanish Chronicles have thrown much light on the origin of Spanish epic poetry. Francisco Rodríguez Marín (b. 1855), editor of *Don Quijote*, a specialist of Spanish folk lore, has succeeded the Master as head of the National Library. Father Asín has won world-wide fame by his illuminating work on the Arabic origins of Dante. Of the younger generation Federico de Onís (b. 1885) has edited *Fray Luis de León* (1914) and Américo Castro (b. 1885) has worked on *Lope de Vega* (1919).

Journalism, always a great art in Spain, where the newspaper is infinitely more read than the book, is cultivated by all writers and everyone of the names mentioned above might be quoted here again. Mention must be made, however, of two eminent contemporary writers whose work is almost exclusively journalistic: Ramiro de Maeztu (b. 1874), a versatile mind whose educating influence on the Spanish reading public has been incalculable; and Luis Araquistain, a powerful dialectician and a master of the polemic style.

BIBLIOGRAPHY.—César Barja, *Literatura Española, Libros y Autores Modernos* (1924); E. L. Gómez de Baquero, *El Renacimiento de la Novela Española en el Siglo XIX.* (1924); Miguel de Unamuno, *En Torno al Casticismo* (1902); W. Starkie, *Jacinto Benavente* (1924); S. de Madariaga, *The Genius of Spain* (1923). (S. DE M.)

SPECTROSCOPY (*see* 25.619).—As developed since 1910 the science of spectroscopy has for one of its chief purposes the analysis of spectra, and the deduction therefrom of the structure of the atoms and molecules which generate the spectra. The progress which has been made in this connection has depended upon improved determinations of the wave-lengths of spectral lines, the further investigation of the varying spectrum of the same substance when excited to luminosity in different ways, the more complete analysis of certain spectra into regular series systems and, finally, on theoretical investigations. In another direction, important advances have been made in the interpretation of the spectra of the various classes of celestial bodies, which may be regarded physically as experiments on large masses of matter at various high temperatures.

Standards of Wave-length.—Extensive interferometer determinations of wave-lengths in the arc spectrum of iron, based upon 6438·4696 "international" ångströms for the red cadmium line,

have been made by K. Burns[1] and others, which provide the necessary standards for the general determination of wave-lengths by interpolation. It has been found, however, that the wave-lengths of many lines differ considerably in different parts of the arc, so that special precautions are necessary in order to obtain comparison spectra in agreement with the tabulated standards. Probably the most accurate set of standards are those given by C. E. St. John and H. D. Babcock,[2] who used a small central zone of a "Pfund" iron arc operated between 110 and 250 volts with five amperes or less, at a length of 12 millimetres. This list contains 1,026 lines, from λ3370 to λ6750, and for most of them the wave-lengths are believed to be accurate to 0·001 ångström.

Flame, Arc and Spark Spectra.—The range of spectroscopic research has been almost indefinitely extended by the discovery that the same substance yields different spectra when stimulated in different ways. Such differences are of little importance from the point of view of chemical analysis, but they have become of great significance to the physicist, and have also greatly aided in the interpretation of the spectra of celestial bodies.

The three typical methods of producing luminosity for the observation of the spectra of metallic elements or their salts are the flame, the electric arc and the electric spark. As a general rule, the three sources exhibit important differences. In the flame the lines are comparatively few in number; in the arc the flame lines remain prominent, but many more lines, including some which are as strong as the flame lines, make their appearance. In the spark, there is a tendency for many of the typical arc lines to disappear, whilst other lines may be much intensified, and entirely new lines may also be present. The important class of lines which are intensified, or which only appear under the violent action of the condensed spark, were designated enhanced lines by Sir Norman Lockyer, and this name has been generally adopted. The different classes of lines are thus commonly known as flame, arc and spark (or enhanced) lines, according to their relative prominence in these three sources. This classification, however, is in some respects imperfect, and more definite designations are now based upon the theoretical considerations to which reference will be made later. A detailed temperature classification of the lines of many elements has been based upon experiments with the electric furnace by King.[3]

Similar variations have also been observed in the spectra of gases when submitted to the action of discharges of varying intensity, and the different classes of lines are sometimes distinguished by analogy as arc and spark lines, although with few exceptions the arc is not actually employed. The actual spectrum given by a gas depends upon its pressure as well as upon the intensity of the discharge by which it is made luminous. Generally speaking, the greater the pressure of the gas the greater will be the strength of the discharge required to produce the "spark" lines.

One important aim of spectroscopic research has been to search for an explanation of these phenomena, for it cannot be doubted that the causes of the variations in the spectra are intimately connected with atomic structure. In this connection it will be instructive to refer first to the spectra of known compounds. There are many compounds which can be excited to luminosity without total decomposition,[4] and it has been found that each compound gives a characteristic spectrum by which it can be identified as such. These spectra invariably consist of bands, and different sets of bands characterise, for example, the oxides, chlorides and fluorides of the alkaline earth elements.

It is sufficiently obvious that if a compound be stimulated so strongly that it becomes dissociated, the spectrum will change from one consisting of bands representative of the compound to one containing the lines of the constituent elements. It is not only compounds, however, that show changes of this character. Experiments on nitrogen, for instance, show a range of spectra from one consisting wholly of bands to one in which lines occur alone. Even hydrogen has two spectra: (*a*) the highly complex, so-called secondary spectrum, which doubtless represents a banded spectrum of rather coarse structure[5] and (*b*) the familiar line spectrum, constituting the Balmer series. Similar results have been obtained for many other elements, and from analogy with the spectra of compounds the natural conclusion is that the band spectra of the elements arise from molecules, while the line spectra are produced by the atoms which are set free when the molecules are dissociated.

If this be a true view, the change in the structure of the atom, or in its mode vibration, which accompanies the successive modifications of the line spectrum becomes a question of paramount interest. Lockyer[6] did not hesitate to believe that while the arc lines of an element were to be attributed to ordinary atoms, the enhanced lines could only be produced by the splitting-up of the atoms themselves, and he called these simpler forms of matter the proto-elements. Proto-calcium, for instance, denoted calcium which had been broken up into sub-atoms by the application of a sufficient stimulus. A somewhat similar, but more probable, explanation has been based upon an application of the quantum theory by Bohr to Rutherford's nucleus theory of the atom. This theory is founded largely on the analysis of spectra into regular series. (*See* ATOM.)

Range of Observations.—For the complete determination of the laws of spectra it is necessary to extend the observations far beyond the limits of the visible spectrum. Conspicuous success in the direct photography of the near infra-red spectrum has been achieved by Meggers and others, by the use of ordinary plates stained with dicyanin.[7] By this method excellent photographs of the arc spectra of a large number of elements, extending to λ10,000, have been obtained with a concave grating, and the positions of the lines have been measured with a high degree of accuracy. For the present, the extreme infra-red can only be investigated by thermal effects, involving the use of the thermopile, bolometer or radio-micrometer, as in the researches of Paschen, Lehmann and Randall.

Spectroscopic observations in the direction of the ultra-violet, beyond the limit about λ1850 set by the absorption of quartz, and beyond about λ1700 set by the absorption of air, which were first made by Victor Schumann, have been greatly extended by the use of concave gratings in vacuum spectrographs by Lyman and others. R. A. Millikan[8] and his colleagues have observed lines as far as λ136Å. Several improvements in technique were necessary to this success. It was achieved, in the first place, by using gratings specially adapted for the purpose; secondly, by working in an essentially perfect vacuum, through the use of powerful pumps; and finally, since no ordinary spark could pass in a vacuum, by the use of a specially strong sparking apparatus which was capable of forcing a discharge across a very small space between the electrodes.

Spectroscopic data thus cover a very wide range, and offer many interesting problems to the investigator. Their solution depends on his ability to make a true analysis of spectra, and to deduce therefrom the corresponding atomic or molecular conditions.

Analysis of Spectra.—Great progress has been made in the investigation of the regularities in spectra. In these inquiries the position of a spectral line is most conveniently represented by its "wave-number" (ν); *i.e.*, the number of waves per centimetre *in vacuo*. In practice it is obtained by dividing 10^8 (the number of ångström units in a centimetre) by the wave-length as corrected to a vacuum. The simplest spectrum is that of hydrogen, which may be accurately represented by the simple formula:—

$$\nu = R\left(\frac{1}{m_1} - \frac{1}{m^2}\right)$$

where m_1,m are integers and R is the "Rydberg constant," having the value 109,678·3.[9] If $m_1 = 1$ and m takes successive integral values 2, 3, . . . the formula represents a series of lines in the extreme ultra-violet which has been called the "Lyman series." With $m_1 = 2$, $m = 3$, 4 . . ., there results the "Balmer series," extending through the visible spectrum to the near ultra-violet. Other series which appear in the infra-red, including the "Paschen series," are similarly represented by putting $m_1 = 3$, 4 and so on. R. W. Wood[10] has extended the Balmer series to $m = 22$ by experiments with long vacuum tubes, while 34 members of this series have been recorded in the spectrum of the sun's chromosphere during total eclipses. In each series, it should be noted, the lines become closer together and diminish in intensity as they approach the definite limit indicated by the first term of the formula. Theoretically, the number of lines in a series is infinite, but it often happens that only a few of the earlier members are observed, and no series has been traced to its limit.

[1] *Lick Obs. Bull.*, No. 247 (1913); *Zeit. f. Wiss. Phot.*, vol. 12, 209.
[2] *Astrophys. Jour.*, vol. 53, 260 (1921). *Trans. Int. Astron. Union*, vol. 1 and 2 (1922 and 1925).
[3] Several papers in the *Astropnys. Jour.*
[4] Stimulation by "active nitrogen," according to the methods of R. J. Strutt (now Lord Rayleigh) is particularly effective for the spectra of many compounds.—*Proc. Roy. Soc.*, vol. 86, 105 (1912).
[5] An excellent photographic map of this spectrum has been given by T. R. Merton, *Proc. Roy. Soc.*, A, vol. 96, 382 (1920).
[6] Sir J. N. Lockyer, *Inorganic Evolution* (1900).
[7] *Scientific Papers, Bureau of Standards*, Washington, No. 312 (1918) and subsequent papers.
[8] *Phys. Rev.*, vol. 23 (1924).
[9] W. E. Curtis, *Proc. Roy. Soc.*, A, 96, 147 (1920).
[10] *Proc. Roy. Soc.*, A, 97, 455 (1920).

There is only one other known spectrum which has the same simplicity as that of hydrogen—namely, the enhanced spectrum of helium. This includes the series first found by Pickering in the star ζ Puppis, and the line λ 4686 and others calculated by Rydberg, by whom both series were attributed to hydrogen. These lines were produced in the laboratory by A. Fowler,[1] and additional lines of the Pickering series, first indicated by Bohr's theory, were afterwards observed by E. G. Evans[2] and by Paschen.[3] It was, in fact, the theoretical work of Bohr which first suggested that the lines in question originated in helium and not in hydrogen.

The enhanced series of helium can be represented by a formula similar to that for hydrogen, with the difference that the series constant has rather more than four times the value for hydrogen, namely 4×109723. When $m_1=3$, and $m=4, 5 \ldots$ we obtain the series having $\lambda4686$ for its first number. The complete Pickering series is given by putting $m_1=4$, $m=5, 6 \ldots$, and a series in the extreme ultra-violet observed by Lyman is given when $m_1=2$. It should be noted that alternate lines of the Pickering series are nearly coincident with the Balmer series of hydrogen.

The spectra which are next in order of simplicity are the arc spectra of the alkali metals, lithium, sodium, potassium, rubidium and caesium. In each of these there are several series superposed, and all the lines are doublets. In the alkaline earth metals, beryllium, magnesium, calcium, strontium and barium, there are two systems of series, one consisting of singlets and the other of triplets. As in the spectrum of hydrogen, the lines of each series converge to a definite limit and may be represented by such a formula as that of Hicks, namely

$$\nu=\mathrm{A}-\mathrm{R}\Big/\left[m+\mu+\frac{\alpha}{m}\right]^2$$

where A, μ, α are constants calculated from the observed lines and m takes successive integral values. A is the limit of the series, and R the Rydberg constant. The constituent series are of different types, having names and symbolical representations as follows:—

Principal series	$=1s-mp$
Sharp series	$=2p-ms$
Diffuse series	$=2p-md$
Fundamental series	$=3d-mf$
F G series,	$=4f-mg$
etc.	etc.

In each case the first term denotes the limit of the series, while the second represents a sequence of *terms*, in which m has successive integral values. A group of such series constitutes a *system*, and there may be two or more systems in the same spectrum, as the singlet and triplet systems of the alkaline earths. It will be observed that in a given system the limit of a series is a term of one of the other series, and that a line is always represented as the difference of two terms. As first indicated by Ritz in his "Combination Principle," other series may exist, such as $2s-mp$, $3p-md$, etc.

In a singlet system, each of the terms has but one value, and all the lines are single. In a doublet system, s has one value and all the rest two values. The principal series thus consists of doublets, $1s-mp_2$ and $1s-mp_1$, diminishing in separation towards the limit; the sharp series of equidistant pairs $1p_2-ms$, $1p_1-ms$. The diffuse doublet series does not consist of double-doublets, as might have been expected, but of groups of three, one possible component being ruled out by a principle of selection to be mentioned later. In a triplet system, all but the s terms have three values, and certain intercombinations with the associated singlet system also occur.

Origin of Spectra.—The theory of N. Bohr[4] offers a very satisfactory explanation of the spectra of hydrogen and enhanced helium, and gives a physical meaning to the spectroscopic terms in general which has proved very fruitful in suggesting new directions of research. According to this theory, the atom of an element consists of a positively charged nucleus with an appropriate system of electrons in orbital motion around it, such that the total negative charge of the electrons is equal to the positive charge of the nucleus. Nearly the whole of the mass of the atom is concentrated in the nucleus, which is very small in comparison with the distances separating it from the electrons. When an electron is removed from its normal position by the application of an external stimulus, it may traverse temporarily one or another of certain orbits determined by quantum considerations and is said to be "excited." In each of these orbits it has a certain amount of energy, and there is no radiation so long as the electron revolves in such an orbit. When the electron returns to its normal position it comes to an orbit in which, for equilibrium, it must possess less energy than it had in the temporary orbit. The difference of energy, which is proportional to the difference of the corresponding terms, is emitted as a homogeneous radiation, and gives rise to a definite spectral line, while, if the electron occupies successively different orbits on its return, several lines will be produced in succession. The actual spectrum at any moment is the summation of the different lines yielded by atoms in different states.

The differences between the arc and enhanced spectra receive a simple explanation on the Bohr theory. The lines of an arc spectrum are supposed to be generated by the disturbance of a single outer electron and its subsequent interaction with the nucleus and remaining electrons. When two electrons are removed from their normal positions, and one remains at a great distance, the return of the second electron generates an entirely different spectrum consisting of the enhanced lines. An atom which has lost an electron is said to be "ionised": if it has lost two electrons it is doubly ionised, and so on.

Assuming the hydrogen atom to consist of a nucleus and a single electron, the energies of the possible orbits can be calculated, and are found to be proportional to the observed terms R/m^2. Helium, the next lightest element to hydrogen, has two electrons, and the mathematical problem of determining their motion has not yet been solved. If one of the electrons is removed, however, the atom is similar to that of hydrogen, except that the nucleus has a double positive charge and four times the mass. The resulting enhanced terms are therefore calculable. They again have the form R/m^2, but R has now a much larger value than it has for hydrogen. It is represented in both cases by the expression $\frac{2\pi e^2\mathrm{E}^2}{ch^3}\cdot\frac{m\mathrm{M}}{m+\mathrm{M}}$, where e,m and E,M are respectively the charge and mass of the electron and nucleus, h Planck's constant and c is the velocity of light. In the case of hydrogen $\mathrm{E}=e$, and when the experimental values of the various quantities are substituted in the formula, the series constant is reproduced with remarkable accuracy. The second factor increases with M, so that it will be slightly greater for helium than for hydrogen. Also, the double nuclear charge makes the first factor in the expression four times as great for enhanced helium as it is for hydrogen. These theoretical requirements have been completely verified by experiment. Fowler, calculating R for hydrogen and enhanced helium from the observed lines, used the theoretical expressions to calculate the value of M/m,—*i.e.*, the ratio of the masses of the hydrogen atom and the electron—and obtained a result in very close agreement with that arrived at by direct measurement. Moreover, he has shown[5] that in the more complicated spectra of the alkaline earths the enhanced line terms are also represented by formulae in which R has four times its value for arc spectra.

More recently, F. Paschen has identified 4 R series and 9 R series in singly ionised and doubly ionised aluminium respectively,[6] while Fowler has traced series of silicon for which the series constant has the successive values R, 4R, 9R and 16 R.[7] For convenience of reference these spectra are designated Si

[1] *Monthly Notices R.A.S.*, vol. 62, 63 (1913); *Phil. Trans.*, A, vol. 214 (1914).
[2] *Phil. Mag.*, vol. 29, 284 (1915).
[3] *Annalen d. Phys.*, vol. 50 (1916).
[4] *Phil. Mag.*, vol. 26, pp. 1–25; 476–502; 857–875 (1913); vol. 27, pp. 506–524 (1913); vol. 29, pp. 332–335 (1915).
[5] *Phil. Trans.*, A, 214, p. 254 (1914).
[6] *Annalen d. Phys.*, vol. 71, p. 142, and p. 537 (1923).
[7] *Phil. Trans.*, A, vol. 225, p. 1 (1925).

I, Si II, Si III, Si IV, and similarly for other elements. These results for elements at successive stages of ionisation give further strong support to Bohr's theory by their verification of the changing value of the series constant as electrons are detached from the atom one by one.

Further developments of the theory, taking into account the variation of the mass of the electron with velocity required by the theory of relativity, have indicated that the lines of the hydrogen and enhanced helium series are complex, and under high resolution should appear to consist of several components. This has been verified by Paschen,[1] who found results for helium in remarkable agreement with the predictions of Sommerfeld. The intensities of the several components also are in the ratio calculated by Sommerfeld by a special hypothesis.

Resonance and Ionising Potentials.—Strong support for the Bohr theory is also given by experiments in which atoms are bombarded by electrons of regulated speed. If an electron of charge e is made to fall through a potential difference V, it acquires a quantity of energy eV, expressed in appropriate units. If such an electron bombards a neutral atom, it is found that no change takes place until V reaches a certain value, when there is a sudden radiation of energy corresponding to a particular line—usually a strong flame line—in the spectrum of the bombarded atom. According to Bohr's theory, the energy in this radiation is equal to $h\nu$, and experiments with several elements show that this critical value of V is determined by the relation $eV = h\nu$. This means that the energy of bombardment has been just sufficient to remove the outermost electron in the atom from its normal orbit to the next permissible orbit, and, on its return, the electron restores the energy in the form of monochromatic radiation of the appropriate frequency. If V is expressed in volts, the wave-number of the emitted line is numerically equal to $V \times 8102$. The value of V when emission first takes place is known as the "resonance" or "radiation" potential. Further, by increasing V, it is possible to remove an electron from the atom altogether. If the energy eV in this case is equated to $h\nu$, the resulting value of ν is found to be equal to the largest term in the spectrum. This term would correspond to the innermost orbit of the electron, and the result indicates that the energy which must be applied to remove an electron from the atom is just equal to the energy possessed by the electron when revolving in its normal position. The potential required to remove an electron from the atom is known as the "ionisation potential." It has been determined experimentally for a number of elements, and has been found to be in complete agreement with the orbital energy as calculated from the largest term in the spectrum. The Bohr theory thus presents a simple picture of the processes taking place in experiments of this type.

Zeeman and Stark Effects.—The resolution of spectral lines under the influence of intense magnetic fields—usually known as the Zeeman effect—has been extensively studied for a large number of elements. Somewhat similar effects, but much greater in magnitude, produced by an electric field, have been brought to light by Stark and examined in considerable detail by a number of workers. J. W. Nicholson and T. R. Merton[2] have shown that the Stark effect may operate to an appreciable extent in an ordinary vacuum-tube discharge, causing a broadening of the lines. Both the Zeeman and Stark effects have been treated on the basis of the Bohr theory with success. A comprehensive set of rules for the calculation of the Zeeman effect for any combination has been given by Landé.[3]

The More Complex Spectra.—The spectra of the higher groups of elements are much more complicated than those of the earlier groups, and few series of the same simple types have been identified. An advance of great importance, however, was made in Professor Fowler's laboratory by M. A. Catalan[4] in the identification of complicated groups of lines in the spectrum of manganese and other elements which could only be accounted for on the supposition that spectroscopic terms may have a greater multiplicity than that represented by triplets. The groups of lines in question, showing internal regularities, were named multiplets, but it may be noted that the *pd* and *df* combinations in a triplet system, each consisting of six lines, are also entitled to the same designation. With this beginning, the analysis of complex spectra has proceeded vigorously, and the structure of even so compl cated a spectrum as that of iron has been elucidated. Thus, quartet, quintet, sextet and still higher systems of spectroscopic terms are now recognised.

Theoretical work based on quantum considerations has also progressed rapidly, and it is now possible to state quite briefly the rules which have been deduced from the analysis of spectra. Following Sommerfeld and A. Landé,[5] a spectroscopic term in general may be represented by n^r_{kj}, where n is the "principal" quantum number (related to m of the previous formulae), k is the "rotational" or "azimuthal" quantum number, j a characteristic "inner" quantum number, and r represents the *maximum* multiplicity in the system to which the term belongs. It is convenient in practice to replace n_k by ms, mp, etc., as used previously, it being understood that $k = 1, 2, 3, \ldots$ for terms of s, p, d . . . types respectively. The various components of a multiple term are then distinguished by using the relevant values of j as subscripts, which differ in this respect from the subscripts adopted until quite recently. When necessary to avoid ambiguity as to the system of terms under consideration, the multiplicity is indicated by an index figure on the upper left side of the term symbol. Thus 3^3p_2 indicates the term $3p$ of a triplet system which has the inner quantum number 2, it being understood that all p terms have $k = 2$. The characteristics of the first six groups of terms are shown in the appended table.

$k=1$	S_0 singlet $r=1$	s_1 doublet $r=2$
$k=2$	P_1	$p_1\ p_2$
$k=3$	D_2	$d_2\ d_3$
$k=4$	F_3	$f_3\ f_4$
$k=1$	s_1 triplet $r=3$	s_2 quartet $r=4$
$k=2$	$p_0\ p_1\ p_2$	$p_1\ p_2\ p_3$
$k=3$	$d_1\ d_2\ d_3$	$d_1\ d_2\ d_3\ d_4$
$k=4$	$f_2\ f_3\ f_4$	$f_2\ f_3\ f_4\ f_5$
$k=1$	s_2 quintet $r=4$	s_3 sextet $r=6$
$k=2$	$p_1\ p_2\ p_3$	$p_2\ p_3\ p_4$
$k=3$	$d_0\ d_1\ d_2\ d_3\ d_4$	$d_1\ d_2\ d_3\ d_4\ d_5$
$k=4$	$f_1\ f_2\ f_3\ f_4\ f_5$	$f_1\ f_2\ f_3\ f_4\ f_5\ f_6$

The combinations which ordinarily occur within the same system are those for which k changes by one unit; *i.e.*, $\Delta k = \pm 1$, and the p terms, for example, combine with s and d but not with f. The combinations are further restricted by the condition that $\Delta j = \pm 1$ or 0, with the exclusion of the transition 0 to 0; thus, in a triplet pd combination the nine lines which are arithmetically possible are reduced to six, namely, p_2d_3, p_2d_2, p_2d_1, p_1d_2, p_1d_1 and p_0d_1. When two or more systems occur in the same spectrum, the k and j rules are still applicable, and intercombinations are restricted to those for which $\Delta_2 = \pm 2$. Thus, in the alkaline earths there are both singlet and triplet systems, but in the combination of $^1S_0$ with ^3p, the application of the j rule shows that the only possible line will be $^1S_0 - {}^3p_1$.

As an illustration of one of the simpler multiplets, the following quintet pd group in the arc spectrum of iron may be quoted, the positions of the spectral lines being indicated by their wave-numbers, and the relative intensities by figures in brackets following the wave-numbers:—

d_0	d_1	d_2	d_3	d_4	
36431(10)	*90* 36521(20)	*184* 36705(15)			p_1
	36269(20)	*184* 36453(30)	*288* 36741(40)		p_2
		36063	*288* 36351(25)	*416* 36767(60)	p_3

Anomalous Terms.—The terms of ordinary types which have so far been considered are regarded as originating in the transitions of a single electron between different virtual orbits. It has been found, however, that in many spectra there are other terms resembling these in regard to their inner quantum numbers and Zeeman effects, but differing from them in following the combination rule $\Delta k = 0$; these are distinguished by writing them in the form s', p', d', etc., and are called "primed terms." A whole series of p' terms has been found in the alkaline earth spectra by H. N. Russell and F. A. Saunders[6] who have shown that the limit of the series is greater than that of any of the regular series. In other words, in some of the combinations pp' the atom radiates a greater amount of energy than that due to the largest jump which a single electron can make. The adopted explanation is that two of the outer electrons are displaced, and that the changes of energy of both are united in the emission of a single quantum.

[1] *Annalen d. Phys.*, vol. 50, pp. 901–940 (1916).
[2] *Phil. Trans.*, A, vol. 216, p. 459 (1916).
[3] *Zeit. f. Phys.*, vol. 15, p. 192 (1923).
[4] *Phil. Trans.*, A, vol. 223, p. 127 (1922).
[5] *Zeit. f. Phys.*, vol. 15, p. 191 (1923).
[6] *Astrophys. Jour.*, vol. 61, p. 38 (1925).

Other anomalous terms are similar in their combining properties to terms of regular types from which they differ only in the fact that they have no place in the Rydberg series. These are distinguished by doubly accented letters, as p'', d'', etc.

Spectra and the Periodic Table.—Attention is being drawn more and more to the relation of spectra to the periodic table of the elements. It has long been known that, when doublets or triplets occur in the spectra, the wave-number separations of their components (which are constant in the sharp and diffuse series) are approximately proportional to the squares of the atomic weights of the elements producing the spectra—so long as those elements belong to the same family sub-group. The Zeeman effect also is generally the same for lines of corresponding series in the spectra of elements belonging to the same group. But perhaps the most comprehensive connection of spectra with the periodic table is established by the " alternation law " and by the " displacement law " of Kossel and Sommerfeld.

The spectra of a large number of elements have now been successfully analysed, and it has been found that there is an alternation of even and odd multiplicities in successive columns of the periodic table. This has been most completely verified for the fourth period of the elements, for which the following details have been given by W. F. Meggers:—[1]

Column	I	II	III	IV	V	VI	VII	VIII		
Element	K-19	Ca-20	Sc-21	Ti-22	V-23	Cr-24	Mn-25	Fe-26	Co-27	Ni-28
Systems		1		1						1
	2		2		2				2	
		3		3		3		3		3
			4		4		4		4	
				5		5		5		5
					6		6		6	
						7		7		
							8			

The numbers following the chemical symbols are the atomic numbers of the elements, and those below represent the multiplicities of the systems of terms which have been found to combine in the production of the actual spectra. Elements in the same column of the table have similar multiplicities.

The displacement law states that, when an element is ionised, the enhanced series take on the same type of complexity as the arc series produced by the element to the left (*i.e.*, in the preceding column) in the periodic table. This has been verified for a considerable number of elements and is probably true for all. The same rule applies also to the spectrum of an element at successively higher stages of ionisation. As a result Mg II, Al III and Si IV, for example, all yield spectra of the same type as that of Na I, only one valence electron being left in each case; these spectra only differ in the displacement of corresponding lines to shorter wave-lengths and in the wider separation of corresponding pairs as the degree of ionisation is greater. Continued observations of this kind may be expected to contribute largely to our knowledge of the structure of atoms.

Suggestion as to the arrangement of electronic orbits in a large number of elements, based upon spectroscopic data, have been made by N. Bohr,[2] and important modifications of Bohr's scheme have been proposed by E. C. Stoner.[3]

Band Spectra.—A typical band consists of a large number of faint lines, which become especially crowded towards the " head," where the intensity appears greatest. Groups of such bands frequently occur, partially overlapping, and there may be several groups in the same spectrum, so that a band spectrum may include thousands of component lines. In each band it is usually possible to pick out a number of regular sequences of lines, each of which may be approximately represented by a Deslandres' formula $\nu = A + Bm + Cm^2$, where A, B, C are constants calculated from the lines and m is the number of a line counted from a suitable starting point. The heads of the bands may be represented by a formula of the same type.

The theory of band spectra, on quantum principles, has lately been greatly advanced. It is supposed that in a molecule the total energy is the summation of the energies due to rotation of the molecule as a whole, to vibrations of the atomic nuclei and to movements of the electrons within the molecule. If a change occurs in one or more of these, the total energy will be changed and, exactly as in line spectra, the difference will be radiated as a single quantum The complexity of a band spectrum is thus due to the great variety of possible states of the molecules by which it is emitted (see Sommerfeld, *op. cit.*, chap. VII.).

The Solar Spectrum.—A striking feature of continued work on the solar spectrum is the identification of a large number of faint lines with lines composing the bands of certain compounds, in addition to the band lines of carbon and cyanogen previously recognised by Rowland and Lockyer. The peculiarities of the region about the G group of Fraunhofer have been shown by H. F. Newall[4] to be due to the absorption of the well-known hydrocarbon band λ 4315, and the group P has been found by A. Fowler and C.L.L. Gregory[5] to include the strong ultra-violet band of ammonia having its maximum near λ 3360. In addition, the band of luminous water vapour beginning at λ 3064 has been found by Fowler[6] to be present in the solar spectrum. A large number of previously unknown solar lines have thus been accounted for, and it is not improbable that the thousands of faint lines which remain unidentified may eventually be traced to other band spectra.

Stellar Spectroscopy.—Our detailed knowledge of the spectra of the stars has been greatly advanced by the use of the large telescopes which have been erected, and considerable progress has also been made in the interpretation of the stellar lines through experiments in the laboratory. In particular, the use of stronger discharges than had previously been employed has led to the discovery of new lines of several elements, which have been identified with lines occurring in the hotter stars. Certain lines of the Wolf-Rayet stars, for example, have thus been traced to carbon by T. R. Merton,[7] and others to oxygen by A. Fowler and J. Brooksbank.[8] The general outcome of the experimental reproduction of stellar lines is to support the view that the order in which the different classes of stars had been arranged is a true temperature sequence. This order, previously indicated by Secchi and Vogel, is now generally expressed by the classification introduced at Harvard by E. C. Pickering, in which the most important classes, passing from the white to the redder stars, are designated by the letters B, A, F, G, K, M.[9] On passing from the relatively cool M stars to the hot B stars, it is necessary, in accordance with the work of Lockyer, to employ a gradually increasing stimulus in order to excite the spectra which appear at successive stages of the stellar sequence.

The theory of thermal ionisation has been further developed by R. H. Fowler and E. A. Milne[10] with important results.

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SPECTRUM.—The word spectrum was used by Newton in 1672 to indicate the elongated array of coloured lights, which appears when a beam of sunlight is passed through a triangular

[1] *Proc. Nat. Acad. Sci.*, Washington, Jan. (1925).
[2] *Ann. d. Phys.*, vol. 71, 260 (1923).
[3] *Phil. Mag.*, vol. 48, 719 (1924).
[4] *Monthly Notices*, R.A.S., vol. 76, 640 (1916).
[5] *Phil. Trans.*, A, vol. 218, 351 (1917).
[6] *Proc. Roy. Soc.*, A, vol. 94, 472 (1918).
[7] *Proc. Roy. Soc.*, A, vol. 91, 498 (1915).
[8] *Monthly Vol.*, R.A.S., vol. 77, 511 (1917).
[9] The work of H. N. Russell, in general agreement with that of Lockyer, renders it probable that the true sequence is from M to B with increasing temperature, and thence from B to M with decreasing temperature, the density increasing throughout. Stars of rising temperature, on account of their great volume, have been called " giants," those of falling temperature " dwarfs." Differences between the spectra of giants and dwarfs of the same spectral class have been found by Adams (see *Monthly Notices R.A.S.*, vol. 81, p. 334) (1921).
[10] *Proc. Phys. Soc. Lond.*, vol. 36 (Feb. 1924).

glass prism and, after refraction and dispersion, is received on a distant white screen.

The name is firmly established for the orderly array of coloured lines, each corresponding to a single component, seen when a sample of light to be analysed has passed through a very narrow slit of a suitable spectroscope. "Spectrum," is used in an extended sense to cover the whole range of rays studied by methods capable of detecting not only visible rays but also ultra-red and ultra-violet rays, wireless waves, X-rays and γ-rays (*see* RAYS).

Ultra-violet Rays.—The existence of ultra-violet rays was discovered in 1801 by Ritter, who found that silver chloride was blackened by rays more refrangible than the utmost limits of the visible rays of the spectrum. The ultra-violet rays were examined in detail by Stokes in 1852 by the use of fluorescent substances to which attention had been called by Sir John Herschel in 1845 in researches on what he termed the "epipolic dispersion of light" by solutions of quinine. Stokes found that quartz prisms and lenses were far more transparent to ultra-violet light than glass, and that they revealed the existence of an invisible region extending as far beyond that previously known as the latter extends beyond the visible spectrum, and exhibiting a continuation of the Fraunhofer lines. He obtained evidence that the limit of the solar spectrum in the more refrangible direction had been reached; for the arrangement which revealed by means of fluorescence the existence of what were evidently rays of higher refrangibility coming from electric sparks failed to show anything of the kind when applied to the solar spectrum.

Measurement of Wavelengths.—On the undulatory theory of light, wavelengths can be assigned to rays of every degree of refrangibility by the use of diffraction gratings. A grating is a plate of glass or of speculum metal worked plane (or concave) and highly polished, and on it fine straight parallel lines are ruled very close together at very regular minute intervals. Thomas Young in 1802 describes the use of a grating ruled on glass with 500 lines to the inch; and, in his developments of the undulatory theory and of the principle of interference, he deduced rough values of the average wavelengths of the various colours. Modern gratings are ruled with 10,000 to 20,000 lines to the inch. They serve admirably for optical work of high precision. But when we have to deal with very short wavelengths such as have been discovered in the last 30 years, a spacing of lines comparable in closeness with the spacing of atoms in solid substances is required.

Ångström Unit.—Wavelengths are measured in terms of a unit known as an Ångström unit (A.U.) or tenth-metre. Such a unit is $\frac{1}{10,000,000,000}$th of a metre $= \frac{1}{10^{10}}$m $= \frac{1}{10^{8}}$cm. The visible parts of the spectrum extend from about 3,900 A.U. to 7,600 A.U., nearly an octave in the musical sense of the word.

In terms of these units, Stokes would seem to have seen lines as far as 1,900 A.U. in the spectra of electric sparks between terminals of metallic lead. With fluorite prisms and lenses (in rarefied hydrogen to avoid the absorption due to air) Schumann photographed spectra extending to 1,000 A.U.; Lyman has reached 600 A.U.; and Millikan has penetrated as far as 200 Ångström units.

Ultra-red Rays.—Rays of invisible heat were discovered by William Herschel in 1801 in the ultra-red region.[1] Langley in 1886 traced, by the use of the bolometer, rays of radiant heat as far as wavelength 182,000 A.U. and Rubens penetrated as far as 610,000 Ångström units.

Thus our knowledge of the spectrum extends from 200 to 610,000 A.U., of which only the region between 3,900 and 7,600 A.U. is visible to the eye as light. (*See* RAYS.)

Maxwell's Theory.—In 1861–5 Maxwell developed, out of the physical conceptions of Faraday, his dynamical theory of the electromagnetic field. He gave reasons for believing that any change in the electrification of a conductor or in the magnetisation of a body is accompanied by the propagation of corresponding disturbances through the surrounding medium. His equations showed that the rate of propagation should be expressed by the same number which expresses the number of electrostatic units in one electromagnetic unit. The comparison of available measures of these electrical quantities gave a number corresponding with the velocity of light. Maxwell adds:—

> At the outset of this paper, the dynamical theory of the electromagnetic field borrowed from the undulatory theory of light the use of its luminiferous medium. It now restores the medium after having tested its power of transmitting undulations and the character of those undulations, and certifies that the vibrations are transverse and that the velocity is that of light. What then is light according to the electromagnetic theory? It consists of alternate and opposite rapidly recurring transverse magnetic disturbances accompanied with electric displacements, the direction of the electric displacement being at right angles to the magnetic disturbance, and both at right angles to the direction of the ray.

Lodge and Hertz.—In 1887–8 Oliver Lodge and Hertz were, each unknown to the other, running a neck-to-neck race, to crown Maxwell's achievement by devising experimental methods of producing and detecting electro-magnetic waves of very high frequency—about 100,000,000 per sec.—very high in comparison with those in common use in ordinary electrical experiments, but very low in comparison with those attained in Langley's examination of the ultra-red parts of the prismatic spectrum. Hertz succeeded in measuring, within the walls of his laboratory, the wavelengths of the periodic disturbances emitted by the spark-discharge of an electric condenser. And from these pioneering experiments the whole system of wireless telegraphy (*q.v.*) has been evolved by the inventive genius of many workers. The wavelengths of Hertzian or wireless waves range from a few hundred metres to long waves of about five km. and more.

X-rays (*q.v.*).—The X-rays discovered by Röntgen in 1895 are now known to be identical in nature with light but to be of exceedingly small wavelengths. A. Laue in 1912 made a fundamental discovery when he passed X-rays through crystals and found evidence which at one and the same time disclosed the orderly atomic structure of such bodies and the undulatory nature of X-rays. W. L. Bragg in 1913 discovered that X-rays could be reflected by the cleavage planes of crystals at nearly glancing incidence; and he and his father Sir W. H. Bragg devised the X-ray spectrometer, by means of which they measured the wavelengths of specially selected X-rays and studied the structure of crystals. Their methods were applicable both to the electrical detection of the rays and to photographic records of the "spectral lines" of such characteristic rays of the elements as were discovered by Barkla in 1904. The tactical array of the atoms in a crystal serves the same sort of purpose as the systematic spacing of lines on an optical grating and wavelengths as small as 1 A.U. were measured (*see* CRYSTALLOGRAPHY).

Mosely in 1913 discovered that in the high frequency spectra of the elements a wonderful progressive increase of wavelengths of homologous lines was disclosed by the elements when arranged in order of atomic weight (*see* ATOMIC WEIGHTS); and theoretical considerations led him in 1914 to prove by measurement of photographic records that (1) every element from aluminium to gold is characterised by an integer which determines its X-ray spectrum, and (2) this integer N, the "atomic number" of the element is identified with the number of positive units of electricity contained in the atomic nucleus (*see* ISOTOPES).

He thus corroborated the conceptions of Rutherford (1911) and of van den Broek (1913) of the nature of this constituent of an atom, and, besides establishing a fundamental principle in atomic physics, provided measures of wavelengths in the extremest regions of the ultra-violet spectrum.

X-rays used in physics and medicine range from about 0·01 A.U. to 12 Ångström units. The highly penetrating rays are of short wavelength; the "softness" of rays increases with the wavelength. The γ-rays emitted by radioactive substances are highly penetrating rays and have wavelengths less than 1·5 Ångström units. The recent observations of Millikan in 1925 on

[1] This region is very frequently called the infra-red region, and its rays the infra-red rays (*see* RAYS).

a very highly penetrating radiation point to the existence of X-rays of wave-lengths even smaller than those of γ-rays.

Thus our knowledge of the spectrum of electromagnetic radiations may be said to extend over a range of more than 70 octaves, or from wavelengths from 0·001 A.U. to 10,000 km.; and within this range the visible rays occupy hardly an octave; the British Broadcasting Company utilise rays ranging over about 2 octaves; and only about 5 octaves in the whole range have escaped actual detection (*see* WIRELESS). *See* E. C. C. Baly, *Spectroscopy* (1924). (H. F. N.)

SPEE, MAXIMILIAN, COUNT VON (1861–1914), German sailor, was born in Copenhagen June 22 1861. He entered the German navy in 1878 and from 1887 to 1888 was Hafenkommandant (commander of the port) in German Cameroon. In 1908 he was made chief of staff of the German North Sea command, and at the end of 1912 took over the Far Eastern Squadron. On Nov. 1 1914 he was engaged by Admiral Cradock off Coronel, on the Chilean Coast, and succeeded in defeating the British squadron. On Dec. 8 1914, however, he was attacked by Admiral Sturdee's cruiser squadron. The Germans were heavily defeated in the battle that took place. This is usually known as the battle of the Falkland Islands, and in it Spee himself went down with his flagship, the "Scharnhorst." (*See* CORONEL; FALKLAND ISLANDS).

SPEED INDICATOR.—Instruments used for measuring either linear or angular speed are classed under the general heading of speed indicators. Those used for indicating linear speed are used most extensively on motor vehicles and are known specifically as speedometers, while instruments based on the same working principles but used to measure angular speed are known as tachometers. Tachometers are always graduated in revolutions per minute, while speedometers are graduated in miles (or kilometres) per hour.

The speedometer is driven from one of the road wheels or from the transmission tail shaft of the vehicle through a flexible shaft and a gear mechanism, and as its indications depend solely upon the speed at which its own shaft revolves, account must be taken in calibrating it, of the diameter of the road wheel from which it is driven and of the gear ratio between this wheel and the speedometer shaft. Inversely, if the scale is fixed, the gear ratio must be varied to suit the wheel diameter.

Odometers.—Speedometers used on automobiles carry, in addition to the actual speedometer mechanism, a so-called odometer, which indicates the distance covered by the car. This instrument comprises a number of dial wheels with numerals imprinted on their circumference, which show through a window in the face plate. The dial wheels do not move continuously but periodically, in steps of one-tenth revolution. Usually there are two sets of such dial wheels, one set showing the total mileage covered by the car since the instrument was installed, the other the mileage covered on a single trip, the dials of the latter being returnable to the zero position at the end of each trip by means of a reset device. An odometer, therefore, may be regarded as an integrator of linear motion; a corresponding instrument for integrating angular motion is known as a revolution counter and is much used on large, low-speed engines, in mechanical tests, and for many other purposes.

Main Principles.—There are three general principles on which the operation of speed indicators may be based, of which that of centrifugal force has been employed longest. With this, a pair of weights is carried on a revolving shaft, in such a manner that they may move out from the axis of the shaft under the influence of centrifugal force, while being forced toward the axis of the shaft by a spring, the motion taking place around fixed pivots. The centrifugal force on the weights increases with the speed, and the faster the shaft revolves, the farther the weights will move out from the axis of rotation. An indicating hand connected mechanically to the centrifugal weights may be made to indicate the speed of rotation of the shaft, or the speed of motion of a vehicle to one of whose road wheels the shaft is connected.

The second principle very extensively used is that of magnetic drag. A cup of sheet aluminium is mounted on a spindle and held in the "zero" position by a spiral spring. A permanent magnet whose lines of force pass through the wall of the cup is rotated inside the latter at a speed proportional to that to be measured. The rotation of the magnet induces currents in the aluminium cup and the reaction between these currents and the magnetism of the magnet produces a drag on the cup, which causes it to turn around its axis against the torsion of the spring, in proportion to the speed of the magnet. A scale printed on the outside of the cup shows through an opening in the face of the instrument, and the scale reading in line with a mark on the face indicates the speed.

The third principle made use of is based on the fact that speed is the quotient of distance by time. Instruments based on this principle comprise an odometer and a clockwork, measuring distance and time respectively, and they effect the operation of division mechanically. (P. M. H.)

SPENDER, JOHN ALFRED (1862–), British journalist, was born at Bath, the son of a doctor, and educated at Bath College, and at Balliol College, Oxford, under Jowett. Adopting the career of a journalist, he was editor of *The Eastern Morning News* from 1886 to 1890, after which he came to London and was on the staff of *The Pall Mall Gazette*. When the *Westminster Gazette* was established in 1893, he became an assistant editor and from 1896 to 1922 was its editor, leaving just after it became a morning paper. As editor of the *Westminster* Mr. Spender won general respect, not only as a brilliant writer but as the possessor of an exceptionally fair and balanced mind. He won, too, a high place in the councils of the Liberal party, and his services to the state included membership of the royal commission on divorce, and of the Milner Mission to Egypt. A slight volume, *The Comments of Bagshot* (1914), reveals Mr. Spender at his best. He has also written *The Indian Scene* (1912); *The Foundations of British Policy* (1917); and *The Life of Sir. H. Campbell-Bannerman* (1923). His brother, Harold, also known as a Liberal journalist, and the author of a number of books of travel and politics, died April 15 1926.

SPENGLER, OSWALD (1880–), German philosopher, was born at Blankenburg in the Harz May 29 1880. He studied mathematics and natural history at various German universities, and at the same time interested himself deeply in history and art. This early and rare combination of scientific knowledge with interest in the humanities is the foundation of the peculiar character of Spengler's work, in which unexpected parallels between scientific truths of physics and mathematics and the artistic and other cultural achievements of an epoch of history are made clear. Spengler's thesis for his doctor's degree dealt with "The Metaphysical Idea of the Philosophy of Heraclitus" (Halle, 1904). From 1907 to 1911 he taught mathematics and physics at a school in Hamburg. In 1911 he conceived the main theme of his work. Abandoning teaching, he completed in 1914 the first version of *Der Untergang des Abendlandes*, which remained unpublished until 1918. A revised and much enlarged edition was completed in 1922. An authorised translation of the first volume into English (*The Decline of the West*), by Charles Francis Atkinson, was published in 1926. The work has had great popularity and influence.

Other works of Spengler, chiefly concerned with contemporary political problems are: *Preussentum und Sozialismus* (1920); *Pessimismus* (1921); *Politische Pflichten der deutschen Jugend* (1924); *Neubau des deutschen Reiches* (1924).

See M. Schroeter, *Der Streib um Spengler, etc.* (1922).

SPERRY, ELMER AMBROSE (1860–), American inventor, was born at Cortland, N.Y., Oct. 12 1860. His education was received at Cortland normal school, 1876–9, and Cornell University, 1879–80. He founded the Sperry Electric Co., Chicago, in 1880, engaging in the manufacture of arc lamps, dynamos and other electrical appliances, and also the Sperry Electric Co., Cleveland, O., manufacturers of electric cars. This last-named company was sold to the General Electric Co., New York City, in 1894. He perfected one of the first arc lamps, and invented aeroplane and ship stabilisers, the highest intensity searchlight (1,500 million candle power), and many special devices for the U.S. Navy. His most important invention was the gyro-compass

(patented in 1918), designed to obviate magnetic disturbances incident particularly to armoured ships and submarines. He further devised the gyro-pilot, a device for the automatic steering of a ship. In 1910 he became president of the Sperry Gyroscope Co., Brooklyn, N.Y., a company formed to manufacture his inventions. In 1915 he became a member of the Naval Consulting Board and chairman of its mines, torpedoes and aeronautics committees. In 1883 he erected the highest electric beacon in the world on Lake Michigan (350 feet).

SPIELHAGEN, FRIEDRICH VON (1829–1911), German novelist (*see* 25.667), died at Charlottenburg, Berlin, Feb. 25 1911.

SPINAL MENINGITIS (*see* 18.130).—The term meningitis signifies merely an inflammation of the membranes (meninges) surrounding the brain and spinal cord. An equivalent term is cerebro-spinal meningitis. As the inflammation is usually incited by microbes and attended by fever it is also called cerebro-spinal fever.

The meninges, as is the case also with the corresponding membranes of the chest (pleura), heart (pericardium) and abdomen (peritoneum), are subject to infection with quite a wide variety of bacteria—cocci and bacilli. According to the microbic incitant, the infection is termed tubercular, pneumococcal, streptococcal, staphylococcal, influenzal (*B. pfeifferi*), typhoid, etc., meningitis. The precise diagnosis of one or another of these varieties is accomplished by means of the bacteriological examination of fluid (cerebro-spinal) withdrawn by means of the device known as lumbar puncture. The above-mentioned class of bacterial infections of the meninges tends to arise exceptionally or sporadically; as a rule it accompanies the corresponding bacterial infection affecting other parts of the body, the lungs, middle ear, tonsils, etc.

Epidemic Form.—In sharp contrast with the sporadic varieties of meningitis is the epidemic form, incited by a particular microorganism, the diplococcus discovered by Weichselbaum in 1887, now called meningococcus, of which many epidemic outbreaks have been recorded in medical literature. The meningococcus possesses biological characteristics which serve readily to distinguish it from other members of the large class of cocci; and it appears not as a single, sharply defined species, but rather as a group in which the composing strains, while showing many properties in general, are yet distinguishable by means of physiological differences, as of power to ferment carbohydrates, reaction to specific agglutinating agents, etc.

As with other such disease-producing or pathogenic bacterial groups, *e.g.*, pneumococci, certain strains or types of meningococci have greater virulence for man than have others. The more virulent strains show greater fixity of biological properties than the more fluctuant, less virulent ones. During epidemics of meningitis the types of enhanced pathogenicity have the wider distribution; while in interepidemic periods the weaker, less defined strains are more frequently encountered.

A very wide epidemic, so-called pandemic, of meningitis prevailed during the first two decades of the present century. It embraced Europe, America, Asia, Africa and many islands of the seas. This pandemic was characterised by high mortality and by those multiple clinical features which have been noted in previous severe epidemics of the disease. A part only of the cases, usually not a large part, was attended by the visible haemorrhages in the skin and mucous membranes to which the name of spotted fever was applied in earlier times. Usually the very severe and rapidly fatal so-called fulminating cases fell into this category.

The fatality of the epidemic outbreaks, whether in Europe, in America or in more distant countries, in the years between 1904 and 1910 did not vary greatly. In the United States the percentage figures were from 75 to 90; in Great Britain 70 to 80; in Germany 60 to 70; in France, Italy and Belgium 75 to 80; in Palestine 80; in Greece 60; in the Transvaal 75. In other words, the pandemic seems to have been little affected by locality or race. As in all previous epidemics closely observed, the mortality was influenced by the age period of the attacked; the very young and the very old rarely survived attack. On the other hand, children over five and adults up to 30 years of age have the best chance of recovery.

Serum Treatment.—The outlook for recovery has been greatly modified by the discovery and use of the antimeningococcic serum, or as it is now called merely antimeningitis serum. In view of the advance of bacteriology and serum therapy, it was natural and inevitable that with the reappearance in force about 1904 of epidemic meningitis, efforts should be made to produce a curative serum. These attempts were carried out simultaneously in Germany by Jochmann and Wassermann, and in America by Flexner. The former failed perhaps because the manner of use was wrong: the serum was injected chiefly subcutaneously. The latter succeeded, because the injections were made repeatedly directly into the inflamed meninges by means of lumbar puncture. Flexner's method was based on an experimental study in which the meninges of monkeys were infected with the meningococcus, and the treatment was applied by lumbar puncture. The serum-treated monkeys survived, while the untreated and those treated by subcutaneous injections of the serum succumbed.

This result is in harmony with what is known of the anatomical-physiological conditions affecting the passage of chemical substances from the blood into the cerebro-spinal fluid. Such passage, even when the membranes are inflamed, takes place to a very small extent or not at all. In order, therefore, to bring the curative serum into relation with the seat of disease, it became necessary to circumvent the protective mechanism of the choroid plexus, which structure determines the quality of the cerebro-spinal fluid. This could readily be done by making direct injections through the lumbar puncture needle.

Results of Serum Treatment.—The consensus of competent opinion is that given a potent antimeningitis serum, which carries the immunity principles of the chief strains of virulent meningococci—a so-called polyvalent serum—its proper employment is capable of greatly modifying the course of the meningitic disease, of reducing the mortality, and of preventing crippling consequences. The results of the serum treatment are affected by such considerations as age of the patient, period of the disease at which the treatment is begun, the manner in which the repeated injections are carried out and also of course by the original severity of the cases themselves. Little has been accomplished in mitigating the effects of the fulminant disease, since often the interval between onset and termination is only 24 to 48 hours.

A number of tabulations have been published showing the effects of the serum according to age groups, days of first injection, etc. The largest compilation is that of Flexner, dealing with about 1,300 cases in which the mortality among those treated in the first three days of illness was 18·1, the second three days 27·2 and after the seventh day 36·5%. The total mortality among these cases was 30·8%, as compared with 75 to 80% among corresponding non-serum-treated cases. Netter's figures for the corresponding three periods are 7·14, 11·1 and 23·5%; and Dopter's 8, 20, 14·4 and 24·1%. Flexner's figures are compiled from the reports of physicians at many places, of whom not a few had had only slight experience with the serum, while Netter's and Dopter's are based on personal experiences largely with a more uniform material and method. Similarly, the influence of age on the results of the treatment is shown as follows: According to Flexner, under one year 50%, one to 20 years 75%, over 20 years 60% recovered; according to Netter, under one year 40%, one to 20 years 79% recovered; and according to Dopter, under one year 53%, one to 20 years 78%, and over 20 years 76% recovered. These are impressive figures when compared with those of earlier epidemics, and especially with corresponding and even simultaneous cases of the same epidemics in which the antimeningitis serum was not employed.

It is desirable to ascertain whether the favourable action of the serum can be related to any other striking results of its use. In this way the mere numerical or statistical evidence may come to be supported. Fortunately, certain important objective effects are produced. Perhaps the most immediatelv impressive

is the modified character of the clinical course of the disease itself. Briefly stated, this relates to the essential disappearance of the chronic cases slowly moving through weeks and months to a fatal issue, attended by hydrocephalus, extreme emaciation and other sequels. Either the cases fail to respond and terminate quickly, or in a few days the real infection is over and the patient convalescent. The growth and multiplication of the meningococcus within the cerebro-spinal fluid are quickly arrested. Probably it is this action of the serum which controls the disease. Next, epidemic meningitis is a disease from which when recovery occurs spontaneously it tends to take place slowly, gradually, or by "lysis"; under the influence of the serum, sudden termination by "crisis" frequently takes place. Finally, the severe consequences, as of hydrocephalus, impairment of vision and mentality, paralysis and joint affections, are diminished. The one severe complication which has not been influenced is deafness, which occurs in a varying, usually small percentage of the cases, and usually very early in the disease.

Mode of Infection.—The mode of infection in epidemic meningitis may be regarded as established. The meningococcus gains access to the interior of the body by way of the mucous membrane of the nose and throat. The incidence of meningitis bears relationship to the proportion of nasopharyngeal carriers of the meningococcus. When the cases are few in any community or group of persons the carrier rate is low. When the carrier rate rises the cases tend to increase in number. During sharp outbreaks, among an exposed personnel, the carrier rate may reach 20%; ordinarily it is 2 to 3% or less.

Probably the meningococcus passes from the nasal mucous membrane into the blood, with which it is carried to the meninges. Whether the microbe ever passes along the direct lymphatic channels stretching from the nasal membrane to the meninges may be doubted. Instances are known in which meningococci were present in the blood some time before signs of meningitis appeared. The intravenous injection of the antimeningitis serum has been successful in removing the microbe from the blood and of curing the general or blood infection. No meningitis followed. It is because of the occurrence of meningococci in the blood stream that early intravenous injection of the serum is recommended by certain authorities as a regular part of its intraspinal use in the treatment of epidemic meningitis. To be of value, the intravenous injection should be carried out very early in the disease, and it should not be substituted for the direct injection into the inflamed meninges. As a rule, a number of intraspinal serum injections on successive days is required to control the infection.

The successful employment of the antimeningococcus serum has led to efforts being made to control other microbic varieties of meningitis in a similar manner, but thus far without notable success. Probably the meningococcus, as compared with the more hardy pneumococcus, streptococcus and Pfeiffer bacillus, is a fragile organism easily subject to injury by direct action of the antiserum. Certainly it tends to be taken up by the white blood cells (leucocytes) present as the result of inflammation. It is this striking intracellular feature which led Weichselbaum, the discoverer, to invent for it the cumbrous name of *Diplococcus intracellularis meningitidis*, now rarely employed. Moreover, with so many of the class of microbes other than the meningococcus, the meningitis is a complication of some other severe infection, as a pneumonia, a peritonitis or other severe affection, so that its amelioration offers fewer possibilities of successful issue than when, as in epidemic meningitis, the chief if not the sole disease is confined to one place. Even with the antimeningitis serum, the natural curative powers of the body come into play, when the recovery of one and not of another individual occurs and there are relatively comparable conditions of infection. Hence, the more seriously embarrassed the body is with multiple sources of microbic poisoning, the less able are these inherent powers to assert themselves, even when assisted by artificially produced healing agents.

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SPITSBERGEN, the Arctic archipelago between Greenland and Novaya Zemlya (*see* 25.708), is now officially known as Svalbard, though the individual islands retain their former names. According to the most recent surveys, the highest peak in the archipelago is believed to be Mount Newton, 5,445 ft., in the eastern part known as New Friesland. Several other peaks in the same and near ranges are over 5,000 feet. Mount Eidsvoll, in King James Land, is 4,770 ft. and Mount Monaco, on Prince Charles Foreland, is 3,543 feet.

Geology.—Considerable exploration has not greatly modified the main conception of the geological structure, but it is now realised that the Caledonian folds of Scotland and Scandinavia pass through Prince Charles Foreland and western Spitsbergen and are probably continued in the north of Greenland. The old rocks of the west, generally described as the Hekla Hook series, seem to be of Ordovician age to which may also be ascribed most of the so-called Archaean rocks of the northwest. There are no permo-carboniferous rocks in King James Land and the strips of rocks on the northeast side of Prince Charles Foreland and the opposite shores of the mainland, formerly attributed to that age, are now known to be tertiary. Certain of the coal measures in Advent Bay prove to be of cretaceous and not tertiary age and these cretaceous beds probably appear also below the tertiary beds in Lowe Sound. An extinct volcano and several hot springs with a temperature of 75° to 82° F. were discovered in Bock Bay, off Wood Bay in 1910. The volcano seems to date from a later period than any other volcanic manifestation found in Spitsbergen. Research has proved that dislocation has played a great part in determining the main features of the fjord system, especially in Ice Fjord where the course of the Fjord has been decided by great faults.

Climate.—From the meteorological data now available, including eight years' records from Green Harbour, the following means may be given:

Cape Thordsen—Jan. +0·3° F., July 39·9° F.;
Green Harbour—Feb. −8·3°, July 39·7°;
Axel I. (Lowe Sound)—Feb. −7·2°, July 40·3°;
S.E. of Edge I.,—Feb. +0·3°, Aug. 37·4°;
Bear I.—Feb. +10·4°, Aug. 40·1°.

The mean annual precipitation at Green Harbour is 11·6 in.; Prince Charles Foreland has more and the interior of Spitsbergen less.

Exploration.—Recent exploration in Spitsbergen has been devoted mainly to geological work, largely with economic ends in view, and detailed cartographical survey.

The principal survey work has been done by Norwegians working in small parties every summer since 1906, assisted by grants from the Norwegian State. These parties have been successively commanded by G. Isachsen, A. Staxrud and A. Hoel, and have mapped in detail the western side of the mainland from the north coast to the South Cape. The work is expedited by the use of photogrammetric methods to assist triangulation. The detailed survey of Prince Charles Foreland was completed by W. S. Bruce and assistants, who also mapped the area between Klaas Billen and Sassen Bays. Swedish surveyors mapped the land round Lowe Sound and Braganza Bay. The Prince of Monaco showed continued interest in Spitsbergen exploration by giving assistance to several explorers, including the Swiss, H. Stoll, who in 1913 crossed the unknown country between Lowe Sound and Agardh Bay.

W. Filchner in 1910 surveyed the glaciated region between Temple Bay and Mohn Bay. Another German expedition under Lt. Schroeder-Stranz in 1912 came to grief on the north coast, with some loss of life, and accomplished nothing. In 1920 J. M. Wordie scaled several of the highest peaks on the west coast, including Mounts Monaco, Rudmose and Barents. In 1923 and 1924 the Oxford expeditions under G. Binney carried out some surveys on the coasts of North-East land and crossed the island. Hydrographic surveys have been carried out by G. Isachsen and others on the west coast and in Green Harbour, by W. S. Bruce in Foreland Sound, Klaas Billen and Sassen Bays and Stor Fjord, and by the Norwegian naval survey in Ice Fjord and on the southwest coast. Swedish Govt. surveyors have been at work in Lowe Sound. Oceanographical work has been done in Spitsbergen waters by Dr. F. Nansen. King's Bay was used by R. Amundsen in 1925 in his unsuccessful attempt to fly to the Pole and again in 1926. The Norwegian Govt. has maintained a wireless telegraph station and meteorological observatory in Green Harbour since 1911. A German meteorological station was founded in Ebeltoft Haven, Cross Bay, in 1910 as the outcome of a visit by Prince Henry of Prussia and Count Zeppelin, when experiments with dirigible balloons were conducted. This station was abandoned in Sept. 1914. From 1920–6 Norway maintained a meteorological and geophysical station for aerological and geo-

magnetic research at Quade Hook, King's Bay. In Aug. 1921 a Norwegian Church was consecrated at Longyear City. There are Norwegian post-offices at the chief mines.

Mining.—The development of the coal-fields has proceeded rapidly, greatly stimulated during the War by the scarcity and high price of coal in Scandinavia. The coal-mine in Longyear Valley, Advent Bay, which has been under American ownership since 1905, was sold in 1916 to Norwegians. Several other Norwegian mines have started, notably in King's Bay and Hjorth Haven in Advent Bay and on Bear Island. Swedish mines were opened in Lowe Sound (Braganza Bay) in 1917. There are Dutch mines in Green Harbour. British enterprise, hampered by war conditions, revived in 1919 in the coal bearing areas in Klaas Billen Bay, Temple Bay and Coles Bay. By 1920 practically all the coal-bearing areas were annexed by one or other company. In 1925 seven mines were exporting coal. The total amount of coal exported in 1924 was 440,000 tons, nearly all of which went to Norwegian ports, including some to Narvik for the Swedish railways. A few thousand tons went to Archangel. The coal exported so far is of Tertiary and Cretaceous age and proves to be good steam coal. Bituminous coal of Carboniferous age will soon be available for export. Mining continues throughout the year but the export season at present is from late May to September. The largest mining camp is Longyear City in Advent Bay, housing some 500 men in summer and 400 in winter. No other minerals besides coal are as yet exploited commercially, but large deposits of iron ore (36% iron) and gypsum are known, as well as smaller deposits of zinc and asbestos. Signs of oil have been reported. Whaling was revived in Spitsbergen waters in 1905 but after a few years was abandoned. Winter fur-hunting is pursued by a few Norwegians.

Political History.—The question of political control had been discussed since about 1870, mainly by Norway, Sweden and Russia, without any solution being found. Spitsbergen therefore occupied the curious position of being *terra nullius*. In 1907, however, Norway again opened negotiations for an international conference to decide the question of sovereignty, and one was held at Oslo (Christiania) in July-Aug. 1910, followed by another in 1912, without definite result. In July 1914 a conference which included also representatives of Britain, France, Belgium, the United States, Holland and Germany tried to devise a form of administration consistent with the country remaining a *terra nullius*, but the outbreak of the World War put an end to the discussions. In 1919 the Supreme Council conferred on Norway, the sovereignty of Spitsbergen, including Bear I., and all islands between 10° and 35° E., and between 74° and 81° North. The signatories of the treaty were Great Britain and the British Dominions, France, Italy, the United States, Japan, Holland, Denmark, Norway and Sweden. Ratifications were delayed and Norwegian sovereignty did not become effective until Aug. 1925. Russia has now adhered to the Treaty. The rights and territories of nationals other than those of Norway are safeguarded, and Norway is not allowed to show preferential treatment to Norwegian mining companies or to levy taxes except for expenditure on the administration. Disputed claims to estates are to be decided by a neutral commission presided over by a Dane. The islands are never to be used for warlike purposes. Svalbard is the new name for all islands in the Norwegian sphere in the Arctic but the names of individual islands are unchanged. Svalbard is deemed a part of the Kingdom of Norway.

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SPITTA, FRIEDRICH (1852–1924), German theologian (*see* 25.711), died at Göttingen June 7 1924. In 1910 he published *Das Johannes-Evangelium Als Quelle der Geschichte Jesu.*

SPITTELER, CARL (1845–1924), Swiss poet and novelist, known by his pen name of Felix Tandem, was born in Liestal, Switzerland, on April 24 1845. He was educated at the Basle *Gymnase* and studied theology at the universities of Zurich and Heidelberg. From 1871 to 1879 he acted as a tutor in Russia; from 1879 to 1880, he was a teacher at the Girls' High School, Berne, and afterwards at Neuenstadt. In 1885 he became editor of the *Grenzpost*, Basle, and in 1890–2 was fiction editor of the *Neue Züricher Zeitung*. In 1892 he settled down as an independent author at Lucerne. In 1919 he won the Nobel Prize for literature and the Prize of Honour of the Swiss Schiller Foundation. He died at Berne Dec. 29 1924.

His chief works are: *Prometheus and Epimetheus* (1881), an epic; *Extramundana*, a poem (1883); *Imago*, a romance (1906); *Schmetterlinge*, poems; *Friedli, der Kolderi*, a tale; *Gustav*, a tale; *Balladen; Conrad der Leutnant*, a tale; *Lachende Wahreiten*, essays; *Olympischer Frühling*, an epic (1900–3); *Glockenlieder*, poems; *Die Mädchenfreunde; Meine frühesten, Erlebnisse* (1914); *Rede uber Göttfried Keller, etc.*

SPOKANE, Wash., U.S.A. (*see* 25.713), had a population in 1920 of 104,437 (of whom 17,096 were foreign born) and had grown by 1925 to about 125,000 within the city limits (local estimate). After the World War there was a lively period of activity in all kinds of construction (public, commercial, industrial and domestic buildings) amounting to an aggregate value of $16,410,489 for the years 1919–24. The assessed value of taxable property in 1924 was $86,549,924. Industrial development progressed until there were (1924) 364 establishments in or near the city, with an output for the year valued at $125,000,000. Meat and other food products, lumber and lumber products, flour, machinery and paper were among the leading commodities produced. The wholesale and jobbing business for the same year was estimated at $197,538,000. By 1925 there were seven hydro-electric plants on the Spokane river, within 30 m. of the city, which had an installed capacity of 185,400 H.P., supplying current in Spokane for the street railways, street lamps and domestic and industrial use. The commission form of government was adopted in 1911. In 1917 a comprehensive park system was laid out. By 1925 there were 2,200 ac. in public parks (the highest *per capita* provision in the country), including a mountain 5,808 ft. high, 35 m. away, owned by the city. Spokane had the lowest percentage of illiteracy and the highest percentage of school attendance among the cities of 100,000 and over in 1920.

SPRAYING: *see* ENTOMOLOGY, ECONOMIC.

SPRINGFIELD, Mass., U.S.A. (*see* 25.739), increased in population 45·8% in the decade beginning 1910, reaching 129,614 in 1920, of whom 31,461 were foreign born, and reaching 142,224 in 1925 (State census). The numerous and diversified manufactures within the city had an output valued at $31,773,000 in 1909; $98,333,000 in 1919; and, after only a slight decrease during the post-War depression, $104,568,038 in 1923. In the industrial district, within five m. of the "municipal group," there were 543 plants in 1924 making 478 different products. In 1916 the Eastern States Exposition (agricultural and industrial) was established, with permanent grounds of 172 ac., in West Springfield; by 1924 plant and equipment were valued at $2,000,000 and included a coliseum with an unobstructed arena 100 by

200 ft. and seating capacity for 5,600 persons. A new Union station was built in 1919. The Hampden County Memorial Bridge (concrete) across the Connecticut river, built in commemoration of the patriotic service of the county's citizens, was dedicated in 1922. Zoning ordinances were adopted in 1922–3–4.

SPRING-RICE, SIR CECIL ARTHUR (1859–1918), British diplomatist, was born in London Feb. 27 1859, the second son of the Hon. Charles Spring-Rice (1819–1870), and grandson of the 1st Baron Monteagle. Educated at Eton and Balliol College, Oxford, he entered the Foreign Office in 1882, becoming private secretary to Lord Granville in 1884 and précis writer to Lord Rosebery in 1885. He went to Washington as third secretary in 1886, and in 1895 proceeded to Berlin. In 1898 he became secretary at Tehran, and in 1901 British commissioner on the Caisse de la Dette in Cairo. In 1903 he went to St. Petersburg (Leningrad), first as secretary and later as councillor of embassy, remaining in Russia till the end of 1905. In 1906 he was sent to Persia as minister, having lately been created K.C.M.G. In 1908 he was created G.C.V.O. and went to Sweden as minister, and in 1912 was appointed ambassador to the United States. He died at Ottawa on his way home to England, Feb. 14 1918. See Sir V. Chirol, *Cecil Spring-Rice: In Memoriam* (1919).

SPRUE.—Sprue (*see* 25.742) (Dutch Spruw) is fairly distributed in tropical and subtropical regions, and it is impossible to affirm positively that cases do not arise in temperate climates.

Symptoms.—The symptoms usually begin with dyspepsia and irregularity of bowel action. In a fully declared case the chief signs are the passage of large, bulky, frothy, pale porridge-like, fermenting stools, especially in the early part of the day, much flatulence and acidity, with a sore, tender, ulcerated mouth, a red, smooth and tender tongue, often with exquisitely painful ulcers on the fraenum and at the sides where the tongue comes into contact with the back teeth. Loss of flesh is very rapid amounting perhaps to 40 lb. in two months. Cramps of the fingers and of the feet and calves identical with those of tetany, are common in severe cases and death occurs either from emaciation, exhaustion and intercurrent disease or, more usually, from intense anaemia, with signs resembling in some respects, but not in all, those of pernicious anaemia (*q.v.*), or rarely from perforation of the intestinal ulcer, since the alimentary tract may show ulcers similar to those present in the mouth.

Causation.—An early and persistent symptom is intestinal disturbance, due, it may be, to the growth and products (toxins) of streptococci isolated from the stools and mouth lesions or to fungoid organisms, monilia or as a sequela of dysentery, though many suffer from dysentery who never develop sprue, and many sprue patients have never had dysentery. It has been ascribed to food deficiency or avitaminosis, but sprue attacks mostly the European in good circumstances, not the native, underfed and living in unhygienic surroundings.

Recent investigations tend to regard sprue as due to disturbance of the parathyroid glands which are closely associated with the thyroid and seem to have a two-fold function, (1) to exert an anti-toxic action, especially against intestinal poisons and (2) to regulate the metabolism of calcium. In sprue the primary mischief appears to be the production of intestinal toxins, a condition very common in tropical and subtropical regions, and arising from one or more causes as noted above. The parathyroids perform their detoxicating function until exhausted and no longer able to cope with the poisons elaborated. Determination of the calcium content of the blood at this time yields definite indications of upset of calcium metabolism. In normal blood plasma calcium exists in two forms, the ionic, or free, and the coagulative, or combined, and present in the proportions of 6 ionic to 4–5 of combined. When the blood coagulates, the calcium of the serum of normal subjects is all in the ionic form. In sprue, either the conversion of the combine to the ionic form does not take place, or a recombination occurs so that, though the total calcium content is about normal, the ionic is found to be reduced. This indicates that the tissues fail to use the calcium absorbed from the alimentary canal in the absence of the parathyroid hormone. In other conditions which may be confused with sprue—such as pancreatic affections, the so-called coeliac disease of children, post-dysenteric diarrhoeas, ankylostomiasis, filariasis, to name but a few—this peculiar behaviour of the calcium does not obtain. The test, therefore, known as Vines's test, after its deviser, is of inestimable value in diagnosis and, since the proportion of ionic to total calcium increases with progress under treatment, affords a reliable indication when carried out at intervals.

The chief points on which the calcium parathyroid-deficiency theory is based are (1) the fatty diarrhoea, loss of weight, cramps, oedema and tetany as symptomatic of faulty calcium metabolism, (2) the low proportion of ionic calcium in untreated sprue, (3) the increase of ionic calcium as the condition improves and its fall if a relapse occurs, (4) the improvement when calcium is administered alone, which is quicker and more stable when combined with parathyroid.

Treatment.—The treatment is rest in bed for a fortnight on a diet restricted to milk (increasing from 4 to 7½ pints daily) which itself contains much calcium and, to ensure an abundance of this element, calcium lactate may be given in cachets (gr. 15 thrice daily) and, to regulate its distribution and support the failing glands, extract of parathyroid (gr. 1/10th twice daily). The parathyroid *must* be free from all admixtures with thyroid (most preparations contain some of the latter) for these two appear to be antagonistic and if any of the latter be present, the symptoms become aggravated and palpitation and other indications of thyroid excess are superadded. With a pure preparation, however, the sprue symptoms improve within a fortnight, the ionic calcium increases to about 8 mgm. %, the stools are reduced to one a day and the soreness of the mouth disappears. Gradual additions to the diet can then be permitted and the patient allowed up for an increasing time each day. At the end of four weeks in favourable cases, the calcium lactate can be dropped and the parathyroid reduced to half doses. By this time or within another week or so, the blood serum will show a normal calcium content, but the parathyroid extract should not be left off entirely for another three to four weeks in order to stabilise the condition before all support is removed. Should any symptoms of recurrence appear, a return for a few days to a simpler diet and to the parathyroid extract will restore health.

Many patients treated on these lines have returned to their duties abroad, many others, unable to come home, have been treated in the tropics and have recovered. A few years ago the appearance of sprue meant immediate return to a temperate climate, prohibition of future residence in the tropics and the ruin of a hopeful career abroad. (H. H. Sc.)

SQUASH RACQUETS (*see* 22.783) has developed remarkably since 1910. Formerly it was played chiefly at public and private schools, while courts were to be found at a few clubs and private houses. Shortly before the War the game began to increase in popularity and afterwards its spread has been rapid, both in Great Britain and America, while there are now a certain number of courts on the continent of Europe.

The standard dimensions for courts are different in the British Isles and the United States and there are also some variations in the rules of the game as practised in the two countries. This, however, has not prevented the players meeting in matches. In 1924 a British team visited Canada and the United States and an American team came to England in 1925. A number of individual and team competitions are now held annually, among them being an amateur championship and a ladies' amateur championship. One advantage of squash racquets is that courts lend themselves readily to artificial lighting and the conditions for play are as good at night as during the day time.

SQUIRE, JOHN COLLINGS (1884–), British man of letters, was born at Plymouth April 2 1884 and educated at Blundell's School, Tiverton, and St. John's College, Cambridge. He then engaged in publishing and journalism, working for a time in the Press Gallery of the House of Commons. He became literary editor of *The New Statesman* in 1913, and was its acting editor in 1917–8. His early poems were issued as *Poems and Baudelaire Flowers* (1909), after which came some clever parodies, *Steps to*

Parnassus (1913) and *Tricks of the Trade* (1917). Further poems included *The Lily of Malud* (1917), *The Birds* (1919), *The Moon* (1920), and *American Poems* (1923). In 1919 Squire founded *The London Mercury*, a monthly journal of literature and the arts, soon a distinctive stronghold in contemporary English criticism. He was also responsible for several volumes of reprinted essays and reviews (some originally under the pseudonym of "Solomon Eagle"), a number of anthologies of verse, and a book of short stories, *The Grub Street Nights Entertainments* (1924). *See* ENGLISH LITERATURE.

STAFF, MILITARY (*see* 25.752).—One result of the unqualified success which Prussian arms achieved in the wars of 1866 and 1870–1 was that the general staff principle, which had so largely contributed to give victory to the hosts controlled by von Moltke in those contests, was adopted by almost every military power during the last quarter of the 19th century. Thus in the different staff organisations as they were constituted in peace-time, work in connection with devising plans for offensive operations and for ensuring territorial defence, duties dealing with the collection of military information, the superintendence of the education of officers, the conduct of manoeuvres and the training of troops, were kept as far as possible distinct from administration—*adjutantur*, as the Germans call it.

General Staff System.—Only two of the more important nations—the United Kingdom and the United States—adhered to previously existing systems, under which preparation for war was relegated to the background in staff duties. Then came the South African War of 1899–1902. The difficulties and disappointments encountered by British military forces in that protracted struggle, coupled with the unsatisfactory working of the staff in the field (especially in its higher grades) during the progress of the operations, made plain the need of reform, and in 1904, the Government set up a "War Office Reconstitution Committee" charged with the duty of reorganising the central administration of the army. By far the most important of its proposals was that a General Staff Department, which was to constitute the foremost branch of the professional side of the War Office, should be created. The recommendations of the committee were accepted by the Government, and so it came about that a British general staff was established 10 years before the outbreak of the World War.

During those ten years remarkable progress was made, and when the nation was confronted by the tremendous emergency of Aug. 1914 it had at its disposition a body of well-trained general staff officers, sufficient for the comparatively small army that was available to take the field at the opening of hostilities, although totally insufficient to meet the requirements of the vast forces which had to be improvised after war had broken out. The Government of the United States was still later than that of the United Kingdom in establishing a general staff of the kind that Scharnhorst had thought of a century before. This was only set on foot in 1911, six years before the entry of the Republic into the great conflict which was to upset so many preconceived ideas on the subject of conducting war, but which was to prove—even more conclusively than had the Franco-German War and the Japanese triumphs of 1904–5—how imperative it is under modern conditions for a state which embarks upon a serious struggle to have an efficient and suitably organised military staff at its command.

Modern Functions of the Staff.—The remarkable progress in modern science has tended to impose new duties and new branches upon military staffs, for instance, the utilisation and control of railway communications, of electric communications, of mechanical traction. The appearance of the tank on the battle-field increased staff work. Finally, the establishment of air power introduced a factor of incalculable importance as affecting the control of the belligerent armies.

One most important duty which devolves upon the general staff in a State compelled by its geographical position and by political and international problems to maintain fighting forces both by sea and by land is the establishment and maintenance of intimate relations with the naval authorities. Attention had fortunately been paid to this question in the United Kingdom during the period that intervened between the creation of the British general staff and the outbreak of the World War, and to this is to be attributed the secrecy and the smoothness with which the British Expeditionary Force was transported across the Channel to France during the fortnight succeeding the declaration of war in 1914. General staffs on the Continent did not, on the other hand, prove to be equally well-informed as to maritime conditions; this was made apparent during discussions such as often took place between military authorities representing the different Allies, concerning the policy which ought to be pursued in the Near East and other problems in which sea-power was necessarily involved. When a country elects to make of its air service a department of State distinct from the army, as has happened in the United Kingdom, it necessarily falls to the lot of the military general staff to maintain those intimate relations with the air staff by which alone co-operation can be secured in time of war.

Staff and Government.—"War," said Clausewitz, "is only a continuation of State policy by other means," and elsewhere that "none of the principal plans which are required for a war can be made without an insight into the political relations." It was a recognition of this truth on the part of her Government that led to the triumphs of Prussia first over Austria in 1866 and then over France in 1870. The history of the short-lived German Empire indicates that in later years there was a tendency for the general staff to attempt to direct, and even partially to succeed in directing the policy of the Government. But the passages quoted above from the great Prussian military writer do not inculcate anything of that kind. What they do inculcate is that there should be at all times an intimate understanding between what has been called the "brain of the army" and the civilian executive at the head of the State.

It is on the central directing branch of the general staff, *i.e.*, on the General Staff Department at the War Office in the case of the United Kingdom, as it was on the "Great General staff" of the days of von Moltke and the German Empire, that devolves the duty of maintaining relations with the Government and of advising it regarding the military aspect of problems created by the international situation. That central directing branch of the general staff is entitled to expect that the Government shall keep it fully *au courant* with the political conditions of the day. The merits of the doctrine preached by Clausewitz seem to be self-evident, but leaders of opinion in the United Kingdom were slow to realise its importance. There existed an almost unaccountable inability to perceive the dangers to which a State unprepared for emergencies is exposed. The bitter experiences of the South African War were required to awaken British statesmen to a realisation of their responsibilities.

The Committee of Imperial Defence.—The lessons of that contest were to some extent learnt, and there was set up the Committee of Imperial Defence, in which professional opinion was given a voice. But although the more prominent members of the Government were included in it, the committee itself was merely a consultative body, and no executive action involving expenditure could follow on one of its decisions without the obtaining of at least nominal Cabinet sanction. Moreover, it did not necessarily follow that the view of the general staff would be accepted by the committee even on academical questions. An interesting example of the working of the system is provided by the story of the Dardanelles.

When hostilities arise some instrument a good deal more effective than a consultative committee is needed to control conduct of the War, and, from Aug. 1914 to the date of the Armistice, the operations were, in the case of the United Kingdom, for the first two and a half years of the struggle under supreme charge of various forms of war council directly representative of the Cabinet and given a free hand by that body. They were later under supreme charge of the specially established War Cabinet. The general staff was practically always represented at the meetings of the war councils and of the War Cabinet, but purely in an advisory position without voting power. As a matter of fact its

opinion was occasionally ignored in questions of considerable importance. This was no doubt partly due to some want of confidence in its judgment felt in Government circles owing to the slow progress made towards victory, and partly due to the personality and the temperament of certain members of the Government itself.

It has been said that a general staff must "think politically." If this maxim is merely to be taken as a meaning that a general staff should appreciate political habits of thought, watch political tendencies and keep itself acquainted with the political aspects of every question influencing military action alike in peace and in war, its truth is indisputable. But one of the most important duties falling to the lot of a general staff, especially in times of emergency, will often be to strive to prevent mere policy from adversely influencing the conduct of operations of war. History provides some striking examples of political considerations gravely prejudicing the prospects of armies in the field. MacMahon's fatal march to Sedan was a case in point. The retention of Gen. Penn Symons' advanced force at Glencoe in the opening days of the Natal campaign of 1899 furnishes another instance.

The Administrative Staff.—Neither in the United Kingdom nor in any other military state does the staff of an army consist of a general staff alone. There must always be its "administrative" side. In peace-time, the administrative staff of an army is in a sense the more important of the two. The army has to be recruited and fed and clothed and equipped, and its discipline has to be maintained.

The British plan subordinates the administrative staff to the general staff less than is the common practice. This is perhaps due to the nature of British campaigns of the 1874–1902 era, campaigns fought in regions often destitute of communications and always poor in resources. Almost everything hinged on supply and transport in these contests. Losses in action were as a rule trifling as compared to losses from disease. For one thought that the commander or his chief advisers gave to the enemy, ten thoughts were given to communications. There was little difficulty in beating the enemy if only supplies could be got up to permit a fight. But, to whatever cause it may be attributable, the fact remains that the chief of the general staff of a British army nowadays is merely in the position of *primus inter pares* relatively to the adjutant-general and the quartermaster-general—and it is the same at the War Office. In almost all other armies, on the other hand, including that of the United States, the chief of the general staff is definitely chief of the staff.

British and Other Systems Compared.—If the existing British staff organisation comes to be compared with those where the chief of the general staff is also chief of the staff, it will be found that there is something to be said on both sides. That part of the British system under which a command or a district is in peace-time supplied with a superior officer in charge of administration, to whom wide responsibilities are allowed and who is generally in practice senior to the principal general staff officer, permits the general in command to devote nearly the whole of his attention to preparing his troops for war. But that arrangement would be unworkable in the field. There the progress of operations is so dependent on the work of the administrative staff that the commander cannot transfer his authority in connection with the latter to somebody else—as is recognised in the British staff organisation in time of war by the heads of the adjutant-general and the quartermaster-general staffs, as well as the inspector of communications, then dealing direct with the commander. Although peace represents the normal state of affairs, armies none the less exist for purposes of war, and in time of war the case for the British system is not so strong.

In face of the enemy, operations—planning them, deciding whether the plan is feasible, and taking the necessary steps for their execution—are of paramount importance, but cannot be said actually to govern administration, for unless the army's establishments are maintained and unless it has its food, its ammunition, etc., it cannot carry out the operations. It is for the administrative staff to say whether the plan is feasible from the point of view of supply, transport, depôts, hospital service, and so forth. It is, however, for the general staff to weigh the administrative as against the strategical aspects of the case and then lay the whole subject before the commander for a final decision. The British *Field Service Regulations* clearly admit by implication that the chief of the general staff is the superior of the adjutant-general, the quartermaster-general and the chief of communications, without their being actually under him. That, under conditions such as develop on active service, is apt to prove a somewhat clumsy arrangement and to give rise to friction. It is neither one thing nor the other.

Granted that the "chief of the staff" system means centralisation, granted that it demands from the chief of the general staff a somewhat closer acquaintance with purely administrative questions than would be necessary if the heads of the chief branches of the administrative staff were virtually his equals, even granted that under it less of his time will be available for the consideration of the strategical and tactical situation than would otherwise be the case, the system does seem a more satisfactory arrangement for purposes of operations in the field than that which found favour in the British Army after the setting up of the Army Council. (C. E. C.)

STAFF, NAVAL.—Modern war involves the task of co-ordinating a multitude of subordinate commands, an array of specialised departments and a number of highly technical services towards a single end. The Command must not lose itself in the maze of detail. It must be free to survey any part of the whole, to formulate important decisions and supply a strong impetus of direction. The task of co-ordinating all these activities and of preparing a clear picture of the situation is performed through the instrumentality of a staff.

The principles of German staff organisation are well known. A clear line is drawn between "operations" and "maintenance," that is, between the task of using the instrument and the task of maintaining it in an efficient state. This is the first principle. The second is that the business of war must be performed by officers specially trained, drawn from the services they control, acquainted at first hand with their needs and seeing things through their eyes. This is the essence of Scharnhorst's and Moltke's system, one of the monumental achievements of the 19th century. It did not, however, commend itself to the navy. The naval officer had been brought up to delight in detail. The old type of flag officer felt quite competent to conduct with one or two assistants all the business of war and was jealous of the idea of training young officers to assist him. He could point, too, to an Intelligence Division in existence since 1885 and to a War College for senior officers, both of which had done a large array of good work.

It was only in 1912, after the Agadir crisis, that Mr. Winston Churchill was able to lay the foundations of a naval staff and to institute a course of staff training, but the navy had not suffered in the South African War and there was no weight of strong service opinion behind him, such as assisted Lord Haldane at the War Office. Under a First Lord's memorandum of Jan. 1912 a chief of the war staff was appointed with three divisions of the war staff (operations, intelligence and mobilisation), and a staff college was started for the training of staff officers. The memorandum was a brilliant one, but the Admiralty system was too strong for it. The chief of the war staff had no seat on the Admiralty Board, his function was purely advisory and he could not speak with any degree of authority. The space of two years was all too short to supply a sufficiency of trained staff officers, and the outbreak of war found the navy 10 years behind the army in this respect.

When war broke out the machinery of the staff more or less collapsed, and its work was performed by a small group of flag officers known as the "war staff group," working more or less independently of each other, a system which made it difficult for the divisions of the staff to get information. No one was quite certain what the flag officers did or even where they did it. The conduct of the Dardanelles campaign revealed the

deficiencies of this system and made it clear that there was no real machinery for the investigation of big strategical questions. Two years passed, and the menace of the submarine led to the inauguration of a better system on the army model.

In May 1917 the office of Chief of the Naval Staff[1] was attached to that of First Sea Lord; and by the appointment of a deputy chief and assistant chief of the staff to the board, the staff was given direct representation on the board and any course of action could quickly be given Board authority. New divisions manned by officers drawn from the fleet and in close touch with its work were added to the staff. An anti-submarine division was organised to control the campaign against the submarine. A plans division drew up plans for the mining of the Bight, Dover barrage and (in conjunction with Adml. Sims and his staff) the great northern barrage. A maritime movements division took the whole regulation of convoys into its hands, and the section dealing with wireless directionals and wireless intelligence was at last placed under the Director of Naval Intelligence and opened to the staff.

The Naval Staff grafted on to the Admiralty in war time in order to meet an urgent need, differs in some respects from the Imperial General Staff which grew up in peace-time at the War Office under Lord Haldane as an integral part of army administration. Thus in the General Staff, the Chief of the General Staff and the Director of Staff Duties exercise a much larger measure of control over the whole field of training than is to be found at the Admiralty, where questions of education seem to get lost in an array of departments, for the division of training which Mr. Churchill contemplated in 1914 never fully materialised. The question of the relationship of the Chief of the Naval Staff to " Chiefs of Supply " (the Third and Fourth Sea Lords), corresponding to the Chief of the Imperial General Staff and the Quartermaster-General, is less acute, for the First Sea Lord has always exercised a high traditional authority in these spheres.

Difficulties between the Chief of the Naval Staff and the Second Sea Lord as Chief of Personnel (corresponding to the Chief of the Imperial General Staff and the Adjutant-General) on questions of training could be largely avoided if the Second Sea Lord's office was reorganised on modern lines. Outside the Admiralty, the Chief of the Naval Staff has relations to maintain with the political executive and the other Government departments, more particularly with the army and air service. The first is best maintained through the Committee of Imperial Defence and the Cabinet secretariat, the latter through liaison and regular staff conferences. War on sea is one thing and war on land is another, and fusion of naval and military staffs would merely mean confusion. Their orbits cross in landing operations and bombardments, and here both services can work together on uniform and well recognised lines. Finally, no system can rise higher than the men who operate it. It is the men in it who bring success to a staff system and mould it as circumstances require. (*See* WORLD WAR: BIBLIOGRAPHY.) (A. C. D.)

United States.—The task involved in co-ordinating a multitude of subordinate commands and specialised technical departments is well illustrated in the organisation of the Dept. of the Navy of the United States. The department is presided over by the Secretary of the Navy, who is a member of the President's Cabinet. Under the Secretary of the Navy there is an Assistant Secretary of the Navy who performs such duties as may be prescribed by the Secretary, his chief duty being departmental administration of navy yards. In 1926 an additional Assistant Secretary of the Navy was provided for by law, to aid the Secretary of the Navy in fostering naval aeronautics. Under the Secretary of the Navy the two broad functions of operations and maintenance are handled by naval officers of the active list.

The chief of naval operations is appointed by the President and confirmed by the Senate for four years, with the rank and title of admiral. Under the Secretary he is charged with the operations of the fleet and with the preparation and readiness of plans for its use in war. To carry on the specialised work which may broadly be termed maintenance, there are under the Secretary of the Navy eight bureaux, each headed by an officer with the rank of rear admiral. The names of the bureaux are indicative of their functions. They are: The Bureau of Navigation, in charge of all naval personnel, the Hydrographic Office and the Naval Observatory; the Bureau of Ordnance; the Bureau of Construction and Repair; the Bureau of Engineering; the Bureau of Yards and Docks; the Bureau of Supplies and Accounts; the Bureau of Medicine and Surgery; and the Bureau of Aeronautics. In addition to the office of the chief of naval operations and the various bureaux, there are three other important offices under the Secretary of the Navy. These are the General Board, the office of the major general commandant of the marine corps and the office of the judge advocate general of the navy. Every chief of bureau or head of an office furnishes such information and data as may be called for by the chief of naval operations.

The chief of naval operations, to carry out so large a task as the operation of the fleet and its preparation and readiness for war, has under him a considerable organisation. Each of the divisions of his office is headed by a rear admiral or a captain. The divisions are organized to carry out the functions of war plans, fleet training, intelligence, inspection of ships, ship movements, communication, the military administration of naval districts and the co-ordination of personnel and material readiness. With this organisation the chief of naval operations is able to prepare and maintain readiness plans for the use of the fleet in war, issue regulations for the training of the fleet in peace and co-ordinate the work of the bureaux in such a way as to meet the material and personnel requirements of the fleet and place it in readiness for war. To advise the Secretary of War and the Secretary of the Navy in matters wherein co-ordination and co-operation are required between the army and navy regarding national defence, there is a Joint Army and Navy Board, whose personnel is drawn from the general staff of the army and from the office of the chief of naval operations. The word " staff " itself is not used in the United States Navy. (E. W. E.)

STAGE AND STAGE PRODUCTION (*see* 26.732).—During the period 1910–26, many plays on the European and American stages were produced according to the principles and theories of the naturalistic theatre, the formal theatre, synthesism, expressionism and constructionism, these movements in theatrical art being the most recent developments of stage theories.

But the majority of modern theatres remain untouched by these movements, and, in these, plays cannot in any way be said to be " produced." The actors play their parts, each for himself, and in the manner he finds most effective for himself, without consideration for, or even understanding of either the total form of the play or the dramatic ensemble. The real producer, the " régisseur " or " metteur en scène " in such theatres is unknown. His place is taken by the leading actor or by someone whose business it is so to arrange matters on the stage that the leading actors may be continually in the limelight. As means of interpreting and expressing the play, the scenic surroundings in these theatres are entirely meaningless. Nearly all the operatic, and a large proportion of dramatic theatres (for example, the Comédie Française in Paris) must be included in this category. The waves of the stormy theatrical ocean beat upon them, but are not strong enough to move them from the spot where they have quietly rested for more than 70 years.

The Naturalistic Theatre

In Germany, interesting naturalistic productions—especially of Hauptmann's plays—were given by Otto Brahm, mostly at the Lessing Theatre in Berlin, from 1904 to 1912. The influence of Brahm is very noticeable in the work of one of the best-known producers of our time, Max Reinhardt. In America, examples of this type are to be found among the productions of David Belasco. In France the naturalistic theatre founded by André Antoine has had no followers worthy of mention, and, practically speaking, has ceased to exist. In Russia, on the other hand, stage naturalism reached its greatest perfection through the work of the Moscow Art Theatre (now known in Soviet Russia as the Moscow Academical Art Theatre) founded by C. S.

[1] The old name War Staff was changed to Naval Staff.

From B. Svetlov's "Contemporary Ballet"

SCENE FOR THE BALLET, "THE FIRE-BIRD"

Decoration by A. Golovin, from the aquarelle by René Lelong

Stanislavsky and V. T. Nemirovich-Danchenko. The Moscow Art Theatre began by following the principles of the productions at the Meininger Theatre established in 1874 by Duke George II. of Meiningen, and carried on until 1890. As at the Meininger, the Moscow artists fought against routine and stale tradition. They took from the Meininger the sets invented by the Duke George to give the full illusion of real living rooms, with ceilings, constructed three-dimensional details, natural lighting and perspective of other rooms. They used also the so-called "horizon" (panorama), introduced for the first time on the stage by the Meininger, the three-dimensional trees placed in the middle of the stage, the natural effects of singing birds, thunder, rain, crickets behind the stove, wind blowing the curtains, and so forth. The production of crowd scenes, neglected before the Meininger, also became a very important feature of the Moscow Art Theatre.

Some of the producers of the Stanislavsky Theatre trained their actors in the same way as did Kroneg, prescribing the exact intonations and emphases, gestures, movements and facial expressions. For the *mise en scène* they adopted Kroneg's method of dividing the stage into numbered squares like a chessboard, and moving the actors from one square to another. Later, while working upon the production of Chekhov's *Seagull*, Stanislavsky discovered that it is not enough for an actor to simulate nature by putting on a naturalistic make-up and using characteristic intonations, gestures, tricks and changes of voice. An actor has to "live" his part, *i.e.*, to "feel" it *really*. To do this, he has to discover beneath the lines and stage directions the feelings that prompt those lines and directions—and because, according to Stanislavsky, an actor, or human being, "cannot naturally feel and express things he had not experienced in his own life," he has to remember and repeat on the stage the emotions experienced in his own life.

The Stanislavsky System.—On that principle is based the Stanislavsky "system of acting," at one time famous in Russia. The system led his theatre from the outward naturalism, toward a kind of inward naturalism, which led not merely to a complete neglect of the form of the play, but even to its destruction. For acting is not a repetition of the feelings experienced by an actor in his personal life, but the creation and expression of complicated feelings and thoughts prompted by the style and form of the play.

Stanislavsky's method was important for the general development of theatrical art, because it forced the producers and actors to forsake the outward naturalism and its tricks, and to give more value to the inner content of the plays and parts. But it brought the Moscow Art Theatre and its followers back to the 18th century, at which period theatrical scholars were of opinion that an actor on the stage "can only repeat emotions he has experienced in his own life," and that "the love-scenes are much better played by such actors as are really in love." The Moscow Art Theatre, when dealing with naturalistic plays, gave, from every point of view, accomplished and beautiful productions. Among these were some of the Chekhov plays, Gorky's *Night Lodgings* and Alexis Tolstoy's *Tsar Fedor*.

But when the producers attempted poetic or symbolic drama —Shakespeare or Pushkin, Byron or Gogol—they inevitably failed. Plays by these authors were dragged down from their heights, and drowned in naturalistic details or pyschological experiments. The language was ruined, its power and beauty being sacrificed to naturalistic principles. A play written in verse was delivered as prose, because "verse is unnatural." In 1923 and 1924 the Moscow Art Theatre went to America with some of its earlier productions of Chekhov, Gorky, Tolstoy and Dostoievsky, and in 1925–6 were seen the new experiments of that theatre, with Aristophanes' *Lysistrata*, and two musical plays, Offenbach's *Pericolla* and *Carmencita and the Soldier*, an adaptation of Bizet's *Carmen*. All these plays were produced by W. Nemirovich-Danchenko on the lines of the formal method of production mixed with the constructive method. Neither method, however, is in any way typical of the work of the Moscow Art Theatre.

The Formal Theatre

The so-called "Formal Theatre" came into being as a protest against naturalism on the stage, at the very end of the 19th century. The "Formalists" held that the naturalistic theatre was not art, but a soulless attempt to photograph life, and that its actors were monkeys, endeavouring to imitate on the stage, characters, with their little habits and tricks, which they had observed in real life. The "formalists" sought first of all to simplify the stage settings. For example, instead of reproducing life-like rooms, giving exact copies of nature, or restoring historical surroundings with fidelity to details of time and place, they recommended "formal" scenery providing for the actor only suitable backgrounds or necessary surroundings for his acting.

The Leading Formalists.—Some of the formalists, notably a few of the new Russian producers, being inspired by the paintings of the later impressionists and primitivists, and by the work of the modern Russian and French painters, advocated the use of painted backgrounds, "panneaux décoratifs," only. Others, such as Adolphe Appia in Switzerland, Gordon Craig in England and Georg Fuchs in Germany, were against the use of flat painted settings, and recommended three-dimensional scenery. Appia and Craig went as far as to declare the painter-artist not only unnecessary, but a positive hindrance inasmuch as he was concerned only to make a picture and cared nothing for the placing of the actor. They thought that the building of the scenery ought to be in the hands of the producer himself. Georg Fuchs advocated the use of "stylised" settings and costumes, instead of the faithfully reproduced historical settings, costumes and life-like appearances. By "stylised" he meant that the settings and costumes should show not local details, or details of any particular historical epoch, but should be designed to provide a general idea of the play. Gordon Craig advocated abstract costumes and scenic surroundings, high screens resembling the towers of Ravenna, steps, platforms and other devices.

The Russian producers of the new school, such as Evreinov and Meyerhold, and before them, S. Marmontov, director of the Moscow Private Opera House, discarded the old-fashioned scene-painter and had their scenery designed by regular artists. With them begins the "picturesque" formal theatrical movement, which brought into fame the names of theatrical decorators such as Vroubel, Konstantin Korovin, Leo Bakst, Nicolas Sapounov, Alexandr Benois and Golovin. The director of the famous Russian Ballet, Serge Diaghilev, has always been one of the promoters of this movement, and thanks to him, such eminent French painters as Derain, Picasso, Matisse, Georges Bracque, Marie Laurencin, have come into fame as theatrical decorators. The Swedish Ballet of Rolf de Mari, following rather unsuccessfully the road indicated by Diaghilev, has shown us scenery by Picabia, Fujita and other modern painters.

In their notions of *mise en scène* and acting, too, nearly all the producers of the formalist school were influenced by Appia, Craig and Fuchs. From the formal stage, the "natural" speaking of lines, the "natural" movements and groupings, were banished, the symbolic and abstract costume plays being preferred. The Russian producer, Meyerhold, went as far as to advocate for the plays of Maeterlinck a kind of monotone voice without inflection, sounding "like drops falling into a deep well." As a reaction against the life-like movement which was the ideal of the naturalistic producers (the "crowd-work" of the Meininger and their followers), the formalists, under the influence of Maeterlinck, were enthusiastically in favour of "static" acting. Those who adopted the "picturesque," two-dimensional scenery dressed, grouped and posed the actors so that they should be in perfect keeping with the painted backgrounds, and even in some cases give the illusion of having been painted on the scenery. The actor being reduced to the position of a mere accessory, his art was eliminated. Some of the theorists had already come to the conclusion that the living three-dimensional actor, in front of the two-dimensional painted backcloth, was an anomaly in the picture, and should be replaced by a two-dimensional marionette.

The inventors of the three-dimensional "formal" scenery gave much more scope to the actor. They invented that kind of scenery in order to free the actor from the limitations of naturalistic settings, and give him a prominent position on the stage. Appia recommended constructions composed of straight lines, as being more in harmony with the three-dimensional actor, and as giving the necessary value to the curved character of the human body. Gordon Craig followed that idea, but Appia, in his scenic designs, although they were formal and stylised, still remained a naturalist. His formal, castle-shaped edifices were built of stone, and his forests, although formally related to the later futuristic scenery, remained real forests. Craig simplified his buildings to abstract three-dimensional screens of one colour, and in his settings will be found rows of steps, and square platforms indoors and outdoors by which means everything is symbolised. Elements of nature are absent, excepting perhaps in the suggestion of the sky.

Ideas of Fuchs.—At Munich in 1908 Georg Fuchs in a theatre (Münchener Künstlertheater) built in accordance with his new ideas, used scenery designed by Erler and other well-known German painters. It was simplified, constructed three-dimensional scenery, but it was not abstract. It was painted, and gave the impression of reality. For instance, the cathedral scene in *Faust* was represented by a massive and lofty church column; the whole stage around the column faded into darkness, and in the background the altar was suggested simply by lights. In a pastorale, he had a real "bosquet" made of real leaves, with arches, against a pale blue background.

Fuchs, like all the formalists, attached great importance to lighting, and in his Munich theatre he arranged a quite new system. There one had for the first time a stage without footlights and battens, but with special arrangements of diffused light resembling the light of nature. His "formal" stage was according to the old idea of Goethe—very shallow and divided into three parts, each one complete step higher than the other. The lowest of these was a narrow permanent proscenium enclosed between two movable flats with doors (called "towers") and covered by a ceiling that could be raised or lowered. This arrangement was afterwards imitated by Max Reinhardt in his *Faust* and other productions in Berlin. The acting ideas of Fuchs were on broad "stylised" lines. The groupings were sculptural and picturesque, and instead of "crowd" scenes ingenious suggestions of masses of people were employed.

Reinhardt and Granville Barker.—These features of the Fuchs stage are to be found in the productions of the latest schools such as the "expressionists" and the "constructionists," and in some of the productions of Reinhardt. In dealing with this famous German producer, it must be said that his fame rests more upon his versatility and his big sense of theatrical business than upon his originality. He started his career as an actor at the Municipal Theatre of Salzburg, and then came to Berlin, where he was with Brahm. When he opened his own theatres in Berlin, he produced plays in a variety of manners, always attaching great importance to good acting. His work was obviously influenced by Brahm, the Moscow Art Theatre, Gordon Craig, Fuchs and others of the later period.

In 1919 he opened his Grosse Schauspielhaus in Berlin, a theatre of "masses." Before beginning the performances there, he staged a Greek play (*Oedipus Tyrannus*) in the circus, bringing the action into the midst of the audience, and in a sense making the audience take part in the performance. It is clear that he found that idea in the writings of some theatrical theorists of the beginning of the 20th century. Among those, one of the most important was the Russian philosopher Viacheslav Ivanof, an authority on Greek literature and the Greek theatre, who advocated the theatre of masses, and the participation of the spectators in the theatrical show, which, according to him, ought to be given in the arena. Later, Fermin Gémier, in Paris, followed Reinhardt's example by producing plays in a circus.

In England, Granville Barker worked on nearly the same lines as Reinhardt; but whereas Reinhardt only changed the style of his productions for the sake of variety, Granville Barker varied the style to accord with the inner meaning of the particular play. Moreover, although he had not such power as Reinhardt in dealing with actors and extracting from them their finest possibilities, he showed much greater artistic taste in selecting his material, and did not work for "stunts" as Reinhardt did in many cases.

The Synthetic Theatre

It is in Russia that the genesis of the theatrical theory of "synthesism" is to be found, from which developed later "expressionism" and "constructionism." That theory originated partly as a result of some stage productions carried out by Komisarjevsky in a new way, in opposition to the methods of the "formal" theatre and partly as an experiment for the purpose of finding a more perfect form of theatrical show. It was intended that this show should, by uniting all the stage arts, produce the most powerful and complete impression on the audience. The "formalists" as the "naturalists," using the same methods of production for all plays, placed the actors and the plays in a condition of dependence upon the laws of nature in the one case, or upon their theories of uniformity in the other. Komisarjevsky, on the contrary, holds that the plays of each author should be produced and acted in a different form, each form to be expressive of the inner contents, rhythm and style of the play produced. Production is an expression of the understanding of the play by the producer, and the ensemble of the actors. The form chosen for that expression need be neither life-like nor formally unlife-like, but it must be synthetically expressive; that is to say, the elements of the scenic surroundings must be selected and put forward in such a way as to create the atmosphere desired by the producer and without distracting the spectator's mind with unnecessary factors, whether life-like, stylised or cubistic. On the other hand all the theatrical arts should be included in a synthesis, just as in an orchestra the different instruments are united for expression of the whole.

From these considerations there was evolved the conception of the synthetic play for a synthetic theatre, in which the movements, words, music and the colours and lines of the scenic surroundings would be united. The general idea, of course, is the same as that which was expressed long ago by Richard Wagner. Wagner, however, subordinated everything to his musical score, to the polyphony of his instrumental and vocal ensemble, and drowned the play and the actors in the orchestra. In acting, scenery, lighting, etc., and even in his treatment of his fantastic stories and characters, Wagner was a pure naturalist, and moreover a stagey naturalist. A school of acting on synthesist lines was opened in Moscow by Th. Komisarjevsky, who adapted and produced operas by Mozart, Rossini, Offenbach and Wagner, and plays by Shakespeare, Beaumarchais, Molière and other leading dramatists.

In 1922 Komisarjevsky produced on the same lines Claudel's *The Tidings brought to Mary* for the Theatre Guild of New York, the only "art theatre" at the present time in the English-speaking world. The Provincetown Playhouse in the same city follows, under the leadership of Robert E. Jones (painter and producer) and K. Macgowan, the path opened in America by the Theatre Guild. The Guild, which started in a small place in Washington square, now has its own playhouse in the West End of New York, equipped with the newest European and American technical improvements. Without being extreme or daring, this theatre showed to New York examples of nearly all the European schools of production. In dealing with the forward movement of the productions in the United States, one cannot omit mention of amateur societies in the provinces, which are much more advanced than the Broadway commercial enterprises. In France, the methods of "formal" production were used by Jacques Coppeau, who even built in his own playhouse (Vieux Colombier) a permanent architectural stage; by Dulain, Louis Jouvet and George Pitoëf. The latter in some of his productions followed the ideas of the expressionists and constructionists. In Belgium Delacre, and in Italy Pirandello follow the paths opened by the producers of the new schools.

The Expressionist Theatre

In Germany the "expressionist" school came into existence. They destroyed reality, decomposing it to create out of its elements new forms which were intended to be symbolically expressive of their understanding of life. Some of the expressionists might be called "cubists," as they treat their productions in the same way as cubist painters treat their painting; others are developing the ideas of the "formalists" and "synthesists." The most important expressionist is Jessner, who, in 1919, when he was appointed director of the Berlin State Theatres, began his expressionistic productions. Of these, *Wilhelm Tell*, *Richard the Third*, *Don Carlos* and *Marquis von Keith* (by Wedekind) were extremely interesting. In the matter of acting, although Jessner is the director of the Schauspielschule, the expressionists have brought nothing new to the stage; they have followed the traditions of Brahm and Reinhardt.

The Constructionist Theatre

The "constructionists" came into being in Russia in the last years of the Revolution. Like the expressionists they have made no new departure in acting, except to bring circus clowning upon the theatrical stage. They have exaggerated the movements of the actors to such an extent that, in their productions, the play itself (which as a rule is always adapted to suit the scenic constructions and the elaborate movements of actors) disappears in a kind of "perpetuum mobile" of the actors. Instead of the painted or constructed scene, the constructionists used naked platforms, steps, ladders, etc., building the action up, instead of having it on the floor level. The most important constructionists are Tairov and Meyerhold. The former at times uses painted, constructive scenery, and advocates "clowning" and perpetual movement of actors on the stage. The latter, in his last productions, left out the "clowning" and exaggerated movement; he leaves the stage quite bare, using only necessary and undisguised rostrums, tracks and steps, sometimes adding insignificant pieces of scenery, or posters dealing with political propaganda, parts of machines, etc., underlining with all these accessories the idea that the production is done in a republic of workmen and peasants. The first constructionist productions were seen in Moscow in 1921. The most important of them are: Crommelynck's *Le Cocu Magnifique* (producer—Meyerhold in 1921), Chesterton's *The Man Who Was Thursday* (Tairov in 1923), *The Storm* by Ostrovsky (Tairov in 1924), *Forest* by Ostrovsky and *The Lake of Ljull* (both produced by Meyerhold).

Constructionism during the last years was accepted in Russia as a kind of national style, and the other producers, even in the very old-fashioned state theatres, have produced some plays and operas in that way. Meyerhold, being a very experienced and imaginative producer, sometimes obtains very powerful effects, but all his work is nowadays carried on in the very narrow channel of political propaganda. The theatre in Russia of the last few years represents the latest phase in the development of stage-craft. It must be confessed that it is a very poor one, and only leads us back to where we started. The old followers of naturalism copied life as it is, down to all the smallest and artistically unnecessary details, but they did not lack romance and a certain poetry in their work. The constructionists substitute scaffolds for natural life surroundings, and showed on these scaffolds actors in new naturalistic plays produced in accordance with the old naturalistic methods, or no methods at all.

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STÅHLBERG, KAARLO JUHO (1865–), Finnish politician, was born on Jan. 28 1865. At the beginning of his public career, he held alternately university and administrative posts until he became a member of the diet in 1904 and of the Finnish Govt. in 1905. He resigned in 1907 and in the following year was appointed a professor of administrative law. At the outbreak of the World War, the Government was Finnish in name only, being composed entirely of Russian officials. Ståhlberg was then president of the Diet and he had to act as the chief public representative of Finnish opinion. He withstood the increasingly oppressive tendencies of the Imperial Russian Govt. with unwavering firmness. After the Russian revolution of 1917 Finland became an independent Republic, and in the summer of 1919 Ståhlberg was elected to the presidency as the candidate of the Progressive and Socialist parties. The country was still split up by sharp internal dissensions, and the new President had from the very beginning to fight the unconcealed hostility and distrust of the conservative parties. He pursued, nevertheless, a conciliatory and mitigating policy with the object of extinguishing the class hatred and casting oblivion over the past. The many beneficial effects of this policy became gradually obvious, and when the time of the next presidential election approached, Ståhlberg could register the personal triumph that the country almost unanimously desired him to accept re-election. He refused, however, and retired on the expiration of his presidency.

STALIN, JOSEPH (1879–), Russian politican, whose real name is Dzhugashvili, was the son of a Georgian peasant, and was born in the Tiflis district and educated in a seminary from which he was expelled in 1898 for revolutionary opinions. From 1898 till 1917 he was engaged in revolutionary propaganda, interrupted by frequent arrests, imprisonments and banishments. He escaped five times from exile. In 1917 he edited the Bolshevik newspaper *Pravda*. Always a close supporter of Lenin, and for a very long time a member of the central committee, he became after Lenin's death the most influential member of the Communist party and general secretary of the central committee of the Communist party. In the civil war he took an active part in the defence of Tsaritsin, which town was subsequently, in his honour, renamed Stalinsk.

STAMBOLISKY, ALEXANDER (1879–1923), Bulgarian statesman, was born at Slavovitsa, in Southern Bulgaria, Sept. 1 1879, the son of a peasant landowner. After studying at the village school and later in the neighbouring town, he attended the agricultural college of Halle in Germany. On returning to Bulgaria, aged 18, he took up journalism, and in 1902 became editor of the organ of the newly-formed Agrarian League. His articles brought him fame and six years later he was elected to the Sobranye, where he made steady progress, soon becoming leader of the Agrarian party.

He now began to organise the peasant masses, who form 80% of the total population of Bulgaria, into agricultural associations. In 1911, when the Grand Sobranye met at Tyrnovo to amend the Constitution, his first conflict with King Ferdinand occurred. After the treaty of Bucharest (1913) Stambolisky and the Agrarians were unmerciful in their criticisms of Ferdinand's policy, though deterred from extreme measures by the fear of external complications. Stambolisky's opposition to Ferdinand came to a head in 1915 during the negotiations that preceded Bulgaria's entry into the World War. The story of the alienation of official Bulgaria by the blunders of Russian and Western diplomacy remains to be written; but the Bulgarian peasants were "pro-Russian by race and pro-British in sympathy." Stambolisky, their representative, backed the Entente in spite of the King's anger, pressure from the Government and the growing influence of the Central Powers. Summoned before the King, Stambolisky threatened him with personal violence if he should fight against the Allies, reminding him that he had a crown to lose. Ferdinand warned Stambolisky to take care of his own head, and ordered his immediate arrest. After being tried by court-martial he was condemned to penal servitude for life.

In Sept. 1918, when the resistance of the Bulgarian troops began to slacken, Ferdinand released Stambolisky, who left for the Macedonian front. He returned at the head of the insurrectionary troops and their arrival at Sofia resulted in Ferdinand's abdication and flight. A partisan of the new ruler, King

Boris, Stambolisky became a member of the Cabinet in Jan. 1919 and Prime Minister in Oct.; as head of the Government he went to Paris and signed the Treaty of Neuilly in the same year. On his return in Dec. he was faced by a railway strike which he settled successfully. In Feb. 1920 he dissolved the Sobranye, and the following month was returned to power at the head of a homogeneous Agrarian majority. From 1920 to 1923, the Agrarians under Stambolisky ruled Bulgaria with a rod of iron. They were not only intolerant of all opposition, but even unjust in their treatment of political opponents. Surrounded by ill-advised colleagues, Stambolisky had neither the strength nor the time to exercise control over the firebrands. But though a dictator at home, he was a peace-maker abroad, and through his influence post-War Bulgaria won the esteem of the Allies. He inspired great confidence, not only at the Peace Conference, but at Genoa, Geneva and Lausanne. He made persistent efforts to improve relations between Bulgaria and Yugoslavia, and showed real statesmanship in concluding the Nish agreement (1922) with that country. He carried out the terms of the peace treaty loyally, and gave full satisfaction to the Allied Military Commissioners in regard to disarmament. With the help of Dimitri Stancioff, the Bulgarian Minister in London, he secured a reduction of Bulgarian reparations from £90,000,000 to £22,500,000.

The overthrow of the Government by a military faction on June 9 1923 was caused by Stambolisky's misguided policy at home. The change of régime took place in one night, the Agrarian Ministers being arrested in their own homes. Stambolisky, pursued by an armed detachment to his native village of Slavovitsa, escaped and fled across the mountains, hoping to reach the frontier. After being followed by soldiers for three days, he was eventually surrounded and shot on June 12. A formidable personality, attractive in many ways, and made of finer clay than the average Balkan statesman, Stambolisky has been called a modern Rienzi. Tall and broad, his demeanour was fierce and his movements ungainly; his rough-hewn face was crowned by a mass of black hair; he impressed everyone with his strength and sincerity. A true patriot but a man of great simplicity, he had only the use of primitive tools. Stambolisky published several books, including *Authority, Anarchy and Democracy*; and *What a Politician ought to be.* (N. Mu.*)

STAMP, SIR JOSIAH CHARLES (1880–), British economist, was born in London June 21 1880. He was educated at the University of London, where he took the degree of B.Sc., with first class honours, in 1911, becoming Cobden Prizeman in 1912, D.Sc. in 1916, and Hutchinson research medallist in 1916. He entered the civil service (inland revenue department) in 1896, and became assistant secretary to the board in 1916. In 1919 he resigned from the service to join Nobel Industries Ltd., of which he was a director and secretary until he accepted the new post of president of the executive of the London, Midland and Scottish Railway in 1925. He was Newmarch lecturer on statistics, University of London, 1919–20, and served the Royal Statistical Society as honorary secretary and editor. Sir Josiah Stamp was knighted in 1920 for "valuable service to the Government in financial matters." As one of the most distinguished economists of his time, he was appointed a member of the committees of experts of the Reparation Commission in Paris and Berlin. He played an important part in the London Conference of 1924. He was also a member of the Northern Ireland finance arbitration committee in 1923–4 and a member of the Committee on taxation and national debt in 1924, in which year he was created G.B.E. (*See* CAPITAL LEVY; REPARATIONS.)

Sir Josiah's chief publications are *British Incomes and Property; The Application of Official Statistics to Economic Problems* (1916, 3rd ed. 1922); *Wealth and Income of the Chief Powers* (1919); *The Fundamental Principles of Taxation in the Light of Modern Developments* (1921, 2nd ed. 1923); *Wealth and Taxable Capacity* (1922, 2nd ed. 1923); *Joint Report on Double Taxation*, League of Nations (1923); *Studies in Current Problems in Government and Finance* (1924); *Business Statistics and Financial Statements* (1924), jointly with C. Hewetson Nelson; and the British edition of Rignano's *Social Significance of Death Duties* (1925).

STAMP COLLECTING (*see* PHILATELY, 21.374).—New postage stamps have been issued in great variety in modern times, and the number of standard varieties listed in a simple catalogue has more than doubled since 1906, being 44,000 as against 20,000. The annual output tends to grow rather than diminish, though the abnormal figure of 15,000 new stamps between 1916 and 1925 was in part due to war upheavals and post-War reconstruction. The effect on the more detailed catalogues used by philatelists is still more marked, and it is estimated that upwards of 160,000 varieties are listed in the leading British (Gibbons) and American (Scott) catalogues, while in Germany a start was made in 1923 with an encyclopaedic catalogue (*Kohl-Briefmarken-Handbuch*, ed. Herbert Munk) in which the first 1,056 pages reach only to "De."

This vast increase has embarrassed publishers of printed albums of the comprehensive kind formerly popular, and it has obliged collectors to set broad or narrow limits on the scope of their collections. General collecting is still extensively pursued but few attempt to collect the stamps of the whole world, selecting instead a geographical or political group, *e.g.*, Great Britain and her Dominions, the United States and her possessions, etc. Still more collectors have carried their limitations further, and specialise in the stamps of individual countries. Intensive special study has reached a stage where at the London International Stamp Exhibition (1923) many exhibits dealt with single issues, and even single stamps.

Except the Tapling Collection in the British Museum, the great general collections of the past, including those of Ferrari, Philbrick, Worthington, Breitfuss, have all been dispersed; the philatelic magnates of to-day possess series of specialised collections, often covering a wide range of countries, but not compiled on the comprehensive lines of the great pioneers; some set a period to their collections, thus eliminating the prolific issues of recent times; 1890 may be taken as the close of the most interesting epoch of stamp issues for the connoisseur, but the close of the 19th century, coinciding with the end of the reign of Queen Victoria, is a convenient period (1840–1901) chosen by many collectors. There is also a modern school collecting stamps of the 20th century.

Specialised Collecting.—The Royal Philatelic Society (London), under the guidance of the 26th Earl of Crawford until his death in Jan. 1913, led the modern trend to historical and technical study of stamps in specialised fields. The philatelist of to-day traces the economic origins of the issue of stamps, the artistic sources of their designs, and the most exact and minute details of their manufacture. The articles "Postage Stamps in the Making" in Gibbons' *Stamp Weekly* and Gibbons' *Monthly Journal* (1910–4), revised in book form in 1916, provided a basis for technical research into the formation and use of dies, plates, stones, etc., the details of paper, watermark and devices to ensure security from forgery or the illicit re-use of stamps.

The effect of this specialism on the market has been remarkable. While rare stamps remain rare, their values have increased largely owing to the number of wealthy patrons who regard rare stamps as a good and protected investment. Comparatively common stamps, especially of the early issues prior to the introduction of perforation, have risen in value owing to the quantities which the specialist requires in order to pursue his technical studies. The original 1d. black (Great Britain) stamp of 1840 is not rare; twopence would buy a good copy at the beginning of this century, and they were abundant on the market for some years later. Intensive study of this one stamp has led to the identification of 240 units from each of the 11 plates, some in two distinct states, used for printing the stamps; the collector, seeking to reconstruct the plates of the penny black, needs not fewer than 2,880 different specimens, to find which he would search through many times that number. There are other features of the study of this stamp, with its curious and interesting postmarks, which cause the specialist to drain the market of it and similar classes. Although common, an ordinary used copy of the 1d. black is worth 5s. (1926), but a copy identified as coming from plate 11 is worth about £5. Similar conditions have elevated the prices of nearly all "first issues" and early imperfo-

rate stamps, notably the beautiful early stamps of the United States.

The Ferrari Sale.—The last great general collection to be dispersed, that of Philippe la Rénotière von Ferrari, who died at Lausanne in 1917, was sequestrated by the French Govt. and sold by auction 1922–5. Its owner had bequeathed it to the Berlin Postal Museum, which already houses a collection of great historical interest and value. In 14 sales, covering 39 days, the portions sold at the Hôtel Drouot, Paris, realised 26,482,964 francs, or £402,965, calculated at the rate of exchange prevailing at the different periods of the sales. This did not represent the entire store of Ferrari's stamp treasures.

Among the notable prices recorded at these sales were: the unigue 1 cent British Guiana, 1856, £7,343; pair of 2 cent British Guiana, 1850, £5,250; Hawaiian Islands, 2 cents, 1851, £3,900; Mauritius, 1847, 2d. £2,338, 1d. £2,090; Baden, 9 kreuzer on green paper (error) £1,816; France, 1849, 15 cents, *tête-bêche*, pair £837; 1 franc (Vervelle) *tête-bêche* in a block of four, £2,706. Some of the little known United States postmaster's stamps also recorded high prices, *e.g.*, Boscawen, 1846, 5 cent, £2,625; Lockport, 1846, 5 cent, £1,875. The price paid for the 1 cent British Guiana, 1856 (£7,343) is the highest price ever paid for a single stamp; the prices quoted for the 1d. and 2d. Mauritius have been exceeded at other sales, and one original envelope, bearing the two denominations used together to prepay a 3d. postage rate, was sold in 1922 for £11,000.

War Time Developments.—During the World War, philately, instead of declining as many thought it would, became enormously more popular; those who suspended their collecting soon found the strain of War conditions called for a mental relaxation, and returned to their stamps. Others, especially those brought into contact with the historic circumstances of the issue of stamps in the War zones and captured colonies, took up collecting with eagerness. Outstanding events of the War were marked for collectors by stamp issues of great interest, like the British and other War issues for Samoa, New Britain, Baghdad, Bushire and Togo. On the enemy side stamps were issued by the German and Austrian armies as they pushed through Belgium, France, Russia, Italy and the Balkans, and the public interest in these issues attracted numbers of new collectors, many of whom have maintained their enthusiasm, and some passed on to the advanced philatelic stage.

The period following the collapse of Austria and the Armistice was not less interesting or prolific. New stamps brought records of the independence of Finland, Poland and the Baltic states of Estonia, Latvia and Lithuania, the much divided Empires of Austria and Turkey, the incidents of the plebiscites, and the mandated territories, and even the League of Nations had a set of Swiss stamps overprinted in 1922.

Aerophilately.—Another phase of the pursuit which has attracted large numbers of new collectors is aerophilately, or, as some wish to call it, " aerophilosemy,"—the gathering together of air-post stamps, in which particular regard is paid to envelopes (" covers ") which have been carried on air mails. Scarce stamps on envelopes or cards carried on historic flights like the transatlantic flights by Mr. Hawker (April 1919) and Sir J. Alcock (June 1919) command high prices. Elaborate catalogues have been published in Britain, France and Germany for the guidance of collectors in this branch of the pursuit.

Forgery remains a menace to the collector, but the advance of scientific knowledge of the old stamps places experts in a strong position with regard to the classic issues. The modern excess of surcharged or overprinted stamps, many of which were of a provisional and short-lived character, and consequently scarce, are the chief temptations to the counterfeiter where the overprints can be fairly closely imitated by modern photo-mechanical processes on the basis of genuine stamps. The expert committee of the Royal Philatelic Society decided in 1925 to discontinue undertaking to pass opinions on stamps issued subsequent to 1913.

Organisation.—Philatelic organisations are to be found in most countries. The Royal Philatelic Society celebrated its jubilee (1919) by a scheme for acquiring a permanent home, possession of which was obtained in 1925. The Junior Philatelic Society, founded 1899, inaugurated a widespread movement which has extended throughout the Dominions and foreign countries, assisting the beginner and medium collector; it has organised the international philatelic exhibitions in London 1912 and 1923. Between 70 and 80 societies in Britain and the colonies are affiliated in the Philatelic Congress of Great Britain, which meets annually. America has its similar institutions headed by the Collectors' Club (New York) and flourishing societies in cities from Boston to San Francisco; in addition there is the American Philatelic Society, a national body holding an annual convention, and the Association for Stamp Exhibitions, Inc., which organised the international exhibitions in New York 1913 and 1926.

Governments now take a new regard for the requirements of stamp collectors. The " Philatelic Agency " was started by the United States as a department of its post office at Washington (1921) to supply current and such stamps of older kinds as may be available to collectors and dealers at face value; similar agencies were set up in Canada at Ottawa (1923) and at Balboa Heights, Canal Zone (1924). Some countries still produce stamp issues more frequently than is necessary for their postal requirements, looking to the revenue obtained from the sales, without postal service, to collectors. In many cases, commemorative issues of stamps are now issued on notable occasions in lieu of the ancient custom of striking of special coins, and in the main such issues add to the fascinating variety of historical and other subjects brought pictorially into association with stamp-collecting.

BIBLIOGRAPHY.—The bibliography of philately is very extensive. E. D. Bacon, *Catalogue of the Philatelic Library of the Earl of Crawford, K.T.*, published by the Philatelic Literature Society in 1911, with supplement in preparation (1926) lists all separate works known to 1908 and periodicals to 1906; this, the most complete library extant is in the British Museum, bequeathed by the late earl. Short selected bibliographies will be found in F. J. Melville, *Chats on Postage Stamps* (1911) and *The Complete Philatelist* (1924). *The Philatelic Index* (1925), issued by the Philatelic Congress of Great Britain, is a tentative index to the contents of the principal British stamp journals. See also S. C. Johnson, *The Stamp Collector* (1920); James E. Handshaw, *Looking Backward* (1923); *The Complete Standard Catalogue of the Postage Stamps of the World*, C. H. McKeel, ed. in 3 parts, St. Louis, (1894–5) and *The Standard Postage Stamp Catalogue* issued by Scott Stamp and Coin Co., Ltd., N.Y. (1923).

(F. J. M.)

STANCIOFF, DIMITRI (1864–), Bulgarian diplomatist, was born at Sistov, Bulgaria, in May 1864, and studied at the Theresianum College, Vienna. In 1887 he entered the Foreign Office, Sofia, and was a member of the delegation entrusted with electing a ruler for Bulgaria. After the choice had fallen on Prince Ferdinand of Coburg, Stancioff became head of the new King's political Cabinet. Afterwards he was successively appointed Bulgarian representative at Bucharest, Vienna and St. Petersburg where he received the title of Minister Plenipotentiary and remained 10 years, succeeding in re-establishing friendly relations between Russia and Bulgaria. He became Minister of Foreign Affairs in 1906 and was for a time Prime Minister after the murder of Petkoff. In 1908 he resigned and became Minister in Paris where he remained until 1915 when he was sent to Rome. During the World War, against which he had vainly protested, he organised Red Cross and Ambulance work. After the Armistice, he was again called to the Foreign Office to resume relations with the Allies. He was a member of the Bulgarian Delegation to the Paris Peace Conference, and in 1920 was appointed Bulgaria's representative to the Court of St. James. Stancioff was Bulgaria's chief delegate to the first international Peace Conference at The Hague in 1899 and was a permanent member of the International Court of Arbitration at The Hague. After the World War he attended the Genoa, Hague and Lausanne Conferences. In 1889, he married the Countess Anna de Grenaud, lady-in-waiting to the princess Clementine of Orleans, the mother of the ex-King Ferdinand.

STANDARDISATION may be defined as the art or process of securing or observing conformity to any measure whether of extent, quantity, quality or value, which has been established

by law, general usage or consent. These established measures are called standards. Examples are standard weights and measures (usually fixed by law); standard screw threads in the mechanical field; standard voltages in the electrical field; standard commercial forms, such as cheques, notes, contracts, invoices, etc., in business practice; standard track gauge in steam railway construction, and standard specifications for steel and other structural materials. Standards usually represent the final conclusions obtained through extensive experimentation and research and serve as a basis for comparison of one product with another, or of actual performance with ideal or desired performance. Standardisation has long been recognised as the foundation of mass production, and has been extensively applied in industries where volume output is the main purpose.

Motor Car Manufacture.—In 1910 the Society of Automotive Engineers in New York appointed a committee to set up standards which would simplify motor car manufacturing. This committee succeeded in establishing many standards for the automotive industry, and its work proved of great importance in the rapid growth of motor car production in America. S.A.E. standards include specifications as to sizes and dimensions of machined parts and fittings used in motor car construction, also to the materials of their composition, and to the tests by which the performance, durability and strength of such parts are determined. The widespread use of, or adherence to, these standards has made possible economies in designing, producing, operating and maintaining motor cars. These economies have helped to reduce the price to the consumer, and thus to make possible their wide distribution.

Impetus During the War.—Up to the time the United States entered the World War (April 1917) standardisation had been applied more extensively in the American motor car industry than in any other field of manufactured commodities. The great demand for munitions, rifles, machine guns, railway cars, ships and the thousands of other materials of modern warfare required the production of all these on a far greater scale than ever before attempted. It became necessary to divide the huge orders among many factories, and arrangements were made for one to furnish one part, another factory another, and so on. These units were then sent to centralising depôts for assembling and final delivery to the point of use or consumption. It was imperative that parts from several sources should be assembled with a minimum of labour. Consequently, standard gauges were made and distributed to the various shops for them to use in checking the accuracy of the parts made by them. It thus became possible to build motor-trucks, tractors, railway cars and locomotives, ships, big guns, shells and innumerable other essential products in enormous quantities. The impetus given to standardisation by war-time conditions has led to a rapid acceleration in the adoption of standards. There is scarcely a single American industry, operating on a large scale, that does not apply standardisation to its products, its processes, its plant equipment, its tools, jigs, dies, fixtures, even to its purchases of the materials used directly or indirectly in the fabrication of its products.

Machine Tools and Shipbuilding.—In 1921 the National Machine Tool Builders Association appointed a committee to co-operate with the American Society of Mechanical Engineers in establishing standards for various parts or features of machine tools. Consideration is being given to T-slots, spindle ends, angle blocks, tool holders, length of ways, bolts and nuts, and so on. Further study is being directed to the establishment of standard names for components now given a wide variety of names. It is being demonstrated that such standardisation is of great convenience to the manufacturer who uses many machine tools, in enabling him to interchange parts, reduce time lost by breakdowns, and thus expedite his own production.

In 1922 the American Marine Standards Committee was formed to promote the simplification and standardisation of practice in the building, operation and maintenance of ships and in the allied industries. This committee is composed of representatives of American shipbuilders, owners, operators, managers, as well as of engineering societies and Government departments. Among the components of ship construction for which the committee is developing standards are air ports, fixed lights, bitts, cleats, chocks, hawse pipes, marine hardware, life-boat fittings and equipment, fire buckets, propeller hubs, piping, gauges, hose couplings, care and operation of boilers, superheaters, engine-room auxiliaries. The adopting of these standards and their incorporation in vessels now building, or to be built, is expected appreciably to reduce the cost of designing, construction, operation and maintenance.

Mutual Standards in Industry.—The trend toward standardisation in various industries led to the consideration of mutual or common standards, *i.e.*, those which might be usefully applied in two or more industries. Groups which hitherto had acted more or less independently of one another in standardisation realised the need for co-operative action and for a centralising agency or clearing-house to co-ordinate and correlate their work. Consequently, the American Engineering Standards Committee was formed in Oct. 1918. In 1925 this organisation had 24 member bodies representing 35 national organisations. The main committee had approved, to Jan. 31 1925, 68 standards of a national character; 12 more were then awaiting approval, and 79 more projects were under way. Trade, technical or governmental bodies co-operating through representatives on special or sectional committees numbered 352, and there were 1,371 individuals on sectional committees.

Projects covered by the A.E.S.C. programme are divided as follows:—

Group	Projects		Group	Projects	
	Total	Approved		Total	Approved
Civil engineering and building trades	32	16	Non-ferrous metallurgy	14	6
Mechanical	26	10	Chemical	12	9
Electrical	17	5	Textile	2	1
Automotive	4	1	Mining	16	1
Transportation	9	6	Wood	5	2
Shipbuilding	1	0	Pulp and paper	1	0
Ferrous metallurgy	9	7	Miscellaneous	11	4
			Total	159	68

The American Engineering Standards Committee co-operates with the Federal Specifications Board, an organisation representing Government Departments, in the preparation of specifications relating to Government purchases of materials and supplies. It also co-operates with the standards committees of other nations in the promotion of international standards applying to manufactured goods. A further development in international standardisation occurred in the organisation of the Pan-American Standardisation Conference at Lima, Peru, in Dec. 1924. The general idea for this conferenc originated with the Latin-American countries.

Government Action.—Nation-wide interest in standardisation has been greatly quickened by the activities of the U.S. Department of Commerce. In 1921 the Secretary of Commerce, Herbert Hoover, established the Division of Simplified Practice to assist commercial organisations, chiefly trade associations, in the reduction of the variety in sizes and dimensions of the products in which their members were offering those products to the trade. It has been previously determined by a committee of eminent industrial engineers that the preventable waste in American industry was unduly high, and that much of this waste of material, labour, time and human energy came from the unwarranted fabrication of many non-essential varieties in the same class or type of goods. As an example, manufacturers of paving bricks were making 66 different types and styles of these articles. They found that 70% of their business came from 11 of the 66 varieties. They decided to eliminate the odd 55 and concentrate production, sale and use thereafter on the 11 staple varieties. This was done in Nov. 1921. In March 1922, the variety was cut to 7; a year later to 6; in March 1924 to 5; and in March 1925 to 4. This was accomplished through the mutual adoption by manufacturers, distributors and consumers of the reduced line of types and sizes as the basis of future business. The Department of Commerce acted solely as an intermediary in bringing about this result. The action was initiated, sponsored and carried through to completion by the industry.

Simplification.—This process of curtailing variety is called simplification to distinguish it from standardisation. The former is a commercial policy or procedure; the latter a technical process, often involving scientific research and investigation. Obviously, there is a relation between simplification and standardisation in that simplification, or the elimination of superfluous and unnecessary varieties in a common product, expedites

or facilitates standardisation. The varieties retained as the simplified line become the accepted standards of the industry, and may remain as "standards" until more adequate and acceptable standards are derived through scientific methods. Simplification is being applied in scores of industries with marked results. It is reducing inventories and idle investments, decreasing manufacturing and selling costs and likewise stimulating turnover, sales and volume production.

Examples of simplification effected are given in the following tables:—

TABLE I.

Commodity	Number of sizes or varieties in use	Number Eliminated	Number Retained	Per cent Reduction
Iron, steel, and their products				
Metal lath	125	101	24	81
Files and rasps	1,351	855	496	63
Woven wire fencing	552	483	69	86
Woven wire fencing packages	2,072	1,934	138	94
Range boilers	130	117	13	90
Hot water storage tanks	120	106	14	88
Steel barrels and drums	66	42	24	64
Forged tools	665	314	351	47
Plough bolts	1,500	660	840	44
Steel reinforcing bars	40	29	11	73
Sheet steel	1,819	1,556	263	86
Steel lockers	65	48	17	74
Tacks and nails (sizes)	428	247	181	58
Shovels, spades and scoops	4,460	4,076	384	92
Hospital beds, Lengths	33	32	1	97
" Widths	34	33	1	97
" Heights	44	43	1	98
Beds, metal	78	76	2	97
Bed springs	78	76	2	97

TABLE II.

Commodity	Number of sizes or varieties in use	Number Eliminated	Number Retained	Per cent Reduction
Stone, clay, glass, and mineral products				
Vitrified paving brick	66	62	4	94
Face brick (smooth)	37	36	1	97
Face brick (rough)	38	37	1	98
Common brick	44	43	1	98
Hollow building tile	36	17	19	47
Roofing slate	98	50	48	51
Blackboard slates	251	226	25	90
Concrete building units	115	91	24	80
Sand, lime brick	14	11	3	79
Hotel chinaware	700	540	160	77
Hospital chinaware	700	587	113	84
Dining car chinaware	700	587	113	84
Milk bottles	49	40	9	82
Asphalt (grades)	88	79	9	90
Asbestos (paper)	14	6	8	43
Asbestos mill board	10	5	5	50
Grinding wheels	715,200	459,400	255,800	64
Wood, paper, etc.				
Box board	244	184	60	76
Milk-bottle caps	29	28	1	97
Tissue paper:				
Roll tissue	13	10	3	77
Shoe tissue	21	15	6	72
Grocers' paper bags	6,280	1,580	4,700	25
Wood beds	78	74	4	95

BIBLIOGRAPHY.—*Management Handbook*, Ronald Press Co. (New York, 1924); *Waste in Industry*, McGraw-Hill Book Co., Inc. (New York, 1921); *Year Book for 1925*, American Engineering Standards Committee (New York); *Simplified Practice, What It Is and What It Offers*, U.S. Dept. of Commerce (Nov. 1924). (R. M. H.*)

STANFORD, SIR CHARLES VILLIERS (1852–1924), British musical composer (*see* 25.773), died in London March 29 1924.

STANISLAVSKY, stage name of Constantine Sergeevich Alexeev (1863–), Russian theatrical producer, was born in Moscow. His father was a rich mill owner and his grandmother a French actress; he studied at the imperial school of dramatic art and in 1888 began work as an actor and producer in the Society of Art and Literature and after 10 years of training founded in 1898 together with the playwright V. N. Danchenko the Moscow Art Theatre. His productions were extremely varied, ranging from the historical *Czar Fedor* to the extreme naturalism of Chekhov's plays. He was also an actor of great force and subtlety, taking the leading parts in Chekhov's and Gorky's plays. Stanislavsky revolutionised the art of producing and is the acknowledged father of the modern Russian theatre. See Stanislavsky, *My Life in Art* (Eng. trans. 1924).

STAR-CONTRA PROPELLER.—The most efficient screw propeller is still far from perfect, owing to the fact that its action on the water is not wholly confined to thrust work in an axial direction, but is accompanied by a certain amount of power lost in giving the jet of water a rotary motion. The rotary or tangential force represents wasted energy, and the device about to be described has been evolved with a view of utilising that force in useful thrust work.

Construction.—The star is fitted in the propeller aperture, either on the fore or on the after side of the propeller proper, as circumstances allow. It consists of a solid casting secured firmly to the rudder post or ship's stern frame. If the device is fitted on the after side of the main propeller it is provided with two blades or fins projecting each side and of special shape. If on the forward side of the propeller proper, the star may consist of two fins rigidly secured to the ship's structure and which may or may not be fitted with outboard or side blades.

Principle and Action.—A ship's propeller causes the propeller stream to move in two directions. The axial movement is that which drives the ship; the tangential movement, that which causes the propeller stream to twist, is loss of power. The Contra propeller has been designed to eliminate this loss, and the results certainly show an increase of efficiency and economy. The water leaving the main propeller blades does so in a direction more or less perpendicular to the blade, but, when a star is provided behind the main propeller, the water flowing between its blades has its direction of flow changed until it is flowing astern in the line of the ship's course. If, however, the device is fitted forward of the main propeller, the water flowing through its blades has its direction changed before it reaches the main propeller. The star blades are so curved that just sufficient change of direction is given to prepare for and to counteract the rotary motion ordinarily given to the water by the main propeller. Since the one change of direction is just neutralised by the other, the water is thrown off the main propeller blades in a direct parallel to the course of the ship.

Advantages of the Star-Contra Propeller.—When fitted with side blades the device is a distinct protection for the main propeller, against other craft, floating or partially submerged objects, and when manoeuvring near dock walls. This particularly applies when working amongst floating ice. A vessel fitted with this device will develop the same speed, but will absorb from 7–10% less power, with consequent saving in bunkers and bunker space, and increase of deadweight cargo capacity. Manoeuvring is distinctly improved, as the increased solidity of the water after leaving the propeller area improves the efficiency of the rudder. The rudder bias is also largely reduced, consequently there is a saving in wear and tear on rudder gear, steering engine, chains, etc. The steering of the ship is improved; and in types having side blades the pitching and rolling is much less. As is well known the reduction of rolling and pitching in rough seas means an increase of speed. The vibration is reduced to a considerable extent as the water is less broken. Even with the most efficient propeller there still remains a considerable percentage of loss through slip, cavitation and other causes, which involves either reduced speed, or unnecessarily large oil or coal consumption. The device is suitable for every type of vessel, from ocean-going liners to small coasters and tugs, and even launches, either with single, twin, triple or quadruple screws driven by reciprocating, turbine, internal combustion or electrical drive. As

regards wooden vessels, the star is equally suitable. Pilot-boats, fishing and sailing craft with auxiliary machinery, should find the device of considerable assistance, as pitching and rolling can be considerably reduced by its installation. Finally, it must be borne in mind that after the initial cost there are no maintenance charges.

See Walter Pollock, "A suggested Method of Increasing the efficiency of the Screw Propeller," *Trans. hist. Naval Architects*, vol. 67, 1925. (Read at Spring Meeting, April 1925). (F. J. D.)

STARK, JOHANNES (1874–), German physicist, was born April 15 1874 at Schichenhof in Bavaria and studied at the University of Munich. In 1900 he became an assistant at the University of Göttingen. He went as professor in 1907 to the Technische Hochschule at Aix-la-Chapelle, in 1917 to Greifswald and in 1920 to Würzburg. Stark devoted himself principally to the study of the modern theory of radiation and the atomic theory. He discovered the Doppler effect in parallel rays, for which the Vienna Academy awarded him the Baumgartner Prize. Later he discovered the Stark effect, named after him, and in 1919 was awarded the Nobel Prize for Physics. He wrote numerous essays on physical problems, including the *Prinzipien der Atomdynamik* in 3 parts (1910–5); *Die elektrischen Quanten*, *Die elektrische Strahlung*, and *Die elektrizität in Gasen* (1902). He was the founder of the *Jahrbuch der Radioaktivität und Elektronik* (1904).

STARS: *see* ASTRONOMY.

STATISTICS AND GRAPHS (*see* 25.806).—Two classes of problems are presented in the examination and interpretation of groups of statistical data. The first is to determine the relation to one another of two series of quantities, the measurements of which have been recorded. The second is concerned with the comparison of the relations of different pairs of series. A simple illustration of the first is the quantity of rain falling at a given observing station during a determined interval of time. If the amounts of the rainfall be set out for each week in a year, the table showing these amounts will indicate the fluctuations in rainfall with the seasons.

Similar tables for other years, when compared with the first and with one another, will show that there is no precise uniformity in the recurrence of wet and dry periods, but if the records for each week in the year are averaged over a series of years, the contrasts between the wetter and drier seasons of the year will become clearer than in the record for a single year. Corresponding records for different places will serve to compare the relative wetness of their climates more accurately than can be done by a simple comparison of the annual rainfall. Observations for the same locality for different periods of time may show changes either in the amount of the annual rainfall or in its distribution through the year. As an illustration of a series of observations in which time is not one of the primary elements, variations with which are the subject of record, we may have a series of measurements of the heights and weights of men between determined limits of age. The average weight of all those whose height is within one-eighth of an inch of, say, 5 ft. 6 in. may be determined, and similarly for heights of 5 ft. 5⅞ in., 5 ft. 6¼ in., and each quarter inch less or more. A table setting out these results will summarise the relation of weight to height among the persons measured.

The study of the variation in magnitude of one of two observed quantities as the other changes naturally leads to the comparison of such variations determined for different phenomena. Thus, the comparison of the seasonal variation of rainfall or of temperature, and the seasonal variation of the death-rate, either in general or that consequent on a particular disease or group of diseases, suggests the question whether the variations of the two phenomena are similar, and similar in a degree which justifies the conclusion that there is a causal connection between them. Corresponding problems arise from comparisons between the tables showing the relations to one another of other pairs of observed quantities.

A large part of the work of recent years in the application of mathematical methods to statistics has been concerned with devising appropriate methods of measuring and testing the degree of association between different series of variable quantities. Among the simpler tests of the closeness of association is the co-efficient of correlation. For the theory of correlation reference must be made to standard works on statistics. It will be sufficient here to indicate generally the mode of calculation of the co-efficient in the case of two variables. Taking two series of values for two quantities examined,

$$x_1,\ x_2,\ x_3,\ldots\ldots\ldots\ldots\ldots\ldots x_n$$
$$y_1,\ y_2,\ y_3,\ldots\ldots\ldots\ldots\ldots\ldots y_n$$

the x's and y's being measured in terms of units suitable to their nature, and denoting

$$x_1y_1+x_2y_2+x_3y_3+\quad\ldots\quad+x_ny_n \text{ by } \Sigma\,(xy)$$
$$x_1^2+x_2^2+x_3^2+\quad\ldots\quad+x_n^2 \text{ by } \Sigma\,(x^2)$$
$$y_1^2+y_2^2+y_3^2+\quad\ldots\quad+y_n \text{ by } \Sigma\,(y^2)$$

the value of r, the co-efficient of correlation between the x's and y's, is given by $r=\Sigma\,(xy)\ \sqrt{\Sigma\,(x^2).\,\Sigma\,(y^2)}$. The values of r may range between +1 and −1, these extreme values corresponding to a linear relation between each x and the corresponding y of the form $ax+by+c=0$. For intermediate values of r such a linear relation does not connect the corresponding values of x and y.

Looking at the matter graphically, if $x=f_1(u)$ and $y=f_2(v)$, the variations of x and y as u and v are given different values and may be represented in the usual way by tracing lines, of one of which the ordinates and abscissae have the series of values given to u and x, and of the other those of v and y. By a suitable choice of scales, the values of x corresponding to values a, 2a, 3a . . . for u may be made to fall vertically over or under those of y, which correspond to values b, 2b, 3b . . . for v. If the variations of x and y are associated, this graphic presentation of them may render the association visible. Such comparisons of the series of corresponding values of two quantities appear sometimes more convincing than the value of the co-efficient of correlation between them.

Value of Graphs.—The graphic method of presenting statistical data has advantages over the tabular statement of the same data, though it is necessary to remember that the facts represented cannot be more exactly represented by a diagram than by the data from which the diagram is constructed. The diagram may, indeed, on account of the limitations ordinarily governing the size of the sheets on which it is drawn and the accuracy of the draughtsman, fall short in accuracy of the statistical tables which it represents. The graphical presentation of such tables has, however, the important advantage that it presents lengthy series of data in a form in which the majority of users of them find it easier to grasp their sequence and their relations than when presented in tabular shape. Thus such a fact, or series of facts, as the variation of the rate of mortality with age appears as a mass of detail very difficult to grasp as a whole when presented in a table of figures; while many find a diagram, in which the rates are shown by the variations in the height of a line above a defined level, shown by a straight line crossing the page horizontally, not at all difficult to appreciate. As a series of observations may thus be represented and grasped with ease, two or more series may be compared with corresponding facility. For useful and effective comparisons attention needs to be paid to the scales on which the different series of numbers are represented.

An illustration is given by the late Professor A. Marshall, in the jubilee volume of the Royal Statistical Society,[1] in comparisons of the quantities of tea and sugar consumed per head of the population of the United Kingdom in a series of years. When both quantities are represented in pounds, the growing use of sugar is clearly manifest, while the consumption of tea appears to have varied little. When the unit of measurement of tea is taken as an ounce, however, the fact that the relative expansion of tea consumed per head was comparable with that of sugar is made clear. Fig. 1 is constructed from data for the 50 years preceding the War similar to those used by Marshall.

[1] *Loc. cit.*, p. 257 (fig. 2).

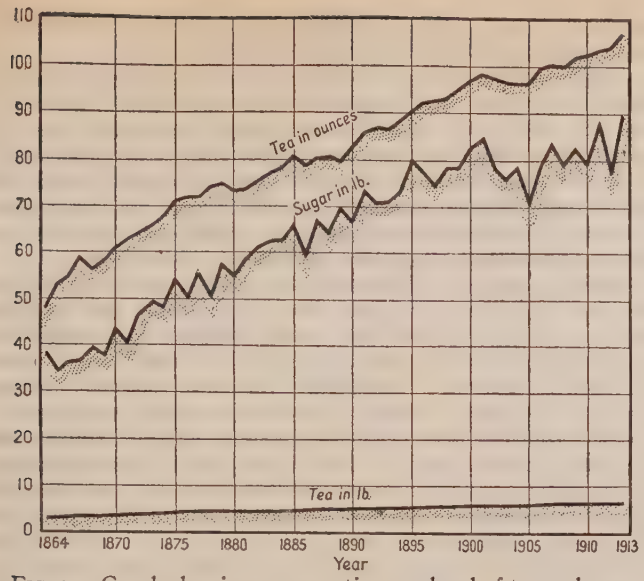

FIG. 1.—Graph showing consumption per head of tea and sugar in the United Kingdom in each year 1864–1913. (Quantities in stock at the end of each year are not taken into account.)

When, of two (or more) curves compared, one represents quantities which increase from left to right of the diagram, though at varying rates, while another shows fluctuations about a line which is, on the whole, horizontal or falling, a correspondence between the two curves may not be easily recognised, even if it be real and close. To bring out the association it may be necessary to adopt a procedure which separates the general trend of the line and the deviations of individual points on the line from that trend. One such method is to calculate the averages of the ordinates of several consecutive points. The line which shows the position of such a series of averages, and the line which shows the deviation of any point from the average of the series to which it corresponds—say, the series which extends equally the right and left of the selected point—may show movements well worthy of separate attention.

It may appear, for example, that even if the lines showing the general trends are far from similar in their variations, the lines which show the deviations from the trends manifest variations having marked features of resemblance for different curves. The marriage rate and the value of foreign trade per head for the United Kingdom furnish an example where the deviations from nine-year averages appear much more clearly similar in their fluctuations than the single-year figures. Fig. 2 shows the deviations for each year 1859–1909 from the averages of the nine-year periods 1855–63 to 1905–13, the marriage rates being those of Great Britain and the foreign trade being represented by the sum of the retained imports and the exports of domestic produce.

Further, the comparison of such deviations suggests that, whatever the causes which underlie the apparent similarity of the variability, they do not produce their effect simultaneously on the two phenomena measured. The maxima and minima of the marriage rate, when examined more closely, occur some months later than those of trade.[1] The association can be tested by the calculation of co-efficients of correlation for different intervals between the points on one curve and the corresponding points on the other; thus the interval for which the co-efficient has highest value may be determined with some precision.

In examining two relations, such as those represented above by $x = f_1(u)$ in and $y = f_2(v)$, the nature of the phenomena may be rendered clearer in some cases by the adoption of appropriate transformations before bringing together the various data to be compared. Thus, if $p = F_1(x)$ and $q = F_2(u)$, the relation $x = f_1(u)$ may be represented by a relation between p and q, say, $p = F(q)$. Similarly, if $r = F_1(y)$ and $s = F_2(v)$, the relation $y = f_2(v)$, expressed as a relation between r and s, may become $r = F(s)$. We can thus obtain, for comparison, graphs of the variations of p and r as q and s vary, and, if the transformations have been suitably chosen with reference to the data to be examined, the new series may reveal relations not clearly manifest from the examination of those from which they were derived. It is not, however, necessary to devote much space to such means of analyzing results in special cases, the general principle underlying them being sufficiently obvious.

As shown in the article PROBABILITY (22.376) the measurements of many phenomena, physical or social, are found to be

[1] R. H. Hooker, "Correlation of the Marriage Rate with Trade," cf. *Journal of the Royal Statistical Society* (Sept. 1901).

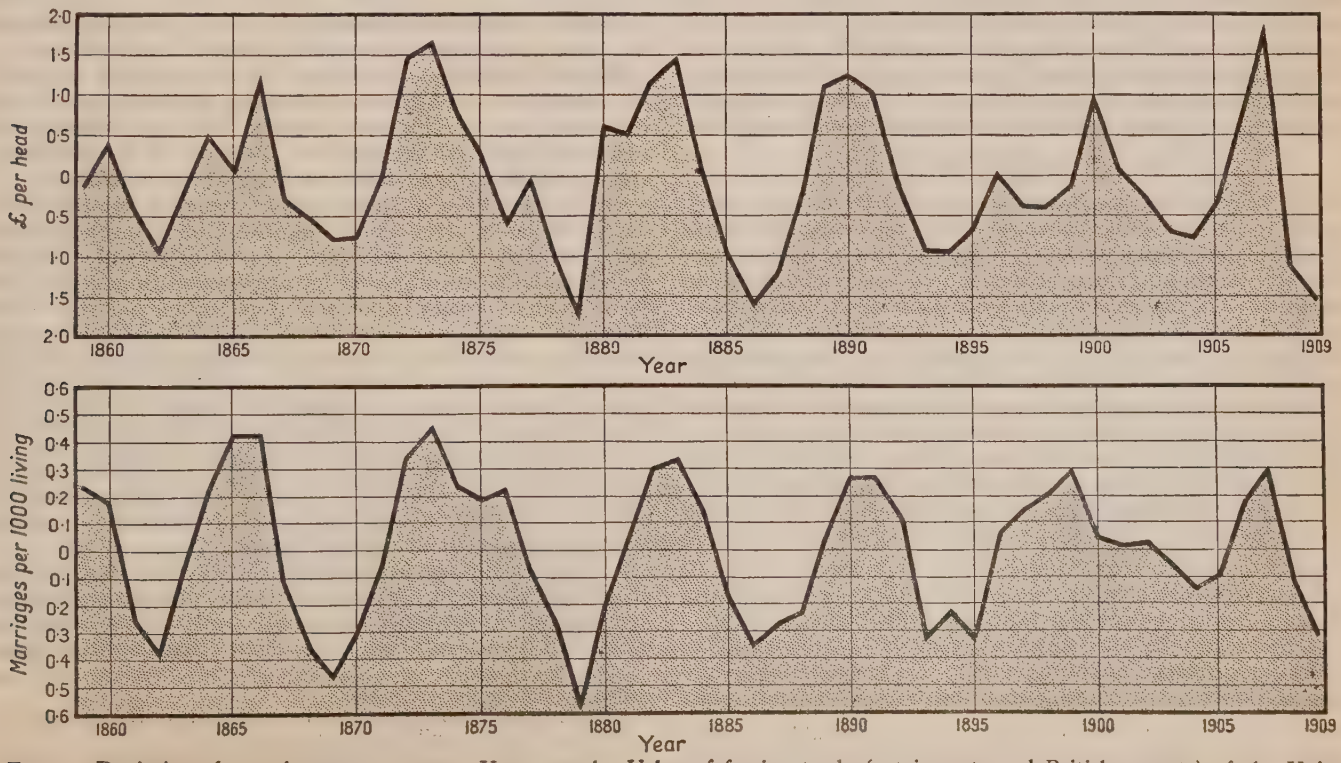

FIG. 2.—Deviations from nine-year averages. Upper graph: Value of foreign trade (net imports and British exports) of the United Kingdom per head of population. Lower graph: Marriage rate in Great Britain 1859–1909 (averages of 1855–63 to 1905–13).

distributed about their average in close accordance with the theoretic distribution of events dependent on pure chance, subject to the qualification that, in social phenomena, the normal evenly balanced distribution of events on either side of their mean is frequently replaced by a distribution leaning more or less markedly to one side or the other. In the actual process of taking observations of a series of phenomena, we may fail to secure measurements of that representative character possessed by the mean of a large number of observations repeated under conditions as nearly as possible identical in all respects. Most commonly we have to be satisfied with a single observation or a limited series of observations. If we could obtain the true means as the values of the x's and y's whose fluctuations it is proposed to compare, we might either find that a marked resemblance of the two curves would replace a vague similarity, or that an apparent similarity would be replaced by a definite independence.

Further, the actual statistics obtained to represent a series of observations may be either a random or a biased selection from the varied possible measurements. It is a serious weakness of many social statistics that the data available are commonly based on a limited series of observations of the consequences resulting from the operation of specified forces, and that limited series is too often affected by conditions which prejudice the representative character of the statistics. If this defect be serious, it may be of doubtful advantage to apply to such data those methods of analysis which might be wholly appropriate to data derived from the repetition of carefully controlled observations of physical or mechanical phenomena. As shown in a paper by Mr. Udny Yule, there may arise, from random sampling of possible data, series which appear to show, between phenomena wholly unrelated, a comparatively high degree of correlation as measured in the usual manner.[1]

The improvement of the data available for statistical analysis is thus of an importance not less than that of the improvement of the methods of analysis and comparison of the data obtained. Considerable advances have been made in this direction in recent years. In comparing two sets, one distant, one recent, of statistical data it is necessary to guard against conclusions which may be invalidated by the inferior reliability, for the particular purpose in hand, of the older data. One great advantage of much of the later statistical material is that the conditions of its preparation, conditions which permit of a judgment as to its reliability or its applicability in particular arguments, are more usually set out with care than was formerly the practice. In many cases it has been necessary to commence a statistical series with imperfect data, the improvement of the data being only possible as the value of data of that character became recognised.

Utility in Commerce and Industry

The value of statistics for business purposes has been appreciated to an increasing degree, and thus an increasing flow of statistical data, which yet leaves much to be desired, has become available for the study of commercial, industrial and other social problems. The movements of prices in Great Britain as reflected in index numbers, for example, are made the subject of regular compilations, not only by *The Economist* and *The Statist*, but by *The Times* and *The Financial Times*. While the three first of these adhere to the formally more simple method of averaging the items by the addition and division of their sum by the number of items, the last, like the index of the Board of Trade, which has a wider range of sources of data than any of the others, makes use of the geometric means of the items, as was done in the index by Jevons for the period 1782–1869 (*cf.* W. Stanley Jevons, *Investigations in Currency and Finance*, ed. 2, pp. 112–50).

In the United States an even greater variety of compilations of general price indices is available than in England, while in both countries there are a number of compilations limited to the prices of specified groups of commodities. The use of index numbers of prices has extended, since the War, to a much wider range of countries than formerly, partly under the influence of the statistical work of the League of Nations.[2]

In the analysis of statistics related to the variations of business activity and prosperity, it appears to have been established that the ebb and flow of different phases of that activity are not simultaneous but follow one another with more or less regularity. Considerable attention is being devoted to the selection of data which may represent most satisfactorily the fluctuations in these different features of the ebb and flow of business, with a view to the establishment of a species of economic meteorology.

Work of International Organisations.—Graphical presentations of the variations of such trade indicators are regularly prepared and circulated by, among others, the organisations known as the Harvard Economic Service[3] in the United States, and the London and Cambridge Economic Service in Great Britain, the former having the longer record of work, and in France, Italy and Germany the carrying out of a similar programme has been taken in hand. The work of the International Statistical Institute in promoting comparability between the official statistics of different countries was interrupted after the meeting held at Vienna in 1913, except in so far as the establishment of a permanent office at The Hague, finally approved at that meeting, led to the collection of certain statistical material from many countries for publication under the auspices of the Institute in the bulletin of the new office.

By the time that serious activities of that office had become possible, the new organisation for international co-operation, the League of Nations, was becoming active in the field of statistics. The League and the Institute have worked in co-operation through a preparatory committee jointly appointed by the two organisations to survey various portions of the field of commercial and industrial statistics. The reports prepared by this joint committee have furnished a large part of the material presented for discussion at the first meeting of the Institute held after the War, namely, that at Brussels in 1923, and also at the meeting of 1925 at Rome.[4] The regular series of biennial meetings of the Institute is now definitely re-established, and the vacancies in its membership which occurred in the ten years of suspended activity are in large measure filled.

Bibliography.—G. Udny Yule, *An Introduction to the Theory of Statistics*, Part II. and the references there given; Arthur L. Bowley, *Elements of Statistics*, Part II., section VI. (A. W. F.)

STEAD, WILLIAM THOMAS (1849–1912), British journalist (*see* 25.817), was drowned on the "Titanic" April 15 1912.

STEAM ENGINE (*see* 25.818).—The article in Vol. 25 traces the history of the steam engine along its two lines of development, as a reciprocating engine and as a turbine—the engine of Watt and the engine of Parsons: it also includes a sketch of the thermodynamic theory which governs both.

The turbine form of steam engine long since established itself as a successful rival to the reciprocating or piston and cylinder form, especially in two great fields—marine propulsion and the generation of electrical power for distribution from central stations. Much the most important steam turbine has been of the compound reaction type, originated by Sir Charles Parsons and developed by him into a prime mover of great power and high efficiency. In Parsons' turbine the principle was for the first time practically applied of dividing the whole heat-drop, from boiler to condenser, into a large number of successive stages. At each stage the steam acquires a moderate velocity by undergoing a small fall of pressure in a row of converging passages or nozzles, and gives up the momentum so acquired to blades mounted on a revolving drum or "rotor."

In Parsons' turbine, as is explained in Vol. 25 (p. 845), rows of moving blades on the rotor alternate with precisely similar rows of fixed blades projecting inwards from the case or cylinder in which it is enclosed; they are so shaped that the steam suffers

[1] *Jour. Roy. Stat. Soc.* (Jan. 1926), Presidential address by G. Udny Yule, "Why do we sometimes get nonsense correlations between time-series?"

[2] See *Memorandum on Currency and Central Banks, 1913–24*, issued by the League of Nations.

[3] These organisations issue to their subscribers the publications containing the data and charts referred to.

[4] *Institut International de Statistique. Bulletin*, Tomes 21, 22, 1924 and 1926.

substantially equal drops of pressure in both, and acquires equal amounts of relative velocity. Later the principle of using many compounded stages was successfully applied to the impulse type of turbine by Rateau and others, producing a machine which also has successive groups of fixed nozzles alternating with rows of moving blades, but the action on the moving blades is in general one of pure impulse: in the moving blade passages there is no drop of pressure, consequently there is no gain of relative velocity and no reaction in the sense in which that word is used when one speaks of a Parsons' turbine.

Electric Power Stations.—In recent years the compound impulse turbine has been brought, in the hands of various makers, to a high degree of efficiency, though not exceeding that of Parsons' reaction turbine. Both types are now in very extensive use, especially in electrical power stations where great numbers of powerful turbines are installed. Many of these develop individually as much as 30,000 kw., and some 50,000 kw., or even more. For such service the turbine is as a rule directly coupled to an alternating-current dynamo. A common speed is 3,000 r.p.m. in turbines of moderate output, or 1,500 in the larger sizes. In turbines of 20,000 kw. or over, it is usual to divide the expansion between two or more separate cylinders, to avoid the use of an unduly long enclosed rotor, and to escape difficulties that might arise from too wide a range of temperature in different parts of the rotor and the enclosing case. Often the two cylinders are arranged in tandem with their rotor shafts in one straight line, mechanically coupled to rotate as one shaft. In some recent instances the high-pressure cylinder is of the impulse type and the low-pressure cylinder of the reaction type. For central station use, the steam turbine has entirely displaced the reciprocating engine, and has achieved an economy of fuel of which that engine is quite incapable. Apart from its higher efficiency, its relatively small bulk, in relation to the power developed, and the convenience with which it is handled in running give it a marked advantage.

Marine Engineering.—In its original application to ship propulsion, the turbine was directly coupled to the propeller shaft, but this arrangement had a serious drawback. To work efficiently, a screw propeller must run at a speed much lower than that which is suitable to the shaft of a turbine. In fast ships the discrepancy is of course less than in slow ships: this consideration practically restricted the early marine use of the turbine to ocean liners, war ships and other fast vessels. Even in them there had to be a compromise: the propeller was designed to make an abnormally large number of turns per min. at some sacrifice of propulsive efficiency, and the turbine had to be designed for an abnormally low speed on the part of the shaft. The low speed of revolution, even with great enlargement of the rotor drums and multiplication of the number of blade rings, seriously hampered its thermodynamic efficiency. Notwithstanding this handicap, the advantage of the turbine in marine use was so conspicuous that in the 10 years from 1906 to 1916 direct coupled marine turbines to an aggregate of 14,000,000 H.P. were supplied by Parsons and his licensees for the propulsion of ships, taking the place of triple or quadruple expansion engines of the reciprocating class.

Improved Designs.—Meanwhile, however, Parsons had made a new departure which was to render the direct-coupled marine turbine obsolete. Realising that the turbine should be freed from the limitation of speed which is imposed by the propeller, he set himself to improve methods of gear-cutting so that the large powers involved in marine propulsion might be successfully transmitted through a reducing gear, which would allow the turbine shaft to run much faster than the propeller shaft. He demonstrated the practicability and the great advantage of such gearing by a large scale experiment on the steamer "Vespasian" in 1910. There gearing was interposed between the turbine and the propeller, a pair of pinions five in. in diameter on the turbine shafts driving a wheel 99½ in. in diameter on the propeller shaft through helically cut teeth on which jets of oil were continuously sprayed. The gear showed itself to be durable as well as efficient, absorbing only about 2% of the transmitted power. Geared marine turbines soon made a rapid advance; they are now employed to the exclusion of direct coupled marine turbines in all modern designs. Up to the end of 1925 they have been supplied to the extent of over 16,000,000 horsepower.

In many turbine driven ships, including all the vessels of the British Navy, single reduction gears are used, with a speed ratio which may be as high as 20, but recent practice in the mercantile marine prefers double reduction gearing in which a total speed ratio of 40 or so is reached in two steps through the use of short intermediate gear shafts. In a recent design of a double-geared marine turbine of 5,000 H.P., to drive a single screw propeller, steam is supplied at a pressure of 500 lb. per sq. in., superheated to 700° Fahrenheit. This is expanded successively in three cylinders of the turbine (high, intermediate and low pressure), the shafts of which run respectively at 5,000, 3,000 and 1,700 revolutions per min., and carry pinions that gear with two short second-motion shafts driving a central propeller shaft at 90 revolutions. With such an installation the consumption of steam is probably less than 8 lb. per H.P. per hour, and the propulsive effect for each lb. of coal, in normal working, is about doubled in comparison with what was usual a few years ago.

The successful application of gearing has opened up for the steam turbine many additional fields of usefulness, as a prime mover in factories, rolling-mills, paper works and so forth, where the shafting or machine to be driven is required to run at a speed much lower than would be suitable for the turbine shaft.

It is unnecessary to describe here in any detail the forms taken by steam turbines, or state the principles which govern the design of their blading, in order to secure that the hydraulic efficiency at each stage shall be high, and that as large a fraction as is possible of the adiabatic heat-drop shall be converted into useful work (*see* TURBINES).

Thermodynamic Efficiency.—The adiabatic heat-drop is a matter of primary importance in determining the limit of performance of any steam engine, whether of the reciprocating or the turbine class. It is measured by the change in the total heat function (*see* 25.825) which the steam would undergo if it expanded adiabatically from the condition as to pressure and temperature at which it is supplied to the final condition of pressure in the condenser. This represents the greatest amount of work which is theoretically obtainable, per lb. of operative steam, under ideally favourable conditions, in a steam engine of any type, so long as the engine follows the "Rankine cycle" (*see* 25.827). Under the conditions of actual practice the effective work may amount to about three-fourths of this quantity. For the convenience of designers, tables of the adiabatic heat-drop between various stated conditions of supply and exhaust have been calculated and published, on the basis of Callendar's Tables of the Properties of Steam.

Any improvement in the thermodynamic efficiency of a steam engine may proceed on three more or less distinct lines:—

(1) By making the actual process of expansion conform more closely to the adiabatic ideal, thereby obtaining a larger fraction of the heat-drop in the form of useful work. This fraction is called the "efficiency ratio."

(2) By increasing the range of temperature through which the engine works, which may be done either: (*a*) by raising the pressure and temperature of the supply; or (*b*) by lowering the pressure (and consequently also the temperature) in the condenser.

(3) By departing from the Rankine Cycle and making the operation of the engine approach more nearly to the Carnot Cycle, which represents the extreme limit of efficiency in the possible relation of work done to heat supplied, when every part of the thermodynamic cycle, including the return of the working fluid to the boiler, is carried out in a strictly reversible manner.

All these lines of development are found in recent practice. They have led to features, some of which call for particular notice, that are characteristic of present tendencies in design.

Blade Design.—The heat-drop is more fully utilised in turbines by better blade design, by avoidance of leakage past the blades, by using blade speeds which are generally higher and are more favourably related to the speed at which the steam issues from the nozzles; also by providing large areas for the passage of steam through the last rows of the blading and for its discharge to the

condenser, so that the last stages in the expansion may be utilised, and that the great volume to which the steam has then expanded may be passed without too high a leaving velocity.

Superheating.—Another factor which makes for an efficient use of the heat-drop is super-heating. It is now an ordinary feature of turbine practice to superheat the steam to a temperature approaching 700° F.: an important effect of this is to reduce frictional losses, and so improve the efficiency ratio by keeping the steam dry throughout a large part of the expansion. This advantage can be still more completely secured when reheating is resorted to, which means that the steam is removed after expanding to an intermediate stage, and is passed through pipes which reheat it to a high temperature. It is then returned to the engine to complete its expansion. By this means the steam can be kept dry throughout the whole or nearly the whole of its action. Reheating in this sense is used in the most efficient modern power stations. On the large scale, and as a feature of steam turbine practice, it is novel, but it was used some 25 years ago by W. Schmidt in compound reciprocating engines, where the practicability and the advantage of high superheat were for the first time clearly demonstrated (*see* 25.829). Schmidt's method was to reheat the partially expanded steam by bringing it into thermal contact with the highly superheated high-pressure supply in a receiver between the two cylinders. The plan adopted in power stations is to take the steam back to the boiler house for direct reheating by the furnace gases. It must be recognised that this involves losses by radiation and otherwise which may go far to reduce the net advantage.

Boiler Pressure.—A high degree of initial superheat has the further merit that it raises the average temperature at which heat is taken in, and so increases the effective thermodynamic range. An advantage of like kind, but greater in amount, can be secured by substantially raising the boiler pressure, and this is a conspicuous feature of modern practice. In recently erected power stations pressures of 500 or 600 lb. per sq. in. are not uncommon, and experiments with pressures of 1,200 and even 1,500 lb. are in progress. Even with the highest pressures that are practicable the temperature of the steam may advantageously be raised by initial superheating up to the highest level which the materials will safely stand

Condenser Design.—At the other end of the process, the pressure in the condenser is limited by the vapour pressure of the available cooling water. A very close approach to this limit is secured in practice, in the large surface condensers which form part of power-station plants, by the methods which are now used for the extraction of air and residual vapour. The gaseous contents of the condenser are usually removed by a combination of two steam-jet ejectors, working in series, which entrain it and discharge it against atmospheric pressure, through an expanding nozzle in which it gains pressure by losing velocity. The liquid condensate is removed by a separate pump, often of the centrifugal type. By this combination a much better vacuum is readily maintained than was practicable in the days of the old-fashioned air-pump, which removed the condensate and the air and vapour together. The condenser pressure is reduced to one inch or even three-quarters of an inch of mercury. To keep a good vacuum is specially important in turbine plants, for the turbine can make full use of the very last stages of expansion, and the large volume which the steam has makes even a small fall of pressure contribute substantially to the total quantity of work that is done.

Feed Water Improvements.—The Rankine cycle (*see* 25.827) is thermodynamically less efficient than the completely reversible cycle of Carnot, because it includes an irreversible transfer of heat to the feed-water in raising it from the temperature of the condenser to that of the boiler. This irreversible feature can be more or less completely eliminated by a device which has recently become usual in turbine plants which aim at high thermal economy. Steam is "bled" from the turbine at several points, at a series of intermediate temperatures, and is used to heat the feed-water step by step in a corresponding series of feed-heaters, through which it passes on its way from the condenser to the boiler. If the number of such steps were indefinitely increased the process of feed-heating would become completely reversible; by providing even three or four steps a good approximation to reversibility is reached. The arrangement is known as regenerative or cascade feed-heating or feed-heating by bleeding.

If the steam were not superheated, and the feed-heating were made reversible, the cycle (with an infinitely large number of steps in the feed-heating process) would become that of Carnot, for all the heat which the working substance receives would then be taken in at the upper limit of temperature, and all the heat it rejects would be rejected at the lower limit, the cycle being completed by two reversible processes, namely adiabatic expansion from the upper to the lower limit on one side, and regenerative return from the lower to the upper limit on the other.

Superheating involves, in practice, a departure from this cycle, by raising the temperature of the steam to a higher level than that at which the chief part of its heat has been received. A limit of temperature beyond which superheating cannot be carried is imposed by considerations relating to the strength and endurance of the materials of which engines are built. With such superheats as are common, cast steel has to be used in the earlier stages of the expansion, cast iron having been found to undergo a progressive growth or change of form when brought into repeated contact with steam at any temperature near the top of the range. The limit of superheating at present recognised as practicable is about 750° F., or 400° Centigrade. Although superheating prevents the cycle of operations from conforming strictly to that of Carnot, it raises the efficiency, partly by increasing the average temperature range, but mainly, as was explained above, by keeping the steam dry.

Modern Examples.—In illustration of these features of modern practice, reference may be made to the steam turbine plant of the North Tees Power Station, planned by Messrs. Merz & McClellan, where there is reheating of the steam during its expansion, and also regenerative heating of the feed-water. The boiler pressure is 475 lb. per sq. in. and the steam is initially superheated to a stop-valve temperature of 650° F. It expands in the high-pressure turbine to 65 lb. and is then returned to the boiler house where it is reheated to 500° F., before expanding in the low-pressure turbine to a pressure of 0·39 lb. (vacuum 29¼ inches). Although this reheating involves the taking in of supplementary heat at a temperature on the whole lower than that at which the main supply of heat is received, it materially improves the action by preventing the steam from becoming wet in the low-pressure turbine. The condensate, on its way back to the boiler, picks up what heat is available from steam drains and gland leakage, and also passes through three cascade feed-heaters to which steam is bled from three suitable points in the turbine, with the effect that its temperature is raised 300° Fahrenheit.

A more recent example, of greater size and still higher thermodynamic efficiency, is afforded by a turbine of 50,000 kw. normal output, supplied by Sir Charles Parsons' firm in 1925 to the Crawford Avenue Power Station, Chicago. This plant has three cylinders through which the steam passes in series, each with its own alternator. Steam is generated at 600 lb. per sq. in., and reaches the stop-valve with a gauge pressure of 550 pounds. It expands in the first or high-pressure cylinder of the turbine through 36 stages down to a pressure of 100 lb., and is then passed through a reheater, returning to the intermediate cylinder at 700° Fahrenheit. There it expands through 23 stages to a gauge pressure of about 2 lb.; it then passes to the low-pressure cylinder where it expands through five more stages (making 64 in all) and is finally discharged to a condenser in which the vacuum is maintained at 29¼ in. (barometer 30 inches). The low-pressure cylinder is set coaxially with the intermediate-pressure cylinder, and the steam passes from one to the other through a large conical connecting passage with the least possible disturbance of the flow, in order that its carry-over energy of motion may be conserved.

The low-pressure cylinder exhausts through very short direct passages of great sectional area into a pair of twin condensers with vertical tubes, one on either side of the shaft, providing

together a condensing surface of 56,000 sq. feet. Steam is bled from the turbine at three places for regenerative heating of the condensate on its way back to the boiler: the water is thereby heated in three steps to 315° Fahrenheit. Heat from the flue gases is used to give a further stage of feed-heating, and also to warm the air-supply to the furnaces. The shafts of the high-pressure and intermediate-pressure turbines run at 1,800 revolutions per minute, that of the low-pressure turbine at 720. The highest blade-tip velocity is 760 ft. per second. With this plant about 33% of the heat supplied to the steam, or fully 27% of the energy of the fuel, should be converted into electrical energy. Parsons estimates that by raising the pressure of supply to 1,500 lb. per sq. in. the latter figure would be increased to 30·2%.[1]

The Reciprocating Engine.—The growth and improvement of the steam turbine and the wide extension of its use, have formed the outstanding feature of the period now under review. With respect to the reciprocating engine regarded separately there is little that need be said. It has shared in the advantages that have come from the general use of superheating, and in some degree from the use of higher pressure. Though displaced by the steam turbine where great amounts of power are concerned, it continues to find much application in moderate as well as small sizes, both on land and as a marine engine. Many vertical triple and quadruple expansion engines, working at pressures of 200 lb. or thereabouts, continue to be fitted on board ship, especially when the speed of the vessel is subject to variation, or the possibilities of local repair have to be particularly considered. For locomotion on railways the reciprocating engine holds undisturbed possession of the field. Attempts have been made to apply the turbine to this use, but they have not gone beyond the stage of experiment (*see* RAILWAY CONSTRUCTION; LOCOMOTIVE DESIGN).

Compound locomotives, extensively used on the continent of Europe, are less generally favoured on English railways, though they have the support, based on experience, of more than one prominent locomotive engineer. Superheating in locomotives is now a standard practice: to effect it the method initiated by Schmidt is employed: a certain proportion of the tubes which convey the hot gases through the boiler from the fire-box to the smoke-box are given a comparatively large diameter (4 or 5 in.) and within each of these a long superheater tube is inserted which is bent back on itself three times; its ends are brought out side by side, and are connected to two headers on the steam supply. By means of the headers these superheater tubes are connected in parallel, so that together they form part of the channel which the steam must traverse on its way from the steam space of the boiler to the cylinders.

Mainly with the object of giving the locomotive more power, three or four cylinders are frequently used instead of two cylinders. With two cylinders the cranks are placed at right angles and the driving effort is subject to wide fluctuations during the revolution of the driving wheels. With three cylinders, set at 120° apart, a much more uniform effort is obtained, and incidentally the variations of vertical force on the rails, due to imperfect dynamical balance of the revolving parts, are greatly reduced. Recent investigations by a special Research Committee on the stresses produced on railway bridges by moving loads have shown that in long bridges these variations of vertical force are the main factor in setting the bridge vibrating and thereby causing the moving load to produce augmented stresses in the members. This consideration may be expected to emphasise the preference, already felt on other grounds, for the three-cylinder type.

The increased use of superheating in engines of all sorts has done much to reduce what is a serious defect of reciprocating engines in general—the thermodynamic waste that occurs through transfers of heat between the working fluid and the metal of the cylinder (*see* 25.828). Superheating makes the transfer of heat comparatively difficult by keeping the steam more nearly dry. The waste arises largely from the fact that in an engine of any usual design the same surfaces are brought alternately into contact with hot and comparatively cold steam. To obviate this in some degree an interesting type has been introduced called the "Uniflow" engine, which completely separates the admission from the exhaust. The exhaust ports are at the middle of a long cylinder and the admission ports are at both ends, the engine being double-acting. There is no separate exhaust valve; the piston itself causes the release of steam by uncovering the central ports as it approaches the end of its stroke. The piston is nearly half as long as the cylinder and only a little shorter than the stroke.

The effect is that the cylinder ends, containing as they do steam chests of live steam, are both kept hot with very little fluctuation of temperature, while the middle region remains continuously at a comparatively low temperature since it comes into contact only with steam that is at or near release. The admission is controlled by drop valves; the clearance spaces are very small; the cut off is early, and a high ratio of expansion is achieved in a single cylinder. Engines of the "Uniflow" type are now extensively used for such purposes as driving factories, and tests show that, for their size, they have a remarkably good thermal efficiency, especially when the steam has a fairly large amount of superheat. There is still enough exchange of heat between the working substance and the metal to make superheating highly advantageous.

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(J. A. E.)

STEED, HENRY WICKHAM (1871–), British journalist, was born Oct. 10 1871 at Long Melford, Suffolk. He studied economics, philosophy and history at Jena, Berlin and Paris universities, and in 1896 joined the staff of *The Times* as acting correspondent in Berlin, and was appointed correspondent in Rome in 1897. Transferred thence to Vienna in 1902 as correspondent for Austria-Hungary, he remained there until 1913 when he returned to London, and was appointed foreign editor of *The Times*, in Jan. 1914. In 1913 he published *The Habsburg Monarchy*, in which the internal condition of Austria–Hungary was critically examined and the possibility of a European war discussed. During the World War Mr. Steed, was mainly responsible for the foreign policy of *The Times* and, in 1918, was chosen to frame the policy of Lord Northcliffe's Department for Propaganda in Enemy Countries. In this capacity he was sent on an official mission to the Italian front where he was authorised by the Allied Govts. to promise independence to the subject Habsburg peoples. He helped also to arrange, in April 1918, the Rome Congress of the oppressed Austro-Hungarian races. In Feb. 1919 he was appointed editor of *The Times* in succession to Mr. Geoffrey Dawson, and held this post until Nov. 1922. After relinquishing the editorship of *The Times* Mr. Steed published *Through Thirty Years*, in which he related his experiences of European politics between 1892 and 1922. In 1923 he acquired the control of *The Review of Reviews*, of which he became editor.

STEEL: *see* IRON AND STEEL; RUSTLESS STEEL.

STEFÁNSSON, VILHJÁLMUR (1879–), arctic explorer, was born Nov. 3 1879 at Arnes, Manitoba, of Icelandic parents. He graduated from the University of Iowa and studied for a while at Harvard university. After two archaeological voyages to Iceland in 1904 and 1905 he turned to arctic research. In 1906–7 he was a member of the Mikkelsen ethnological expedition to the Eskimo tribes of the mouth of Mackenzie river and Northern Alaska, and in 1908–12 he went on another expedition to the arctic regions north of Canada, where he discovered several unknown Eskimo tribes. In 1913 he was made commander of the Canadian arctic expedition undertaken under the auspices of the Canadian Government. During the six years 1912–8 he explored vast regions north of Canada and Alaska, wandering for months on moving ice, accompanied by two or three companions. He discovered a new land north of Prince Patrick Island in 1915, and in 1916 another new land, west of Axel Heiberg Island. In 1918 he explored the Beaufort Sea, disproving the existence of the so-called Keenan Land. Stefánsson laid

[1] Parsons on Steam Turbines, *Trans. of the First World Power Conference* (1924), vol. 2, p. 1477.

great stress on the economic value of the arctic regions, chiefly as meat supplying countries, and by his advice reindeer were successfully introduced in some of the arctic regions where they were not found before. After his return he received the thanks of the Canadian privy council and was awarded the founder's medal of the Royal Geographical Society.

His principal publications are: *My Life with the Eskimo* (1913); *Anthropological Report* (1914); *The Friendly Arctic* (1921); *The Northward Course of Empire* (1922); *Hunters of the Great North* (1922); *Kak the Eskimo* (1924); *The Adventure of Wrangel Island* (1926).

STEIN, SIR MARC AUREL (1862–), British archaeologist, was born at Budapest Nov. 26 1862. Educated at Budapest and Dresden and at the Universities of Vienna and Tübingen, he went to England for further study and then to India, where he became principal of the Oriental College, Lahore, and registrar of the Punjab University in 1888. He was appointed in 1899 to the Indian Education Service, and for the next two years carried out archaeological explorations for the Indian Govt. in Chinese Turkistan. In 1906–8 he made further explorations (*see* 27.425) in central Asia and western China, receiving the gold medal of the Royal Geographical Society. From 1910 he was superintendent of the Indian Archaeological Survey, and in 1913–6 carried out explorations in Persia and central Asia, described by him in *The Geographical Journal* (1916). He was created K.C.I.E. in 1912. In 1926 he continued his explorations on the Northwest Frontier and has identified the site of Aornus (*see* 1.548) thus correcting Abbott's view. His other publications include *Chronicle of Kings of Kashmir* (1900); *Ancient Khotan* (1907) and *Ruins of Desert Cathay* (1912).

STEINER, RUDOLF (1861–1925), German philosopher, was born Feb. 27 1861 at Kraljevic, Austria, the son of a small railway employee. From 1890 to 1897 he worked in Weimar at the "Goethe-Schiller Archive," editing Goethe's works on natural history. In 1902 the German section of the theosophic association was founded and Steiner was called upon to become its spiritual leader. As such he developed for some years an astonishing activity as regards lectures and writings, but then became opposed to theosophy altogether, and was therefore excluded from the theosophical centre under English leadership. Steiner now developed his own teaching in a series of writings. He called this "anthroposophy," *i.e.*, wisdom of humanity: mankind is regarded as the centre of all perceptions of this "spiritual science," and an attempt is made to deduce the nature of the world from the nature of humanity. In 1913 the Anthroposophical society was formed to further spiritual research on Steiner's principles. In order to try his educational and political views in practice, Steiner founded the Waldorf School, near Stuttgart, and the "free high school for spiritual science" known as the "Goetheanum" at Dornach near Basle, which was burnt a few years later. All Steiner's works are published by the *Philosophisch–anthroposophischer–Verlag*, Berlin, and by *Der kommende Tag*, Stuttgart. He died at Dornach May 30 1925.

His chief works include: *Goethe, als Vater einer neuen Aesthetik* (1888), Eng. ed. in preparation; *Die Philosophie der Freiheit* (1894), Eng. trans. ed. H. Collinson, *The Philosophy of Freedom* (1916); *Friedrich Nietzsche* (1895); *Goethes Weltanschauung* (1897); *Theosophie* (1904), Eng. trans. by E. D. S., *Theosophy* (1910); *Haeckel, die Welträtsel und die Theosophie* (1905), Eng. trans. *Haeckel, The Riddles of the Universe;* and *Theosophy in Three Essays on Haeckel and Karma* (1914); *Wie erlangt man Erkenntnisse der höhern Welten* (1909); Eng. ed. trans. Clifford Bax, 2 vol., *The Way of Initiation* and *Initiation and its Results* (1909–10); *Die Aufgabe der Geisteswissenschaft und deren Bau in Dornach* (1916); Eng. ed. trans. A. M. Wilson, *The Mission of Spiritual Science and of its Building at Dornach, Switzerland* (1917); *Die Kernpunkte der Sozialen Frage* (1919); Eng. ed. *The Threefold State—The True Aspect of the Social Question* (1920); *In Ausfuhrung der Dreigliederung des Sozialen Organismus* (1920), Eng. trans. in *The Threefold Commonwealth*, vol. 1, No. 5, 6 (1921), complete Eng. ed. in preparation.

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STEINMETZ, CHARLES PROTEUS (1865–1923), American inventor, was born at Breslau, Germany, April 9 1865. He was educated at Breslau, Zürich and Berlin, specialising in mathematics, electrical engineering and chemistry. Becoming an active socialist, he had to leave Germany and went to the United States in 1889, beginning work in Osterheid and Eickemeyer's factory, Yonkers, N.Y., where his knowledge brought him speedy promotion. In 1893 he became consulting engineer of the General Electric Co., Schenectady, and from 1902 was professor of electro-physics at Union University there. He served as president of the city council and of the board of education of Schenectady. He was one of the greatest scholars and scientists in the electrical field and on the mathematics related thereto, and his researches did much to further the progress of applied industrial chemistry. True to his socialistic view of life, he refused to accept remuneration for his services, other than his bare living expenses. He died at Schenectady, N.Y., Oct. 26 1923.

He was the author of *Theory and Calculation of Alternating-Current Phenomena* (1897); *Theory and Calculation of Transient Electric Phenomena and Oscillations* (1909); *Radiation, Light and Illumination* (1909); *Engineering Mathematics* (1910); *Electric Discharges, Waves and Impulses* (1911); *America and the New Epoch* (1916); *Theory and Calculation of Electric Circuits* (1917); *Theory and Calculation of Electrical Apparatus* (1917).

STEVENS, JOHN F. (1853–), American civil engineer and railroad official, was born at West Gardiner, Me., April 25 1853. He was assistant engineer of the city of Minneapolis in 1874–6, afterwards engaging in railroad engineering with the Sabine Pass and North-Western, Denver and Rio Grande, Chicago, Milwaukee and St. Paul and Canadian Pacific Railway companies. In 1889 he became connected with the Great Northern Railroad, in 1895 becoming chief engineer, and in 1902 was made its general manager. In 1903 he was chief engineer with the Chicago, Rock Island and Pacific Railroad, and in 1904 became second vice-president. He was appointed chief engineer of the Panama Canal in 1905, at the time when its construction policy was being determined, and the success of the enterprise owed much to his ability. For a short time in 1907 he was chairman of the Isthmian Canal Commission. He became vice-president of the New York, New Haven and Hartford Railroad in 1907, and in 1909 was president of the Spokane, Portland and Seattle, the Oregon Trunk and Allied railroads. He was head of the American Railway Commission to Russia, 1917–8, and president of the Inter-Allied Technical Board supervising the Siberian railways, 1919–23.

STEVENSON, ADLAI EWING (1835–1914), American political leader (*see* 25.907), died at Chicago June 13 1914.

STEWART, JULIUS L. (1855–1919), American painter (*see* 25.914), died in Paris Jan. 4 1919.

STEWART, WILLIAM DOWNIE (1878–), New Zealand politician and publicist, was born at Dunedin July 29 1878, his father being a member of the Legislative Council. He was educated at the Otago Boys' High School and Otago University, taking his degree in 1900. He travelled through China and Siberia during the Russo-Japanese War, and on his return practised law in Dunedin, at the same time entering politics as the unsuccessful candidate for Dunedin South in the election of 1906. He was elected a member of the council of Otago University and of the Dunedin city council, was mayor in 1913–4, and in the latter year was elected to Parliament as member for Dunedin West. A period of War service with the Otago Regiment in 1916–7 interrupted his political career, but he was re-elected in 1919 and in 1922 joined the Massey Ministry as Minister for Industries and Commerce. On the death of Mr. Massey he was regarded as a strong candidate for Premier, but his absence and ill-health were against him and Mr. Coates was chosen. Mr. Stewart, Minister for Customs and Emigration under Mr. Massey, became Minister for Finance, and later attorney-general. He is joint author (with Professor Le Rossignol) of *State Socialism in New Zealand*.

STEYN, MARTINUS THEUNIS (1857–1916), Dutch South African politician (*see* 25.915), retired in 1910 and died at his farm near Bloemfontein Nov. 28 1916.

STIEGLITZ, ALFRED (1864–), American photographer, was born at Hoboken, N.J., Jan. 1 1864. He was educated at the College of the City of New York (1879–81), at the Berlin Polytechnic, Germany (1882–8), where he made a study of photochemistry and photography, and at the University of Berlin (1888–90), where he studied chemistry. In 1890, on his return to New York City, he engaged in photoengraving and colour printing. He became editor of *The American Amateur Photographer* in 1892. He founded *Camera Notes* in 1897, and was editor till 1903, in which year he became publisher and editor of *Camera Work*. In 1905 he founded and became director of "291," a public laboratory for research in aesthetics of life. He wrote *Picturesque Bits of New York and Other Stories* (1897), and contributed numerous articles on photographic and artistic subjects to magazines and technical journals.

STINNES, HUGO (1870–1924), German industrialist, was born in Mülheim Feb. 12 1870. Educated as a mining engineer, in 1890 he entered his grandfather's firm but two years later established a business of his own, with a capital of 50,000 marks. The business expanded steadily and came to include, besides dealing in coal, the ownership of coal mines, barges, river steamers and sea-going vessels. Stinnes organised an international business in coal, including the importation of coal from England. He built up a fleet of steamers trading in the North Sea, the Baltic, the Mediterranean and the Black Sea. He also established iron and steel factories. During the World War he commanded a large share of the industrial work required by the German authorities and rapidly increased his shipping interests. His connection with the Government led to his acquisition of political influence and in 1920 he entered the Reichstag as a member of the Deutsche Volkspartei, the new electioneering name of the former National Liberal party. About the same time he began to buy up newspapers, whose democratic opinions were quickly modified in accordance with his own. In 1921 he was reported to be contemplating the formation of a super-trust to control the whole of German industry. He died in Berlin April 10 1924. After his death the business, conducted by his son, rapidly shrank. In June 1925 a conference of bankers was called to investigate the financial affairs of the trust; and bit by bit the great organisation was liquidated and sold. In Oct. 1925 a new company was registered at Hamburg under the title of Hugo Stinnes Coal Trade and Shipping Co., Ltd., the Stinnes family retaining 40% of the shares.

STOCK EXCHANGE (*see* 25.930).—Two features of importance marked the history of the stock exchanges in the few years preceding the World War. One was the rise in the rate of interest that set in after the South African War, which caused a steady and persistent decline in the values of fixed interest-bearing securities. The other was the boom in rubber and oil shares due to the invention of the internal combustion engine.

The rubber boom began in 1909 and lasted for three years. The price of rubber rose to over 12s. per lb., and the wisdom of the old coffee and tea planters in the East Indies and Malay States in planting rubber introduced by seed from Brazil was amply confirmed. A large number of new companies were formed, many with shares of 2s. each, which became especially popular with small speculators and investors. Huge profits were made by the pioneer companies, and the shares of two of them, the Pataling and the Selangor, rose to premiums of more than 3,000%. The inevitable over-production of rubber brought about a reaction, and before the War came the price of rubber had fallen to a normal level, which, however, left the best producers with a comfortable margin of profit and the less efficient with a fierce struggle for existence. The oil boom followed shortly after the rubber boom, and, though the market was narrower than that for rubber shares, it persisted for a much longer period. The price of oil rose steadily, reaching its highest point shortly after the outbreak of war. This was due partly to the increased use of motor vehicles (*q.v.*) and the conversion of ships' engines from coal to oil, and partly to the fact that the refining and distribution of oil was in the hands chiefly of two or three organisations with world-wide connections and associations. The oil boom lasted about 10 years, but it did not provide quite the same opportunities as rubber for the company promoter, although oil companies' dividends remained for years on a high level.

I. EFFECTS OF THE WORLD WAR

For some time before the outbreak of the World War markets were depressed. Early in July 1914 rumours of war began to affect the Continental bourses. On July 13 the Vienna market was demoralised by fear of hostilities, and its alarm was promptly reflected on the Berlin Bourse, Germany being Austria-Hungary's chief lender, and holding government and municipal loans of the Habsburg Empire estimated at over £200,000,000. On Monday July 27, the day before the declaration of war by Austria, the panic in Vienna was such that the bourse was ordered to be closed for three days. As it proved it was closed indefinitely. The Brussels market followed the lead of Vienna, ceasing business on July 27, and the Paris coulisse, or outside unofficial market, suspended operations on the same day. On Wednesday July 29 all account dealings in Berlin were suspended, transactions being confined to cash bargains. The Amsterdam and St. Petersburg bourses were entirely closed that day, while on Thursday July 30 all markets suspended business except London, Berlin, Paris (official market) and New York.

London.—London was not seriously perturbed until July 24, when the terms of the Austrian ultimatum to Serbia became known. On Thursday July 30 the stock exchange, which for days had been inundated with selling orders from the Continent, owing to the continental bourses virtually ceasing to function, was opened for the last time in that memorable year. During the first two hours no attempt was made to do business, and the next morning (July 31) the committee for general purposes decided not to reopen the House until further notice, and it remained closed until Jan. 4 1915. Business, however, was not entirely suspended. A certain amount of dealing took place on a strictly cash basis, in spite of official discouragement, and on Sept. 14 the committee had to take notice of these transactions. They fixed minimum prices for trustee stocks, based on the quotations ruling on July 30, with the object of preventing disastrous depreciation, and when in Oct. the New York Stock Exchange made minimum prices for American shares, these values were adopted by the London Stock Exchange. The maintenance of the minimum prices was insisted upon by the banks, which were vitally interested as large holders of trustee investments, and also because they had undertaken to continue their loans against securities without asking for additional margin.

On Nov. 19 1914 the stock exchange committee passed a special set of rules to govern the arrangement of the uncompleted mid-Aug. account. Bulls of stock carried over on July 27 (the date of the previous settlement) were required to put up a 5% margin on high-class securities and 10% on others, and pay interest fortnightly, or, alternatively, pay a higher rate of interest in lieu of margin. The taker-in was obliged to continue to take in at July 27 prices until after the War, but in the event of prices of the carried-over stocks rising to the level of July 27 1914 they had either to be paid for and taken up by the buyer or sold for his account. About £90,000,000 had been borrowed against securities, and it was not until the moratorium, first declared on Aug. 4, came to an end on Nov. 4 1914 that it was possible to carry through the mid-Aug. settlement. The affairs of a small number of members were in this operation wound up under the liquidation rule, but the amount of stock carried over under the special regulations was smaller than had been expected. The arrangement for carrying over stocks and shares worked well, thanks largely to the Americans' demand for their own securities, and the open position on the London Stock Exchange, which in Aug. 1914 was about £90,000,000, was reduced by the end of 1915 to about £20,000,000.

On Dec. 23 1914 the stock exchange committee decided to reopen the House on Jan. 4 1915, special conditions being promulgated for the conduct of business. The minimum price

list was extended to include interbourse securities. Minimum prices were gradually abolished, however, as liquidation ceased and prices settled down to a new level of investment values. On July 3 1916 the last of the London minimum prices were removed. The special arrangements compelled all dealings to be made on a cash basis. Naturally, the elimination of speculation reduced the volume of business, which was further restricted by a rule prohibiting dealings in stock that had not been in physical possession in the United Kingdom since Sept. 1914, and by the temporary existence of minimum prices, which virtually stopped business in the securities affected. But as these rules were relaxed business increased. On the day of reopening the number of bargains was less than 1,000. Gradually it expanded, but the daily average in 1915 was nearer 2,000 than 3,000. Every bargain had to be recorded, an innovation that was left in force for some time after the War, and then unfortunately dropped.

The course of prices in 1915 and the subsequent war years was generally downward. The market for American securities, however, was strong and active, and in 1915 showed a substantial advance. Wartime prosperity in the United States caused a great demand for American securities held in Europe, and European holders were encouraged to sell by the appreciation of the dollar in terms of sterling and francs. In the second half of 1915 the British Govt. bought large quantities of American securities held in the United Kingdom, and sold them in order to provide itself with the means for making payments for munitions, etc. About £150,000,000 of American securities held by British investors were sold back to the United States in 1915. Towards the end of 1915 the Government ceased operations in the market, and invited holders either to sell or lend to it approved American and other foreign securities. The terms of purchase were approximately the parity of New York price, and for a loan a bonus of ½% per annum in addition to the interest or dividend was paid, plus a premium of 2½% in the event of the Government's deciding to exercise its right to sell the stock lent to it.

In 1917 there was a check to the depreciation of fixed interest-bearing securities which had gone on ever since the South African War, while, owing to inflation of the currency and the activity of business to which war orders and war expenditure had given rise, a strong upward movement in industrial securities occurred. The following table, compiled from figures published by *The Bankers' Magazine*, shows the course of investment values at different rates on the London stock exchange since the calculations were first made.

Date	Market value of 387 representative securities
Jan. 1907	£3,843,000,000
July 20 1914[1]	3,371,000,000
Nov. 1918[2]	2,822,000,000
Dec. 1919	2,635,000,000
Dec. 1920	2,320,000,000

[1] Pre-War. [2] Month of Armistice.

These values relate to 387 representative securities down to Dec. 1920. The general depreciation was due to the exceptional inflation rendered necessary by the War, which reduced the value of money and therefore of those securities interest on which was fixed. Taking the values of 108 fixed interest-bearing securities, we find that the total market valuation on July 20 1914 was £1,989,000,000 and at the end of 1919, £1,378,906,000—a net depreciation of about 30%. The prosperity of industrial companies, especially those engaged in war work or in supplying foodstuffs, enabled them to pay high dividends, and in many cases to distribute bonus shares as well. The value of 279 speculative securities, *i.e.*, securities the dividends on which fluctuate according to profits, was £1,382,000,000 on July 20 1914, and at the end of 1919 £1,255,578,000, a net depreciation of 9% on the period.

Paris.—The Paris bourse was reopened on Dec. 7 1914, and thereafter there was a steady rise in prices. After 15 months of war the first French war loan was raised. As a necessary preliminary the settlement of the end—July 1914, which had been suspended, was begun on Sept. 30 1915 and carried through without much difficulty. The Bank of France gave credit freely for the purpose, lending the parquet or official market about 150,000,000 and the coulisse or kerb market, 35,000,000 francs. Five % was charged from July 1914 to Sept. 1915 on all unsettled bargains, holders had to pay their differences in full or pay 10% of them, and 10% at each subsequent monthly settlement, until the 100% was wiped off. Six % interest was charged on unpaid differences. All new business was restricted to cash, account dealings being confined to clearing up accounts which existed before Aug. 1 1914. Little of interest occurred during the remainder of the war period, except that industrial shares were strong while Government securities were steady, dealings in the latter being subject to strict regulations.

Berlin.—For years before the War the Berlin bourse had frequent attacks of nervousness. Sept. 4 1911 was panicky owing to alarms in foreign politics. Early in 1912 the Government commissary of the bourse issued a public warning against excessive speculation. During the year rumours of war caused heavy selling from time to time, and on Oct. 1 the Balkan mobilisation caused a panic in which settlement stocks lost on an average 20 points in one day. Altogether, the total loss of market values in 1912 amounted to £150,000,000.

On the outbreak of war, the German Govt. imposed more stringent conditions upon the stock exchange than those imposed by any other government. The open market for stocks and shares was abolished, and the publication of prices was strictly forbidden. Cautious efforts, however, were made towards the end of 1915, and with some success, to liquidate bourse transactions which had remained in suspense. Much speculation took place in 1916, and this was given as a reason for continuing the veto on the publication of prices. But for purposes of taxation assessments lists of prices were issued at the end of that year for the first time since July 1914. These showed many big rises in industrial securities owing to the enormous profits made by German companies. All German war loans were, however, listed by special instruction at the price of issue. Prices continued to rise in 1917 until America entered the War, when a reaction occurred. At the end of 1917 lists of prices were again drawn up for taxation purposes, but publication of prices was still prohibited. Between Sept. and Dec. 1918 the quotations of German securities on the German markets fell so heavily that German financial writers estimated the decrease in capital value at about 50%. Then began the collapse of Germany's credit in foreign markets.

Amsterdam.—The Amsterdam stock exchange was not reopened until Feb. 9 1915. In that year foreign stocks were very weak, owing to persistent selling from Germany. The year 1916, however, witnessed a larger volume of business and remarkable fluctuation in prices. At the close of it many shares showed enormous gains. Home industrial concerns which made huge profits as the result of the elimination of German competition made the largest advances. The Dutch Indian plantation companies made very large profits, especially those producing sugar. Royal Dutch shares were introduced for the first time on the American market in 1916. Russian stocks fell precipitately in the last months of 1917 on the stoppage of interest payments and the Bolshevik Government's decree repudiating the national debt. This meant a serious disaster to Dutch investors, for they were reckoned to own between 1,500 million and 2,000 million florins of Russian Govt. municipal and railway bonds. In 1918 the tendency of the market was irregular and sometimes weak owing to the German collapse, but large new issues of capital were made by commercial and industrial concerns.

In Vienna and Budapest extravagant speculation sent prices up to extraordinary figures on the enormous paper profits made by practically all businesses. A heavy fall followed the military collapse of 1918. In Switzerland the Basel and Zurich bourses suspended operations towards the end of July 1914, but the

Geneva and Lausanne bourses remained open during August. On Jan. 7 1915 the Basel stock exchange resumed the publication of its daily price list, but it was not until June 26 1915 that transactions were extended to the full pre-War list. The Zurich bourse restarted official business on May 15 1916.

New York.—The New York Stock Exchange was called upon to stand the first shock of Austria's declaration of war on July 28, and on that day, for the first time that year, transactions exceeded 1,000,000 shares. The Toronto and Montreal markets were closed that day after being open for business for a short time. On July 30 violent breaks in prices occurred on the New York Stock Exchange and the next day the committee decided to follow the lead of London, and to close the Exchange. It tentatively reopened its doors again on Nov. 28 1914 for trading in bonds only. As the experience was encouraging, it was decided to reopen the House for regular trading on Dec. 13. Minimum prices had been fixed by the committee on Oct. 13, and trading in unlisted securities was resumed on the following day. The minimum prices were revised from time to time, and abolished on March 31 1915, a rise in quotations rendering minima no longer necessary.

Then followed the most remarkable era in the history of this exchange. The year 1915 established a fresh record for feverish activity and wild fluctuations. Million-share days, sensational advances and equally sensational declines, were common occurrences. Participation by the outside public had seldom, if ever, been witnessed on the same scale before. Under clique and pool manipulation prices were whirled upwards with amazing rapidity. Even more remarkable was 1916. Activity was intense, and prices rose to exceptional heights, the public buying with great confidence the shares of companies believed to be making big profits out of war orders. Every dollar security offered from Europe was eagerly purchased; it was estimated that the United States absorbed about 1,700 million dollars American railroad securities in payment for munitions. In 1917, the year of America's entry into the War, there was a heavy reaction, which particularly affected railroad shares and bonds, the former decreasing in value by 2,000 million dollars and the latter by 1,000 million dollars. This was attributed to a heavy increase in cost of railroad operation with no compensating advance in railroad charges. Heavy liquidation in the autumn of 1917 carried prices of the best investment stocks down to a level lower than that touched in the financial panic of 1907. Heavy taxation for war purposes frightened capital for a time, but in 1918 opinion had settled down to the exigencies of war finance and there was a recovery on the Stock Exchange.

II. MARKET CONDITIONS AFTER THE WAR

Revival of Speculative Business.—The years 1919 and 1920 witnessed on the London Stock Exchange marked activity in speculative securities and a persistent neglect of fixed interest-bearing securities, especially Government stocks. In the summer of 1919 various wartime restrictions were removed from the London Stock Exchange, including the embargo on exports of capital, thus enabling foreign-held securities to be sold on the London market. Oil shares rose to extravagant heights, and Rand gold shares had a boom on the high premium in sterling which they received for their gold. Rand mines shares were introduced on the New York market towards the close of 1919, this being the first time that South African gold shares were listed in Wall street. Diamond companies enjoyed a wonderful period of prosperity. Record dividends were paid by all kinds of companies, and share quotations reached unprecedented figures.

The Great Slump.—In 1920 nomination for membership of the London Stock Exchange rose in price to £650, but by the end of the year it was almost unsalable. The first signs of war impoverishment appeared in the spring. The demand for goods and services suddenly failed; a crisis developed, starting in Japan, and the foreign exchanges showed a general collapse in terms of the American gold dollar. The fall in commodities forced traders to realise securities. The pressure for money and general nervousness depressed British Govt. stocks down to a level at which they gave a return of over 6% per annum. The decline in stock exchange values as measured by 387 representative securities was the heaviest ever recorded in one year, the loss being £315,600,000. Commercial and industrial securities declined by 40·9%, British and Indian funds by 11·9% and Foreign Govt. bonds by 18·8%. Iron and steel shares fell by 33·7%; and South African mining shares by 39·2%. So severe were the losses that for the next two years investors avoided speculative shares, and bought mainly gilt-edged stocks, which had a rise of about 25% in 1921 and 1922. The issue of foreign Government loans in London, suspended on the outbreak of war, was resumed in 1921.

The trade slump in America in 1920 was heralded by a decline in the stock market. Stocks reached their peak in Nov. 1919, when they touched a figure only fractionally below the highest point of the war period—101·51, which marked the culmination of the famous war brides boom of 1916. Nov. 1920 was a month of devastation and almost of panic. *The Annalist's* index number fell to 66. In 1921 the Wall street market made a recovery, but the tendency was very erratic. As in England, fixed interest-bearing stocks found favour. On the London Stock Exchange British Govt. securities rose 12%. A feature in this year was the collapse of Grand Trunk stocks on the decision of a majority of the arbitration court that for the purposes of the sale to the Canadian Govt. the preference and ordinary stocks were valueless. Mr. Taft, the dissenting arbitrator, held that they were worth at least $48,000,000. But the Canadian Govt. accepted the award of the majority, with the result that Canadian credit among English investors was seriously prejudiced. Continental bourses had an irregular experience. The Swiss markets were depressed, and towards the end of the year showed signs of panic. Germany, on the other hand, had a buoyant market owing to inflation.

Improving Conditions.—The year 1922 witnessed a general recovery in prices on the London stock exchange, thanks partly to cheap money due to the depression in trade. Confidence in home railway stocks, which had fallen to a low level, revived on the amalgamation of the railways into four groups. A revolutionary strike on the Rand ended in a fashion that restored sound conditions for the gold-mining industry. On the Continent the outstanding events were a further rise in German mark securities, and a panic in Switzerland on a capital levy project, which, however, was defeated. In New York the stock market advanced about 40% by mid-Oct., when a Near East war cloud caused a sharp reaction.

The following year (1923) was a less buoyant period in London than 1922, movements on balance being small. By this time continuous inflation in France had depressed French Govt. credit down to a 7½% basis, but industrial securities were firm on active trade produced by monetary inflation. Prices of German industrials reached fantastic figures in worthless marks. In Wall Street in 1923 there was much liquidation.

The year 1924 brought active and strong markets to the London Stock Exchange, and at times business reached the dimensions of a boom. A boom in tea shares was an outstanding event. In Paris the public held aloof from the bourse, and all forms of securities developed extreme weakness, this being due to the disturbance of public confidence caused by continuous budget deficits and depreciation of the franc. The abandonment of the old mark involved a complete revaluation of securities on the German bourses. After the elections in Nov. 1924, the New York Stock Exchange jumped into a veritable boom. In 18 trading days listed stocks alone showed a market appreciation equal to the whole amount of Britain's debt to the United States.

The course of values on the London Stock Exchange from Dec. 1921 to Dec. 1925 is shown in the subjoined table:—

Date	Market value of 387 representative securities (*Bankers' Magazine*)
Dec. 1921	£5,393,000,000
Dec. 1922	6,105,000,000
Dec. 1923	6,257,000,000
Dec. 1924	6,518,000,000
Dec. 1925	6,465,000,000

These values relate as before to 387 securities, but include some of the big war loans. Since Dec. 1923 the figures relate to 365 securities, the amalgamation of the railways having resulted in a diminution in the number of securities.

On the London Stock Exchange 1925 was a good year, the outstanding feature being a boom in rubber shares on a rise in the price of the commodity. Share values on an average were doubled during the year. Fixed interest-bearing securities fell about $3\frac{1}{2}\%$, but commercial and industrial securities, which rose 9·4% in 1924, advanced a further 4·3% in 1925. Home railway stocks were heavily depressed by a falling-off in traffics. High yielding European reconstruction securities were strongly supported, and Brazilian securities got back into favour once more.

In New York there never was a year in which a bull movement lasted so long or rose so high. It really began on Oct. 29 1923, when the average price of 50 representative securities forming *The Annalist's* index number stood at 77·15, which was the lowest of that year. By Nov. 1925 the index number had risen to 136·63. The period of greatest activity and spectacular rises was after the Nov. elections of 1924. On the Continent the Paris bourse was much affected by the depreciation of the franc, the flight from which was continuous and growing all the time. French Govt. and all fixed interest-bearing stocks declined, but industrial securities rose on the large profits made in active trade at constantly rising prices. In Italy industrial securities had a boom for a short time and then declined heavily, for reasons which appeared to be connected with stringency of money. The Berlin bourse presented no feature of great interest (apart from the liquidation of the Stinnes trusts), owing to the scarcity of money. (C. J. M.)

III. THE NEW YORK STOCK EXCHANGE

History.—The New York Stock Exchange is international in scope in that it affords a market place for securities from all parts of the world. The stock exchanges in the smaller cities of the United States are more provincial in character, dealings being confined mainly to local securities. Springing from an association of stockbrokers started in 1792, which operated in the streets and from neighbouring coffee-houses, the New York Stock Exchange was organised in 1817. The board met in various places, including the old Merchants' Exchange at Wall and William streets, but did not take permanent form until 1842, when it was established in the new Merchants' Exchange, now head office of the National City Bank of New York. It was the country's largest local exchange, but did not become a national market until 1875, when the adoption of the telephone, telegraph and stock ticker and the development of New York as the nation's financial metropolis brought securities from all parts of the country. About the same date the merger with it of two rival organisations brought the new association's membership up to 1,060. In 1879 40 new memberships were created, and the total has since remained fixed at 1,100. The Exchange now occupies an imposing building of its own covering approximately 32,000 sq. ft. of ground space bordering on Broad, Wall and New streets.

For many years, the business on the exchange floor has been confined to bonds and stocks as well as " rights " to subscribe to the latter. In the autumn of 1925, issues " listed " on the New York Stock Exchange had a total market value of approximately $64,500 million. More than $35,000 million of this amount was represented in 1,158 bond issues and more than $29,000 million in 1,000 stock issues. The bulk of these issues were bonds and stocks of American business enterprises; but, through the recent development of interest in foreign investments, the listings in Jan. 1926 included 112 foreign bond issues, whose market value considerably exceeds 2,000 million dollars. The daily turnover in shares has risen with the growth of the country in wealth and industry; on several occasions more than 3,000,000 shares have been sold on the New York Stock Exchange in a single day. Since this does not include sales of less than 100 shares the actual daily total has probably exceeded four million.

Distinctive Features.—The New York Stock Exchange differs from the exchange in London in not permitting on its floor trading in puts, calls or other optional contracts. Members are not, as in London, divided into brokers and dealers, inasmuch as a stock exchange member can exercise either function, except where the same transaction is concerned.

Other distinctive features of the New York Exchange are as follows: (1) Applicants for listings must provide carefully engraved certificates designed to prevent forgeries, registry of transfers to avoid over-issuance, and sufficient preliminary distribution to avoid violent price fluctuations. The requirements also cause the applicant to publish essential facts regarding capital structure and balance sheet items, and to agree to make public future earning statements, dividend notices and like matters. (2) The comprehensive ticker system makes it possible to report all sales of stocks and bonds in multiples of 100 shares almost instantaneously throughout the United States. (3) Member firms, some of which maintain numerous branch offices, have elaborate private wire systems. (4) Contracts are settled the next full business day through the operation of the Stock Clearing Corporation, a subsidiary. (5) The business of the exchange is rigidly supervised by a governing committee of 40 members, and by sub-committees which take charge of such routine features as the arbitration of disputes, admissions to membership, requirements for listing new securities and the business conduct of members. (6) The exchange keeps in touch with the financial condition of member firms through a questionnaire system which is compulsory for all member firms which, as brokers, handle margin transactions for the public. (7) The governing committee of the exchange, as trustee for its members, holds all the stock of the exchange's several subsidiary corporations, among which, in addition to the Stock Clearing Corporation, are the New York Stock Exchange Building Co., which holds a title to and administers the Stock Exchange building, and the Quotation Co., which supervises the collection and distribution of price quotations made on the exchange floor.

The latest available list of stock exchanges in the United States, totalling 27, includes, in addition to the New York Stock Exchange, New York Curb Market, New York Consolidated Stock Exchange, Boston Stock Exchange, Boston Curb Market; and one each in Providence, Hartford, Philadelphia, Baltimore, Washington, D. C., Richmond, Pittsburgh, Wheeling, Cincinnati, Louisville, Columbus, Cleveland, Detroit, Indianapolis, Chicago, St. Louis, New Orleans, Colorado Springs, Salt Lake City, Spokane, Los Angeles and San Francisco. The stock exchanges of the smaller cities are organised and conducted on similar lines to the New York Stock Exchange. (C. E. Mi.)

STOCKHOLM (*see* 25.934), the capital of Sweden and its industrial and intellectual centre, with a population of 420,812 in 1923, is the chief port for imports, though second to Göteborg in exports, and has a large number of industrial establishments. The 80,000 sq. metres of the free port were increased by 191,300 sq. metres in 1925, and additional warehouses built; the new dock, to be finished in 1926, will take the largest vessels calling at Stockholm. Now that ships can reach the Mälar side of the harbour by passing through the Södertälje canal, further harbour works are projected on Lake Mälar, and a quay is to be built to accommodate the vessels up to 3,500 tons using the Hammarby channel, completed in 1925. Over 50% of the tonnage using the port is Swedish.

The work of rebuilding the railway station was begun in 1924, the goods station being replaced by another to the north of the city, and its site used for extending the passenger station. The line to Göteborg was in process of electrification in the same year. A stadium in Swedish mediaeval style, which will seat 15,000, was opened for the Olympic Games in 1912. The new law courts were finished in 1915, and the huge municipal buildings, of brick with a tower at the southeast corner, in 1922. The Engelbrekt church, standing on a hill and approached by flights of steps, was finished in 1914, and the Riddarholm church, the burial place of the Swedish kings, has been restored and mediaeval paintings brought to light. A statue of Jenny Lind, the singer, was unveiled in 1924.

STOCKPORT, England (*see* 25.937).—The area of the borough has been increased by the inclusion of Heaton Moor, Heaton Chapel and Heaton Mersey in 1912, and Heaton Norris in 1913, and the boundary now touches that of Manchester at Levenshulme. The population in 1921 was 123,309, and the area of the borough 7,063 acres. There are 214 ac. of parks and recreation grounds, including the Woodbank Memorial Park of 95 ac., added to Vernon Park in 1921, and the South Reddish recreation ground of 7 ac. (1922); the Great Moor recreation ground was being laid out in 1926. Waterworks opened at Kinder in 1912 include a huge reservoir covering 44 ac., and supply an area of 80 square miles. Sewage disposal works were in course of construction in 1926. New buildings include those for the grammar school at Mile End (1916); the central library in Wellington Road (1913); and St. Mark's church (1921). An art gallery was presented to Heywood in 1912, and the foundation stone of a War memorial hall laid in 1923.

STOKE-ON-TRENT, England (*see* 25.951).—The single borough which unites under this name the six " potteries " towns of Staffordshire had an area of 20,759 ac. and a population of 240,440 in 1921. Since 1918 three members have been returned to Parliament for the divisions of Stoke, Hanley and Burslem. The unions of Stoke, Wolstanton and Burslem were amalgamated in 1922 and there is one parish conterminuous with the borough. In 1925 Stoke was created a city, and the corporation consists of 28 aldermen and 84 councillors. The administrative services have been gradually centralised; the offices for police and education are at Hanley, but the remainder at Stoke. The town hall was enlarged in 1910–2, and the county court offices have been separated from it. A cenotaph was erected in 1920 opposite King's Hall, which is part of the town hall. A central school of science and technology was opened in 1914, and the foundation stone of a large extension was laid by King George V. in 1925, when he proclaimed the city status of the borough.

STOLYPIN, PETER ARCADIEVICH (1863–1911), Russian statesman, was born at Baden-Baden in 1863, the son of Adml. Stolypin by his wife, a princess of the house of Gorchakov. He was educated at the University of St. Petersburg, and in 1884 entered the Government service. In 1902 he was appointed Governor of Grodno, and in 1903 was transferred to Saratov, where he became known as a firm administrator. In 1906 he was recalled to take up the position of Minister of Internal Affairs, and in July of the same year succeeded Goremykin as Minister President (*see* RUSSIA). His firm and repressive policy toward all kinds of sedition caused him to be regarded as a deadly enemy by the revolutionary party, and many attempts upon his life were made. In Aug. 1906 a bomb was exploded at his summer residence, which seriously injured one of his daughters, but all efforts to kill him proved vain until 1911, when he was shot in a theatre at Kiev on Sept. 14, before the eyes of the Imperial family, by a Jew named Mordka Bogrov. The Minister died of his wounds Sept. 18 1911.

STOMACH: *see* ALIMENTARY SYSTEM.

STONE, MARCUS (1840–1921), British painter (*see* 25.957), died in London March 24 1921.

STONE, MELVILLE ELIJAH (1848–), American journalist, was born at Hudson, Ill., Aug. 22 1848. In 1860 his father was made pastor of a Methodist church in Chicago, and it was there that he got his schooling. In 1864 he began work as a newspaper reporter, but he became proprietor in 1869 of an iron-foundry and machine shop. In the great Chicago fire of 1871 this was destroyed, and Stone then engaged in the administrative work of municipal relief and reconstruction. In 1872 he became one of the editors of the Chicago *Republican* (subsequently *Inter-Ocean*), and later of the *Post and Mail*, becoming for several years a political correspondent at Washington.

At the end of 1875, having returned to Chicago, Stone, with a colleague, started the evening *Daily News* (*see* 19.571), and two years later Victor F. Lawson became a partner. The venture was very prosperous. He and Lawson bought out the *Post and Mail*, and in 1881 they established the *Morning News* (later *Record* and *Record-Herald*). In 1888 he retired, taking a prolonged holiday in Europe. Returning to Chicago in 1891, he and others founded the Globe National Bank, of which he became president. In 1893 he accepted the position of general manager of the Associated Press. At that time the Associated Press was still struggling (*see* 19.547) with its competitor, the United Press, but its enterprise now received a new stimulus, and by 1897, under Stone's management, and as subsequently reorganised in 1901, its service knew no rival. He held this position until April 1921, when he retired. During that period of 28 years the budget of the Associated Press had grown from $500,000 to $6,000,000, and it had come to furnish more than half the news printed in American papers. See his autobiography, *Fifty Years a Journalist* (1921).

STORY, JULIAN (1857–1919), American artist (*see* 25.970), died at Philadelphia, Pa., Feb. 24 1919.

STRACHEY, GILES LYTTON (1880–), British writer, son of Sir Richard Strachey, the Indian Administrator, was born March 1 1880, and educated at Trinity College, Cambridge. He was an occasional contributor to the monthly and quarterly reviews, and published a short but illuminating book on *Landmarks in French Literature* (1912). He achieved wider renown by *Eminent Victorians* (1918), vivid, polished and unusually caustic portraits of Cardinal Manning, Florence Nightingale, Dr. Arnold and General Gordon. In *Queen Victoria* (1921) Strachey's biographical power and his ironic style showed themselves broadened and mellowed, the result being a most successful blend of sympathy and detachment in depicting the Queen, her family and her epoch. The two books set up a fresh standard for modern English biography which a good many contemporary writers were quick to acknowledge. A collection of essays, *Books and Characters*, appeared in 1922, and his " Leslie Stephen " lecture on Pope in 1925.

STRACHEY, JOHN ST. LOE (1860–), British journalist, was born at Sutton Court, Somerset, Feb. 9 1860, the second son of Sir Edward Strachey, 3rd Bart., and Mary Isabella, daughter of John Addington Symonds. He was educated at Balliol College, Oxford, graduating with a first class in modern history, and was subsequently called to the bar; but he adopted journalism as his profession. In 1886 he became assistant editor of *The Spectator*, and after the death of R. H. Hutton and the retirement of Meredith Townsend (1897) he became proprietor of the paper, which under his editorship not only maintained but increased the high reputation it had gained (*see* 19.562) for sober political criticism and well-informed appreciation of art and literature, so that he exercised great influence upon English opinion. St. Loe Strachey also edited (1896–7) *The Cornhill Magazine*. He was specially interested in problems of rural housing, pauperism and local government generally. In 1925 he relinquished his editorship of *The Spectator*, but did not cease to contribute to its columns. *See* ENGLISH-SPEAKING PEOPLES, RELATIONS OF THE.

Amongst his publications are: *The Manufacture of Paupers* (1907); *The Problems and Perils of Socialism* (1908); *The Practical Wisdom of the Bible* (1908); *A New Way of Life* (1909).

STRAITS SETTLEMENTS (*see* 25.980).—The population according to the census of 1921 was as follows: Singapore (with Labuan, Christmas Island and the Cocos-Keeling Islands), 425,912; Penang, Province Wellesley and the Dindings, 304,335; Malacca, 153,552; total, 883,769. The population was estimated at 950,952 in 1924. Both birth-rate and death-rate were highest among the Malays. The total death-rate, 27·42 per 1,000 in 1924, was the lowest recorded; the death-rate per 1,000 among Europeans was 7·82. Malaria remains a prolific, though diminishing, cause of death; as for beri-beri, the deaths were reduced from 2,056 (with a total population of 705,405) in 1911, to 1,299 in 1921, and 910 in 1924, owing probably, in part, to a better understanding of dietary requirements. Chinese immigrants reached maximum numbers in 1911 (269,854); in 1924 there were 181,430, and they exceed emigrants by 87,749. About 70% were men. An increase of immigration in recent years is due partly to improvement in commerce, especially the tin trade, but partly also to the disturbed conditions in southern China; the number of Chinese women and children arriving in 1924 was the highest recorded, and their coming commonly implies intention to settle

permanently. Immigrant Indians arrived at Penang to an average yearly number of 54,000 in 1921–4; the numbers, again, fluctuate with the conditions of trade (*see* MALAY STATES, FEDERATED).

In many respects the colony actually benefited from the World War; there was, for instance, an increase in the gross value of trade from £63,600,000 in 1914 to £148,200,000 in 1917. The Chinese community was on the whole prosperous, and while the increased cost of living and the high rate of exchange with China bore hardly upon the poorer classes, the increase of wages in great measure counterbalanced these disadvantages. The Chinese freely supported patriotic and charitable funds, and after some demur, before its purpose was fully understood, recognised without further difficulty the War tax ordinance of 1917. The War, however, produced its problems for the community. It was necessary to establish a censorship of Chinese newspapers, and in June 1919 an anti-Japanese boycott resulted in rioting in Singapore and Penang, while a Chinese patriotic league and an anarchical body, the so-called Truth Society, gave some trouble. Preventive action, however, was taken by the Chinese protectorate and the police, and by 1925 the activities of secret societies generally had been markedly curbed.

Tin and Rubber.—The export trade of the colony depends primarily upon tin and rubber. The British Malay territories produce nearly half the world's yield of tin ore (the Federated Malay States yielding the bulk), and more than half the smelted tin. Smelting is carried on mainly at Pulau Brani, near Singapore, and at Butterworth (Penang), ore being imported not only from the Federated Malay States but also from the Dutch islands (Banka, etc.). Tin was more early developed than rubber, mainly, in the first instance, by Chinese enterprise. The production of rubber was not large before 1909–10, when world production received powerful stimulus.

The reaction from prosperity which began to affect world commerce after 1920 struck hard upon the tin and rubber trades of the colony (including that of the Federated Malay States). The assistance of the Government was necessary for both. Tin was purchased by the Government at agreed prices, and the stock for which there was no immediate market was brought into the so-called Bandoeng pool, formed in co-operation with the Govt. of Netherlands India on behalf of the mining industry of Banka and other Dutch islands; the stock thus retained was disposed of by 1924–5 as prices revived. The output of rubber was restricted by legislation in concert with the Govt. of Ceylon, on the basis of the Stevenson scheme, stock being released as justified by current prices. These arrangements aided the return of prosperity to the colony; moreover, in the case of the rubber industry occasion was afforded to rest the plantations, and in particular to restrict the tapping of young trees.

Problem of Food Production.—The principal economic problem with which the colony has had to cope was not connected with the War. The remarkable extension of rubber planting about 1909–10 led to the neglect of fruit cultivation and other forms of native agriculture, and this tendency persisted. The people ceased in great measure to cultivate their own food crops and raise their own live stock, and became dependent on imported foodstuffs. In 1917 rice was imported from Rangoon, Siam and French Indo-China; wheat flour from Australia and India; cold storage foodstuffs from Australia and other foodstuffs from China. Difficulties connected with shortage of supplies and shipping made it necessary to set up food control in 1917. An inquiry was instituted into measures for increasing home produce of rice and other foods, and "cultivation clauses" were inserted into leases of newly alienated lands. In 1918 the United States restricted imports of rubber, with a consequent reaction upon the Straits Settlements industry. This could not, however, immediately affect food cultivation, and in that year shortage in India, floods in Siam, and the demand for imported rice in Java and Japan caused serious conditions in the Straits Settlements. Siam prohibited export of rice in July 1919: the Straits Settlements controller took entire charge of import and wholesale dealing and a food production department was established which fostered home planting, and in spite of many difficulties it was found possible, early in 1920, to ensure supplies for several months. The Governments of the Straits Settlements, Netherlands, India and Ceylon agreed in 1919 to purchase through a single agent to avoid competition.

Trade and Finance.—Traders generally have been encouraged to develop a wider range of products. Exports of rice, fish, areca nuts, sago, copra, pepper and preserved pineapples showed an increase in 1924 over those of 1923. In 1925 the fisheries department was undertaking research, with a shore institution and a ship, into the possibilities of extending the fish trade, canning such products as anchovies, etc.

The value of exports, which fell to £56,138,000 in 1921, rose to £89,430,000 in 1924; and that of imports from £65,791,000 to £98,915,000 in the same years respectively. The figures for 1921 were little more than half those for 1920; but they are not strictly comparable, because a new system was introduced in 1921 whereby each territory of British Malaya (including the Federated Malay States) makes returns which are consolidated for the whole, whereas previously there was some measure of duplication.

The revenue of the colony amounted to $28,639,161, and the expenditure to $26,706,316 in 1924. The value of the dollar is fixed at 2s. 4d. The cost of living for Europeans is high, for there is a tendency for the dollar more nearly to equal the shilling in purchasing power.

Education.—The centenary of the modern foundation of Singapore by Sir Stamford Raffles was the occasion for local celebrations in Feb. 1919, and by way of commemoration it was decided to found a Raffles College for higher education. Evidence of the general enthusiasm for this scheme was given by the prompt provision of subscriptions which ensured its success and enabled plans to be laid forthwith. The Straits Settlements Govt. promised a donation of $1,000,000; the same Government and those of Johore and Kelantan guaranteed annuities in perpetuity amounting to $63,000, and by the Governments of the Federated Malay States and Kedah, and from various private sources, annuities for a term of years, amounting to $655,000, were promised. Designs for the new buildings were adopted in 1924, and the erection of science and administrative blocks, a hostel and staff quarters was authorised. There have been other signs of a demand for a more active education policy, this being especially desirable as a counter-measure against undesirable propaganda. The Rockefeller Foundation in 1924 granted an endowment of $350,000 for chairs of bacteriology and biochemistry in King Edward VII. College of Medicine at Singapore, the Government undertaking to bring the provision for these chairs up to the level of others in the college.

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STRANG, WILLIAM (1859–1921), British painter and etcher (*see* 25.982), died at Bournemouth April 12 1921, having been elected an R.A. a month before that date (see *Catalogue of William Strang's Etched Work, 1882–1912* (1912).

STRASBOURG (*see* 25.984) was acquired by France under the treaty of Versailles, and is now the chief town of the department of Bas-Rhin and the principal eastern port of France. The population was 166,767 in 1921. A commission was appointed to bridge over the administrative and legislative difficulties of the transference from Germany to France. The Hôtel des Deux Ponts, in the same street, was the German headquarters during the World War. Kehl, a town with a population of 8,800, on the German bank of the Rhine, was constituted one with the port of Strasbourg for purposes of exploitation for a period of seven years from 1919. Extensive improvement schemes were approved in 1924, including the creation of a large port above Strasbourg, connecting with the older harbour by canal, and a petroleum harbour below the town. Work was begun on the

more important parts of the scheme at once; the port entrance has been altered, and several new quays have been built. No development has taken place in connection with the proposal to build a canal to link up Strasbourg and Basle. The university was reopened as a French institution in 1922.

STRATEGY (*see* 25.986c).—Whilst peace is largely an economic and political struggle between men whose purpose is to gain physical and individual security, war is largely a physical struggle between nations in which the acquisition or maintenance of economic and political security is the aim. In peace man uses his physical force to conquer Nature; in war he uses it to conquer his own kind. In the one case the conflict is mainly a material one, in the other it is largely ethical, as it is directed against opinion sustained by force and not against matter merely endowed with energy.

Relationship of Peace and War.—In peace the ethical rights of nations are maintained by force actual or potential according to the political system in vogue; for even in the most democratic nations the power of the majority expressed in the legislative, police and military forces of the nation is the foundation and guardian of the national will. In peace as in war the final arbiter of law and order is military force. The means differ in degree though the end is the same. The end is the maintenance of internal existence, in the one case through prevention of internal disruption, and in the other through the prevention of external pressure. It is for this reason that William James, when discussing "The Moral Equivalent of War," was of opinion that: "Every up-to-date dictionary should say that 'peace' and 'war' mean the same thing, now *in posse*, now *in actu*. It may even reasonably be said that the intensely sharp competitive preparation for war by the nation is the real war, permanent, unceasing; and that battles are only a sort of public verification of mastery gained during the 'peace' intervals." And Clausewitz—"that war is nothing but a continuation of political intercourse, with a mixture of other means." And again: "We see, therefore, that war is not merely a political act, but also a real political instrument, a continuation of political commerce, a carrying out of the same by other means . . . for the political view is the object, war is the means, and the means must always include the object in our conception. . . . State policy is the womb in which war is developed, in which its outlines lie hidden in a rudimentary state, like the qualities of living creatures in their germs."

If in peace force is essential to the maintenance of tranquillity, prosperity and the security of the social order: in war (the causes of which may always be traced to some discontent in the existing state of peacefulness), the true political object is to create a better condition of peace than that which existed before its outbreak. This condition is in nature three-fold—in order that the war may have proved itself economical, then must the peace which follows it be more contented, prosperous and secure than the one the war destroyed. In great civilised nations this destruction of the conditions of peacefulness—rather than of the material power of the enemy or of the enemy himself, is accomplished by military pressure and resistance as exerted by the instrument of war, which may be an army, a navy or an air force, or all three combined.

To animate this instrument the will of the majority of the nation must support the war; for in democratic countries it is this will, as expressed by the government, which makes war, accepts defeat or insists on victory. Further, to maintain the fighting forces which express the national will through physical action, the economic strength of the nation must be sufficient to provide them with all material needs, and never more so than to-day when the rapid mechanicalisation of the means of waging war is bringing all three services into intimate relationship with civil industry, and through civil industry with each other. The co-ordination of all these means—the will, economic strength and fighting force of the nation—toward the attainment of the political object of the war may be termed grand strategy, or the major movements and higher leadership which control, direct and influence the war.

Grand Strategists of History.—There is nothing novel in this conception, for as a foundation of military action the co-ordination of political direction and military control are as old as organised warfare itself. But whilst during the earlier history of war co-ordination was less complex since armies were more independent and self-supporting, in modern wars its importance has become more and more manifest until its establishment on a scientific footing may be considered one of the most important of military problems. For co-ordination to exist, united control of all the forces expended in war as well as liberty of action in their expenditure are essentials. In democratic nations the first should be the prerogative of government, and the second of military command.

In the World War of 1914–8 a lack of strategical direction, especially on the side of the Allied Powers, was manifested on its outbreak, and was never overcome; for though towards the end of the War Marshal Foch was appointed generalissimo of the land forces of the Allies, no true political unity of control was created or could have been created in the circumstances. Failing the establishment of a despotism, which is almost unthinkable among allied democratic powers, this weakness in political control must always constitute the Achilles heel of nations temporarily confederated to resist the military pressure of a common enemy. In this War we find the Allied grand strategy far more rudimentary than that of Alexander the Great. He, as tyrant of the Grecian States, combined in his own person complete political control and unity of command. The grand strategy which he developed stands as a model for all times.

He saw that the states and cities of Greece could only be controlled by outward pressure, and that this pressure could only be gained through the conquest of the Persian Empire. His method was logical and scientific. First, he established tranquillity at home, without which his overseas expedition would have had no secure base from which to operate. Secondly, he gained command of the sea, and through this command control of the economic resources of Egypt, which were vital to the prosperity of Greece. Thirdly, he gained command of the land, and by ascending the throne of the Great King was able to control not only the military resources of Persia but also its immense wealth. Lastly, he attempted to bound his vast empire by unattackable frontiers so that it would be secured against invasion. His crucial idea was the establishment of a more contented, prosperous and secure peace. In the World War of 1914–8 we see no such grand strategy, because unity of political control was non-existent, and failing this unity true liberty of military action was impossible.

Throughout the entire history of war the most successful of the great captains, such men as Alexander, Caesar, Gustavus, Frederick and Napoleon, have been despots or autocrats, not because despotism and autocracy are in themselves military virtues, but because they permit of the closest political control of the strategy of a war. To-day the difficulties incumbent in grand strategical control are increasing, for whilst in the past military power mainly depended on man-power, which enabled all armies to establish a similar organisation and tactics, industry and industrial wealth are replacing population as the foundation of military strength. This amongst allied powers will frequently mean a divergence in military organisation, a variation of tactics, and consequently an increasing difficulty in control and combined action.

Problems of Grand Strategy.—Though there can be no doubt that the establishment of a more contented, prosperous and secure state of peacefulness is the true grand strategical object of a war, it by no means follows that this has generally been accepted; in fact few wars have led to so desirable a conclusion. The reason for this is twofold. First, no nation has hitherto possessed the grand strategical machinery necessary to co-ordinate political thought and military action, consequently warfare has assumed an almost entirely military aspect. Secondly, the causes of war have never been scientifically analysed, and have been obscured and hidden beneath the political pretexts and excuses justifying its outbreak.

As these justifications are seldom rational or true, a great war has normally been declared when through political obscurantism the mind of a nation is in an irrational mood. The nation is stirred up to fury, and the soldier, stimulated by this national emotion accentuated by the dangers which surround him, seeks a solution to the war in a victory of destruction. He attempts to impose on his enemy not so much his will as his physical force, and the result in the World War of 1914–8 was that the victors suffered but little less than the vanquished. This system of "Absolute Warfare," much lauded by Clausewitz, and founded on the ideal of absolute government, has toned the whole course of warfare since his day. The solitary exception was the campaign of 1866, in which Moltke's object was not to destroy Austria, but to gain her over as an eventual ally. As long as this barbarous system of grand strategy endures great wars will be concluded by vindictive peace treaties out of which further great wars will evolve. No modification or reduction of armaments can ameliorate this system, for its betterment must be sought in a change in the political brain—in the theory of war, and not in its tools.

Granted a political organisation which can co-ordinate, control and direct the forces of war, the next problem in grand strategy is the co-ordination, control and direction of the means. Hitherto military means have been mainly considered, but during the World War it became apparent that economic and ethical action played as important a part. To compel an enemy to accept defeat his national will must be broken. The traditional method has been to destroy the enemy's armed forces—the shield which protects this will. Though during the World War this method was universally adopted, as the War proceeded, the economic attack by blockade, bunker control and unrestricted submarine warfare, and the ethical attack by insidious propaganda became formidable instruments in undermining the national *morale* of the belligerents. In the case of Germany and her allies these means led to their defeat as much as did military pressure, because they directly attacked the national will to win.

The co-ordination, control and direction of the fighting forces themselves is the next problem, and here grand strategy merges into grand tactics, and policy into plan. In the case of Great Britain there was no grand tactical control during the World War, because no organisation existed which could co-ordinate naval and military force or action. The result of this was that directly power of movement ceased on the Western Front, command of the sea at once suggested, as it had done during the Napoleonic wars, a change of the theatre without reference to the grand tactical objective, which remained the defeat of Germany. This lack of grand tactical co-ordination undoubtedly prolonged the War for many months.

Once given a political organ which can formulate policy, and a military brain which can produce a co-ordinated plan in which the fighting forces are considered as one force, the next problem is the execution of the plan. This demands expenditure of force, and here grand strategy and grand tactics merge into strategy and tactics as these are generally understood.

Expenditure of Military Force.—Expenditure of military force is an art, and like all other arts it is based on science. The science of war is the science of human conflict in all its forms, whether the battle is a fight between two men or two or more nations. Without this science warfare must largely remain in an alchemical state, and be governed by chance and not by law. If force has to be expended in war, then the side which can best economise its force is the side which is more likely to win. Economy of force is, therefore, the governing law of war. Granted this law the next question is to decide on the nature of force; and as an army is but a number of men, the forces of war are to be sought in man himself. Human force is threefold in nature, it is mental, moral and physical, and no one of these forces can be expended without influencing the remaining two. Economy in the expenditure of these constitutes the central problem of strategy and tactics.

The expenditure of force presupposes pressure and resistance, and these two govern the direction force eventually takes. In war each side must have an object which provisionally fixes the direction of military operations. To maintain this direction pressure and resistance must be exerted. These two factors if correctly employed lead to an economical distribution of force from which concentration of force may be developed. Thus are obtained three principles of war, namely, the principles of the direction, distribution and concentration of force, and these should control the formulation of all plans of war. These three principles are, consequently, closely related to the mental sphere of force—to the thoughts in the head of the general-in-chief out of which he evolves his plan. Before this plan can be transformed into physical action, that is executed by the men themselves, the troops must not only be willing but determined to carry it out. To do so their *morale* must balance their fear, consequently their determination to act must be supported by moral endurance. Further, to economise this endurance, they should aim at surprising the enemy, that is demoralising him.

In the moral sphere of war we thus obtain three principles closely related to the former ones. They may be called the principles of the determination, endurance and demoralisation of force. It is in this moral sphere that the decisive battle is waged. To attack the enemy's determination to win, physical action must be brought into play. Men must move, and movement depends on how far offensive action can be protected. Thus are obtained three physical principles of war, namely, those of mobility, security and the disorganisation of force (offensive action). Nine principles of war, therefore, govern the expenditure of force. Three are related to pressure, three to resistance and three to the control of their resultant—the direction of the operation, the determination of all ranks to attain the object in view, and movement towards the objective itself.

These nine principles, which are expressions of the law of economy of force, form the foundations of the science of war, without which the art of war is solely determined by individual predilection or chance. This science is expressed as an art through the instrument of war, the military organisation at the command of the general-in-chief, who, to act rightly, expends its force by applying the principles of war according to the ever-changing conditions which surround him. These conditions can either assist or resist him, and by a correct, that is, an economical application of principles to conditions, he abstracts the highest assistance from all the forces which surround his army. For him to do so with true economy it is necessary that the organisation of his army should be suitable to the nature of the operation in hand. This suitability consists in power to develop protected offensive action in the shortest possible time and at the highest possible speed.

From these considerations we see that not only are strategy and tactics complementary halves of the art of war, but that the geometric strategical ideas so favoured in former days, such as interior and exterior lines, lines of operation, concentric and eccentric attacks, etc. etc., are but details of the art of war, which should be as "fluid" as any other art, and is so when it is based on a full understanding of the science of war instead of on a personal improvisation. All that is necessary to prove the close inter-dependence of strategy and tactics is to turn to the history of war and examine its course.

History of Tactics.—The tactics of the Roman legion were based on the strategical mobility which their magnificent roads allowed. This mobility could only be maintained as long as troops were concentrated in large bodies. Once defensive tactics led to an over-distribution of force, through the establishment of a cordon system along the frontiers, the Gothic horse rapidly overruns the Empire, and after the battle of Adrianople (378) an infantry decline sets in. Thence onwards, except in mountainous and swampy countries, infantry degenerate into camp followers. As the Roman roads fall into disrepair the use of cavalry becomes general; further, all nomadic warriors are horsemen.

Influence of the Horse.—The influence of the horse on tactics is profound, and through tactical change strategy and organisation are modified, and the first post-classical cycle of war is

entered. The superior carrying power of the horse at once suggests the general use of armour from which to develop the offensive power of the soldier. The armoured horseman changes the whole organisation of war. Armies grow smaller since armour is expensive; casualties amongst armoured horsemen grow less and less, and the strength of a nation depends more on its ability to produce armour than on its man-power. Two defects are, however, never overcome, the first is the armouring of the horse, the second the difficulty of an armoured man using missile weapons when mounted. Strategy, save as stratagems, disappears; the tactical shock becoming the sole purpose of battle. This condition of war lasts for 1,000 years, when the long bow and pike attack the unarmoured parts of the horse, and gunpowder attacks armour itself. The result is the reappearance of infantry. By the date of the battle of Agincourt (1415) the mobility of the armoured horseman is reduced to zero.

The second tactical cycle is now entered. Protection by armour is by degrees replaced by protection through fire power, from which the shock of the pike-men is developed. As the musket, and later on the bayonet, are comparatively cheap weapons, armies grow in size, numbers of men rather than skill become the aim of the military organiser; roads grow in importance to maintain these masses, and casualties increase as fire power is developed; ultimately we enter the period of absolute warfare. The introduction of railways and steam power generally is followed by an enormous increase in the size of armies and in the perfection of weapons and equipment. Hordes of men are poured on to the battlefield, their control is difficult, their supply even more so, and, as fire power increases, the protective power of firearms is supplemented by the trench, and strategy vanishes through a general inability to move. By the year 1915 the zero point of movement through rifle and gun power is reached.

As the second cycle was introduced by the discovery of gunpowder, the third is introduced by the discovery of petrol. The first tactical cycle, based on armour, was protective in nature; the second, based on gunpowder, was offensive; and the third which has now begun is based on petrol, and its predominant quality will be mobility. In the World War the transition became apparent when a solution to static warfare was sought in prolonged artillery bombardments. The railways could amass thousands of tons of shells at the railheads, but from these points forward hundreds of lorries had to be used to move them. The shell failed to solve the problem of mobility, since in destroying the enemy's defences it simultaneously destroyed the surface of the ground, rendering it unfit for wheeled traffic. Eventually the tank solves the problem, as it can dispense with roads and move across country. This power, the ability of developing offensive action from protected cross-country movement coupled with the power of aircraft to attack an army in rear without engaging its front definitely ushers in the third tactical cycle which must profoundly influence strategy.

The Passing of Linear Warfare.—From the days of the Romans to present times the network upon which strategy was woven has been the road systems existing at any specific date. Armies advanced and retired along roads, their power of manoeuvre being largely limited by their number and condition. From road columns they deployed into battle lines, and in classical times line met line in a hand to hand struggle. After the introduction of firearms, a space, or no-man's-land, was developed between the contending forces, possessing in the days of Frederick the Great a depth of some 50 paces. This space profoundly influenced tactics, for the side which could make the better fighting use of it generally won.

To take advantage of this area weapons were improved, and accuracy, range and volume of fire increased, until in the World War its depth extended over 1,000 paces. Gas as a weapon was then introduced to obliterate whatever human resistance existed in or on the other side of this space, and eventually tanks were built to cross it and pass through the hostile battle-front and attack the enemy's rear organisation and services. Aircraft could do likewise by passing over in place of, through or round the enemy's line. The line had, in fact, reached its zenith, and was no longer an economical formation, since it could not guarantee the protection of the area in rear of it. The influence of these tactical changes must pronouncedly modify strategy, as linear warfare will be replaced by area warfare, the strategy of which being to a large extent independent of roads and railways will become two and three dimensional.

These changes in the art of war face all civilised armies to-day, and it is for this reason that a science of war is necessary, so that the past history of war may be methodically analysed, and future tactical, administrative and strategical tendencies predicted. Without such a science, supported by sound political control, strategy must remain, as it has in the past, either the perquisite of genius or the plaything of chance. *See* WAR. (J. F. C. F.)

STRATFORD-ON-AVON, England (*see* 25.998), had a population of 9,392 in 1921 and an area of 4,013 acres. A summer season of the Shakespeare festivals, which have been under the control of Mr. Bridges Adams since Sir Frank Benson's resignation in 1919, has been held since 1910. Nash's house was adapted for public use in 1912. In March 1926 the Shakespeare Memorial Theatre was destroyed by fire; but the library and museum, in adjacent buildings, were saved. A water supply scheme, by gravitation from a reservoir at Snitterfield, was completed in 1923.

STRATHCONA AND MOUNT ROYAL, DONALD ALEXANDER SMITH, 1ST BARON (1820–1914), Canadian statesman (*see* 25.1000), died in London Jan. 21 1914. His barony passed by special remainder to his daughter Margaret Charlotte, wife of Robert Jared Bliss Howard of Montreal (d. 1921).

STRAUSS, RICHARD (1864–), German composer (*see* 25.1003). His opera, *Ariadne auf Naxos* (1912), was produced at His Majesty's Theatre, London, by Thomas Beecham in May 1913 and the same year *Der Rosenkavalier*, first produced at Dresden in 1910, was performed at Covent Garden with great success, eight performances being given; in point of fact, this proved to be Strauss's most popular opera. His other works include *Festliches Praeludium*, for orchestra (1913), and *Josephs Legende* (1914). In addition to the works enumerated, mention should be made of *Eine Alpensinfonie*, (1915, op. 64); and the three-act opera, *Die Frau ohne Schatten*, libretto by Hugo von Hofmannsthal (1916, op. 65). In the winter of 1920–1 Strauss visited South America, where he officiated at Buenos Aires as opera conductor, subsequently returning to Vienna.

STRAVINSKY, IGOR FEDOROVICH (1882–), Russian composer, was born at Oranienbaum, near Leningrad, on June 5 (old style) 1882. He began to study composition privately under Rimsky-Korsakov in 1902 and four years later produced his first work, a symphony. This was followed in 1908 by a *Fantastic Scherzo*, the *Dirge in Memory of Rimsky-Korsakov* and the orchestral tone-picture, *Fireworks*. Much of his subsequent music was composed for Serge Diaghilev's Russian ballet, and includes *The Fire Bird* (1910), *Petroushka* (1912), and *The Rite of Spring* (1913). Stravinsky's music aroused a great deal of controversy, chiefly owing to a peculiar originality of structure which impressed his audience by the sense of surprising novelty which it conveyed. Among his later works are *Renard* (1915), *L'Histoire du Soldat* (1917), the symphony for wind instruments to the memory of Claude Debussy (1920), *Mavra* (1921) and *Les Noces Villageoises* (1923).

STREET: *see* ROAD CONSTRUCTION.

STREET TRAFFIC: *see* TRAFFIC PROBLEMS.

STRESEMANN, GUSTAV (1878–), German statesman, was born in Berlin May 10 1878 and studied political economy in Berlin and Leipzig. After completing his studies he went on the management of an industrial association, and in 1903 became secretary to the *Bezirksvereins des Bundes der Industriellen* (District Association of the League of Industrials) in Dresden. He soon succeeded in organising the *Sächsischen Landesverband des Bundes der Industriellen* (Saxon Provincial Union of the League of Industrials) out of the different district organisations. Thanks to his far-reaching organising activity Stresemann secured a prominent position for these associations in the economic and political life of Saxony. The Union in 1925

numbered about 7,000 industrial undertakings with some 600,000 workmen.

Stresemann's excellent organising successes brought him more and more influence in the headquarters of the Union of Industrials in Berlin. Provincial unions were founded on the Saxon model in Württemberg, Silesia and Thüringia, Stresemann playing a prominent part. In the further course of his activity in the field of political economy, he was founder and first president of the German-Canadian and the German-Austrian-Hungarian Economic Association (Wirtschaftsverband) and vice-president of the German-Bulgarian League in Berlin. He was also prominent in the organisation of the German Fleet League (*Flottenverein*).

In 1913 Stresemann and Ballin, the general manager of the Hamburg-America line, founded the German-American Economic Association, which was destined to be expanded into a German world commercial association, a plan prevented by the outbreak of the World War. In 1907 Stresemann had been elected to the Reichstag as member of the National Liberal party, where he often spoke for his party on questions of public economy and foreign policy, and enjoyed increasing respect. He soon became a member of the central executive of the party, and Bassermann, recognising his great talent as an organiser and speaker, trained him, so to speak, as his successor. During the War Stresemann pursued a vigourous Nationalist policy, and was one of those who brought about Bethmann Hollweg's fall. After the collapse he founded the German People's party (Deutsche Volkspartei), becoming its president, having been, after Bassermann's death, president of the National Liberal party.

The German People's party, led by Stresemann, played a decisive part in Germany's internal policy after the War. It was opposed to the Weimar Constitution; on principle it remained long in opposition to the Governments of the Left. When the Ruhr conflict reached its climax, Stresemann published a series of articles which attracted much attention, urging a radical change in German policy; after the fall of Cuno's Cabinet, in Germany's darkest hour, he became Chancellor of the Reich with a Ministry of the so-called "great coalition," including all parties from the Social Democrats to the German People's party. As Chancellor, he wound up the Ruhr conflict. After a bare two months the Social Democrats abandoned him because he had had to take strong measures in the name of the Reich against the manifestations of Bolshevism in Saxony and Thuringia. He formed, however, a second Cabinet, which lasted till the end of Nov. 1923.

In Marx's Cabinet, which followed his own, Stresemann became Foreign Minister. His was the guiding influence on the foreign policy of this cabinet. He was largely instrumental in bringing about the acceptance of the Dawes plan by Germany and the Conference of London in Aug. 1924. After Marx's resignation he refused to form a new Cabinet, and used his influence to get the German Nationalist party included in the Government. He felt the valuable economic forces of this great party should not be condemned to eternal fruitless opposition. He himself remained Foreign Minister in Luther's first and second Cabinets.

During the long governmental crisis he sent the famous Feb. memorandum of 1925 to the Entente, which laid the foundations of the Pact of Locarno. Throughout 1925 this policy initiated by Stresemann was the focus of interest, not merely of Germany, but of the whole world. The conference of Locarno brought success. On Dec. 1. 1925 the Pact of Locarno was solemnly signed in London.

A man with many bitter enemies as well as sincere admirers, it must be agreed that Stresemann carried out a consistent policy without regard to party hostility. He can thus claim the merit for having freed the Ruhr district and the first Rhineland zone from foreign military occupation, for having laid the political foundations for the stabilisation of the currency and for having brought about less strained political relations between Germany and the outer world. One of the best speakers in Germany, he also possesses great political ability and practical common sense. He wrote on the Pact of Locarno for this *Encyclopædia*. (F. KLE.)

STREUVELS, STYN (1871–), pen name of Frank Lateur, Flemish writer, was the nephew of the priest-poet Guido Gerelle. For a long time he worked as a pastry cook at Avelghem in Flanders and then settled down at Ingoyghen, close by, in order to devote himself entirely to literature. Essentially a man of the soil, he nevertheless possessed a delicate artistic sensibility and acquired considerable literary culture. He is the most popular contemporary writer in Flanders and enjoys a great reputation throughout Holland, although he frequently introduces the Western Flemish dialect into his writings. Many of his novels have been translated into German. His descriptions of the countryside, no less realistic than poetical, are presented with enormous vigour and pungency in a style which seems to echo the rhythms of nature herself. *De Vlaschaard* (1907) is considered his best work.

STRIKES AND LOCKOUTS (*see* 25.1024).—The period under review has been characterised in all industrialised countries by an endemic condition of industrial warfare. Despite all the machinery of conciliation and the immense amount of both voluntary and legislative effort to secure the peaceful and equitable settlement of disputes between employers and workers, the organic development of the economic system is continually being interrupted by trials of strength which bring widespread distress both to those directly involved and to the rest of the community. The following article is confined to a statistical statement and description of the principal strikes and lockouts which have occurred between 1907 and 1924. For a discussion of the broader questions involved *see* INDUSTRIAL RELATIONS and TRADE UNIONS.

I. GREAT BRITAIN AND NORTHERN IRELAND

The following table brings together the general totals for the strikes and lockouts which have occurred in each year under review in Great Britain and Northern Ireland.[1]

Year	Number of disputes beginning in year	Total number of workpeople involved	Aggregate duration in working days of all disputes in progress during the year
1907	585	146,000	2,150,000
1908	389	293,000	10,790,000
1909	422	297,000	2,690,000
1910	521	514,000	9,870,000
1911	872	952,000	10,160,000
1912	834	1,462,000	40,890,000
1913	1,459	664,000	9,800,000
1914	972	447,000	9,880,000
1915	672	448,000	2,950,000
1916	532	276,000	2,450,000
1917	730	872,000	5,650,000
1918	1,165	1,116,000	5,880,000
1919	1,352	2,591,000	34,970,000
1920	1,607	1,932,000	26,570,000
1921	763	1,801,000	85,870,000
1922	576	552,000	19,850,000
1923	628	405,000	10,670,000
1924	709	612,000	8,320,000

The great majority of the disputes were relatively unimportant; roughly 90% of all the disputes involved less than 1,000 workpeople, and only about 2% involved more than 5,000.

[1] The exclusion of the area now forming the Irish Free State does not materially affect the figures except in 1913, when a "general strike" occurred at Dublin, *i.e.*, a strike aimed at dislocating the whole of the trades of a city or territory—the only instance before the General Strike of 1926 of such a strike on a considerable scale in the British Isles. The strike (which was unsuccessful) involved about 20,000 workpeople, and included, at the time of its maximum extension, tramwaymen and other transport workers, and the employees of flour-millers, coach-builders, biscuit-manufacturers, coal-merchants, steamship companies, master builders and several other trades, including even farmers in County Dublin.

These latter disputes, however, though so few in number, accounted for five-sixths of the time lost by all the disputes, and it is mainly these large disputes which account for the variations between the figures for the different years in the last column of the table.

The low totals for the War years 1914–8 contrast with the high figures for the three years immediately after the War, viz.: 1919–21. Since then the amount of industrial disturbance due to disputes has diminished very substantially. The loss of time through disputes, in all but five of the years included in the table amounted to the equivalent of *less than one day in the year*, if spread over the entire working population; that is to say, to less than the effect of a single public holiday, an almost insignificant loss by comparison (for example) with the loss through sickness or through involuntary unemployment.

The statistics relating to the causes or objects of disputes show that wages questions account for about two-thirds of the total number of strikes and lockouts. In years of good or improving trade, such disputes largely arise out of demands for advances in wages; and it is worth noting, in this connection, that no important disputes arising out of resistance to a reduction in wages occurred between 1908 and the end of 1920. Disputes arising out of questions of hours of labour were unusually frequent in 1919, when the movement towards shorter hours was at its height: 10% of all the disputes of that year were due to questions of hours. In other years the proportion averages less than 3% of the total number. Disputes arising on questions of particular classes or persons (*e.g.*, demarcation disputes, strikes for the removal of an unpopular foreman or for the reinstatement of a dismissed fellow-worker) account for about 15%; and other disputes (largely concerned with questions of trade union principle) for a similar proportion of the total.

Of all the disputes, about 25% ended definitely in favour of the workpeople, about 30% in favour of the employers, and about 45% were compromised. Even this large figure, however, does not fully represent the predominance of compromised settlements, because the tendency to settlement by compromise is greatest in the case of the larger disputes; hence of all the workpeople directly involved in strikes and lockouts about 65% resumed work after a compromised result, while about 20% resumed after a settlement definitely in their favour and about 15% sustained defeat.

The great majority of the disputes—between two-thirds and three-quarters of the total—were settled by direct negotiation between the parties or their representatives, and one-half of the remainder by conciliation or by arbitration. Other methods by which strikes and lockouts have been terminated in recent years have included unconditional surrender of the workpeople, the closing of works and the replacement of workpeople. During the War years a number of disputes were terminated by administrative decisions of the Government. One of the greatest disputes, viz.: that in the coal-mining industry in 1912, was settled by the enactment of the Coal Mines (Minimum Wage) Act. Particulars of industrial disputes in Great Britain will be found in the official *Abstract of Labour Statistics* and in the monthly *Ministry of Labour Gazette;* the issue of the *Labour Gazette* for July 1925, contains a review of the disputes of the 15 years 1910–24, and that for Jan. of each year, which contains a review of the disputes of the previous year.

Principal Disputes in the United Kingdom.—It has already been pointed out that a very small minority of the disputes account for by far the greater number of workpeople involved and of days lost; two or three big disputes, indeed, commonly account for an altogether disproportionate share of the days lost in any year. The most remarkable example of this occurred in 1921, as will be seen from the following figures:—

	Workpeople involved	Man-days lost
One coal-mining dispute	1,150,000	72,000,000
One cotton dispute	375,000	6,750,000
761 other disputes	276,000	7,120,000
Total	1,801,000	85,870,000

On the other hand, in some years there were no disputes of outstanding importance; the years 1907 and 1909 are examples, though it will be observed that both these years had more industrial disturbance, so far as mere number of disputes goes, than the intervening year, 1908.

Brief comments are appended on some important disputes.

The cotton strike of 1908 is memorable as having been, with two other disputes of the same year, the last important dispute, for the long space of 12 years, arising out of resistance to a reduction in wages in that trade.

The seamen's and transport workers' strike in 1911 began with the seamen striking in support of a demand for a conciliation board. Dock labourers and other transport workers joined in the strike, partly in sympathy with the seamen and partly in support of their own demands for improved conditions. There was a good deal of dissatisfaction with the working of the agreements reached in settlement of these disputes, and further strikes occurred in the following year, particularly on the Thames and Medway. The railwaymen in 1911 struck for an improvement in the Railway Conciliation Board scheme, which had been set up in 1907. The cotton dispute of 1911–2 began with strikes of weavers in Lancashire against the employment of non-unionists, to which the employers replied by a general lockout.

The coal strike of 1912 arose out of a demand by the Miners' Federation for the payment of an individual district minimum wage for all underground workers in mines, irrespective of the question whether the men's working places were abnormal or not. The dispute was settled by the passing of the Coal Mines (Minimum Wage) Act 1912, which provided for the setting up of joint district boards to determine the minimum rates of wages of underground workers in coal-mines.

The World War, as will be seen, by no means put an end to strikes; but most of them were small, and were speedily brought to an end. Hence the aggregate duration was brought down to a very low point in 1915 and 1916. There were, however, several unauthorised strikes in the engineering and munition trades in 1917, which caused great concern at the time, though only one was of very serious importance as measured by aggregate duration. It was in these disputes that "shop stewards" (sometimes acting in defiance of their own trade-union executives) first came prominently into public notice.

There were many industrial disputes in 1918, but the great majority involved small numbers and were of short duration. In 1919 and 1920, on the other hand, there were many serious disputes. A great railway strike occurred in Sept. and Oct. 1919, the National Union of Railwaymen being dissatisfied with the new standard rates proposed for certain grades. There was also a prolonged ironmoulders' strike, which lasted for four months, and seriously dislocated the engineering industry. In the same year there was a great strike in the cotton trade, both the spinning and the weaving branches being affected. The operatives asked for a reduction in hours and an advance of 30% on list prices. The advance was granted, and the hours reduced to 48 per week (instead of 46½, as asked). The principal dispute of 1920 and again of 1921 was a national strike in the coal-mining industry (*see* COAL).

The cotton dispute of 1921 arose out of a demand of the employers for a reduction of 95% on the standard lists of wages (equivalent to about 30% on the rates then actually being paid). This was reduced to 80% during the subsequent negotiations. The dispute was finally settled by the operatives accepting a reduction of 70% (60% at once, and another 10% after six months).

The engineering dispute of 1922 arose out of the rejection by the members of the Amalgamated Engineering Union, on a ballot vote, of a provisional agreement on overtime and the exercise of managerial functions which had been reached between the executive of the Union and the Engineering and the National Employers' Federations in Nov. 1921. The members of the Union were, therefore, locked out on March 11; and members of other unions employed in federated engineering shops were also locked out on the following May 2. On May 17 the employers put forward new proposals, embodying the principle of prior consultation with the workpeople when a proposed change involved the displacement of one class of workpeople by another. These terms were eventually accepted by all the unions concerned, and work was resumed at various dates in June. The shipbuilding dispute of the same year arose out of a proposed reduction of wages; a modified reduction was accepted after a stoppage of six weeks.

The shipbuilding dispute of 1923 was confined to the United Society of Boilermakers and Iron and Steel Shipbuilders, which refused to accept an agreement with the Shipbuilding Employers' Federation relating to overtime and night-shift working, which had been signed by the other shipyard unions. The lockout was settled, after a stoppage of nearly seven months, by the federation agreeing to reconsider, in consultation with the Boilermakers' Society, five points which were alleged to need correction or adjustment in their application to the members of the society.

THE GENERAL STRIKE OF 1926

The great coal dispute of 1921 was terminated (*see* COAL) by the signing of an agreement between the miners and the mine-owners, providing for the automatic regulation of wages from one period to another on the basis of the ascertained costs of production, proceeds, etc., in an earlier period. In Jan. 1924 the Miners' Federation gave three months' notice to the Mining Association to terminate the agreement of 1921. In June 1924, after prolonged negotiations, a new agreement was made, which

was, in the main, much more favourable to the men than the agreement of 1921, though it contained some provisions intended to benefit the owners. *See* Coal.

Unfortunately, not long after the new agreement came into force the industry entered upon a period of very severe depression; and the agreement, therefore, with its improved terms to the miners, proved extremely onerous to the owners. On June 30 1925 the owners gave the miners one month's notice to terminate the agreement; and on the following day they communicated to the miners their proposals for a new agreement, which were rejected by a delegate conference of the Miners' Federation. On July 30 the Prime Minister offered financial assistance to the industry until April 30 1926, to allow time for a full investigation to be made; and on the following day (the day when the owners' notices to the men would otherwise have expired) the terms were accepted, and arrangements were made for work to be continued. The total cost of the subvention, from the beginning of Aug. 1925 to the end of April 1926, was £24,000,000.

The Samuel Report.—On Sept. 5 1925 a royal commission was appointed, under the chairmanship of Sir Herbert Samuel, "to enquire into and report upon the economic position of the coal industry and the conditions affecting it, and to make any recommendation for the improvement thereof." The royal commission issued its report on March 6 1926, suggesting a number of measures that might be taken for the improvement of the industry, but also expressing the opinion that an immediate reduction of working costs, by means of a revision downwards of the minimum percentage addition to standard rates of wages, was essential, as a temporary measure, to save the industry. They considered it essential that, though national wage agreements should continue, there should nevertheless be, as hitherto, considerable variation in the rates of wages in the several districts, and laid it down that, "before any sacrifices are asked from those engaged in the industry, it shall be definitely agreed between them that all practicable means for improving its organisation and increasing its efficiency should be adopted."

The report was accepted by the Government in its entirety, but only subject to acceptance by the other two parties. The owners issued a statement expressing general agreement with the report; but they at first desired to initiate negotiations with the miners on district lines. Later, under pressure from the Government, they withdrew from this position; but the best terms which they were able to offer represented a severe reduction of wages in most districts; and, owing to the delay already mentioned, these terms were not presented to the miners, nationally, until the owners' notices were on the point of expiring. The miners were strongly averse to any reduction of wages or any increase of hours; they also wanted assurances that were not forthcoming as to the measures of reorganisation mentioned in the paragraph quoted textually above. No settlement was found possible; and the owners' notices, which they had issued in anticipation of the termination of the subsidy period on April 30, took effect on that date.

A General Strike Called.—Meanwhile, the general council of the Trades Union Congress, who had already come to the assistance of the miners in July 1925—the Miners' Federation had "placed their case unreservedly in the hands of the general council" at that time—again intervened; and prolonged negotiations followed. On May 1 1926, with a view to assisting the miners, the general council issued instructions calling out on strike the railway and transport workers, the printing and paper trade unions, some branches of the metal and engineering and of the building trade workers, and some other classes; and it was intimated that other classes of workers would be called out later, if necessary. This was the first example of a general strike in Great Britain, though there had been a strike of this kind in Dublin in 1913, involving about 20,000 workpeople.

The stoppage on the railways and at the docks, of tramway and omnibus services, and of printing, was at first nearly complete; though there was some recovery as the strike went on. Volunteers, and men who had refused to come out or had gone back to work, maintained or restored a skeleton service on the railways and omnibus routes, and on some of the provincial tramways; some work was also done by volunteers at the docks. Apart from this, the Government were able to introduce an emergency service of motor transport, sufficient to ensure a supply of necessary foodstuffs; and many thousands of volunteers offered themselves for work in all sorts of capacities, and as special constables. Strict orders were issued by the Trade Unions to their members to refrain from provocation, and cases of serious disorder or violence were rare.

The success of these measures, together with a judgment given by Mr. Justice Astbury declaring the general strike to be illegal and not covered by the protection of the Trade Disputes Act, and pronouncements in the House of Commons to the same effect, no doubt hastened the termination of the strike. The general council had also been in touch with Sir Herbert Samuel, who had been acting, unofficially, as a mediator, and had agreed with him on a formula which, it was hoped, would enable negotiations to be resumed. In this hope the general council informed the Prime Minister on May 12 that they had decided to call off the strike unconditionally. Sir Herbert Samuel's formula was not, however, accepted by the miners; nor was it adopted by the Government, who, on the termination of the general strike, immediately resumed negotiations with the miners.

Some difficulties arose in connection with the resumption of work after the general strike. The most important source of dislocation, at least on the railways, arose from the fact that, partly owing to the lack of coal traffic and the necessity of economising coal, a great reduction in the railway services was in any case inevitable, and it was, therefore, impossible to re-employ immediately all those who had gone on strike. On May 14, however, the railway companies came to an agreement with the three railway trade unions, on the basis of undertaking to take back the men as work could be found for them; the trade unions also acknowledged that they had been guilty of a "wrongful act" in bringing their members out on strike without the usual notice. Similar agreements were made with the other trade unions. The strike of the miners, however, still continued.

II. FOREIGN COUNTRIES

A brief account is given below of strikes and lockouts in the years after the War in the principal European countries, other than Great Britain, from the official statistics available at the beginning of 1926:—

Belgium.—The average annual number of labour disputes in the post-War years (1920–4) in Belgium was 261, directly affecting an average of 145,105 workers. Particulars are not available as to the number of working days lost. There were no features of particular interest in connection with the disputes; 1920 was the year most affected (517 disputes directly affecting 296,192 workers).

France.—The latest figures available for France are for 1922. For the four post-War years the figures are as follows:—

Year	Number of disputes	Number of workpeople directly affected	Aggregate duration in working days
1919	2,053	1,206,175	16,128,638
1920[1]	1,924	1,487,996	24,563,527
1921	576	453,564	8,092,388
1922	711	307,056	3,385,902

[1] Figures for 1920 and subsequent years include Alsace-Lorraine.

A noticeable feature in France has been the tendency to strike among employees of public bodies.

Germany.—During the post-War years (1919–23) the average annual number of disputes in Germany was 3,762, which directly affected 1,657,469 workers and involved a loss of 23,158,100 working days on the average. The years 1919, 1921 and 1922 were the most serious. It should be noted that political motives were the cause of many German strikes in those years, *e.g.*, the Kapp Putsch and the occupation of the Ruhr.

The Netherlands.—The average annual number of strikes in the post-War years (1919–24) in the Netherlands was 380, which directly affected 50,567 workpeople and involved a loss of 1,687,983 working days on the average. In the year 1923 a dispute occurred in the textile industry, which affected 22,200 workpeople and caused the loss of 3,119,100 working days. The last figure is greater than the total loss in any other of the six years in all industries.

Scandinavian Countries.—Widespread disputes in the spring of the year, when most collective agreements terminate, are a marked feature in the Scandinavian countries: in Denmark, for example, in the spring of 1925 an almost general dispute (strikes and lockouts) directly affected 95,000 workpeople and involved a loss of 4,021,900 working days.

The average annual number of strikes, workers affected and days lost in these countries in the post-War years was as follows:—

Country and years	Number of disputes	Number of workpeople directly affected	Aggregate duration in working days
Denmark, 1919–24	164	27,748	892,699
Norway, 1921–4	58	61,168	2,405,946
Sweden, 1919–24	355	78,724	4,114,706

A great lockout (Feb. 14 to May 27 1924) in Norway affected 39,476 workpeople and involved a loss of 2,962,263 working days. Compulsory arbitration was in force in Norway from 1916–21, when the Act was allowed to lapse. It was renewed in 1922 for a year, but an attempt to renew it in 1923 failed. In Sweden the peak year of the period was 1920, when 486 disputes occurred directly affecting 139,039 workpeople and causing a loss of 8,942,543 working days.

Spain.—The average annual number of disputes in the post-War years (1919–23) in Spain was 380, which directly affected 149,371 workers and involved the loss of 3,952,986 working days on an average.

III. BRITISH DOMINIONS

Canada.—The average annual number of disputes in the post-War years (1919–24) was 163, which directly or indirectly affected 52,580 workpeople and involved a loss of 1,716,577 working days on an average. The year 1919 alone accounted for more than one-third of the total number of working days lost.

Australia.—The average annual number of disputes in the post-War years (1919–24) in Australia was 477, which directly and indirectly affected 137,226 workpeople, and caused a loss of 2,010,036 working days on an average. The year 1919 alone accounted for rather more than half the total number of working days lost (6,308,226 out of 12,060,216).

South Africa.—The average annual number of disputes in the post-War years (1919–23) was 30, which covered 33,680[1] workers and involved a loss of 565,832 working days on an average. The year 1923 was distinguished by having only two strikes affecting 50 workers and involving the loss of 740 working days.

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Europe: *Annuaire Statistique de la Belgique* (1920–1 and 1922); *Revue du Travail, passim; Statistique des Grèves* (1915–8, 1919, 1920 and 1921–2), issued by the French Ministry of Labour and Health; *Statistisches Jahrbuch für das Deutsche Reich* (1924–5); *Werkstakingen en Mitsluitingen gedurende het jaar* (1923), issued by Dutch Central Statistical Bureau; *idem* (1924); *Statistiske Efterretninger* (July 24 1925) and *Statistisk Aarbog* (1924), issued by the Danish Statistical Dept.; *Megling og voldgift Tariffavtaler og arbeidskonflikter* (1924), issued by Norwegian Central Statistical Bureau; *Arbetsinställelser och Kollektivavtal ar 1924*, issued by Swedish Dept. for Social Affairs; *Anuario Estadístico de España* (1923–4).

British Dominions: *Labour Gazette* (Feb. 1925); *Labour Report* (1924), issued by Commonwealth of Australia Bureau of Census and Statistics; Official *Yearbook* of the Union of South Africa (1910–24).

(J. H.)

IV. THE UNITED STATES

The distinction, for statistical purposes, between a strike and a lockout is often difficult to make and therefore, when figures for several years are presented, strikes and lockouts are grouped as "industrial disputes." Table I. sets forth the number of strikes and lockouts and the number of workers involved, during the period 1914–24.

TABLE I.

Number of Industrial Disputes and Number of Employees Affected 1914–24

Year	Disputes	Employees Involved
1914	1,204	..
1915	1,500	..
1916	2,667	1,599,917
1917	2,325	1,227,254
1918	2,151	1,239,989
1919	2,665	4,160,348
1920	2,226	1,463,054
1921	1,785	1,099,247
1922	865	1,608,321
1923	1,132	744,948
1924	872	654,453

Compiled from the Bureau of Labour Statistics, Monthly Labour Review.

The distribution of these disputes among the several more important industries of the United States is illustrated by Table II.:—

TABLE II.

Number of Disputes in the More Important Industries 1914–24

Industry	Number of Disputes										
	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Building	275	231	394	468	434	473	521	583	113	206	267
Clothing	78	139	227	495	436	322	336	240	215	357	223
Furniture	18	20	50	43	26	35	26	17	4	12	34
Iron and Steel	14	30	72	56	74	76	25	25	10	10	7
Leather	..	..	34	19	16	27	32	26	17	17	5
Lumber	40	14	44	299	76	46	38	25	10	19	6
Metal Trades	129	321	547	515	441	581	452	194	82	111	57
Mining	51	67	416	449	208	176	183	95	49	159	177
Paper Mfg.	..	..	54	41	40	47	39	42	12	16	6
Printing	20	7	27	41	40	71	83	506	56	19	12
Shipbuilding	..	..	31	106	140	109	45	20	4	6	1
Meat Packing	..	..	70	38	42	74	42	30	6	11	14
Stone	..	..	61	26	14	13	29	34	61	15	15
Textile	54	84	261	247	212	273	211	114	115	134	79
Tobacco	..	..	63	47	50	58	38	19	12	16	12
Transportation	52	18	228	343	227	191	241	37	67	30	18

Compiled from the Bureau of Labour Statistics, Monthly Labour Review.

During 1910 the most important strikes occurred in the bituminous coal-mining industry and in the New York and Chicago clothing industries. On April 1, 300,000 miners went on strike to support wage demands. In most districts the operators soon granted the wage increases but 45,000 men remained out until September. The Columbus street railway employees struck in April, May and July because of discharges of union members.

In 1912 the textile strike at Lawrence, Massachusetts, and the anthracite coal strike were most important. The Lawrence strike lasted 9 weeks, affected 12 mills and involved 23,000 workers. A state law limiting the hours of work for women and children to 54 a week caused a reduction in wages against which the workers had struck. As a result of this strike 30,000 employees received wage increases of from 5% to 20% and increased pay for overtime. The unskilled workers received the largest increases. The

[1] It is not stated whether this is the number of workers directly affected, or the number directly and indirectly affected.

anthracite coal strike began March 31 1912, and lasted seven weeks. Some 170,000 workers went out. The strike resulted in wage increases, abolition of the sliding scale and establishment of a grievance committee. A strike in Paint Creek and Cabin Creek, W.Va., from April 1912 to July 1913 was marked by the loss of 13 lives. Its violence attracted much attention and the U.S. Senate ordered an investigation.

In 1913, 25,000 workers in the silk factories of Paterson, N.J., struck for shorter hours and increased wages. The strike failed. In September, the employees of the Colorado Fuel and Iron Co. struck for recognition of the United Mine Workers' Union, increased wages and observation of state mining laws. Both sides committed violence. John D. Rockefeller, Jr. at first declined to intervene. State troops were brought in and killed a number of strikers and members of their families. President Wilson then sent 2,000 Federal troops to restore peace. His proposal for settlement was accepted by the miners but rejected by the operators. After an investigation by the U.S. Commission on Industrial Relations, John D. Rockefeller, Jr., visited Colorado and instituted a system of employee representation; the workers were granted the basic eight-hour day and a check-weighman, but the union was not recognized.

In 1915 there were 102 strikes and six lockouts of machinists between July and October. In nearly every case the basic eight-hour day was gained. The coal strike in that year involved 350,000 men.

When the United States entered the World War in 1917 the American Federation of Labour discouraged strikes in the essential industries. A number did occur, however, and these were mediated by Government committees. On the whole the War period was one of industrial truce. During the War the greatest number of disputes occurred in the metal trades, building, clothing, textile, transportation and mining industries. In 1917 a very violent disturbance occurred in the mines at Jerome and Bisbee, Arizona. In July of that year 1,200 Bisbee strikers were loaded on cattle cars by armed citizens and transported across the desert to Columbus, New Mexico. Here they were taken over by soldiers and fed on army rations for three months, after which they scattered.

When the War was over the war labour adjustment boards were dissolved and workers, who had been prevented from striking by the promise of peaceful settlement, felt that the government and employers had broken faith. Some 176,000 employees struck in the clothing trades, 150,000 in the textile industry, 100,000 marine workers and 100,000 shipyard workers. The employers launched the "American Plan" of open shop and industrial unrest grew apace.

In Sept. 1919 the steel strike began as a result of the united action of 24 international unions. Some 365,000 men left their jobs but gradually they went back to work. By Jan. 1920 the remaining 100,000 men still out were sent back to work and the strike ended. In Seattle a general sympathetic strike with the shipyard workers, involving 60,000 people, was called and lasted from Feb. 6 to 11. The strike failed. In Aug. 1919, although forbidden by their national officers, 250,000 railway shopmen went on strike because of the delay of the Wage Adjustment Board to reach a decision on the demands of the men for increased pay. After six days the strike was called off and the men returned to work. At the request of President Wilson the demand for a wage increase was postponed to give the Government an opportunity to reduce the cost of living. In Nov. 1919, 435,000 bituminous coal-miners struck for wage increases of 60%, the six-hour day and the five-day week in order to distribute work throughout the year. An injunction was issued to prevent the use of union funds for strike benefits. In March 1920 an agreement was reached providing for a 27% increase in wages. In Sept. 1919, 93% of the Boston policemen struck for the right to organise and affiliate with the American Federation of Labour. Their places were filled with other men.

The coal strike of 1922 began on April 1, involving 600,000 men and effecting a complete tie-up of the central competitive (bituminous) field and of the anthracite industry. The operators wanted the creation of a permanent arbitration board, and the union wanted the creation of a Government fact-finding commission and the continuation of collective bargaining. This, rather than wages, came to be the real issue in the anthracite strike. An agreement was reached on Sept. 2, providing for the continuation of existing wages and recommendation to Congress that a coal commission be appointed. The bituminous operators wanted district agreements, the union wanted a national agreement. The union demands included also continuation of existing wages, the six-hour day and five-day week. An agreement was reached Aug. 15, providing for cessation of the strike, and appointment of a joint committee to negotiate a wage scale to go into effect April 1 1923.

The strike of the railway shopmen began July 1, involving 500,000 men and constituted the most complete tie-up of that branch of the railway industry that the United States has ever seen. The shopmen struck primarily against the road's practice of contracting out work to non-railway shops and against the basic wage of $800 a year established by the Railroad Labour Board. On Sept. 13 the unions and 50 railways signed an agreement which 126 roads signed by Oct. 27.

The most important strike in 1923 was that of 155,000 anthracite coal-miners in September for the check-off of union dues and a 20% increase in wages. The strike was settled after three weeks on a compromise basis, the miners securing a 10% wage increase. In May, 50,000 New York City clothing workers struck for a 10% wage increase. The strike lasted two weeks, embraced 2,000 shops and was won by the workers. The most important strike of 1924 was in the ladies' garment industry. On July 8, 50,000 workers led by the International Ladies' Garment Workers Union struck for an increase in wages, a 40-hour week and unemployment insurance. The strike lasted 13 days and was a success.

Industrial disputes were in general less numerous and less severe in 1925 than in any preceding year except the very quiet year of 1922. During the first half of 1925 some 720 strikes and lockouts involving 199,500 people took place. During the third quarter of the year 363 disputes occurred. The principal disputes were in the clothing, textile, building and coal-mining industries. The most important strike was that of 148,000 anthracite coal-miners which began Sept. 1, in a demand for a 10% wage increase, the check-off of union dues, two-year contract and complete union recognition. The strike lasted 170 days and covered the entire commercial anthracite area. An agreement ratified Feb. 17 1926 continued the terms of the previous contract, and set up a board of conciliation and other arbitration machines. The agreement is to be in force until Aug. 31 1930. New York dressmakers, numbering 30,000, struck on March 10 in 2,000 shops to enforce a provision in the joint agreement. The strike was novel in that the strikers reported at their places of work each morning and sat at their machines for six days without working. The strike was a success. (*See* INSURANCE, SOCIAL.)

(J. R. Co.)

STRINDBERG, AUGUST (1849–1912), Swedish author (*see* 25.1038), died at Stockholm May 14 1912. His plays have been translated into English by E. and W. Oland (1912–3) and H. B. Samuel (1914).

See A. Henderson, *European Dramatists: August Strindberg* (1914); C. D. Marcus, *Strindbergs Dramatik* (1918); C. L. Schleich, *Erinnerungen an Strindberg* (1917).

STRZYGOWSKI, JOSEF (1862–), Austrian scholar, was born at Bial, near Bielitz, March 7 1862. In 1892 he became a professor at Graz, and in 1909 was appointed professor of art at the University of Vienna. He wrote numerous works on art, dealing especially with Oriental influences on Western art (*see* BYZANTINE ART, 4.907; ROMAN ART, 23.475).

His works include: *Byzantische Denkmäler*, 1–3 (1891–3); *Hellenistische und Koptische Kunst in Alexandria* (1902); *Koptische Kunst* (1903); *Die bildende Kunst der Gegenwart* (1907); *Ursprung der Christlichen Kirchenkunst* (1920, Swedish and English trans.); Ed. *Early North European Church Art and Wood Architecture* (1925).

STSHERBATSKY, FEDOR IPPOLITOVICH (1867–), Russian orientalist, was born at St. Petersburg (Leningrad) Sept.

19 (old style) 1867 of a family of old nobility. He was educated at Tsarskoye Selo, and studied philology at the St. Petersburg University, specialising in Sanscrit under Prof. I. P. Minajev. He graduated in 1889 and studied three years abroad, first at Vienna under Prof. G. Bühler, then in Bonn, under Prof. H. Jacobi. In 1904 he became professor of Indian literature at the St. Petersburg university, and in 1916 was elected member of the Prussian Academy of Sciences. The years 1910–1 were spent in British India for scientific research. His knowledge of Tibetan languages and of Buddhism enabled him to enter into friendly relations with the leading Buddhist priests. He was invited to meet the Dalai-Lhama, with whom he had several interviews without any interpreter. His thorough understanding of Buddhism makes his work, *The Theory of Knowledge and Logic according to the Later Buddhists* (1899), a most valuable book (German translation, 1924). He has published many Sanscrit MSS. in the *Bibliotheca Buddica* of the Academy of Sciences. In 1923 the Royal Asiatic Society published his work, *The Central Conception of Buddhism*, and in 1926 was published *The Conception of Nirvana*.

STURDEE, SIR FREDERICK CHARLES DOVETON (1859–1925), British sailor, was born at Charlton, Kent, June 9 1859, and entered the navy in 1871. He was promoted lieutenant (1880), commander (1893), captain (1899), rear-admiral (1908), vice-admiral (1913), admiral (1917) and admiral of the fleet (1921). He saw service in Egypt (1882) and in Samoa (1899), when he was in command of the Anglo-American force. He was assistant director of naval intelligence to the Admiralty (1900–2) and chief of staff, Mediterranean Fleet (1905–7) and Channel Fleet (1907). In 1910 he became rear-admiral of the first battle squadron, and commanded the 2nd cruiser squadron (1912–3). During the World War Sturdee was made chief of the war staff in Nov. 1914. As commander-in-chief in the South Atlantic and Pacific, he led the squadron which won the battle of the Falkland Is. Dec. 8 1914, and he was in command of the 4th battle squadron when it took part in the battle of Jutland. He was created K.C.B. in 1913, K.C.M.G. in 1916, and a baronetcy was conferred on him in 1916, with the title "of the Falkland Is." From 1918–21 he was commander-in-chief at the Nore. He died May 7 1925.

STURDZA, DEMETRIUS (1833–1914), Rumanian statesman (*see* 25.1051), died at Bucharest Oct. 21 1914.

STÜRGKH, CARL, Count (1859–1916), Austrian politician, was born at Graz Oct. 30 1859, of an ancient noble Styrian family, and in 1881 he became an official of the Statthalterei at Graz, and later of the ministry of education. He left the state service in 1891, when he was elected as a representative of the loyal landholding interest to the Reichsrat. He attached himself to the Left of the German party, and came forward as a keen opponent of universal suffrage. He was from Feb. 10 1909 to Nov. 3 1911 minister of education, and a zealous advocate of the humanistic education traditional in the gymnasia. On Nov. 3 he became Prime Minister. Stürgkh was one of the committee of five ministers who decided on the dispatch of the ultimatum to Serbia and the declaration of war, which brought on the World War. He was killed on Oct. 21 1916 by a shot fired by the Social Democrat Freidrich Adler, a son of the Social Democrat leader, Viktor Adler, as a protest against Stürgkh's government without parliament (*see* Austrian Empire).

ŠTURSA, JAN (1880–1923), Czech sculptor, was born at Nové Město in Moravia. In 1899 he entered the Academy of Fine Arts at Prague as a pupil of Myslbek. His early works manifest the influence of the symbolic literature of that period, but by 1905–7 he had already attained an individual expression in such works as "Puberty" (1905), "The Melancholy Girl" (1906) and "Primavera" (1907). A journey to Italy in 1907 was the opening of a new epoch in his creative work. He was captivated first and foremost by the warm magic of femininity which is manifested in "Eve" (1908, State Gallery, Munich), "Hetaira" (1909), "Messalina" and the monumental representation of the dancer "Sulamith Rahu" (1911), now in the gallery at Venice. At the same time he interpreted the opposite feminine type, the intellectuality of which is incorporated in the monument to Hana Kvapilova (1912), the famous Czech actress. During the same period Šturs a produced the group of statuary for the pylons of the Hlavka Bridge at Prague. In 1916 he was appointed professor at the Academy of Fine Arts in Prague, and it was in this period of his artistic maturity that he created the "Wounded Man." He also produced a number of portrait busts, the most noteworthy of which is that of President Masaryk. The leader of the modern school of Czech sculpture, he died in 1923.

STURZO, LUIGI (1870–), Italian priest and political organiser. Born at Caltagirone, Sicily, on Nov. 26 1870, he entered the priesthood at an early age, but soon took to politics and showed from the first a marked ability in creating diocesan committees, co-operation unions, etc., and guiding the masses in the direction of Christian democracy. He was practically unknown outside his native province, until on the outbreak of the War, he came to Rome as secretary of the Azione cattolica. After the Armistice he was chosen political secretary of the *Partito Popolare italiano*, founded early in 1919. There had been a political Catholic movement in Italy even before the War, but it was due to the organising genius of Don Sturzo that the *Partito Popolare* made such rapid progress in so short a time. The general tendency of the party was Christian Socialist, and Don Sturzo advocated social reforms of a radical nature, especially in agriculture, as the majority of the party's adherents were peasants; unlike the Socialists, he demanded the expropriation of the land with compensation for the landlords, collaboration of capital and labour in industry and a patriotic foreign policy.

But an extremist wing, led by Sig. Miglioli, soon arose, and Don Sturzo, although mildly critical of its Bolshevik methods, never definitely disowned it. At the elections of Nov. 1919, thanks to the proportional system introduced by Nitti, the *Partito Popolare* secured 101 seats, and subsequently, by holding the balance between the various parties, became a dominant force in Italian politics. When Sig. Bonomi was trying to form a Cabinet after the fall of Giolitti in Feb. 1922, it was Don Sturzo who dictated its composition to him and became his *éminence grise* after it was constituted. In the early days of Fascism Don Sturzo did not oppose it, although there were frequent affrays between the black-shirted *squadre* and the Migliolini. After the march on Rome he allowed several Popolari to enter the Cabinet, but his half-hearted support of the Mussolini Govt. resulted in their withdrawal, and Don Sturzo and his party definitely joined the opposition. A section of the party, having remained faithful to Sig. Mussolini, broke away from the *Partito Popolare* and constituted the *Centro nazionale cattolico*. Don Sturzo's activities had, however, brought him into disfavour with the Vatican, which, after issuing a general admonition to priests not to mix themselves up with party politics, hinted that he would be well advised to leave Italy. He consequently went to England and France. In 1925 he published *Pensiero antifascista*. (L. V.*)

SUBMARINE.—The first practical submarine was constructed by David Bushnell in 1775, and his ideas were revived some 25 years later by R. Fulton, who constructed a boat called the "Nautilus," driven by means of a hand-worked screw and fitted with a copper vessel containing compressed air to give a reserve supply for breathing. This air enabled the boat to remain under the water for about four hours. The vessel actually descended on trial to a depth of 25 ft. and placed a torpedo underneath a ship.

The Submarine before the World War

American Civil War.—The first vessels to take part in actual warfare were of a type known as the Davids, built by the Confederates during the American Civil War. These were small iron boats propelled by hand from four to seven knots and armed with a spar torpedo bearing about 50 to 70 lb. of powder. One of these, manned by nine men, attacked the Federal warship "Housatonic" and sank her, but was herself sunk by the wave thrown up by the explosion. About 1860, the submarine boat

began to slowly develop from the crude form propelled by manual labour to a power-propelled vessel, which could be considered a factor in naval warfare. In 1863 the "Plongeur," 146 ft. long, 12 ft. in diameter, and propelled by an 18-H.P. compressed air engine, was built in France.

The "Holland" Type.—A very important type was constructed in 1877 by Mr. Holland, which was propelled by a petrol engine. For the purpose of diving, water was admitted into internal ballast tanks until the boat had a small positive buoyancy, immersion being maintained by the use of horizontal rudders. The importance of this type is due to the fact that the first submarines for the British Navy were based on Mr. Holland's ideas. The following are a few of some of the other types of submarines built by the various naval powers round about this period.

Russian Boats.—In 1881, M. Goubet constructed several submarines for the Russian Govt., 16½ ft. long, of oval section, 5¾ ft. by 3¼ ft. amidships, tapering to a point at each end. The boat was manned by two persons only, and all valves and other mechanism were brought within reach of the two operators in order that no movement which might upset the trim of the boat was necessary. The power for driving the screw propeller was obtained from an electric motor driven by accumulators, and submersion was effected by admitting water into ballast tanks, this water being expelled by a pump when the boat was required to be brought to the surface again.

Construction in U.S.A.—In 1887 the United States of America invited designs for submarines, and after careful consideration of all those submitted the Holland design was accepted and formed the basis of the designs for the "Plunger," the "Holland" and the six vessels of the "Adder" Class. The latter were single screw boats, 63 ft. long, 104 tons surface displacement and were driven on the surface by petrol engines, giving a speed of about 8½ knots. When submerged, an electric motor supplied from accumulators was used, giving a speed of seven knots. They were armed with one bow torpedo tube and carried five torpedoes, and, as in the original Holland design, they were submerged by admitting water into internal ballast tanks and then dived by the aid of horizontal rudders.

Another interesting type was the "Narval" design by M. Laubeuf and constructed in 1899. She was 112 ft. long, 12 ft. 4 in. beam, displaced 104 tons, and had a surface speed of 11 knots and eight knots submerged. The machinery was a triple expansion steam engine, obtaining steam from a water tube boiler burning petroleum. This formed the motive power for surface propulsion and also the power for driving the dynamo for recharging the accumulators, which furnished the power in the submerged condition. The vessel had a double hull and was submerged by admitting water into the space between the inner and outer hulls, control in the horizontal and vertical directions being effected by rudders fitted forward and aft.

Great Britain.—In 1900 five "Holland" type boats were ordered for the British Navy, which were practically identical with the boats of the American "Adder" class previously mentioned. After experience with these, 13 boats of an improved design were laid down in 1902 and known as the "A" class, followed by 11 boats of the "B" class, completed between 1905 and 1906, and then 38 of the "C" class, completed between 1906–10. All these boats were armed with two torpedo tubes, and all except the A.13 were driven by petrol engines on the surface and electric motors when submerged. The A.13 was fitted with heavy oil engines for surface propulsion.

In 1907, the first of a larger and improved type, known as the "D" class, was laid down, particulars of which were as follows: length 162 ft., breadth 20 ft. 6 in., draft 11 ft., surface displacement 500 tons, submerged displacement 620 tons; horsepower on the surface 1,200 H.P., submerged 500; speeds 14½ to 15 knots on the surface and nine to 10 knots when submerged. This "D" class immediately preceded a somewhat similar type of vessel, which formed a very large proportion of the number of submarines in the British War flotillas.

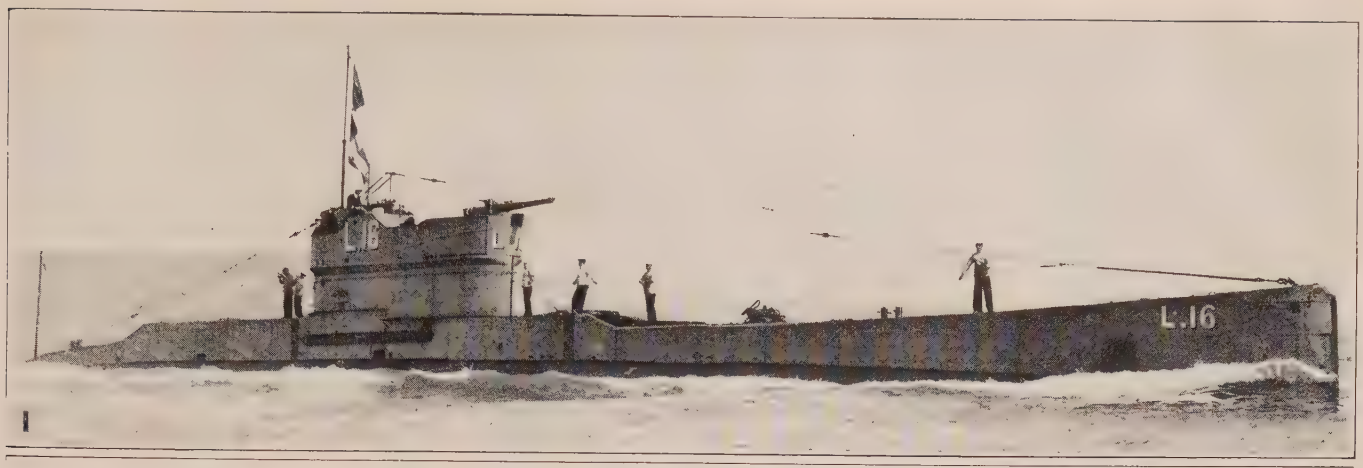
In these vessels a more radical departure from the parent Holland type was made than in the "A," "B" and "C" classes, main ballast tanks being introduced on the outside of the main circular pressure hull. The hull shape was modified by the adoption of twin screws driven by vertical four-cycle Diesel engines instead of the single screw driven by horizontal petrol engines in the previous boats, the disposition of the twin bow torpedo tubes vertically instead of horizontally, and the provision of a stern torpedo tube. These departures from the previous type were made with the objects of increasing the endurance of the boats at sea and of eliminating the risks attending the use of petrol. The external tanks enabled the reserve of buoyancy to be increased, thus rendering the boats less liable to founder suddenly in case of collision or similar accident, and making them more habitable at sea.

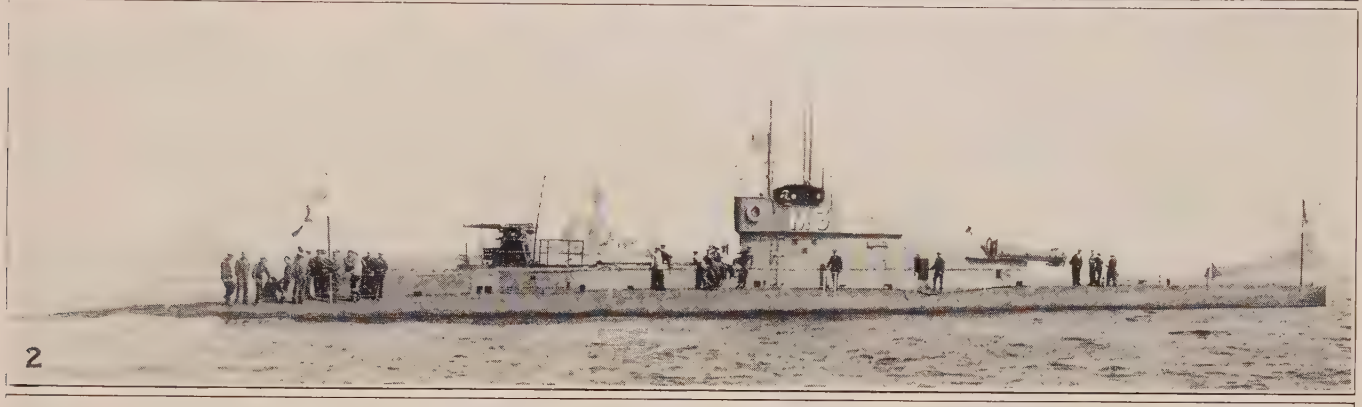
A 12-pdr., on a mounting which was housed inside the superstructure and operated by compressed air so as to pass rapidly from the firing to the housing position, was installed in "D4" and was the first instance of the mounting of artillery on a submarine. Up to this time the British submarines only had torpedo tubes forward and aft, but a demand arose in the fleet for broadside tubes, and to meet this demand the "E" class was designed for the 1910–1 programme. The provision of the two broadside tubes in the "E" class was the chief cause of the difference in dimensions between this class and the "D's," but of course this increased size had its natural concomitant in increased power, speed, habitability and endurance. In the first "E's," one bow tube only was fitted, owing to reports against these tubes having been received, but in the later "E's" of the 1911–2 programme the two bow tubes were again fitted. This class also was the first to have the main hull sub-divided by transverse bulkheads, thus increasing the safety of the boats in case of accident, and also increasing the strength of the hull against external pressure.

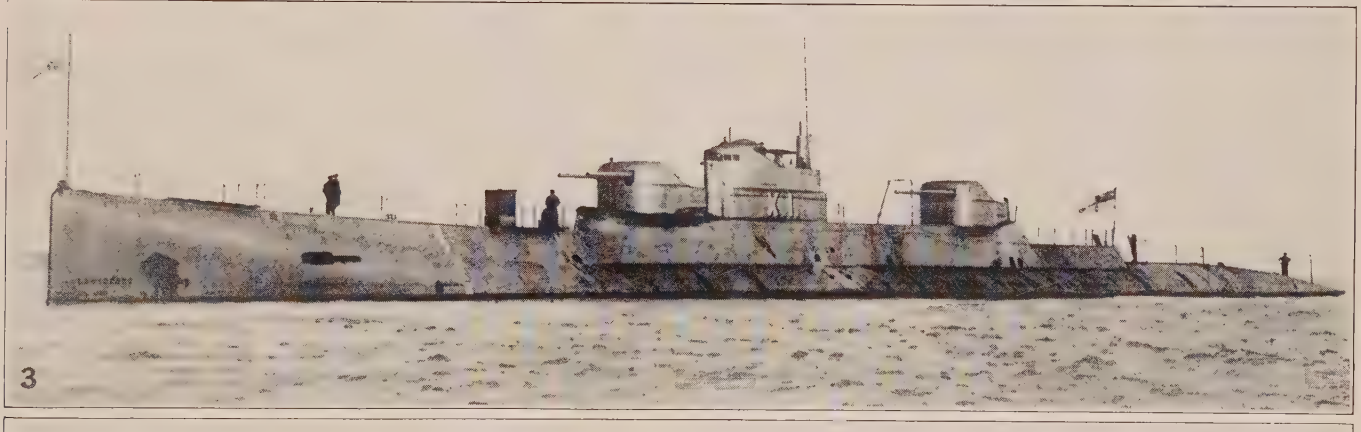
These vessels proved themselves a very suitable and reliable type in many ways. Two of them, A.E.1 and A.E.2, proceeded under their own power to Australia and took up duties with the Australian navy. One of them had over 30,000 m. to her credit before it was necessary to refit the propelling machinery. As seagoing boats they were a distinct step in advance of previous classes. The extensive superstructure, combined with the navigating bridge built over the conning tower, made them easy to navigate in even the roughest weather. This advantage is the more appreciated when it is understood that only in the finest weather could a "B" or "C" class boat cruise on the surface with open hatches. The overall length of the "E's" was 181 ft., beam 22 ft. 7 in. over the side tanks, and the displacement when submerged was 780 tons. The torpedoes carried were 18 in. in diameter, and a spare torpedo was carried for each tube, making eight torpedoes in all for the original "E's" and 10 for the later boats. A 12-pdr. gun was also carried.

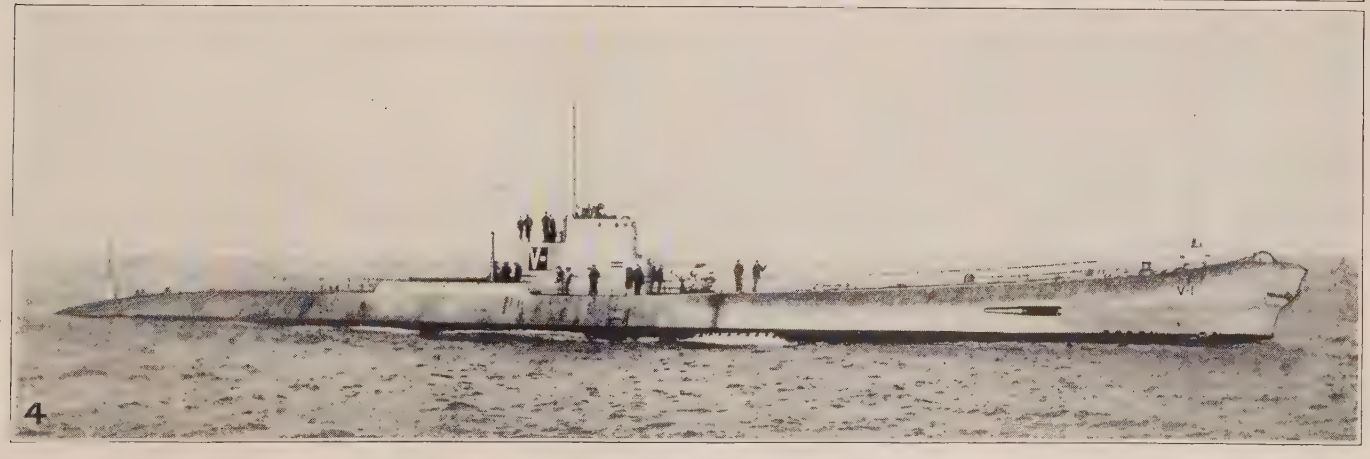
The endurance at a cruising speed of 10 knots was 2,650 naut. m. on 45 tons of oil. A surface speed of 15 knots was obtained, the power being provided by two Vickers heavy oil engines, each of 800 brake horsepower. The motors for use when submerged each developed 420 b.h.p., giving a speed of 10 knots. The power for the motors was provided by two separate batteries, each of 112 cells. Air storage was provided by 57 bottles stowed about the ship, the bottles being charged by high pressure air compressors. To equip these boats for more effective scouting and patrol work a wireless installation was fitted, the aerial being carried on folding masts. In addition, a set of under-water signalling gear was fitted. Two periscopes were carried, one being a simple single power instrument, the other being arranged for use with varying powers and also for use as a "sky searcher" for detecting aircraft.

Another type of submarine with a complete double hull was developed by Messrs. Vickers, and four of these boats were ordered and called the "V" class. These were 147 ft. 6 in. over all, beam of outer hull 16 ft. 3 in., and submerged displacement 460 tons. The speeds were 13 knots on the surface and 8½ knots when submerged, the armament consisting of two 18-in. bow tubes. The "G" class followed upon the Vickers design and was









TYPES OF MODERN SUBMARINES

FIG. 1. H.M. Submarine L. 16. (Great Britain). FIG. 2. H.M. Submarine M. 3. (Great Britain). FIG. 3. H.M. Submarine X. 1. (Great Britain). FIG. 4. Fleet Submarine V. 1. (United States).

(Figs. 1, 2 and 3. Photographs by Abrahams & Sons, Devonport. Fig. 4. Courtesy of U.S. Navy Dept.)

of increased dimensions and displacement, being 187 ft. long, 22 ft. 8 in. beam and a submerged displacement of 970 tons. The " G's " dimensions followed the single hull " E " class very closely but with increased displacement, consequent on the provision of the double hull. Their full surface speed was 14–15 knots, obtained by twin heavy oil engines, each of 800 brake horsepower. Submerged, the speed was 10 knots with 2 motors each of 420 brake horsepower. The armament was two bow and two broadside 18-in. torpedo tubes and one stern 21-in. tube, with, in addition, two guns mounted on the superstructure, one being a disappearing 3-in. " Q.F." type and the other a 2-pdr. " H.A."

The Submarine During the War

World War Construction and Types.—In the early months of the World War a large number of " E " boats were ordered, in addition to some to the design of the Electric Boat Co. of America. The first batch of these latter, known as the " H " class, were built at Messrs. Vickers' Canadian establishment at Montreal, and later, more were built by Messrs. Vickers at their home works to a slightly modified design to enable them to carry a heavier armament. These were 171 ft. 9 in. long, 15 ft. 9 in. beam, and of 510 tons submerged displacement. The speeds were 13 knots on the surface and 10 submerged. The chief feature in this class was the very powerful torpedo armament carried in relation to their size, four 21-in. torpedo tubes being arranged in the bows and six torpedoes carried.

Another interesting type of submarine was the " J " class, the first of which were ordered at the beginning of 1915. These were the fastest internal combustion engined boats in the world, since they obtained a speed on the surface of over 19 knots. They were of the double hull type, 275 ft. long, 23 ft. beam and 14 ft. draught, displacing on the surface 1,210 tons, and when submerged 1,820 tons. For surface propulsion three sets of oil engines were fitted, giving 3,600 S.H.P. The horsepower for submerged propulsion was 1,350. Four bow and two broadside tubes were fitted for firing 18-in. torpedoes, and in addition one 3-in. or 4-in. H.A. gun was mounted.

As the submarine requirements during the World War of the main fleet increased, it became necessary to have a type which, whilst still retaining the ordinary functions of the submarine, could yet maintain station with the fleet when cruising. This involved a higher speed on the surface than the " J " class, and the necessary requirements were embodied in the design of the " K " class. These vessels had a submerged displacement of 2,560 tons and a surface displacement of 1,880 tons. They are 338 ft. long overall with a beam of 26 ft. 6 inches.

The double hull principle is embodied in a modified form, the ends of the boat, which might be damaged without endangering its immediate safety, having only a single hull at the sides. The speed was 24 knots, the power being obtained from twin sets of geared steam turbines developing a S.H.P. of 10,500, the steam being obtained from two Yarrow boilers. The funnels were arranged to hinge down when preparing to dive, and water-tight hatches covered the funnel openings as the latter hinged back. The turbine machinery was supplemented by an 800 B.H.P. heavy oil engine, coupled up to a dynamo. This arrangement enabled the turbines to be reserved for higher speeds only, whilst the dynamo, in addition to charging the batteries, supplied the main motors with power for cruising at economical speeds. Submerged, the speed of these vessels was nine knots.

The turbines are installed in a separate compartment, water-tight bulkheads being provided at the forward and aft ends of the compartment, with two doors in the former, one for access to the boiler room and one to the main passageway to the fore part of the vessel, and one in the latter for access to the motor room. The boiler room contained, in addition to the boilers, feed and oil pumps, heaters and filters, and forced draft fans, the latter driven by impulse steam turbines. The hinged funnels are lowered and the opening closed simultaneously by means of an electric or hydraulic motor and similar covers for the boiler room air vents are also hydraulically operated.

Additional protection for the navigating officer and quartermaster was provided in the form of a deck house built over and around the ordinary conning tower. The periscope fittings were the longest fitted up to that time, being 30 ft. from eye-piece to head-piece. Another important accessory was the long-distance wireless installation, the aerials being carried on telescopic masts, enabling the commanding officer to keep in touch with his base when operating a very great distance from it. A telemotor system was installed for raising the periscopes and telescopic masts, and also for working the ballast tank vent valves, and the introduction of this hydraulic power for such operations made such large submarines a practical proposition. The armament of this class was four bow and four broadside 18-in. tubes, with a spare torpedo for each tube, and in addition three guns, two 4-in. and one 3-in., for high angle work. These vessels were self-contained units of the fleet and did not rely on a parent ship as in the case of the " E " and other classes.

Further Developments.—As the War progressed it became necessary to add more submarines to the fleet, and the first of the " L " class, the design of which was based on the very successful " E's," was ordered towards the end of 1917. These combined the best qualities of the previous boats with an increased speed over that of the " E " class. (See Plate, fig. 1.)

The circular single hull was used with the side ballast tanks as in the " E " class, and in the first design for these boats the stern was wedge shaped, as in the " E " and " H " boats, but a second design had an improved duck stern, like the " J " and " K " classes. The length extreme is 231 ft., the beam near the side tanks 23 ft. 6 in., and the total submerged displacement 1,070 tons, with a surface displacement of 890 tons; 12-cylinder oil engines, developing a total B.H.P. of 2,400, gave, with twin-screws, a speed of 17½ knots on the surface, and the submerged speed, with a total B.H.P. of 1,600, was 10½ knots. The torpedo equipment in this class consisted of four 18-in. or 21-in. tubes in the bow and two 18-in. in the broadside room, with a spare torpedo for each tube. A 4-in. gun was mounted on the superstructure just forward of the bridge and conning tower. A novel feature was the night periscope fitted, which enabled the crew to keep a more effective watch at night.

The " M " Type.—Another outstanding type of boat was the " M " class, which were really submarine monitors built to carry a 12-in. gun. They were of the double hulled type, 296 ft. long, 24 ft. 6 in. beam, and with a draught of 15 ft. 9 in. had a displacement on the surface of 1,600 tons, becoming 1,950 tons when submerged. The speeds were 16 knots and 9½ knots on the surface and submerged respectively, the horsepower of the machinery being as in the " L " class boats. In addition to the 12-in. gun a 3-in. H. A. gun was carried, and the torpedo armament consisted of four 18-in. bow tubes. Only three of these boats were completed, the last being delivered from Messrs. Armstrong's, the builders, in Oct. 1920. (See Plate, fig. 2.)

The " R " Class.—The " R " class, ordered late in 1917, were small vessels of single hull type, as the original Holland boats, built as a " submarine destroyer of submarines " or " contre-submarine type." Their outstanding feature was that, unlike all other submarines in the world, they were faster below the water than on the surface. The speed submerged was 15 knots with 1,200 H.P., and that on the surface was 9½ knots with 240 H.P., the armament consisting of six 18-in. bow tubes. These boats were intended to submerge and chase the German U boats and use their six bow tubes by salvo in order to destroy them. Only two of these vessels were in the service in 1926.

Minelayers.—Another type developed under the stress of World War requirements was the minelaying submarine, and several of the " E " and " L " classes were equipped for this service. The mines were loaded into vertical tubes, which passed through the external tanks, and mechanical gear was fitted for locking the mines in position and releasing them when required.

Performances.—The K26, a boat built to an improved " K " design, completed in 1923, undertook a world voyage in 1924. She left Portsmouth on Jan. 2 1924 for Gibraltar and Malta, arriving on Jan. 14. After the fitting of special ventilating

TABLE I.

	Completed	Launched	Length	Breadth	Draught	Displacement		Speed		Horsepower		Armament
						Surf.	Sub.	Surf.	Sub.	Surf.	Sub.	
			ft. in.	ft. in.	ft. in.	tons	tons	kts.	kts.			
British Empire	1910	1911	162 0	20 6	11 0	500	620	14½	10	1,200	550	3 18-in. T.T.
France	1910	1911	166 6	16 4	10 5	402	496	12	8	700	440	1 18-in. T.T., 5 18-in. in external frames.
	1909	1909	199 10	18 6	13 7	570	797	15	10	1,700	..	1 18-in. T.T., 6 18-in. in external frames.
Germany	1910	1910	180 0	18 6	11 0	400	550	13	9	1000	600	4 17·7-in. T.T.
Italy	1911	1911	148 0	13 9	9 9	249	295	13	8½	600	400	2 18-in. T.T.
Japan	1911	1911	134 10	13 8	..	280	314	13	8	600	400	2 18-in. T.T.
United States	1910	1910	140 0	14 0	..	278	340	13	9	600	400	4 18-in. T. T.

arrangements, she continued her passage through the Red Sea and thence to Colombo and Singapore, at which places she arrived respectively on April 29 and May 14. Leaving Singapore on June 10, she arrived in England at Portsmouth on Aug. 26. At the time of this cruise the K26 was the largest and heaviest submarine in service in any navy. Since then, however, further developments have been made in large submarine design, the X7 holding pride of place as the largest submarine in the world in 1926, her dimensions being as follows:—

Length 350 ft., beam 29 ft., 10 in., draught 17 ft., surface displacement 2,525 tons, submerged displacement 3,600 tons. The cost of this vessel, excluding the armament, is estimated at about £950,000.

The original British Holland boats particulars were as follows: Length 63 ft., beam 11½ ft., surface displacement 104 tons, submerged displacement 120 tons.

France.—In the early stages of the submarine, France displayed greater originality, due to the fact that in that country there was a strong school of thought which even then considered that the vessel would drive surface war vessels from the

TABLE II.

Type and Class	Length	Breadth	Draught	Displacement		Speed		Horsepower		Armament	Crew
				Surf.	Sub.	Surf.	Sub.	Surf.	Sub.		
	ft.	ft.	ft.	tons	tons	kts.	kts.				
Ordinary U Type											
Class U86	230	20⅝	13⅙	800	940	16½	8	2,400	1,180	2 bow T.T.'s, 2 stern T.T.'s, 1 4·1-in. gun, 1 3·5-in. gun.	..
Class U161	235	21 1/12	12¾	828	1,018	15½	8	2,400	1,160	4 bow T.T.'s, 2 stern T.T.'s, 2 4·1-in. guns.	..
UA Cruiser or UK type											
Class U135	275½	25	14½	1,190	1,560	16	7	main 3,500, aux. 900	1,940	4 bow T.T.'s, 2 stern T.T.'s, 1 5·9-in. gun, 1 3·5-in. gun.	46
Class U139	302⅔	29½	15 1/12	1,950	2,500	15·8	7·4	main 3,500, aux. 450	1,760	4 bow T.T.'s, 2 stern T.T.'s, 2 5·9-in. guns	..
Class U142	320	31½	17 1/12	2,160	2,760	18	8	main 6,000, aux. 550	2,600	4 bow T.T.'s, 2 stern T.T.'s, 2 5·9-in. guns.	83
UB or Coastal Type											
Class UB1–17	92	10¼	10	128	143	6½	5½	60	120	2 bow T.T.'s (17·7-inch).	14
Class UB18–47	118½	14¼	12⅙	275	304	9	5·8	282	280	2 bow T.T.'s (19·7-in.), 1 mach. gun, 1 2-in. or 3·5-in. gun.	23
Class UB48–136	181½	19⅓	12	521	657	13½	7½	1,100	760	4 bow T.T.'s, 1 stern T.T. (19·7-in.), 1 mach. gun, 1 3·5-in. or 4·1-in. gun.	34
UC or Small Minelayer Type											
Class UC1–15	111½	10⅓	10	170	185	6½	5	90	138	12 mines, 1 mach. gun	16
Class UC16–79	170	17 1/10	12	417	509	11–12	7	500–600	460	18 mines, 2 bow T.T.'s, 1 stern T.T., 1 mach. and 1 3·5-in. gun.	28
Class UC90–120	184	18⅕	12	496	575	11–12	6½	600–650	600	14 mines, 2 amid. T. T.'s, 1 stern T.T., 1 mach. and 1 4·1-in. gun.	32
UE or Large Minelayer Type											
Class U71–80	186	19⅝	15 1/12	762	846	10·6	8	800–900	800	36 mines, 1 for'd and 1 aft T.T. in superstructure, 1 mach. and 1 3·5-in. gun.	32
Class U117–126	267 5/12	24	13⅝	1,170	1,515	14¾	7½	2,400	1,150	42 mines, 4 bow T.T.'s, 1 mach., 1 5·9 or 2 4·1-in. guns.	45
Deutschland Type	214	29⅝	15	1,525	1,885	10	5½	800	800	2 bow T.T.'s, 2 5·9-in. guns.	..

TABLE III.

	Launched	Length	Breadth	Draught	Displacement		Speed		Horsepower		Armament
					Surf.	Sub.	Surf.	Sub.	Surf.	Sub.	
		ft. in.	ft. in.	ft. in.	tons	tons	kts.	kts.			
Great Britain	1923	350 0	29 10	17 0	2,780	3,600	..	..	..	..	Reported as 6 T.T.'s and 4 4-in. guns.
	Bldg.	..	..	..	1,480	1,750	..	..	..	..	..
France	Bldg.	..	..	..	1,360	..	18	10	..	..	10 T.T.'s and 1 3·9-in. gun.
	(1924–5)	256 6	21 6	15 0	1,130	1,415	16	10	2,900	1,800	10 T.T.'s and 1 3·9-in. gun.
	Bldg.	216 6	16 0	11 6	590	758	14	9½	1,250	1,000	7 T.T.'s and 1 3·9-in. gun.
Italy	Bldg.	282 3	24 7	14 1	1,300	1,600	18	10	...	..	6 T.T.'s (21-in.) and 1 4·7-in. gun.
	Bldg.	223 0	18 8	13 9	805	950	17½	9	..	..	6 T.T.'s (21-in.) and 1 4-in. gun.
Japan	Bldg.	..	..	..	1,500	2,000	20	10	5,200	..	6 T.T.'s.
	1923	..	..	..	1,050	1,500	..	..	..	..	6 T.T.'s.
	1923	..	..	..	770	1,000	..	..	..	..	..
United States	1924	341 6	27 6	15 6	2,164	2,520	21	10	6,500	..	6 T.T.'s (21-in.), 1 5-in. and 1 3-in. A.A. guns.
	1923	240 0	21 9	13 6	990	1,230	14½	11	1,800	1,500	5 T.T.'s (21-in.) and 1 4-in. gun.

For further information *see* BATTLESHIP; NAVY, etc.

seas. In 1910, the "Gifford," the last of the famous "Pluviose" type of submersible, was launched, the "Pluviose" having been launched in 1907. There were in all 34 boats of this class built, the earlier vessels being steam propelled and the later by Diesel engines. This type was designed by M. Laubeuf and was of particular interest, since the original German U-boats were copied from the Laubeuf design and clearly showed their parentage even in their latest stage of development. The development reached as regards vessels launched or completed about this time is shown in Table I.

From this stage onwards the development of the vessels of all nations followed similar lines to that of the British boats already described, the desire for heavier armaments, greater endurance and improved seagoing powers leading to larger dimensions with the concomitant increase in displacement and horsepower of machinery, and this normal process of evolution continued until the beginning of the World War in 1914.

Germany.—The next most important naval Power during the World War was Germany, who made her supreme effort on the sea with the submarine. There were at least seven distinct types laid down during the War period by the Germans, each type being divided into various classes. The modifications to the parent type producing these classes were brought about by War experience. The types were as follows:—

1. The ordinary U-boat, 2. the UA cruiser or UK type, 3. the UB or coastal type, 4. the UC or small minelayer type, 5. the UE or larger minelayer type, 6. the UF or Flanders coast defence type, and, 7. the converted Deutschland type.

The particulars of these various types and the subdivision into classes are shown in Table II.

Of the UF or Flanders coast defence type about 80 were ordered, but none were ever completed, and it is possible that the bottling up of Zeebruge and other ports by the British navy rendered the boats useless for their intended purpose and caused their construction to be stopped. They were generally similar in design to the medium UB type shown in the preceding table. The boats of the Deutschland type are of especial interest, since they were originally designed as submarine mercantile vessels. Further details of these German submarines are given in a paper read by Mr. A. W. Johns before the Institution of Naval Architects, London, in March 1920, and of the profile and sectional views of types of U-boats (see figs. 1a and 1b) are reproduced by permission from that paper.

Washington Conference.—The construction of submarines was considered, together with that of other war vessels, by the Washington Conference in 1922, and it was proposed on behalf of Great Britain that submarines should be abolished by all nations. Lord Lee, the then First Lord of the Admiralty, contended that the submarine could not be regarded as a defensive weapon because the War had shown it was unable to disturb large groups of naval units, it was impotent against a big naval attack, could not stop the transport of large masses of troops and, finally, was suitable only as a weapon of offence against merchantmen. Almost all the other Powers, however, were in favour of the retention of the submarine and the proposal was consequently not adopted.

After the Conference, therefore, it was only natural that the nations should turn again to the consideration of submarine construction, and the trend of design (see Plate, fig. 4) is shown by Table III. of the vessels launched or laid down since 1923.

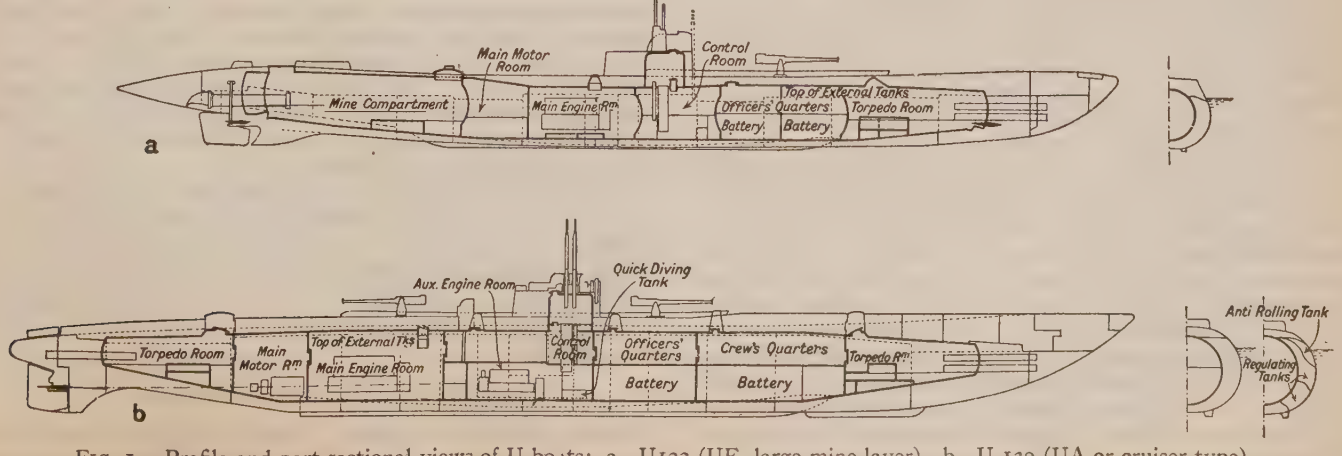


FIG. 1.—Profile and part-sectional views of U-boats: a. U122 (UE, large mine-layer). b. U 139 (UA or cruiser type).

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SUBMARINE CAMPAIGNS.—The submarine was a new weapon of as yet unknown capabilities in Aug. 1914 when the World War broke out. The British had some 56 submarines of varying ages, the 18 newest boats of the D and E classes being grouped in the 7th Flotilla and based on Harwich. In charge of the whole submarine service was Commodore Roger Keyes who also took an active part in their operations. The 7th Flotilla was used throughout the War mainly in keeping a more or less continuous watch on the mouths of the German rivers and in other places where German warships might be expected. The A and B classes were fit only for coast defence. The C class which could keep the sea for a few days guarded the Forth, the Thames and the Straits of Dover.

Germany, in Aug. 1914, had 28 submarines of which the first batch, U1 to U18, had an unsatisfactory type of engine and could be relied on only for short voyages or for guard duties near home. U19 to U28 were able to make longer journeys, but to what extent was as yet unknown either to Germany or to England.

I. THE OPENING PHASE

Both belligerents, at the outset, had the same ideas as to the method of employment of a submarine in War; it was to be used for attacking warships. It carried no guns since it could not use them without coming to the surface to fire; and its only armament consisted of torpedoes to be discharged when the boat was submerged.

Campaign of 1914.—It was expected by the German Naval Authorities that, on the declaration of War, the British Navy would immediately appear in Heligoland Bight to make an attack in force; the submarines were therefore sent to defence stations to meet the impending attack. When, after two days, no British ships appeared, the German command determined to attempt to locate them and 10 U-boats proceeded to the North Sea on Aug. 6, sweeping in line abreast. This was the first time so many submarines had acted as a squadron, and much was hoped from the operation; but only 8 boats came back, and they had little to report. One boat, U15, had seen some of our cruisers, only to be cut in half by the "Birmingham." Of the fate of the other lost boat, U13, nothing definite is known. The reconnaissance had proved too costly; a squadronal attack by submarines was not repeated, and thenceforth the U-boats operated singly. Further attempts were made throughout Aug. to find the British main fleet; when these also failed, the German command definitely decided to abandon submarine operations against the Grand Fleet, and use the boats in attacking smaller men-of-war than capital ships. The first submarine success of the War was achieved by Hersing, who in U21 on Sept. 5 sank the light cruiser "Pathfinder" off St. Abbs Head. A week later Horton in E9 sank the light cruiser "Hela" in Heligoland Bight, with the result that the High Sea Fleet abandoned the Bight as an exercising ground. The most resounding event of the campaign of 1914 was the sinking of the "Aboukir," "Hogue" and "Cressy" with over 1,200 men on Sept. 22 by Weddigen in U9. Though the feat was an easy one, for the ships conveniently stopped to lower boats and waited to be torpedoed, its effect was to raise the submarine in the estimation of both belligerents from a difficult and dangerous toy to a formidable weapon. Imaginative lookouts saw submarines everywhere and after a credible report that periscopes had been seen in Scapa Flow, the Grand Fleet withdrew from there on Oct. 16 till the Flow could be made secure by submarine-proof net-booms.

In actual fact, no U-boat had yet been near Scapa. It was in southern waters, in an attempt to hamper the transport of our troops to France, that the German effort had been directed. An attack on the Dover patrol on Sept. 27 decided the Admiralty to prevent entrance into the Straits of Dover by a minefield. This was laid early on Oct. 3, the public announcement of its limits being made to the press the evening before. Possibly the Germans regarded the minefield as existing only on paper; their submarines continued to enter the Channel by the Straits. U20 left on Oct. 10 to attack the large convoy of Canadian troops expected at Southampton. She was sighted and hunted by the Dover Patrol, and returned to Germany by the northabout route, being thus the first submarine to circumnavigate the British Isles. U17, returning from a cruise, stopped the British merchant ship "Glitra" off Stavanger and sank her. This was the first merchant ship to be sunk by a submarine.

Before the year ended Wegener in U27 sank a seaplane carrier off the Belgian coast and Forstmann in U12 penetrated into the Downs and torpedoed the guardship "Niger" in the middle of all the shipping congregated there. Of our own submarines E3 was torpedoed by Wegener off the Ems; the other E-boats had had little success though Horton succeeded in sinking a German destroyer on Oct. 6. A bold attempt was made by 5 U-boats to locate the Grand Fleet; one of them on Oct. 24 entered Scapa Flow, once more the Grand Fleet base, but at the time the battle fleet happened to be out exercising. One of these 5 U-boats, U18, was hunted by small craft till she crashed on to the Orkney rocks and sank. Once more the submarines returned without precise information of our capital ships, and the stream of transports passing to France became as before the chief objective. Schneider in U24 torpedoed a crowded steamer off Cape Gris Nez, assuming that the passengers were soldiers; but they were Belgian refugees, women and children, and the crime gave a shock to the civilised world. Hersing in U21 destroyed two vessels bound for Havre, though neither was carrying any goods consigned to military authorities. The leisurely nature of his proceedings in stopping the vessels gave plausibility to the current idea that a merchant ship with hidden guns would have a good chance of destroying a submarine; and on Nov. 26 the Admiralty gave orders for one to be so fitted, the railway steamer "Victoria," which left for her first trip three days later. She was the first of the long and honourable line of the so-called "Q" ships. Hersing's operations off Havre led to the institution of two measures which rendered the troops for France more safe; from that time on they were allowed to cross only at night in fast ships and these were always escorted by destroyers. On New Year's Day the old battleship "Formidable" was sunk by Schneider. This first campaign extended to the end of Jan. 1915. At the end of that month Hersing appeared off Barrow-in-Furness, fired a few shots at an airship shed after having been watched for half an hour by the battery commander, and then proceeded to Liverpool Bar where he sank by bombs three small steamers. Schwieger in U20 proceeded to the Channel with orders to sink without warning large vessels steering for French ports; he carried out these instructions so thoroughly that three ships approaching Havre disappeared, one, the "Oriole," with no survivor. Schwieger became later one of the most notorious exponents of ruthless submarining.

So far the campaign had been against normal objects of warfare—warships, transports, military works. But its results were insufficient to warrant the supposition that by submarines and minor weapons could Germany ever succeed in reducing the British Navy to an equality with her own. After considerable debate and hesitation she decided to use her submarines against a new objective.

II. THE ATTACK ON COMMERCE

Submarine Blockade Declared.—Early in Jan. Admiral von Pohl, Chief of the German Naval Staff, proposed that submarines

should be used as the agents in a commerce blockade of the British Isles. At first the Kaiser refused to sanction the measure, but he consented after the fight on the Dogger Bank on Jan. 24 had demonstrated the danger of operations by large ships. On Feb. 2 appeared a note warning neutral shipping to avoid the Channel, where German submarines would attack vessels bound for France, regardless of the flag carried. This was followed on Feb. 4 by a wider statement that after Feb. 18 enemy vessels near the British Isles or in the English Channel would be destroyed, and that neutral ships ran grave risks of being treated in the same way, since British ships frequently wore neutral ensigns as a ruse. Scandinavian vessels were advised to go round the Shetlands.

Anti-submarine Measures, Feb. 1915.—Great Britain used the fortnight's respite in preparations to meet the attack. To destroy the German submarines in their own bases was realised as impossible without large armies, and these the military authorities preferred to use on other fields. Beyond the laying of mines in German waters, anti-submarine war was therefore limited to defensive measures. Fifty coasting vessels were provided each with a gun aft. There were already a number of trawlers armed and working as auxiliaries to the east coast destroyer patrol; this "auxiliary patrol" was now increased to over 500 vessels and distributed round the coast to operate from various bases. Trawlers and destroyers in many cases were already fitted to tow an explosive charge with which to attack a submerged submarine; but what was felt to be the most hopeful weapon was the "indicator" net, of 6-ft. mesh in large detachable sections each trailing a buoy which should flame at night. These nets were shot from drifters, each of which could manage a mile of them. Arrangements were made for indicator net lines to be maintained in various places, particularly in the North Channel between Ireland and Scotland, across the southern exit of the Irish Sea, and, most urgent of all, across the Straits of Dover. So important was this last that Rear-Admiral Hood, commanding at Dover, was instructed that the barring of the Straits was his principal duty.

Campaign in Home Waters, 1915.—To carry out the ambitious project of stopping the imports of Great Britain, Germany had only 18 submarines capable of long voyages, the highest numbered boat being U35. But over 160 of various types were building or on order. The first boat to proceed for the new campaign was U16 (Hansen), which left Germany on Feb. 9 for the Channel with orders that up to Feb. 15 only ships about to enter French ports were to be destroyed without warning; after that he should sink any vessel which might seem to be British, regardless of the ensign she wore. On the way to Dover Strait, Hansen gave chase to the steamer "Laertes" (Capt. W. H. Propert), who, though his vessel was unarmed, refused to surrender in spite of machine-gun fire, and eventually tired out his pursuer. In the Channel, Hansen torpedoed a British collier without warning, sank a French collier by bombs after surrender, and returning on the 19th torpedoed without showing himself the Norwegian tanker "Belridge," the first neutral to feel the sting of Germany's new campaign. His place on the transport route to France was to be taken by U6, but that boat was rammed off Beachy Head by the steamer "Thordis" (Capt. J. W. Bell), and had to return for repairs.

During the first week of the campaign, Feb. 18 to 25, U30 sank two vessels off Liverpool and U8 torpedoed without warning 5 off Beachy Head. Observing that such landmarks as this were places where shipping naturally converged the Admiralty now insisted that ships should avoid all prominent headlands and keep in mid-channel; and in the hope of rendering Dover impassable obtained on March 1 Treasury sanction for the building of a fixed boom of nets from Folkestone to Gris Nez. This proved a formidable and indeed hopeless undertaking; and throughout this campaign the destroyer patrols and the drifting nets were the only obstacles to the passage of submarines.

The Base at Zeebrugge.—U8 had come from Zeebrugge. As soon as the Germans captured the Belgian coast they established a Naval Corps there under an Admiral. He repeatedly urged the favourable situation of Zeebrugge as a base for submarine operations in the Channel, but had to be content with occasional visits of U-boats, until the special types of small UB- and UC-boats should be ready. One objection was that Zeebrugge was specially liable to air attack; U14, ready to start for attack on the transports, was damaged by aeroplane bombs and on Feb. 14 returned to Germany for repairs.

Submarines continued to pass Dover Strait and sink vessels in the Channel and on the west coast. On March 4 the net and destroyer patrols succeeded in sinking U8, whose crew surrendered. The Admiralty refused to accept as lawful the German method of sinking ships without warning and detained these men for trial, a measure that produced such violent reprisals in Germany that they were eventually treated as ordinary prisoners of war. Weddigen in U29 after sinking 6 vessels, one a defensively armed ship, was himself rammed on March 14 by the battleship "Dreadnought" and drowned with all his crew. Four days earlier U12 was rammed by the destroyer "Ariel" and surrendered. A third loss at this time caused special uneasiness in Germany. U37, a new boat, operating in the Channel, disappeared without a trace. Other boats had reported nets, mines and various obstructions in the Straits; and it seemed too dangerous to allow the scanty force of U-boats to run unnecessary risks. On April 10, although the Army Command was pressing for more intensive attack on the transports of the B.E.F., High Sea Fleet submarines were ordered to make their passage to and from the Channel only by the north of Scotland. Thus the Dover net had proved effective; but by the irony of fate, it was on that very date that Admiral Hood hauled down his flag at Dover to be superseded by Admiral Bacon. Henceforward U-boats found it so difficult to approach the transports route that they ceased to enter deep into the Channel.

The UB-boats.—Attack in that area was left to the little UB-boats. The first 18 of this class built specially to work from Flanders, had a surface speed of only 6½ knots and had as their armament at first merely two torpedoes and a few rifles. Such vessels could manifestly operate only by torpedoing ships without revealing themselves. The first completed was UB10, but the first success fell to UB4 which on April 10 torpedoed the Belgian relief ship "Harpalyce." On the 14th the Dutch "Katwyk" was torpedoed without warning by one of these UB-boats near the North Hinder light vessel. Although nets were moored off the Belgian coast and the patrols were numerous and active, these feeble little UB boats fought the tide rips and navigated amongst the sand banks of the east coast sinking ships and raiding the fishing fleets. On June 21, UB6 passed through the Dover barrage and reconnoitred Boulogne. Thenceforward the Dover patrol could not keep them out.

The UC-boats.—Flanders was also a base for submarine minelayers, known as the UC class, which instead of torpedo tubes carried mine tubes containing mines. The UC-boats, no faster than the UB's and totally unarmed, were intended only as secret minelayers. Their method was to creep at night to some light vessel or buoy and lay their mines close to it. The first to reach Flanders was UC11 which on May 29 started for her maiden cruise to mine the South Goodwin. She fouled an indicator net and was chased till she unknowingly entered a British minefield. Escaping the double peril of net and mine she proceeded to her objective, and laid her field. On her second trip she was caught in another net, from which, however, she disentangled herself without provoking a hunt. The mines laid by the UC-boats being always on the thickly frequented East and South coast routes claimed many victims, regardless of nationality. An account of the Admiralty's method of dealing with the UC mines belongs more to Mine-sweeping (*q.v.*).

Attack in the Western Approaches.—After April 10 U-boats operated only in the North Sea and in the Western Approaches. In the North Sea the attack was chiefly on shipping of the Scandinavian Powers, especially early in May when three of the latest submarines sank between them half a dozen Danish, Norwegian and Swedish steamers, besides fishing vessels. Germany's plan was to keep three U-boats at work in the Western Approaches,

a scheme which employed 9 boats, 3 working, 3 on passage, 3 resting. Only the best boats could reach Southern Ireland, where they found easy prey in the open waters between Ireland and Ushant. It was no part of the German intention to exempt passenger vessels from attack; in their announcement of Feb. 4 such had been specifically mentioned as liable to danger, and several large liners were sunk. The liner "Falaba" was torpedoed, after five minutes warning, by U28, 57 passengers being drowned; and on May 7 Schwieger in U20 torpedoed the "Lusitania" without any warning and drowned 1,198 men, women and children.

The chorus of praise which in Germany greeted this masterpiece of the submarine war had soon to be modulated into a minor key, for among the murdered were citizens of the United States, whose President now protested against Germany's methods. Two American steamers, the "Gulflight" and "Nebraskan" were torpedoed without warning in May; but as they both reached port, the irritation roused in the United States by their cases was swamped by the rising tide of anger over the "Lusitania." So powerful was the feeling that the German political authorities gave way, and on June 5 issued orders that large passenger ships were to be spared unless they made deliberate attempts to injure submarines, a reservation that was to have important consequences. On Aug. 19 Schneider met the White Star liner "Arabic" and assuming that she intended to ram him torpedoed her without warning with the loss of 44 lives. American indignation flamed up anew. To placate it orders went out on Aug. 30 that no liners were to be sunk without due regard to the safety of passengers.

This was followed on Sept. 20 by the total suspension of submarine warfare on the west coast and in the Channel, in effect, the conclusion of the first submarine campaign in Home Waters. In the course of its progress the decoy ship idea had been developed in three forms—a small tramp steamer with concealed armament, a trawler apparently fishing but really towing a submarine and a sailing smack with a hidden gun. None of these types of vessel was worth a torpedo, and the hope was that the enemy would come close either to fire guns or to send a party on board with bombs. The first success fell to the "Prince Charles" (Lt. Mark-Wardlaw), outwardly a slovenly collier, which on July 24 destroyed U36 west of the Orkneys. On the day the "Arabic" was torpedoed, another decoy ship, the "Baralong," sank U27; a month later she sank U41. By the towed submarine decoy U40 was torpedoed on June 23 and U23 on July 20. The armed sailing smack "Inverlyon" (Gunner E. M. Jehan, R.N.) sank UB4 on Aug. 15.

The first submarine campaign against merchant ships resulted in the loss of 166 British steamers and 168 British fishing vessels, the latter a class which by the Hague Convention should have been spared. France, Russia and Belgium had lost 34 ships between them. But the attack was not only on belligerents; it was directed against all the nations of the world. Of the neutrals, Norway, having the largest mercantile marine, had suffered most; 51 Norwegian ships had been sunk by submarines alone. Sweden and Denmark each lost 15, Holland and Spain 2 each. Several of these neutral vessels were torpedoed by UB-boats at night without warning. These losses are exclusive of ships which struck mines; Holland had suffered specially by these.

Spring Campaign of 1916.—During the winter the naval authorities in Germany managed to wring from the political heads permission to torpedo defensively armed vessels without warning, though passenger ships were still to be spared; and in Feb. 1916 the attack began again, many more submarines both of the U and UB classes being now ready. As before, the Southwest approach was its main theatre. In the former campaign U-boats had quickly taken advantage of the Admiralty's orders that ships were to keep away from land and thus incidentally away from protection, since the auxiliary patrol was not then effective more than 40 m. from shore. But now, a new principle was adopted. As soon as a submarine was known to be present in a certain area, all outbound shipping which would pass that area was held in port until it was thought the enemy had gone away, and incoming vessels were directed by wireless to hug the shore where the patrols were thickest. In the southern part of the North Sea the UB-boats secured some neutral victims, notably the large Dutch liner "Tubantia," torpedoed without warning on March 16. They also torpedoed at night several vessels at anchor off British and French ports. Particularly was this the case with Havre, where store ships had frequently to wait for hours before they could be admitted to the congested harbour. As a deterrent to submarine action there the Admiralty sent over a detachment of drifters, whose nets, now studded with mines, succeeded in accounting for UB26 on April 5. A fortnight earlier the Q-ship "Farnborough" (Comm. Gordon Campbell) destroyed U68, off the southwest corner of Ireland.

On March 24 Pustkuchen in UB29 torpedoed the French packet "Sussex," crowded with passengers for Dieppe. After the "Lusitania" correspondence, Germany had promised President Wilson not to molest passenger ships of any nationality and not to torpedo without warning any unarmed vessel. The promise had been disregarded from the beginning; indeed, the first vessel attacked in this second campaign, the "Arbonne," had been torpedoed without warning and without survivor by UB2 on Feb. 21; but the President first took notice of the "Sussex" incident. Thoroughly roused, he sent what was practically an ultimatum demanding the immediate abandonment of Germany's "present methods of submarine warfare against passenger and freight-carrying vessels." The German Govt. surrendered and at the end of April stopped this second campaign.

Between the beginning of Feb. and the end of this spring campaign submarines destroyed 58 British mercantile and fishing vessels and 18 Norwegians; France lost 3 steamers, and several other nations one or two apiece.

Autumn Campaign of 1916.—Throughout the summer of 1916 the U-boats with Adml. Scheer were employed with the fleet, and merchant ships in Home Waters were left alone. In July, however, the Flanders submarines made a serious raid on North Sea fishing vessels, sinking 47 between July 4 and Aug. 6, among them the little "Mary Ann" of 5 tons, the smallest vessel sunk by a submarine. The UB-boats sank a few other vessels, including the "Calypso," torpedoed without warning on July 10, with a loss of 30 lives. In Sept. began a continuous attack on the vessels carrying munitions to Russia; between Sept. 20 and Oct. 16 a total of 13 Norwegian, 4 Russian and 3 British ships were sunk in the Arctic Ocean. In response, four Q-ships and 3 British submarines were sent to operate on the Murman coast but achieved no success, though two German submarines were destroyed by Russian patrols.

In the summer of 1916 the political situation of the Allies was, perhaps, at its lowest ebb throughout the War. Germany's prompt surrender to President Wilson's ultimatum at the end of April diminished the tension across the Atlantic, whereas the Allied blockade was now so effective that it drew from the United States a strong protest. Encouraged, doubtless, by this reversal of the situation Germany decided to renew submarine warfare on commerce, theoretically in accordance with prize law. The attack was at first mainly against Scandinavian shipping by which iron ore amongst other things was brought across the North Sea and coal carried to France and Italy. In Sept. and Oct. Norway lost 5% of her mercantile marine. In the English Channel the UB-boats, now armed with guns of some size, and in the western approaches the large U-boats, did much damage; as a rule they took care to give some warning except in the case of defensively armed vessels, though the destruction of 3 vessels without warning at the end of Oct. caused the drowning of 85 non-combatant seamen. The rate of sinking increased so much that Adml. Jellicoe took the unusual step of writing direct to the Prime Minister drawing his attention to the fact that the loss of shipping alone might soon cause the Allies to conclude peace. As a result of the conference which followed he was appointed First Sea Lord to carry into effect the various proposals he made for dealing with submarines. By that time the tension between the United States and Germany had been increased by the appearance

of U53, Lt.-Comm. Rose, off Nantucket on Oct. 7. There within sight of land Lt.-Comm. Rose sank 5 ships, 3 British, 1 Dutch and 1 Norwegian. His voyage out and back occupied 42 days. No other commerce-destroying submarine visited America in 1916; perhaps the emotions stirred by Rose were not quite what was intended.

In face of the severe attack on their ships, Norwegian owners were inclined to keep the remainder in port; and since British munition works and the continuance of the War by France depended on the cargoes they carried, the position was serious. Attempts were made to maintain a patrolled lane across the North Sea, but between Sept. 1916 and Jan. 1917 inclusive, 170 Norwegian, 29 Swedish and 50 Danish ships were destroyed by German submarines, as against 86 British sunk in Home Waters in the same period.

One of the problems to be solved was to find some efficient method of damaging a submarine when it was submerged. The explosive charge towed by a patrol vessel soon proved to be nearly useless, since it could easily be avoided; and experiments were made with bombs which could be dropped or thrown overboard. By the middle of 1916 had been evolved the " depth charge," a large bomb which exploded at either 40 or 80 ft. below the surface, according as set. Depth charges were heavy things and had to be heaved over on to the submarine; they could, therefore, be used only at very close quarters. Much was hoped from them; but it was soon apparent that unless the bomb exploded within 30 ft. or so of the submarine, it did not damage it sufficiently to bring the boat to the surface either on account of the dislocation of its machinery or to allow the crew to escape. It was not till the following year that the depth charge, fired from a sort of howitzer, became a really formidable weapon in the hands of the anti-submarine forces, which in the autumn campaign had mainly to rely on the ram, the towed charge, the net, the mine and the gun. These effected the destruction of only three or four U-boats between Sept. 1915 and Jan. 1917.

At the end of Nov. 1916 a success fell to the Q-ship " Penshurst " under Comm. F. H. Grenfell, R.N., which gives an excellent illustration of the work of a decoy ship. The " Penshurst " had been cruising for a year and never met a submarine till Nov. 29 1916, when she was fired on by one near the Lizard. The circumstances of light and range were unfavourable to the " Penshurst " and she had to reveal her armament without making sure of her quarry, which submerged and escaped. Realising that the character of his ship was now revealed, and that no submarine would approach him on the surface, Grenfell returned to harbour. In the course of the night he had his ship painted in a different way and altered the appearance of her masts, so that when the " Penshurst " sailed next morning the submarine commander would never suspect her of being the vessel which had opened fire on him from hidden guns. Before long, the " Penshurst " took in a wireless signal reporting a submarine had been sighted near Guernsey.

Grenfell steered in that direction and soon sighted the enemy. But just then a seaplane flew over and dropped a bomb near the submarine, making it submerge. The " Penshurst " carried depth charges as well as guns and Grenfell was about to make arrangements for dropping these when the submarine came to the surface and began to shell the " Penshurst." This was Grenfell's opportunity. He stopped his ship; sent away in boats all his crew but the gunners; and when the submarine approached to finish off the apparently abandoned " Penshurst " he sank her instead with his concealed guns. Thus UB19 met her end. Six weeks later, Grenfell in the " Penshurst " destroyed UB37, after having silently endured a gunfire which killed some of his gun's crew and wrecked his depth-charge dropping gear.

The Mediterranean to Jan. 1917.—In the Mediterranean, as in the North Sea, submarine operations were at first limited to military objectives, though they soon degenerated into commerce warfare. Austria had a dozen or more submarines which she used against warships, the first to suffer being the French " Léon Gambetta," flagship of the Adriatic patrol, sunk on April 27 1915, with the loss of 570 lives. In June the British light cruiser " Dublin " was torpedoed but did not sink. When Italy joined the Allies on May 23 the Italian Navy supplied targets for Austrian submarines and before the end of July two Italian surface men-of-war and an Italian submarine had been sunk by the Austrian U-boats. The result was that the heavy ships of the Italian Navy became almost entirely retained in port.

A more important object for submarine attack was provided by the British and French squadrons operating in 1915 for the capture of the Gallipoli peninsula. At the end of April one of the most efficient German submarine commanders, Hersing in U21, left Germany for Constantinople, a journey of unprecedented length. Arrangements were made to supply him with oil halfway; but when he met his supply steamer he found that she had brought the wrong kind of oil and he decided to go on without it. He gave up the idea of making Constantinople and proceeded instead to Cattaro in the Adriatic, reaching it on May 13 with only half a ton of oil left. A week later he received orders to attack the ships bombarding at the Dardanelles. Before the end of May 1915 he sank the battleships " Triumph " and " Majestic " and entered Constantinople, having dealt the distrusted Dardanelles enterprise a wound from which it never recovered. Germany also sent by train UB- and UC-boats in sections to be erected at Pola; by the autumn U33, U34, U35, U38 and U39, the latest and best U-boats, had arrived at Cattaro, bringing up the German submarine force in the Mediterranean to 5 large U-boats, 4 UB-boats and 4UC-boats. Three of the last class worked from Constantinople, the remainder from the Adriatic against merchant vessels. In Nov. Arnauld de la Perrière was appointed to U35 and, in spite of his French name, proved himself one of the most redoubtable German champions in the war against merchant vessels.

In the Mediterranean the conditions were greatly in favour of the U-boat; the clear air and smooth seas gave the man at the periscope a better chance than his colleague in home waters, peering through the mists and storms of the North Sea and Atlantic; moreover, the immense distance between Gibraltar and Malta, and between Malta and Suez, precluded the possibility of efficient patrol at any but a few points. All the submarine commander had to do was to go out on to the steamer track and pick off the ships one by one as they came up to him. If they were armed he could torpedo them without revealing himself; if unarmed they could be shelled into surrender. The only dangers he could not avoid were the very rare meetings with Q-ships and the passage of the net barrage maintained after Sept. 1915 by British drifters across the Otranto Straits in the hope of stopping approach to the submarine bases in Austrian waters. The protest of President Wilson had no effect in the Mediterranean and the sinking of merchant vessels continued without those interruptions which cut the Home Waters campaign into such well-defined sections. When the President was promised that submarines would operate in accordance with their own prize law a month or two elasped before there was any resumption in the Mediterranean of the practice of torpedoing at sight. But in Nov. 1915 the " Californian," " Treneglos," " Orange Prince " and " Hallamshire "; in Dec. 1915 the " Persia " and " Clan MacFarlane "; and in Jan. 1916 the " Glengyle " were all torpedoed without warning. All were large ships, the " Persia " being a P. & O. liner full of passengers; the loss of life in her case was 334.

For a few months in the autumn of 1915, when it seemed possible that the Turks would attack Egypt, the German submarines were employed in conveying war material to the restless tribes to the westward of the Egyptian border. On one of these trips U35 sank the patrolling British armed merchant cruiser " Tara," whose crew were driven by Senussi into the interior, where they subsisted on snails and such meagre provisions as their captors consented to dole out until they were rescued by the Duke of Westminster's armoured cars. After the evacuation of Gallipoli peninsula, the German submarines confined themselves to attack on merchant ships. In the 18 months from Hersing's arrival to the end of Jan. 1917, a total of 200 British, 189 Italian and 52 French ships were destroyed in the Mediterranean.

During this period seven Austrian submarines had been destroyed, three by Italian men-of-war, one caught in the Otranto barrage, three others by unknown circumstances. Several of the German UB- and UC-boats were lost from various causes; but none were destroyed by British or Allied warships. The Q-ship "Margit" had a chance of opening fire on a submarine in Jan. 1916, but did not succeed in sinking it. On the whole, the Mediterranean was a safer field of operation for submarines than home waters.

Operations of British Submarines in the Baltic.—British submarines had no such easy work as the German U-boats. Germany sent no troops abroad, and her imports reached her from contiguous countries by land or in short passages across the Baltic. In that sea several British submarines operated. The first was E1 (Lt.-Comm. N. F. Lawrence) which passed through the Sound into the Baltic on Oct. 17 1914. She fired two torpedoes at, but missed, a German cruiser near the entrance to Kiel Bay and seriously disturbed what had been thought the security of that sea. E9 (Lt.-Comm. Max Horton) arrived in the Baltic two days later. After a few days in harbour the two E-boats commenced operations against the German fleet and though they did not succeed in sinking any ships, the knowledge of their presence brought to an end the safety with which German forces had exercised in the Western Baltic. The ice of the Baltic winter soon kept the British submarines in harbour to wait for the spring. In May Max Horton torpedoed a German cruiser; in June, a destroyer and collier and in July an old cruiser.

The Germans by then were making a strenuous effort to capture Riga. To assist in the defence the Admiralty despatched E8 and E13 in August. The latter, through a breakdown of her compass ran ashore in Danish territory on Aug. 19, and was allowed by the Danes 24 hours to endeavour to refloat. Before this interval elapsed two German destroyers appeared and opened fire on her and on the seamen swimming from her towards the Danish shore, causing the death of 15 of them. This outrage on humanity and Danish sovereignty was possibly the outcome of German irritation at the interference with their plans due to the activity of our submarines; on that same day E1 torpedoed the battle-cruiser "Moltke" off the Gulf of Riga and sent her back to port for repairs. Two days later the Germans abandoned their attack on Riga. In the autumn our submarines were used chiefly in stopping the passage of iron ore from Sweden to Germany. Between Oct. 11 and 23 they sank 14 large German steamers loaded with ore and so effective were their operations that 37 other steamers ready to sail were held up in Swedish ports till a system of convey could be organised. In Nov. the old cruiser "Prinz Adalbert" was sunk by E8 and in Dec. a light cruiser and a torpedo-boat were destroyed. During that autumn and winter some 20 German steamers aggregating 45,000 tons were sunk or seriously damaged by our submarines, producing a sort of paralysis in the transport of iron ore to Germany.

By July 1916 there were 8 British submarines in the Baltic, 4 of the E class and 4 of the C class; Commander Cromie of E19 took command of this Baltic flotilla, which was put under the direct orders of the Russian Commander-in-Chief. Throughout 1916 and 1917 the boats were used by him in an interminable series of reconnaissances; they had no opportunity of interfering with the iron-ore traffic and little chance of attacking warships, since the essence of reconnaissance is that the presence of the watcher should be unsuspected. The outbreak of the revolution in Russia still further limited their activities. In Nov. 1917 C32 was so badly damaged in an encounter with German patrols that it was decided to destroy her and send the crew home. Finally, on April 3 1918, news having been received that the Germans were advancing on the submarine base at Helsingfors, the whole flotilla went out to sea through the ice and was blown up by its officers. Thus perished E1, 8, 9 and 19 and C26, 27 and 35. Comm. Cromie never returned to England; he was killed by Bolsheviks on the steps of the British Embassy.

British Submarines at the Dardanelles.—The operations at the Dardanelles gave opportunities for some remarkable exploits by the British submarines attached to the Eastern Mediterranean Squadron. Their ability to interfere with Turkish transport to the Gallipoli peninsula was fully realised; but the passage of the Dardanelles at first seemed impracticable. The Straits are 27 m. long and for 3½ of these miles they are only 1 m. wide; there, in the Narrows, it was known that anti-submarine nets, booms and minefields had been placed; but the nets and booms, it was thought, might be passed by specially fitted submarines. Lt. N. D. Holbrook, in B11, was the first to try. He successfully negotiated the passage of the minefields and on Dec. 11 1914 torpedoed a Turkish cruiser, the "Messudieh." On the return journey his compass became unserviceable, and to the already great enough hazards of the mines and the pursuit was added the difficulty of navigating an unfamiliar channel without a compass. Surviving all these perils he returned and was awarded the Victoria Cross. No further attempt was made till the spring of 1915. In April, E15 (Lt.-Comm. T. S. Brodie) opened the campaign, but unfortunately grounded some 10 m. up the Straits and was lost. Strenuous efforts were made by other submarines, destroyers and even battleships to destroy the hull of E15 so that the Turks could not use her; but the activity of the defence foiled them all. It was left to one of a pair of picket boats which crept up the Straits on a pitch black night to find and torpedo the wreck of E15.

The ill-luck of Lt.-Comm. Brodie did not deter his colleagues, British and French, from following. E14 (Lt.-Comm. E. C. Boyle) sank three Turkish ships, including a transport with 6,000 troops aboard; but AE2, a submarine of the Australian Navy, was sunk by gunfire on April 30. In May the French submarine "Joule" struck a mine and was lost in her first attempt at the passage. E11 (Lt.-Comm. M. E. Nasmith) returning from a successful voyage found a mine sitting on his bows, but was able to get rid of it by clever manoeuvring. He had penetrated as far as Constantinople itself, where he torpedoed and sank a Turkish gunboat. Near Rodosto he sank several transports and store ships, his nearness to shore in one case being such that he was forced to retire by a party of horsemen. He returned to Constantinople and torpedoed the man-of-war "Stambul," in the Golden Horn itself. It was the first time that an enemy had appeared in that harbour since it had become Turkish; and his exploit had the effect of stopping for the time all sea communication between Constantinople and Gallipoli.

E12 (Lt.-Comm. K. M. Bruce), E7 (Lt.-Comm. A. D. Cochrane), E2 (Comm. David Stocks), E20 (Lt.-Comm. C. H. Warren) and H1 (Lt. Wilfred Pirie) also made the difficult and dangerous passage with more or less striking results. E12 on one occasion encountered and sank a decoy which carried a masked gun. Amongst other exploits Lt.-Comm. Cochrane attacked the railway line and blocked it for a time. E14 and E11 were up the Straits together at the end of July and sank between them some 30 ships bound for Gallipoli. Every possible obstacle was put in their way by the Turks, who had erected a powerful barrage at Nagara. The French submarine "Mariotte" fouled a mine, and while trying to free herself was shelled into surrender (July 26). Bruce in E12 cruised in the Sea of Marmora from Sept. 16 to Oct. 25, 40 days, during which he sank 34 ships and did much damage to magazines and railways ashore. On the way back the bows of his boat carried away part of the Nagara obstruction and E12 was dragged down to a depth of 245 ft. before she could gain control. The entanglement, whatever it was, was scraped off her by a chain boom a little lower down the Straits and though she broke surface in her plungings and came under fire from guns and torpedoes, she managed to reach Helles in safety.

In Nov. E11 and E20 and the French submarine "Turquoise" went up the Dardanelles to continue the disturbance to Turkish communications. Only one of them returned. The "Turquoise" ran aground and was captured intact. A paper found by the Turks in her revealed a rendezvous, and by despatching a submarine to that spot they were able to torpedo E20. Nasmith in E11 cruised for 47 days in Turkish waters; before returning he destroyed or rendered useless 11 steamers and 35 sailing vessels, in face of all the barrages, patrols and batteries set up to prevent him and in spite of the fact that shipping for safety's sake had

been kept in harbour as much as possible. When the Gallipoli peninsula was abandoned at the end of 1915 the necessity for running the risk of penetrating the Dardanelles no longer existed and the operations of British submarines came to an end; but the record of their work will always remain an inspiring chapter in the history of the British Navy.

Analysis of the Autumn Campaign.—During the autumn campaign of 1916, German submarines in Home Waters had been acting under some sort of restrictions as regards sparing passenger ships and refraining from torpedoing vessels without warning. These restrictions were not in accordance with Admiral Scheer's ideas; his view was that the submarine as a weapon could best achieve results by surprise; and to him it seemed unreasonable to expect submarine commanders to expose themselves to the great risks known to exist if they came to the surface and warned vessels before sinking them. Most large merchant ships were now armed for defence, and some had even sunk attacking submarines; and, moreover, there was always the possibility that a tramp steamer, harmless to the outward eye, might really be a Q-ship, to attack which was death. Only reluctantly had Scheer allowed his High Sea Fleet submarines to participate in the autumn campaign, and he expected little good from it. The results exceeded anticipation; indeed, Oct. 1916 proved the worst month of the three campaigns of 1915 and 1916. In that month submarines destroyed 148,000 gross tons of British shipping and 124 foreign ships of 164,000 tons—a total of over 300,000 tons for all the nations of the world. The progress of the campaign in Dec. 1916 and Jan. 1917 can be seen in the following table:—

Destroyed by Submarines

	Dec. 1916		Jan. 1917	
	Ships	Gross tons	Ships	Gross tons
British	39	110,160	51	111,974
Allies	58	66,690	63	58,253
Norwegian	32	43,537	34	55,487
Danish	17	16,113	13	17,151
Other Neutrals	21	39,900	19	42,142
Totals	167	276,400	180	285,007

An interesting feature in the campaign is that the shipping of the neutral nations suffered more severely than British; in Dec. 70 neutral ships to 39 British and in Jan. 66 neutral to 51 British, of which 16 were small fishing craft. Norway, in particular, lost nearly as many vessels as England. Such favourable results of the submarine attack on merchant vessels, restricted as it was, strengthened the arguments of that party in Germany who were convinced that, if all restrictions were removed, submarines could double their rate of destruction and would, in any case, bring to a standstill the Norwegian traffic to England. Their arguments gained the day and it was decided to carry on the submarine attack as in 1915 without restrictions. The step would probably compel the United States to break off relations; but the submarine party were confident that before America's military forces could affect the issue of the War, it would be over, with England vanquished. So certain did this seem that Germany put forward a proposal of peace, but as it was couched in terms such as a victor uses to the vanquished, it was rejected.

Then, on Feb. 1 1917, was re-introduced the original method of unrestricted warfare. Areas enclosing the British Isles and France, the Mediterranean and, later, the Portuguese Atlantic Islands and the area round Archangel, were declared war zones; vessels of any nationality or character found in the war zones would be destroyed, and though no special efforts would be made to kill the crews, consideration for the safety of their lives would not be allowed to hinder the submarines in their work.

III. THE FINAL STRUGGLE

Second "Unrestricted" Campaign, Feb. 1917 to Nov. 1918.—To carry on the unrestricted campaign Germany had 111 seagoing submarines of the U, UB and UC classes. Though the UC-boats were still primarily minelayers whose operations are treated elsewhere (*see* MINELAYING), they now carried guns and a few torpedoes and could therefore wage war on merchant vessels in the same way as the other classes of boats. Attached to the High Sea Fleet there were 29 submarines active and 20 under repair, the figures for the other stations being: Flanders 31 and 2; Baltic 0 and 2; Adriatic 7 and 17; Constantinople 2 and 1; a total of 69 at work and 42 under repair.

The declaration of unrestricted warfare, which meant that neutral vessels would again be sunk without warning, had a serious effect on the departure of ships from Scandinavian countries. This had been foreseen by the British Admiralty and was countered by the detention of each Scandinavian ship already in British ports until it was known that a corresponding vessel had sailed for England. Even with the reduction of traffic at sea resulting from the natural reluctance of non-belligerents to take the risk of entering the war zones the losses were:—

	February		March		April	
	Ships	Gross tons	Ships	Gross tons	Ships	Gross tons
British	114	260,000	146	287,000	196	522,000
Allies	77	77,000	114	115,000	108	145,000
Neutral	60	132,000	78	122,000	126	185,000
	260	469,000	338	524,000	430	852,000

The rate of increase in losses was such that it seemed that the submarines would win the War for Germany. They were being completed faster than they were being destroyed so that their number increased from 111 on Feb. 10 to 127 on April 10. It was clear that the existing methods of fighting them were insufficient. Though all the forms of defence—detaining ships in harbour when a submarine was known to be about, causing ships to hug the shore, sending Q-ships on the traffic routes, arming more and more merchant ships, patrolling the avenues of approach—and all the weapons of attack, such as depth charges and hydrophones, were made more and more efficient they could not stay the tide of devastation. On April 19, the worst day for England of that worst month, 11 British merchantmen and 8 fishing vessels were sunk by submarines; and it has been stated that one out of every four vessels that left Great Britain in that month never returned. There were few successes during these first three months of the unrestricted campaign to hearten the defence; 2 UB-boats from Zeebrugge stranded on the Dutch coast, one UC-boat was blown up by mines off Sunderland, two British submarines torpedoed German boats, a destroyer "depth-charged" UC39, and Captain Gordon Campbell in the Q-ship "Farnborough" got U85 after an action which so nearly meant the loss of his ship and her gallant crew that he sent by wireless to Admiral Bayly at Queenstown the famous signal "Q5 slowly sinking respectfully wishes you Good-bye." It is satisfactory to know that she did not sink and that Captain Gordon Campbell survived to be the hero of a service manned by heroes. One episode of these terrible three months remained unique; the British submarine E50, proceeding under water, rammed a German boat also submerged, bringing into the realm of fact one of Jules Verne's most lurid fancies. Though she struck the German craft three separate blows, it escaped to tell the tale of one more peril for the U-boat.

Escorted Convoys.—Nevertheless, the submarine was winning. Unless some new and effective device could be put into action the surrender of the Allies was in sight. But the device was on the point of adoption. Scandinavian vessels refused to sail without escort and since it was impossible to escort each singly, they were gathered into convoys guarded by such armed vessels as could be spared. The principle of escorting a convoy had been in force for some months with the trade between Holland and England, and with the continuous export of coal to France, which being carried in slow vessels could be accompanied by armed trawlers; but the difficulties in escorting an ocean convoy had been considered too great for the means at our disposal. When at last the method was tried, these difficulties were found to have been over-estimated, and gradually the gathering of merchant vessels into escorted convoys became general. Special schools were established to train the masters of ships in the complicated

manoeuvres of zigzagging in squadrons and a large organisation came into being to collect each convoy and its escort. Between March and Aug. 8,000 colliers crossed the Channel to France in groups under some sort of escort and only 14 of them were lost.

In proportion as the convoy system became universal so did losses diminish. In May submarines sank 303 vessels of all nationalities totalling 550,000 tons; by Nov. the totals had fallen to 116 and 259,000 tons. Of 6,000 vessels convoyed between Norway and the Humber the loss by submarine action was 1%. One reason for this marked diminution was that now the U-boat had to run into danger to secure any prey. Before the introduction of convoy the submarine, by eluding the patrols, could deal with ships at leisure; but now she could not approach the bait without running the chance of being hooked. An ingenious system of dazzle painting was introduced and a convoy appeared in a periscope as a shapeless mass of stripes and blurs continually altering as the ships zigzagged; the escorting destroyers and trawlers forced a watching submarine to keep its distance, and its best chance was to catch a straggler. But this again was not infrequently a Q-ship, masquerading as a lame duck to invite attack. As the losses in shipping diminished the rate of destruction of submarines increased; in April, May and June of 1917 12 boats; in the next three months 20; and in the last quarter of 1917, 24 boats. To Comm. Maurice Blackwood in the Q-ship "Stonecrop" fell a special prize in Sept. when by admirable coolness and cunning he entrapped and sank U88. The "Stonecrop" was sunk next day by another submarine; but in U88, which disappeared with all hands, was the notorious Schwieger, who two years before had sunk the "Lusitania" and forced the United States to consider the possibility of joining the Allies. The United States declared war in April 1917 and before the end of the year had sent 37 destroyers to assist in convoy work. One of these destroyers, the "Fanning" while on convoy duty in Nov. 1917 dropped a depth charge on U58 and forced her to surrender. This was the only submarine known to have been destroyed by the United States forces.

Even with the addition of the United States destroyers it was not possible to escort every vessel, and on some routes merchant ships had still to fight for themselves. A curious fate overtook U28 in September. She met a vessel making for Archangel with ammunition; she first torpedoed it and then came close to sink it by gunfire. Her second shot burst among the ammunition, and the terrific explosion which resulted wrecked the submarine. U28 disappeared forever, leaving her men struggling in the water. Another Archangel steamer, armed for defence, fought a duel with a submarine till dusk without a decision. The submarine followed, intending to torpedo the ship in the darkness. She crept up on the quarter and fired two torpedoes; but the wary skipper, hearing an unusual noise, put his helm hard over and saw the white track of the torpedoes pass along his ship's side. Half an hour later he observed a luminous patch ahead of him and steering for it had the satisfaction of ramming his pursuer and ending her career. The submarine was U49; the steamer, the "British Transport."

Every type of vessel contributed to swell the number of lost submarines. In April 1918, Motor Launch No. 413, a vessel of a type built specially to deal with submarines, was on patrol in the Western Mediterranean, with her hydrophone out listening for the sound of a submarine's propeller. One was heard; and in the dim light of dawn, it could be seen rapidly approaching till it passed across the bows of ML413. Seeing the motor launch it submerged, but ML413 followed the wake and continuing along it and in the same direction till she was 150 ft. ahead of it she dropped four depth charges. The humming of the submarine's propeller instantly ceased. At daylight pieces of wood were seen floating, one a large fragment of varnished mahogany with steel hinges, undoubtedly part of a door from the interior of the submarine. The depth charges had been well aimed; they had torn the submarine to pieces. Later it was proved that this was UB71.

The Attack Defeated.—As 1917 progressed it became increasingly clear that the submarine attack on merchant vessels had been countered. The number of submarines in commission reached its maximum of 140 in Oct. and then slowly diminished. They failed to impede either the transport of British troops to France or of American troops to Europe. Only one transport of the latter, the "Tuscania," was torpedoed, and in her case the loss of life was 44. Although four of the best U-boats were sent across the Atlantic specially to attack troop transports, and they destroyed 60 ships between them, not one contained troops. Moreover, one of the submarines, U156, was lost in the great minefield laid across the North Sea.

Throughout the War the British had made efforts to mine the exits from submarine bases and the entrance to the English Channel. They were ineffectual, owing mainly to the defects of the British mine. The advent of America into the War gave us access to her factories; and a newly designed mine, produced in immense quantities, made it possible to close Heligoland Bight from time to time and to make the Straits of Dover absolutely impassable. A similar barrage was established across Otranto Straits; and sinkings in the Mediterranean, where they had been specially heavy, began to diminish.

By the end of the summer of 1918 it was obvious to the German authorities that the submarine campaign could not be a success; and when the land operations also failed, the Flanders bases were evacuated, and the submarines there were blown up—all except one, UB116, whose commander, Lieutenant Emsmann, made one last effort. He reached the entrance to Scapa Flow on Oct. 28, but the search-light picked him up and his boat was sunk in the very gates of his enemies. The Armistice terms included the surrender of all German submarines. One hundred and thirty-eight still remained and these came in to Harwich. One hundred and ninety-two had been destroyed and seven interned. In addition, 7 Austrian submarines had been destroyed. An analysis of the methods of attack shows that the destroyers and patrol vessels with their guns, depth charges and rams accounted for 64 boats; mines and mine nets destroyed 43; British submarines torpedoed 18; Q-ships sank 11. The cause of loss of 19 is unknown; the remainder met their end from various weapons.

In view of certain controversies, it is of interest to record that no "Dreadnought" was sunk by a submarine, while U29 was rammed and sunk by H.M.S. "Dreadnought" herself. Of the submarine commanders, Arnauld de la Perrière is credited in Germany with having destroyed 400,000 tons of shipping in 10 voyages; Forstmann in U39 with 380,000 in 16 voyages; and Max Valentiner with 300,000 in 17 voyages. These were all in the Mediterranean where conditions were specially favourable. A more dangerous career was that of Steinbrinck who in 24 voyages is claimed to have sunk 210,000 tons. He was operating from Flanders in UB- and UC-boats and had to overcome every obstacle that ingenuity could devise and, moreover, had to navigate among the tide-rips and shoals of the Channel and the east coast of England in boats of feeble engine power. Perhaps the most indefensible outrage perpetrated by the submarine commanders was the torpedoing by Patrig in U86 of the hospital ship "Llandovery Castle" on June 27 1918. The vessel was unmistakably a hospital ship marked with all the signs which should secure international immunity; she was 116 m. from land; but he sank her, and drowned 14 nurses and 226 other persons, only one boatload being saved.

Conclusion.—How near did the submarine campaign approach its object of reducing seagoing tonnage below the irreducible limit necessary for the needs of the Allies? One cause of the ferocity with which it was waged was the hope of terrorising merchant seamen into refusal to sail. This hope was from the first vain. The experiences of seamen whose ships had been sunk, instead of frightening them, stirred up rather their fighting spirit. When Admiral Jellicoe visited the Crystal Palace in 1918 he found there a number of merchant seamen at gun drill. Most of them had had their ships torpedoed under them. One, a steward, had suffered thus four times; he was learning to shoot so that he might sink a submarine with his own hand. As regards the destruction of tonnage trading with the Allies, so long as it exceeded by as much as 600,000 tons a month all replacement by

building, the campaign would most probably have brought the War to a close with Germany as victor. The figure of 600,000 tons net loss was perhaps exceeded in some of the months of the first half of 1917; thenceforward it fell, till in the summer of 1918 the rate of output of new shipping far exceeded the rate of destruction. The submarine campaign against merchant shipping was a bold experiment carried out, after some hesitations, with ruthless thoroughness. It failed. It strewed around the British Isles a rampart of broken hulls and the bones of gallant men. Its record is mostly the sordid story of armed men against the defenceless; but everywhere in the gloom shine out deeds that will stir the hearts of men so long as they admire courage dauntless and sustained.

TABLE I.

Ships and Tonnage Sunk by Submarines, 1917–8

A = Number of British and Allied merchant ships and fishing vessels sunk by submarines.
B = Number of neutral merchant ships sunk by submarines.
C = Total gross tonnage in thousands of tons.
D = Number of German submarines sunk.

	1917				1918			
	A	B	C	D	A	B	C	D
Jan.	96	65	293	2	112	19	299	9
Feb.	171	66	468	4	104	19	316	4
Mar.	204	85	511	4	147	25	332	5
April	277	118	840	2	96	12	262	6
May	192	89	551	6	108	18	291	17
June	211	81	633	4	77	22	241	3
July	171	56	495	6	83	24	260	6
Aug.	149	33	490	4	84	30	272	6
Sept.	137	18	316	10	65	8	181	9
Oct.	134	19	429	8	41	9	107	19
Nov.	95	21	260	9	..	..	..	4
Dec.	123	28	353	7	..	..	..	..
Totals	1,960	679	5,639	66	917	186	2,561	88

TABLE II.

British, Allied and Neutral Vessels Sunk by Submarines

	1914–5	1916	1917	1918
				(10 months)
British merchant vessels	231	288	1,052	527
British fishing vessels	168	134	200	76
Allied merchant vessels	76	344	708	314
Neutral merchant vessels	93	332	679	186
Totals	568	1,098	2,639	1,103

Grand total, 5,408 ships; 11,189,000 gross tons.

	1914–5	1916	1917	1918
				(10 months)
German submarines destroyed	24	25	66	88

Grand total, 203 ships.

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SUCHOW, China (*see* 26.7), with a population of about 500,000, is a manufacturing centre. Since the opening of the port some industrial establishments have been started on European lines. In 1911 the colleges of Shanghai and Suchow were united, and are established as Suchow University on a large campus; negotiations were in progress in 1924 for the co-operation of the university and other institutions of eastern China in the management of legal and medical schools. A municipal council was formed in 1920.

SUDAN, ANGLO-EGYPTIAN (*see* 26.10).—Its status is defined by the Anglo-Egyptian convention of 1899 made after its re-conquest by the joint efforts of the British and Egyptian Armies. According to this convention an Anglo-Egyptian condominium was established over the Sudan and the administration placed in the hands of a governor-general to be nominated by the British Govt. and appointed by a royal decree of Egypt. This secures British predominance in the administration. Area 1,014,600 square miles. The population in 1921 was estimated at 4,853,000.

I. POLITICAL HISTORY

Pre-War Period.—Until a few years before the War the Sudan was little known and its possibilities were not fully realised. Great progress was made under the administration of Sir Reginald Wingate and his lieutenants, the results slowly becoming apparent in the agricultural development, increasing trade and added security. In 1911 experiments were started in the area lying between the White and Blue Niles, known as the Gezira, with the object of ascertaining whether long-staple cotton could profitably be grown. Early in 1912 the railway from Khartoum to El Obeid was completed, thus bringing the Gezira area within easy reach of Khartoum, and making the resources of the rich gum and cattle areas of Kordofan more fully available. In the same year the land settlement and cadastral survey of the Gezira, undertaken with a view to safeguarding native rights therein, was finally completed.

By that time the possibilities of cotton growing had been more fully realised, and the matter was energetically taken up by the British Cotton Growing Association. Delegates, headed by the chairman in person, visited the principal cotton areas early in 1912, and reported their conviction "that in the Anglo-Egyptian Sudan there is one of the very finest cotton-growing propositions in the whole of the British Empire, both for Egyptian and American cotton. There are almost boundless possibilities for the future." Shortly after the return of the delegates to England an influential deputation waited on the British Govt., and urged the desirability of guaranteeing a loan for cotton development. As a result an Act was passed in 1913 giving parliamentary sanction for a guarantee of £3,000,000, of which £2,800,000 was to be applied to irrigation of the Gezira and railway extensions, and £200,000 to other irrigation projects in the neighbourhood of Kassala (the Gash delta) and Tokar (the Baraka delta).

The foundations of the Sudan's economic career were thus laid, but the completion of the projects then planned was delayed for many years by the outbreak of the World War. Just at this time (1913–4) the value of any project for giving to large areas the certainty of adequate water supplies by means of artificial irrigation received a striking demonstration. In 1913 rains were very bad and the river flood was the lowest recorded for more than a century so that all over the Northern Sudan, and particularly in the Gezira area, famine conditions obtained during the following winter. The situation was saved by the Government importing corn from India, and it is probable that this contributed more than any other factor to the quiet that prevailed in the Sudan during the four years of the War.

War Period.—Fortunately rains and Nile flood alike were excellent in 1914 and, except in Darfur, the outbreak of War excited no great attention in native circles. The province of Darfur, some 142,500 sq. m. in extent, lying about three weeks' journey west of Khartoum, had never been administered nor visited by any official of the Government since the re-occupation of the Sudan, but had been left in charge of a native sultan, owing nominal fealty to the Sudan Government. This Sultan, Ali Dinar, adopted an aggressive attitude in 1915, and his warlike preparations at the beginning of 1916 made it imperative to suppress him before he took the offensive and invaded the neighbouring province of Kordofan. An expedition was therefore despatched to Darfur, under the command of Lt.-Col. P. V. Kelly, and a crushing defeat inflicted on the Sultan outside his capital of El Fasher on May 22 1916. The Sultan fled with the remnants of his army and was killed in the following November. The country then rapidly settled down, and, with the exception of a fanatical outbreak which occurred in the south of the Province in 1919, administration progressed smoothly and successfully on the same lines as in the rest of the Sudan. The western frontier of Darfur,

which had been a bone of contention between the British and French Govts. ever since the days of Fashoda, was the subject of negotiations between the two Powers in 1919 and again in 1923. After the completion of a joint survey of the whole boundary from, approximately, lat. 5° N. to lat. 19° N. a settlement was finally embodied in a Protocol during Jan. 1924.

Post-War Period.—Within the Sudan the immediate political results of the War, apart from the Darfur expedition, were relatively unimportant. The ultimate effects were still difficult to gauge in 1925. That the world cataclysm should have no reactions in the Sudan was out of the question, and the economic development of the country, which, at the close of the War, at once brought it into close touch with European thought and European markets, rendered any such idea doubly impossible. Moreover, the intellectual ferment into which Egypt had been plunged as a result of the War, the political disturbances of 1919, and the Press agitation engineered by Egyptian Nationalists for the ejection of the British from the Sudan and its incorporation with Egypt had their effects, and the national self-consciousness which is dormant in every race showed signs, under Egyptian instigation, of awakening among that section of the Sudanese, town dwellers for the most part, which by education and contact with outside influences tended naturally to be receptive of new ideas. Happily 1920 was a year of prosperity, rich harvests and increasing trade, and the interests of the classes in question was largely centred on money making and the possibilities of the Gezira Irrigation Scheme, on which preliminary work was being actively prosecuted.

Legitimate aspirations in the political field, however, were not ignored. Late in 1920 the Milner Commission, which, though primarily appointed to inquire into the causes of the disorders in Egypt and to make recommendations as to the future constitution of that country, had also touched in its report upon the question of the Sudan, expressed the opinion that the "present administration is popular in the Sudan and, with few exceptions, peaceful and progressive conditions prevail throughout the country." At the same time a warning was issued against undue centralisation, and a policy of "decentralisation and the employment, wherever possible, of native agencies for the simple administrative needs of the country" was advocated. This policy was not in fact a new one, but its reassertion by so authoritative a body undoubtedly exercised a revitalising effect, and considerable strides were subsequently made in the direction recommended.

The only disturbance to an ordered and healthy course of political evolution in the Sudan, came as a reaction from political disturbances in Egypt. The Milner Commission recommended that whatever change was made in the relation between Great Britain and Egypt, British predominance in the Sudan should not be affected. Accordingly when in Feb. 1922 the independence of Egypt was declared, provision was made for the maintenance of the "status quo" in the Sudan, and the Sudan was included as one of the four matters reserved for future negotiations between Great Britain and Egypt. It soon became clear, however, that the grant of independence to Egypt was to be followed by further demands, and the Nationalist party under Zaghloul adopted as one of its principal political cries the claim that the independence of Egypt was meaningless without the independence of the Sudan, meaning by "independence" in the latter case subordination of the Sudan to Egypt.

An active campaign of Anti-British propaganda and intrigue was conducted from Egypt in the Sudan, where the position was complicated by the fact that the whole military garrison of the country was furnished by the Egyptian Army, consisting partly of purely Egyptian units but mainly of locally recruited units officered by Egyptians and Sudanese with a small addition of British officers. It would have been idle to expect that all the seed then sown would fall on barren ground. The really remarkable fact was that so little germinated. A "White Flag League" with funds and motive power drawn from Egypt, but with a membership composed for the most part of young Sudanese, had been started in the Sudan, and, as a result of its activities, a few minor disturbances occurred in Omdurman, Khartoum, Port Sudan, Atbara and elsewhere. More important incidents were mutinies of the Egyptian Railway Battalion at Atbara, and of the Sudanese cadets of the military school in Khartoum, in Aug. 1924, but the country as a whole remained staunch and viewed these manifestations with distaste or indifference.

Concurrently with these local developments correspondence had been passing during the summer of 1924 between the British Prime Minister (Mr. Ramsay MacDonald) and Zaghloul for arranging conversations to discuss the four points which had been reserved in the declaration of 1922 for further discussion. These conversations finally took place in Sept. and Oct. and ended abortively. The British Prime Minister then addressed a despatch[1] to the British High Commissioner in Cairo laying down very clearly the position and policy of the British Govt. in relation to Egypt and the Sudan. The following passage may be quoted:—

> . . . In the meantime, the duty of preserving order in the Sudan rests, in fact, upon His Majesty's Government, and they will take every step necessary for this purpose. Since going there they have contracted heavy moral obligations by the creation of a good system of administration; they cannot allow that to be destroyed; they regard their responsibilities as a trust for the Sudan people; there can be no question of their abandoning the Sudan until their work is done. His Majesty's Government have no desire to disturb existing arrangements, but they must point out how intolerable is a *status quo* which enables both military and civil officers and officials to conspire against civil order, and unless the *status quo* is accepted and loyally worked out until such time as a new arrangement may be reached, the Sudan Government would fail in its duty were it to allow such conditions to continue. His Majesty's Government have never failed to recognise that Egypt has certain material interests in the Sudan which must be guaranteed and safeguarded—these being chiefly concerned in her share of the Nile water and the satisfaction of any financial claims which she may have against the Sudan Government. His Majesty's Government have always been prepared to secure these interests in a way satisfactory to Egypt. I have in the preceding paragraphs defined the position which His Majesty's Government are compelled to take up in regard to Egypt and the Sudan and which I conceive it to be my duty to conserve unimpaired.

[1] Cmd. 2269 of 1924.

The failure of Zaghloul in London left him without any constructive policy for dealing with the Sudan, and the forces of disorder asserted themselves. On Nov. 20 1924 Sir Lee Stack, the Governor-General of the Sudan, succumbed to a murderous attack made on him in the streets of Cairo. An ultimatum was at once presented by the British Govt. and among its terms was the immediate withdrawal of all Egyptian troops from the Sudan, *i.e.*, all purely Egyptian units and the Egyptian officers of the Arab and Sudanese units. The demand was refused, and on Nov. 23 orders were issued for their compulsory evacuation. Some of them departed without demur; others adopted an attitude of passive resistance. At this stage some black Sudanese detachments stationed in Khartoum, probably misunderstanding the exact position of affairs, and certainly instigated by the Egyptian officers and by sympathisers among their own officers, mutinied on Nov. 27, and it was not until the 29th that order was restored. In outlying districts the evacuation of Egyptian troops took place without trouble except one incident at Talodi, which ended with no loss of life.

The evacuation of the Egyptian units and personnel was followed by the creation of a Sudan Defence Force, consisting of Sudanese and Arab units which had hitherto been incorporated in the Egyptian Army and which, in the new force, undertook allegiance solely to the Governor-General of the Sudan. By the end of the year conditions had been restored to normal. The Egyptian troops had gone, a number of Egyptian officials, whose political sympathies with their motherland had led them into excess, had been deported, and the country settled down with relief to the ordinary business of life. The disturbances had been limited to the few urban centres and had never had any effect on the country as a whole. In Jan. 1925 Sir Geoffrey Archer, the newly appointed Governor-General, arrived from Uganda. At the close of 1925 the country was peaceful and contented.

II. ECONOMIC HISTORY

The economic progress of the Sudan after 1914 was largely the result of the development of certain large projects for the growing of long staple cotton under irrigation in the Gezira, Kassala and Tokar areas, the increasing export of gum, and the general improvement of agriculture in the southern areas where the rainfall is sufficient to produce regular crops of cotton, sesame, ground nuts, etc. Work on the Gezira irrigation project, for which the British Govt. had in 1913 agreed to guarantee a loan for £3,000,000, was suspended during the War and resumed in 1919. Costs of all material and labour having doubled, the amount asked for was increased to £6,000,000, the guarantee by the British Govt. authority being given by the Sudan Loan Act of 1919. This amount once again proved an underestimate and by successive loan Acts, the authorised sum was increased to £13,000,000, of which about £12,000,000 was required for the Gezira scheme itself. The scheme was successfully completed in July 1925 and an area of about 160,000 ac.

put under cultivation, of which 80,000 ac. are under cotton, 40,000 durra and 40,000 Lubia (a green crop). By the 1926 season the total canalised area of the original project was available, *i.e.*, 300,000 ac., of which 100,000 will be under cotton, 100,000 under food crops and 100,000 fallow. This project will have a very great effect on the economic position of the country. A moderate estimate of the average value of the cotton crop is £E.2,000,000. The work is being carried out on the basis of a partnership arrangement between the Government, the Sudan Plantations Syndicate and the native cultivators. The latter receive the whole of the food crops and 40% of the value of the cotton crop and get land and water free.

The Kassala cotton area consists of the delta of the inland river Gash in the Eastern Sudan, some 60 m. long by 10 to 20 m. wide. A railway giving direct access to the sea was essential to the development of the area, and in 1922 a loan of £1,250,000 was authorised, guaranteed under the Trade Facilities Act by the British Govt., for the building of a railway from Haia Junction near Thamiam station on the Atbara-Port Sudan Line, to Kassala. This line was completed in 1925. The exploitation of the area is being carried out by the Kassala Cotton Company under an arrangement similar to that of Gezira. In the Tokar area cotton is grown between the Red Sea mountains and the coast. The natural conditions are similar to those at Kassala. The value of the crop for 1924–5 was about £500,000. A short railway line used for the transport of the crop connects Tokar with Trinkitat harbour on the Red Sea. In addition to these projects steps have been taken since 1922 to encourage the development of rain grown cotton in the central and southern districts. These had not yet produced large results up to the end of 1925, but returns were steadily increasing. In 1925 cotton exports from the Sudan were valued at £E.1,636,784. Apart from cotton the most important export is gum arabic; the average value of total exports of this product for the period of 1923–5 was £E.881,811, as compared with an average of £E.470,220 for the period 1911–3.

The general growth of trade and production is shown in the following tables:—

External Trade

	Imports		Exports and Re-exports
	Government	Public	
	£E.	£E.	£E.
1913 .	504,176	1,605,300	1,278,841
1922 .	1,696,535	2,556,355	2,298,770
1923 .	1,694,779	2,974,225	2,758,425
1924 .	1,820,210	3,654,700	3,830,171
1925 .	1,609,317	3,828,410	4,168,364

Communication and Transport.—The extension of the Halfa-Khartoum railway line to El Obeid, and the construction of the branch to Kassala were of immense importance to the development of the country, which depends very largely upon the extension of transport facilities. The Atbara-Port Sudan line is taking an increasing quantity of both exports and imports, the traffic via Halfa and the Egyptian railways having greatly decreased since 1910, particularly since the abolition of the British Protectorate over Egypt. Port Sudan had, by 1925, become a regular port of call for ships travelling through the Red Sea; its increasing trade is shown by the following table:—

Shipping at Port Sudan

	British Vessels	Tonnage	Foreign Vessels	Tonnage	Total Vessels	Total Tonnage
1908	191	269,626	40	84,625	231	334,251
1913	242	527,845	72	194,025	314	721,870
1922	342	1,138,601	110	361,334	452	1,499,935
1923	456	1,768,603	153	496,772	609	2,265,375
1924	513	1,940,266	186	582,963	699	2,523,229
1925	563	2,470,493	223	704,007	786	3,174,500

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SUESS, EDUARD (1831–1914), Austrian geologist (*see* 26.21), died at Vienna April 25 1914.

SUEZ CANAL (*see* 26.22), the waterway linking the Mediterranean Sea with the Gulf of Suez in the Red Sea. It was obvious in 1909 that the Suez Canal must be recognised not only as an essential waterway of the world, but also as a permanent factor in the commercial and political association of the East and West. The company, therefore, decided to approach the Egyptian govt. with a request for the prolongation of their concession, which was due to expire in 1968, on terms that appeared exceptionally favourable to Egypt.

That view was not shared, however, by the Egyptian parliament, which unanimously rejected the terms offered by the company and the request for an extension of their lease. But this fact had no untoward influence, either upon the shares of the company or upon the sea-borne trade entrusted to it. On the contrary, the traffic through the canal continued to increase until the outbreak of the World War in 1914, which utterly changed the character of the administration and purpose that had hitherto been associated with the name of the company. In consequence of the hostilities, the entire defence and direction of the canal—its enormous plant and its expert personnel—was handed over to the British military authorities. The canal became the strategical frontier of Egypt, guarded by the armies and navies of France and of the British Empire. Its waterway was open to the ships of Allied and neutral powers for the whole of those four eventful years, except during a few hours of fighting on Feb. 3 1915 when a Turkish Army that had marched across the desert from Damascus to invade Egypt was routed—never to return. From end to end the banks of the canal resembled one long armed camp, of which all traces had in 1925 disappeared; and the only signs visible to future generations of that great upheaval will be the three War monuments at Port Said, Ismaillia and Suez, and the railway which Lord Allenby laid from Kantara to Jerusalem for the subjugation of Palestine.

The figures show how much the canal suffered commercially during the War, and also how plainly the subsequent reaction proved its necessity for the wellbeing of the world. In 1912 5,373 ships, with a net tonnage of 20,200,000, passed through the canal. In that year the receipts amounted to 140,000,000 francs and the expenditure to 47,500,000 francs in round figures. By the year 1917 the traffic through the canal had gradually dropped to 2,353 ships, with a net tonnage of 9,000,000; the receipts were reduced to 72,000,000 francs and the expenditure to 37,000,000 francs. After peace was declared in 1918 the reaction immediately set in: statistics for 1919 show that close on 4,000 voyages were made through the canal, representing a total of 16,000,000 tons; the receipts for that year were 184,500,000 francs, and the expenditure amounted to 42,000,000 francs. The figures 1924 show that during that year 5,122 ships, with a total net tonnage of 25,000,000, passed through the canal, the receipts amounting to 508,500,000 francs and the expenditure to 60,000,000 francs. The depreciated value of the franc is largely accountable for the huge total recorded as receipts in 1924, since the Suez Canal Company convert all their takings from Egyptian francs (at 25·20 to the £E.) into French francs.

Improvements: Canal.—Since the War, the engineering programmes, which had been seriously interrupted, have been taken in hand with redoubled vigour. The 1912 programme has been completed, and the 1923 programme is already in advance of its time schedule. These programmes include the building of jetties and of "bassins," and the widening, deepening and straightening of the canal, a process which will be continued until the two largest ships that use Eastern and Far Eastern ports can cross one another in the canal without tying up.

Another great improvement is the creation of a new city opposite to Port Said, to which the name of Port Fuad has recently been given. To this new centre of activity all the company's engineering and repair shops were transferred, an operation which greatly reduced the congestion in Port Said. On this, the Asiatic side of the canal, all the employees and workpeople now resident in Port Said will eventually live; and in this hope the company drew up a

far-reaching scheme for a kind of garden city with avenues and boulevards, shops and schools, hospitals, churches and mosques, and with dwelling houses and apartments suitable for all classes of a very international community.

Some 12,000 persons (including wives and children) are dependent upon the company for their maintenance in Egypt—that is to say, from Port Said to Suez. Between the highest and lowest grades of these we find superintendents, doctors, architects, schoolmasters, priests, nuns, clerks, pilots and representatives of every rank in the organisation of industry, down to the native labourer. For all of these the company has the greatest care: a minute study of the detailed accounts for any one of recent years will convince the most scrupulous sociologist or socialist, that few companies give such unremitting attention to the wellbeing of their personnel. It is certain that, in Egypt, no body of employees or of workmen enjoy such comfortable circumstances. Since the War salaries have been raised, sick pay increased, an eight-hour day instituted, holiday pay and free tickets granted to the servants of the company and their families without distinction of grade or nationality; and a co-partnership scheme has been created, to which all are admitted and thereby become entitled to a share in the profits of this great undertaking. The company also provides its people with cheap houses, free dispensaries, hospital accommodation, co-operative stores, schools, sports and—most important of all—with a plentiful supply of filtered fresh water at the price of 50 centimes a ton. Under these exceptional conditions, service with the company is as eagerly sought for in Egypt as in France; and, whilst labour and other political troubles were rife throughout Egypt in 1919 and 1920, they scarcely created a ripple of disturbance on the calm social waters of the Suez Canal administration.

Control and Finance.—It will be seen that there is no foundation for the prevalent idea that it is a British undertaking which belongs to the British Govt., even though the British Govt. holds (as has already been shown) seven-sixteenths of the shares. The company is, as a matter of fact, French through and through for purposes of administration. On the board of management there are 1 Dutch, 10 British and 20 French directors, and they work in closest harmony together. Of the ten British directors, three represent the British Govt. in respect of their large holding of shares, and seven represent the shipping and commercial interests of Great Britain, which now supplies about 60% of the total traffic through the canal. Next in order of importance comes the Dutch mercantile marine, with 10% of the total; and third on the list we find Germany (whose flag was not seen on the canal between 1915 and 1920) providing 6·5%, France 6% and so on. The capital sum (£4,000,000) invested by Great Britain in Suez Canal shares in 1875 has been repaid about eight times in dividends and interest. In 1922 His Majesty's Govt. received £892,000; in 1923, £1,016,000, and in 1924, £1,167,000, free from all taxation at the source. The French Govt. owns no shares in this pre-eminently French enterprise, but it benefits to no small degree by the prosperity of the company, whose business was taxed in 1925 to the extent of about 42,000,000 francs.

M. Ferdinand de Lesseps' great undertaking has fully justified its existence. It is upon the facts stated above, rather than upon the present value of the shares (*i.e.* 14,000 francs, on Dec. 4 1925, for a share whose face value was 250 francs) that the company base confident hopes for their continued prosperity and usefulness until their lease from the Egyptian Govt. expires. (*See* PALESTINE, CAMPAIGN IN.)

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SUGAR: *see* CONTROL, INTER-ALLIED; FOOD SUPPLY.

SUK, JOSEF (1874–), Czech composer, was born at Křečovice Jan. 4 1874. He attained maturity almost at the very outset of his career and his compositions are distinguished more for their quality than for their number. All his work is marked by a finished skill, both of content and form. In his resourceful harmonisation and varied rhythm he showed himself a follower of the tendencies inaugurated by Dvořák. He wrote compositions for piano, violin, cello and orchestra. His symphonic poem "Prague" is an elaborate evocation of the glory of the Czechoslovak capital. His symphony "Asrael" and the symphonic poem, "A Summer Legend," are of an elegiac character. Suk excelled also in vocal compositions, both for male and female voices. His most noteworthy work is that entitled "Ripening," which, in three sections, Life, Work and Love respectively, expresses his own emotional development. He was one of the founders of the Bohemian Quartet, and in 1922 became professor at the Master School for composition at the Prague Conservatoire, where he had studied under Bennewitz, Stecker and Dvořák.

SULGRAVE MANOR, the early English home of the ancestors of George Washington. Situated 2½ m. northwest of Helmdon in Northamptonshire, it has come to be recognised as a shrine for all patriotic Americans and thoughtful English folks to visit. Laurence Washington, twice mayor of Northampton, bought the property from King Henry VIII. in 1539, on the dissolution of the smaller religious houses. It had previously belonged to the priory of St. Andrew, Northampton. Laurence Washington, from whom George Washington was seventh in direct descent, and his children and grandchildren lived in the manor house until 1610.

The place, therefore, carries the history of the Washington family back to the days of Henry VIII. and the English Reformation, and antedates Mount Vernon, George Washington's home in Virginia, by 200 years. It was purchased, in Jan. 1914, for £8,400, by the British committee for the celebration of 100 years of peace between Great Britain and the United States (1814–1914), and the whole property, including the contents of the manor house, is vested in three ex-officio trustees: the American Ambassador in London, the British Ambassador in Washington and the regent of the Mount Vernon Ladies' Association of the Union. It is administered and controlled by the Sulgrave manor board, a body formed to carry on the work of the British peace centenary committee in perpetuity. The manor house has been partially restored to its original condition, and tastefully furnished with choice furniture of the period. A portion of the grounds has also been laid out. At the conclusion of this preliminary work, a formal reopening and dedication took place, on June 21 1921, in the presence of a large Anglo-American gathering.

The portion of the house restored is the oldest part, the south or Tudor wing. On the south gable are the royal arms of the Tudors; and in the right spandrel of the arch of the main doorway, the Washington Arms, three mullets and two bars, which were the inspiration of the Stars and Stripes, the American national flag. The building is, therefore, one of rare historical interest, and every care is taken by the Sulgrave manor board to preserve its distinctive character and atmosphere. The furnishings are, for the most part, gifts from both British and American donors, and include an original Gilbert Stuart portrait of George Washington and many other treasures. (L. OF F.)

SUMMER SCHOOLS (*see* 6.19).—The introduction of new subjects into the curriculum and the development of new teaching methods are responsible for the growth of summer schools and vacation courses for teachers.

History of Movement.—Among the earliest must be mentioned the one carried on at Naas in Sweden and attended by teachers who desired to learn Sloyd as an introduction to handwork. A course on somewhat different lines was introduced and conducted at Leipzig by Dr. Goetze, and in the latter part of the 19th century these courses attracted many teachers from England and America during the summer vacation. The progress of handwork in English schools soon led to the establishment of summer courses under the direction of the Educational Handwork Association.

I. IN GREAT BRITAIN

In a less specialised field, the University Extension Movement had established summer meetings held alternatively at Oxford and Cambridge. These were attended by many teachers, although designed primarily to meet the needs of students in University Extension classes. The Science and Art Department, now merged in the Board of Education, provided holiday courses for selected teachers in various branches of science; and certain

French universities organised summer classes in French language and literature which attracted teachers of modern languages.

Present Organisation.—From these beginnings the movement developed rapidly, and the provision of summer schools and vacation courses became extremely liberal, although it does not yet cover the whole ground or meet the needs of all teachers. The courses offered present great variety alike in their curriculum and organisation. Some extend over a month, while others last only a fortnight, or even a week. Some are specialised in character, as, for example, a course dealing with the teaching of Latin; while others cover a wider range and aim at supplying form teachers in secondary and elementary schools with information concerning new developments in school organisation and in general method. The Board of Education continues to provide courses for selected teachers who receive financial aid in the shape of a grant and attend lectures and demonstrations in such subjects as rural education, modern languages, science, geography and history. Music also receives considerable attention, and every summer vacation sees a large number of teachers of music attending the courses provided in their subject.

Features of Summer Courses.—A well-arranged course is not confined to lectures and demonstrations—it provides opportunities for social intercourse and for free discussion, and some of the most successful courses are held in university towns, where the students live for a time in a college and enjoy the amenities of the playing fields and the river. A very popular course, which is held in London under private auspices, aims at giving to teachers from the provinces and from abroad an intimate knowledge of the chief attractions of London and of hearing addresses from eminent men and women, besides providing courses of lectures on modern lines.

Courses for Teachers.—It is now generally accepted that teachers should be encouraged in every possible way to refresh their minds and revivify their work by attending summer schools. It is recognised, however, that for many teachers the best refreshment is a complete holiday, and some of the courses arranged are therefore held at times outside the holiday period, the teachers being granted leave of absence to enable them to attend. This plan calls for the co-operation of the local authority and the Board of Education, and this is held to be justified on the ground that the work of the teacher gains in efficiency and therefore brings a return in public service. In England the practice of giving a "Sabbatical year" has not been widely adopted, although in some universities certain professors or lecturers have been granted leave of absence for a term or more to enable them to pursue definite lines of research. It is increasingly held, however, that the continued efficiency of school teachers demands that some arrangement should be made by which they may have the opportunity of bringing their studies up to date. The report of the departmental committee on the training of teachers recommended that teachers of experience should be granted leave of absence in order that they might attend university courses on education, and thereby equip themselves for posts of responsibility in the educational service. (F. R.)

II. IN THE UNITED STATES

The long summer vacation which interrupts the work of schools in the United States during the months of July and Aug. is a survival of the period when the population was very largely agrarian and there was a demand during the harvesting period for the labour of young people. With the readjustment of industrial and economic conditions, the summer vacation has come to be recognised as undesirably long. In spite of this fact, the sessions of public schools continue to follow established tradition. Various devices have been suggested for the utilisation of the summer months. A number of school systems have organised elementary vacation schools, where a programme of supervised play and handwork is carried on. In a few cases the regular programme of studies has been conducted in what is known as the all-year school. Summer schools at the elementary level are, however, relatively rare. They are somewhat more common in secondary schools. Here they serve most frequently the purpose of offering opportunity to backward pupils to make up their deficiencies. They furnish, however, to some extent an opportunity for shortening the period of high-school attendance for those who wish to complete their work as fast as possible.

It is in the fields of adult education and of higher education that the summer school has achieved its most distinguished success. In its earliest form the summer school provided series of lectures and entertainments intended to supply adults with an opportunity for intellectual recreation during vacation. Chautauqua, N. Y., was the home of the largest and most influential school of this type. From Chautauqua the practice of adult education spread, and the word chautauqua has become current as the designation for almost any course of lectures, whether given in the summer or winter, whether lasting for six weeks or three days. Chautauquas are now common as community enterprises and as enterprises sponsored by churches and schools.

University Activity.—It is significant that the first proposal for a summer session of a university came from a man who had been intimately associated with the Chautauqua movement, William Rainey Harper. When President Harper organised the University of Chicago in 1892, he planned its session in four units of twelve weeks each, and arranged that one of the sessions should fall in the summer covering the weeks during which most schools and colleges have their summer vacation. President Harper's idea was scoffed at in many quarters by those who believed that summer study would degrade academic standards. The movement to establish such sessions in universities, however, spread, until they became very common. At first the institutions which held summer sessions limited them to six weeks, and the University of Chicago was practically alone in its efforts to conduct four full quarters of work. During the period of the World War a great stimulus was given to the summer school, because it was recognised that economy of plant and of the student's time could be effected by holding summer sessions. A number of the war boards urged institutions to keep their doors open throughout the year, and as a result several of the larger institutions, especially among the state universities, responded favourably. A poll of 31 leading universities showed the following facts regarding length of summer sessions:—

Number of weeks in session . . .	6	8	9	10	11	12
Number of institutions	10	4	1	3	10	3

Types of Students.—The student body of summer sessions is seldom recruited from the regular undergraduates. The typical undergraduate, accustomed through the high-school period to a long interruption of his study in the summer, demands a summer vacation. Graduate students, pushed by the urge to secure a higher degree as early as possible, not uncommonly take advantage of summer sessions. The great majority of the summer student population is made up of teachers and school administrators who during the other three quarters of the year are professionally engaged in school work. It has come to be a very common practice for boards of education either to require summer study of their employees or to reward such study by special salary inducements. A large number of institutions other than universities hold summer sessions. Normal schools almost universally do so. The aggregate number of students in the summer schools of higher institutions is large. Thirty-one universities reporting for eight years show an increase from 36,971 students in 1918 to 87,208 in 1925. In some of the states it is reported that 80% of the teachers attend regularly summer sessions either in normal schools or colleges or universities. (C. H. J.)

SUMMER TIME: *see* DAYLIGHT SAVING.

SUN: *see* ASTRONOMY; SOLAR ENERGY.

SUN CURE: *see* HELIOTHERAPY.

SUNDERLAND, England (*see* 26.100), with an area of 3,357 ac. and a population of 159,055 in 1921, is a great shipbuilding centre and has a large coal trade. New libraries have been opened in Hendon, Monkwearmouth, and in the western district of the city. The parish of St. Aidan's, Grangetown, was formed and the church partially finished and consecrated in 1911, and the church of St. Gabriel's, Monkwearmouth, was built in 1912.

Backhouse Park of 13½ ac. was presented in 1923, and a War memorial has been erected in Mowbray Park. The south breakwater at the harbour entrance has been extended, making the pier 2,844 ft. long; the area of the harbour, which has been enlarged by dredging, is about 150 ac. A large dry dock, 515 ft. long, was opened in 1925.

SUN YAT-SEN (1867–1925), Chinese republican leader. Dr. Sun (known in China by the more familiar title of Sun Wen) may truly be described as the Father of the Chinese Republic. His father, a poor farmer living at Hsiang Shan near the Island of Macao, was a convert to Christianity (under the London Missionary Society) and his son early espoused the Christian faith and continued to describe himself as a Christian till his death, before which he gave instructions that he should be buried with Christian rites. Another influence of his early years came from his uncle who had fought in the Tuiping rebellion and who was the village schoolmaster at his birthplace (Hsiang Shan).

At 18 years of age he was employed at the mission hospital in Canton and had already acquired some knowledge of the English language from an English lady. In 1891 he entered upon a medical course at the newly formed medical school in Hongkong of which he was the first graduate in 1894. It was here that his life-long friendship with Sir James Cantlie began. Through a Chinese fellow student, Dr. Sun came into association with a secret society which was planning to overthrow the existing régime in China and which offered to assist him in the carrying out of the plans which were already developing in his mind. The first of a number of definite revolutionary efforts with which Dr. Sun was associated was brought to light in 1895. The other members of the group concerned with this attempt were executed, Dr. Sun alone escaping with his life. Thus began that long period of Dr. Sun's life during which he was working outside his native country with the object of bringing about a revolution. In all, 10 abortive attempts were made. Dr. Sun worked indefatigably during these years, taking three trips to Europe, four to the United States, five to Japan and also visiting the East Indies and Straits Settlements and Honolulu on several occasions. In the latter place, shortly after the Chino-Japanese War in 1895, he established Hsing Chung Hui, the forerunner of later revolutionary organisations. Of these the most important was the Tung Men Hui formed in Japan with the help of General Hwang Hsing. In 1898 he determined upon those principles which he later announced and expounded at great length. The three fundamental principles were Nationalism, Democracy and Socialism, and the five spheres in which they were to be worked out were: the executive government, the legislative field, the judicial field, the civil examinations and the department of censorship or impartial scrutiny of public matters and officials.

It was not, however, until 1905 that Dr. Sun publicly declared his adherence to these ideas and worked them out in fuller detail. Immediately following the Boxer outbreak in 1900 Dr. Sun attempted to use the reaction as a means of establishing a democratic government and ending the Manchu régime, but this attempt as others proved abortive. In 1905 the Chinese Revolutionary League was formed in Europe and Japan and through this Dr. Sun enlisted the support of a great number of Chinese not resident in China. Dr. Sun raised during this period large sums of money among adherents to the revolutionary cause and was thus able to spread his ideas through secret agencies in China itself. His activities brought him into prominence and a large price, finally amounting to £100,000, was placed upon his head. On one occasion in 1896 he was kidnapped while in London and held at the Chinese Legation for several days. His release came about through a note to Sir James Cantlie, which was smuggled out of the Legation and which led to Lord Salisbury taking the matter up as one of privilege.

In 1911 the revolution broke out in China which was to sweep away the effete Manchu leaders and to set up, in name at any rate, the new Republican form of Government. Dr. Sun's personal influence had much to do with the inner organisation of this revolt, and in particular with the form in which an alternative to the Manchu régime was presented to the nation. While there was a widespread feeling that the dynasty had outlived its usefulness, there was little understanding of what was involved in establishing a republic and only the efficient organisation of the Kuo Ming Tang (Dr. Sun's creation, known as the Republican party) was able to turn the anti-Manchu tide into a pro-republican movement. Dr. Sun was in England when the revolution began and was called back to China as soon as it became general. On Jan. 5 1912 he took the oath of office as Provisional President of the new Republic, this position having been offered to him by the National Convention which was then meeting in Nanking.

On Feb. 12 an Imperial Edict announced the abdication of the Emperor and the substitution of republican for monarchical Government. Yuan Shih-K'ai was entrusted with the task of carrying through the changes involved, and Dr. Sun, realising the impossibility of uniting the country under his own presidency and in hopes of unity being attained under Yuan, resigned his presidency in favour of the latter. He accepted the post of Director-General of Transport and Trade and in this position made some study of the constructive side of the task involved in making a new China. He travelled widely throughout the country, being no longer a suspected traitor but the honoured Father of the Republic. He was, however, always more of the propagandist and inspirer than the practical administrator.

He became increasingly restless under the leadership of Yuan Shih-K'ai, and in 1917, after the latter's coup d'état and death, he put himself at the head of a movement for an independent republic of South China. The strength of his support had always been drawn from Kwang-tung province and here he might have remained within his own group had he been able to work with others and content to develop one part of China, leaving the rest to go its own way. However, he soon found it impossible to co-operate with the military leaders in Canton and he resigned from his position as President of the Republic of South China. The military régime was maintained largely by Kwang Si troops until 1921 when Ch'en Ch'iung-ming drove them out and called in Dr. Sun again.

The following year he determined on an advance in force against the north, while Ch'en Ch'iung-ming desired to consolidate the work begun in the province of Kwang-tung. This led to an open breach and Dr. Sun was once more driven from his native province, finding refuge in Shanghai. In Feb. 1923 he called to his aid troops from Kwangsi and Yunnan and thus defeated his one time colleague and subsequent rival, General Ch'en. From that time until his death he was acknowledged as the chief executive of the Province, but his effective sway did not extend far beyond Canton and even there was maintained only by the use of the troops from elsewhere. He used and permitted very violent methods, more particularly in the attack upon the Merchants Volunteer corps and the looting and burning of a considerable part of the city of Canton in March 1924. In these ways he lost much of the support which had been given to him and to the Kuo Ming Tang by Chinese overseas. At the same time his pronounced socialist views ensured him the support of the mass of the workers and on a number of occasions he used his influence to secure higher wages for labourers, particularly when strikes were declared in Canton.

So far as local support was concerned Dr. Sun's star seemed to be declining in the autumn of 1924, but he was still idolised by the student class and in his own party where his was a name to conjure with. It was then that Feng Yü-hsiang brought about his coup whereby Wu Pei-fu (a determined enemy of Dr. Sun's) was routed and Chang Tso-ling co-operated with Feng to put the old Anfu leader Tuan Ch'i-jui in the position of Chief Executive in Peking. Dr. Sun had been cultivating friendly relations with the parties now predominant, and he was called to Peking to confer with them in regard to the calling of a people's conference and other matters connected with the establishment of the new régime. For some time past his health had been failing with the growth of what proved to be cancer of the liver and he finally succumbed to this complaint on March 12 1925, shortly after reaching Peking. Time was sufficient however again to reveal the

difficulty which Dr. Sun always had in co-operating with others, particularly those who did not fully share his ideals. A serious difference over the method of calling the conference had developed and Sun Yat-sen's death seemed the only thing to prevent open hostility.

Dr. Sun left behind him two wills which have been very widely distributed and commented upon in China, one concerning his personal effects, a very simple document; the other a re-affirmation of the principles by which his life had been guided and an expression of his desire to see these carried out after his death in the reconstruction of China. Dr. Sun was a man of outstanding personality, and one whose position came to be recognised throughout the whole of China. It would be no exaggeration to say that before his death he was recognised as the leading figure in the country, even those who criticised him most severely recognising the contribution which he had made to the new order and the power which his personality had exercised upon his fellow countrymen. This he owed to his sincerity, single-mindedness and courage. He was kind-hearted and an eager student, humble-minded and patriotic. His ambition was for China rather than for himself. By his personal charm he won to his side many who did not fully share his theories.

Nevertheless he showed weakness in certain directions. He frequently made mistakes in his estimate of men, more particularly in the military leaders with whom from time to time he allied himself. He failed clearly to see the danger of seeking his own high ends through methods which were really at variance with them. He was not able to see all round a question and therefore lacked powers of constructive statesmanship. His was a restless spirit and he was not content to settle down to more commonplace tasks. The most considerable effort made by Dr. Sun in the field of constructive policy is to be found in his volume *The International Development of China* (1922).

His public works include a number of speeches, articles and pamphlets, more particularly the following: *The Doctrine of Sun Wen; The International Development of China; The Principles of Democratic Government* (statement of 25 outstanding points). See Sir James Cantlie and C. S. Jones, *Sun Yat Sen and the Awakening of China* (1912); P. Linebarger, *Sun Yat Sen and the Chinese Republic* (1925). (H. T. H.)

SUPER-POWER.—This phrase has come into wide use in connection with the extensive development of the electric power industry. It has been defined as " the systematic grouping and interconnection of existing power systems to the end that greater economy will be effected." According to another authority, " Super-power is the term used to designate the furnishing of large blocks of power generated in efficient power stations and transmitted in bulk at very high voltage, such as 220,000, and supplied through transformers to the present power systems for distribution at some lower voltage." An interesting analogy compares a super-power system to a power bank in which deposits or withdrawals are made at widely different points. Any surplus production of an existing power system can be absorbed and simultaneously a deficit on the part of another system can be made up by the resources of the super-power network.

Basis of the System.—In its strictly technical sense, as pointed out by W. S. Murray, the basis for a super-power system lies in the economy effected by the interconnection of electric power systems whose peak loads are reached at different times; in other words diversity economy. In a power system, A, the capacity of plant in the power station must at least be equal to the peak or maximum load although the average load may be

FIG. 1.—Map of the region included in the U.S. super-power survey, 1920. (Transactions A.I.E.E. 1920.)

only from 20% to 30% of this. A neighbouring power company, B, may have similar characteristics except that the time when the maximum load occurs may be quite different from that of A. In such a case it is obvious that, given suitable connections, power house A could carry the peak load on both systems. This would leave power house B with a non-peak or base load which might be carried most economically by a hydroelectric plant or a steam plant located at the coal mine but within the range of practical transmission. The extension of this idea to the operation of a number of independent systems is the basis of super-power. The most important of the advantages are:—

(*a*) A higher capacity factor on the combined systems resulting in fewer generating units and reduced investment per kilowatt.
(*b*) A higher load factor resulting in substantial fuel economy.
(*c*) Greater reliability and continuity of service, especially in the supply of large railway or industrial loads.

U.S. Government Survey.—In the years 1919–20 a Government super-power survey was made in the United States cover-

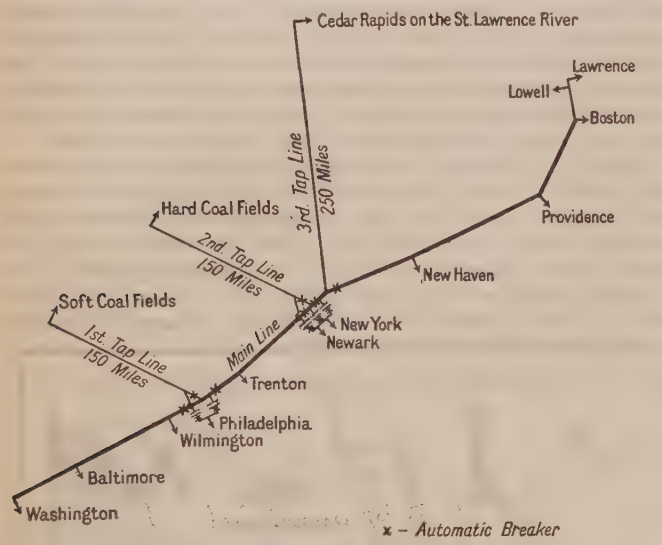

FIG. 2.—Main transmission lines and location of base load power plants for the U.S. super-power survey, 1920.

ing the region lying between Boston and Washington with a view to ascertaining what fuel economies and other advantages might be derived from interconnection and co-ordination of the power sources and industries in this territory. The subsequent report, in the preparation of which a large body of representative engineers co-operated, affords an admirable model for any study of this kind. It was shown that the total capacity of all the individual generating plants in the region was then about 13,000,000 kw. but the average load factor was only 15%. In other words, for every 100 kw. of generator capacity only an average of 15 kw. was produced. By reinforcing the power utilities with a super-power system it was shown that the load factor could be raised to 50 or 60%, and that coal could be saved to the extent of 30,000,000 tons per year. Many contingent economies were indicated, such as the reduced load on the railways for coal transportation and the diminished maintenance and upkeep of machinery.

While the report made clear that it is no function of the super-power system to replace the existing power companies, it was also shown that something more than the mere linking up of the present networks would be called for in order to meet the expanding demand for electric power. The following were therefore proposed to amplify the existing equipment of the individual power companies.

(*a*) A transmission bus line extending the entire length of the super-power region from Boston to Washington consisting of four circuits at 220,000 volts.
(*b*) A group of base load power stations located in the bituminous coal-fields of West Virginia.
(*c*) A similar group located in the anthracite coal-fields of Pennsylvania.
(*d*) A hydroelectric power plant on the St. Lawrence river.

These three groups of generating stations are to be connected by transmission lines direct to the 220,000 volt bus line at the most logical points. Base load stations are mentioned particularly because it is assumed that the peak loads would be carried by the most economical of the existing stations in the local industrial centres. It is clear, however, that, with the development of the super-power idea and the improvement in load- and capacity-factor, local peak loads would become of less and less importance. While the centres of population form the logical foci for factories, it is not necessary nor desirable for large power stations to be built in the heart of modern industrial cities and one effect of super-power will probably be the decentralisation of the power industry, the principal power sources being at the mine and the waterfall with auxiliary stations a short distance outside the individual centres.

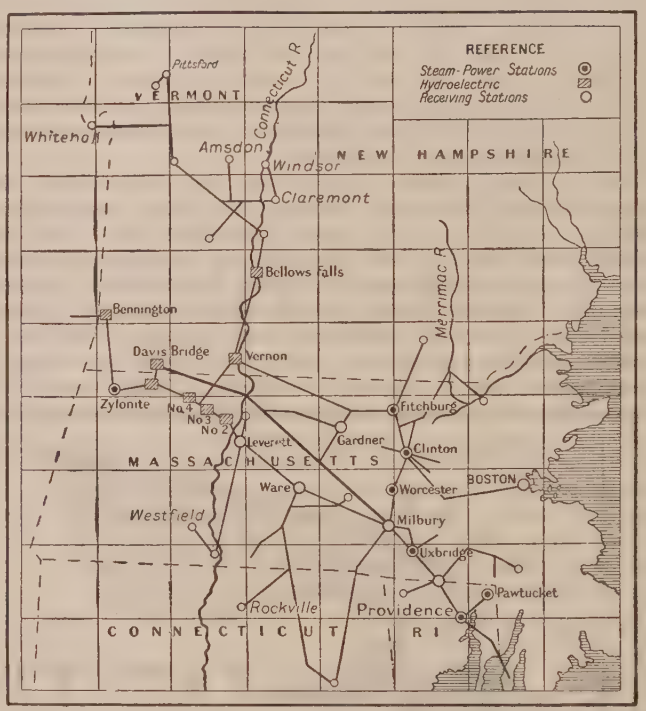

FIG. 3.—Super-power system of the New England Power Co. (Map divided into 25 mile squares.)

Other Systems.—While the development of electric power in the Boston-Washington zone has not entirely followed the lines of the above report, the tendency is in that direction. Meantime other super-power systems have grown up—mainly in the United States, of which the New England Power System and its affiliations form an interesting example (fig. 3). This company operating in Massachusetts, Vermont, New Hampshire, Connecticut and Rhode Island covers a territory of more than 20,000 sq. m. with connections to systems in other states. It has been evolved by the consolidation both financially and physically of a number of smaller independent power companies and operates (1926) eight water-power and six steam-power stations. It has a total installed capacity of nearly 200,000 kw. and in addition purchases 100,000 kw. from neighbouring systems. It should be noted that this does not comprise the entire energy consumption of the territory because several large steam plants of modern design are independently operated in Boston, Providence and other large cities. These are, however, susceptible of being connected with the New England system. Transmission lines amount to a total of 765 m. of 110,000 and 66,000 volts. A glance at the map will show widely distributed load centres concentrating toward the southeast extremity of the region and supplied by steam stations in the proximate locality. About 100 m. to the west is the Deerfield river, on which a number of power houses have been built, chief among which is that at Davis Bridge (45,000 kw.), from which an important trunk line has been constructed 76 m. southeast to the substation at Milbury.

This line, which will ultimately be operated at 220,000 volts, forms the backbone of the system and serves as a bus to distribute the load between the hydroelectric stations in the west, the steam stations in the east and the various load centres.

While special attention has been drawn to the New England system, this has been used simply as an illustration. The American Gas and Electric Co. in western Pennsylvania and the Southern Power Co. in North Carolina and a number of others might have been described as exemplifying the super-power idea in practice.

Developments in Japan.—Outside the United States, Japan and Germany have shown the most important developments. In central Japan there is virtually no coal and, while water-power sites are plentiful and are freely developed, the variation in flow of the streams is a serious handicap and leads to a high cost of development because of the difficulty of storage as well as a low capacity factor. This has been fully recognised by the engineers of some of the most important power systems. In a study of the subject Minoru Fukuda has shown that the present energy demand of central Japan is of the order of 1,400,000 kw. divided almost equally between the eastern and western zones. The potential water power available is 3,530,000 kw. but the dry season reduces this by 20%. To utilise the water power economically therefore an auxiliary 700,000 kw. must be provided by steam plants to operate during the low-water period. While there appears to be a reasonable surplus of potential power over consumed power, the load- and diversity-factors must be taken into account and only by the adoption of super-power principles can these power resources be made to meet the demand which will come upon the combined systems.

Conditions in Germany.—In Germany the problem has been somewhat different and less onerous because the majority of the new power plants are designed to burn briquetted lignite; the plants have been built in close proximity to the mines and, because of the relative absence of water power, the problems of distributing base and peak loads between steam and water stations have not arisen. Nevertheless the super-power idea is well illustrated by recent developments of the Elektrowerke A. G. and the Rhenische Westfalische Elektrizitätswerk.

BIBLIOGRAPHY.—The literature of super-power is distributed through the transactions of the principal national engineering societies during the years 1919–26, particularly the *Transactions of the American Institute of Electrical Engineers* (New York) and *Trans. World Power Conference 1924* (London, 1925); *Professional Paper No. 123*, issued by the U. S. Geological Survey, describes most fully the super-power survey of the Boston-Washington region already referred to, as well as treating of the general principles of the subject. In addition should be mentioned W. S. Murray, *Superpower* (1925); G. Klingenberg, *Bau Grosser Elektrizitätswerke* (1913 and 1914).

(E. V. P.)

SUPILO, FRANO (1870–1917), Yugoslav statesman, was born of poor Croat parents at Cavtat (Ragusa Vecchia) in southern Dalmatia. At the age of 20 he obtained a subordinate post on the staff of a small provincial Croat newspaper. In 1900 he was made the editor of *Novi List*, a new paper, founded by a group of Croat patriots at Fiume, and he rapidly made this a rallying ground for the younger generation of Yugoslavs in their struggle against the intolerable régime of Count Khuen Héderváry. In 1905, together with Trumbić, Čingrija and Smodlaka, he played a leading part in drawing up the resolution of Fiume, which became the basis of political co-operation between Serbs and Croats in the critical period before the World War. When the Magyar Coalition parties came into power in Hungary in April 1906 and placed the Serbo-Croat coalition in office at Zagreb, Supilo became a deputy at Budapest.

Within a year Magyarising tendencies produced an acute conflict between Budapest and Zagreb, and for a time Supilo was the soul of Croat resistance. He thus became a marked man and was specially aimed at in the notorious forgeries by which the Austro-Hungarian Foreign Office attempted to prove Serbia's revolutionary intrigues in Croatia and thereby to justify the annexation of Bosnia in 1908. At the Friedjung trial, however, in Dec. 1909 Supilo was triumphantly vindicated. On the eve of the World War he devoted his energies to pleading the cause of Yugoslav unity before the statesmen of the Entente. He was the first to discover the secret negotiations with Italy which culminated in the Treaty of London (April 26 1915) and earnestly warned Sazonov of the disastrous complications to which it would give rise; but he was unable to prevent the promise of wide Slav territories on the Eastern Adriatic to Italy in the event of victory. Supilo came into conflict with the Pan-Serb and reactionary tendencies of Pašić, and even withdrew from the Yugoslav Committee, which in the early stages of the War he regarded as unduly subservient to Belgrade. But before his premature death (in London, Sept. 23 1917) he heartily endorsed the Declaration of Corfu, issued in July 1917, which laid down the broad lines upon which the future Yugoslav State was to be constructed.

SUPPLY AND TRANSPORT (*see* 26.113).—The administration of supply and transport became of the first importance as the World War developed into a struggle between two groups of nations, each using the full resources of civilisation to exhaust the other. In the last stage, supply was the determining factor; munitions, food, equipment, railways, roads, ships, had become the most important things, and victory inclined to the force which could best maintain supplies, as well as men, at some particular point; which could best develop, conserve and transport its material. At the same time, in foodstuffs, forage, clothing, timber and metals, and in transport material, the world shortage was acute. Thus the work of administration was not only very heavy because of the number of combatants and the development in scale of equipment, but also because of the economic scarcity owing to world exhaustion.

The development of supply and transport services will be best understood by a very brief review of the positions respectively of the chief armies at the beginning and end of the World War.

Position in 1914.—When the armies first took the field in 1914, Germany was at a clear advantage. She had prepared for the War with meticulous care. The equipment of the German soldier was in every detail complete, and comprised several novel ideas for greater comfort and efficiency. The German transport organisation was fine, and showed that there had been a clear thinking out in advance of the new problems of ammunition supply raised by the free use of heavy artillery in the field. German staff documents published since the War by General Ludendorff indicate that these matters had been closely studied from 1910 onwards, and that the German staff were very confident of the superiority of their organisation of transport and supply. The French administrative services in 1914 appeared much weaker if examination were confined to plans and *matériel*. The troops were not as well provided for, the transport organisation not as well planned. But if the human factor were taken into consideration, much of the handicap was made up. The French showed a genius for improvisation on the actual battle field and a faculty for "getting there" with inferior means. Their food scales for man and beast (to give an example) spelt scarcity in British eyes: but they sufficed. In the battle the French soldier was not inferior in energy and endurance and the French transport was generally up to time.

British Services in 1914.—The British administrative services in 1914 were lavish both of supplies and transport. But the British Force was small, and though its scale of transport was generous compared with the French, the total was only 250 motor-cars, 950 motor-lorries, and 40,000 horses. With railway transport it had at first no concern, as the French took charge of that.

Progress During the War.—As the War developed, the Germans suffered from a steady deterioration as compared with the French and the British. The War had become a contest of *matériel*, in which Germany could not keep up. The French, on the other hand, were able to develop their supply and transport on more generous lines with the help of British and American resources. The British developed a complete machine of administration, helped by the fact that the nation took the view that all reasonable expenditure was justified in securing for the troops the best

possible chance of victory and the best possible comfort in the trenches. But the Germans, considering the depletion of their resources, kept up a wonderful efficiency in supply and transport. They realised, perhaps more clearly than the other armies, the importance of these services; in their High Command, the Quartermaster-General was allowed a remarkable power.

Trench Warfare Conditions.—During the long period of "trench warfare" which followed the battle of the Marne, the administrative systems of the three armies were adapted to new conditions, the chief of which were: an enormous increase of ammunition expenditure; the introduction of poison gas as a weapon, calling for new supplies of offensive and defensive material; and a great simplification of transport which in a stabilised warfare could follow almost a civilian routine disturbed only by the chances of shell fire and aerial bombs.

Administration thus, whilst it had to cope with the progressive increase in the scale and variety of supplies per division, was given as a rule ample time to increase its transport facilities. It could add to its broad-gauge railway tracks, supplement them by light railways and tramways as well as by motor roads and develop the canal systems as useful adjuncts. As the War opened out, with the development of great attacks on both sides, problems of supply and transport became more difficult. In facing such a German effort as the Verdun attacks of 1916, the French had a very difficult problem of transport, which was met by a motor-lorry mobilisation, the success of which was one of the great feats of the War.

Reorganisation of British System.—From 1914 up to the date of the first battle of the Somme (July 1916) the British administrative services had had no very severe test, but had developed their system almost completely. In munitions, the British Army was now better supplied than any other force in the field. It had control of its own railway services and supplementing the French broad-gauge railway system on its front—which it had taken over and increased—had a system of light railways, and a greatly increased scale of motor transport. But the Somme battle showed that supply had been increased beyond the scale that transport could cope with. There followed in Nov. 1916 a reorganisation of the system. One feature of this reorganisation was good. The division of authority which put the administrative services really under two heads, one for the battle area and one for lines of communication, was done away with. The military railways, which had been hitherto somewhat starved, were reorganised according to the plans of a civilian expert and were generously supplied with staff and material. But here, what proved in the result to be a mistake in organisation was made: railways were separated from the control of the quartermaster-general (who kept control of other forms of transport) and put under a director-general of transportation. Thus there were two separate transport authorities.

Errors of Dual Control.—After the battle of the Somme the line was practically stable for a long time. Whilst this almost stationary trench warfare continued, the weakness of the division of authority and the mistake of allowing any but the military idea to rule in an essential part of an army organisation were not apparent. When the Germans attacked in the spring of 1918 the mistake showed very clearly, and the railways were brought again under the control of the quartermaster-general, after an interval during which the traffic to be carried and its priority was regulated by a committee composed of staff officers and officers of the transportation directorate. But the transport situation in the interval was very critical. The German advance had brought the British front lateral line—St. Just—Amiens—St. Pol—Hazebrouck, under shell fire at many points. The Germans, whose strategy under General Ludendorff was dominated largely by transport considerations, sought to paralyse completely the whole railway system by continuous air attack on the British rear lateral—Eu—Abbeville—Étaples, especially at the points where it crossed the rivers Canche and Somme. Whole-hearted work in building "avoiding" lines and bridges and the efforts of the motor transport just kept the position in hand until a British advance in front of Amiens relieved the front lateral. Fortunately the building up of a G.H.Q. reserve of motor lorries had just been brought to completion.

Motor Transport System.—In the winter of 1917–8 the battle of Passchendaele had exposed a weakness in light railways—that they had to work along defined tracks which could be intensively shelled by the enemy—and therefore it was decided to trust more to motor transport. There was effected a complete reorganisation of it with the central idea of doing away as far as possible with the "earmarking" of motor vehicles for particular units or particular tasks and making its total strength completely mobile and liquid. Vehicles saved by this "pooling" were formed into a G.H.Q. motor reserve. In the spring of 1918 this G.H.Q. motor reserve was able to take up part of the traffic load and was largely responsible for saving the situation. (*See* MOTOR TRANSPORT.)

Transport Values.—One of the most interesting problems of supply and transport is that of the relative value of roads (motor and horse traction), light railways and broad-gauge railways. Light railways (*q.v.*) at one stage of the War were perhaps overestimated. There was an inclination to regard them as all-sufficing. The British system ultimately gave to them what was considered their proper rôle, recognising that they were most valuable when the line of battle was stabilised for some length of time, but tended to be less valuable as the war became one of movement. In the spring of 1918 the British Army had 920 m. of light railways in operation: in the summer, 100 m. less. Its advance was planned on the principle of concentrating labour in pushing forward the broad-gauge railways and then the roads from them, trusting to motor transport and to horse transport to carry on the load from broad-gauge railhead. Earlier in 1918, controversy on the subject was keen and the French were inclined to take a differing view. The Germans were tied to light railways, for they had not the means to extend their motor traction. The position on Nov. 11 1918 seemed to justify the British view. From a transport point of view the British force was at that date in the best position of all the Allies to make a further advance.

Position in 1918.—The autumn of 1918 will be the most useful date to compare the administrative machines of the Allied armies. Both French and American systems kept a dividing line as regards administration between base and the fighting line. The British system had abolished that in 1916 (with the post of inspector-general lines of communication). The French divided the zone of the armies into the zone of the advance and the zone of supplies (with sometimes an intermediate zone). In the zone of the advance, administration was in charge of the *aide major-général chargé de la direction de l'arrière* at headquarters. But his administration had no functions of procurement, only of distribution. In some points of administration the dividing line between the zone of advance and the zone of supplies was abolished, *e.g.*, all motor transport and all light railways, wherever operating, were controlled from headquarters. The French system of supply and distribution was fashioned for war in the home country or near to it; when it was transplanted (for instance to Salonika) it was adapted nearer to the British system. The American system put administration on the fighting line under an assistant chief of staff (G.4) at G.H.Q., and on lines of communication under a general commanding service of supply (corresponding in some degree to the old British Inspector-General of Communications). Under the American system the chiefs of the supply service were not at G.H.Q. but at the H.Q. of service of supply.

With both the French and the American systems, evacuation and hospitalisation of casualties were purely "Q" services; in the British Army they were under the Adjutant-General, assisted by the Quartermaster-General. Some other differences came from geographical reasons. The Americans had to have their real supply base in France (for the British, the United Kingdom, and for the French, France was the ultimate supply base); so they held great stocks in depots, 15 days of supplies in advance depots, 30 days of supplies in intermediate depots, 45 days of supplies in base depots. The American Army relied more largely on local

purchases (from the Allied armies and from European civilian sources) than did the armies with their home bases nearer at hand. General Pershing founded a general purchasing agency to control these purchases. In 1916, of 17,600,000 ship tons used by the American Army, only 7,600,000 tons came from the U.S.A. and 10,000,000 tons were purchased locally, and to the end of the campaign the American Army drew largely upon British and French supplies.

Relations with Navy.—The British administrative machine in one point was inferior to the American machine in 1918. Under the British system the navy had control of all supplies by ship until discharged from the transport. The navy could put a supply ship into any port it pleased and naturally was mainly guided by shipping considerations. The American system put the supply ships under army direction when they came within the three-mile limit from shore, and shipping could then be directed to the port of supply which was most convenient from the army point of view. The French and the Americans used the railway regulating stations as depots, the British used them as sorting stations only. The British used the base ports to sort goods to a great extent; the Americans did not do so. In the autumn of 1918 they found their one great depot and sorting and regulating station at Is-sur-Tille insufficient for the needs of their growing army and they were proceeding with the organisation of another station when the Armistice came.

The staffs of the various combatant nations are working out the lessons of administration as taught by the World War. One principle seems to be generally accepted, that it is wise to centralise all administration of supplies and transport under one head over the whole war area, trusting to him to devolve and co-ordinate. Another conclusion is that if civilisation has ever to face another great war it will be, even more than the contest of 1914–8, a war of material, a struggle in which supply and transport will be the governing factors. (T. C.)

SUPREME COUNCIL.—This term was evolved to denote the organ of supreme control at the Peace Conference at Paris in 1919. It was thought by some (and the idea was subsequently expressed by Sir Maurice Hankey, the Secretary to the Council of Four at Paris) that this device was a new one, and the phrase "Diplomacy by Conference" was coined to express it. But, in fact, a similar procedure was followed at Vienna during 1814–5 and subsequent years, with strikingly analogous results.

Lord Castlereagh devised the system in the autumn of 1814 of discussing large questions of policy with the plenipotentiaries of the other Great Powers—Austria, Prussia and Russia. These meetings were of the nature of conversations and were quite informal, but were generally responsible for the decisions that were taken. In Jan. 1815 Talleyrand, the representative of France, was admitted as a fifth member to the inner Cabinet of Four. Castlereagh was so pleased with this system that he endeavoured to prolong it by arranging for "periodic reunions" of the Great Powers (Article VI. of the Second Treaty of Paris, 1815). These reunions resulted in Congresses and were, for a time, successful in settling the affairs of Europe. But from 1818 onwards difficulties began to appear. Castlereagh insisted that the British representative at the Congress of Troppau (1820) and of Laibach (1821) should be merely a spectator. At Verona (1822), Canning, who had succeeded Castlereagh as British Foreign Minister, instructed the British representative to dissent from the proceedings, and this action, in effect, ended the system of "periodic reunions" which had obtained between 1814 and 1822. The experiments between the years 1919–22 followed an almost exactly similar course.

The Peace Conference.—The Peace Conference which opened at Paris in Jan. 1919 started by excluding all but the Great Powers from anything but formal deliberations. The original supreme organ was known as "The Council of Ten" and consisted of the heads of the Delegations of the Great Powers and of their respective Foreign Secretaries. This body was found too unwieldy, and it was considered that its numbers caused leakage and undue publicity. To meet this difficulty President Wilson proposed, and Mr. Lloyd George supported, the experiment of a Council of Four ("The Big Four"), who were the above named, together with M. Clemenceau (France) and Signor Orlando (Italy).[1] By this device business was transacted rapidly and informally and secrecy effectively preserved. After the departure of President Wilson and Mr. Lloyd George on June 28 1919, the Council of Four was superseded by a Council of Five which included Japan. The leading diplomat of each Great Power attended on behalf of his country. This arrangement ended in Jan. 1920, and the United States then withdrew her representative altogether.

The Supreme Council (as it was now called) did not, however, die at once, though it ceased to sit at Paris *en permanence*. Parts of its functions were transferred to the Ambassadors' Conference (*q.v.*) and part to the League of Nations (*q.v.*). Attempts were, however, still made to establish a system of "periodic reunions" between the premiers or leading men representing each Great Power. This was exactly on the lines previously attemped by Lord Castlereagh, but the meetings were actually much more frequent. There were nine such in 1920, of which three were in England; six in 1921, of which three were in England; two in 1922, of which none were in England.

The "periodic reunions" of the Castlereagh era were successful until the then enemy (France) had paid a considerable part of her indemnity, that is, up till 1818. After that date divergences between the Great Powers began to appear. So also during the years 1919–21. At the Conference of London (Feb. 21–March 14 1921) it became quite clear to the Great Powers that Germany had, in the military sense, become incapable of resisting them. It was also doubtful whether any forcible measures could actually produce substantial sums by way of reparation. On this point, grave divergences appeared between England and France. The supreme test came at the Conference of Paris (Aug. 8–13 1921). At that meeting there was a complete division between the French and British views over the assignment of territory in Silesia respectively to Germany and to Poland as a result of plebiscite. Finding agreement impossible Mr. Lloyd George appealed to the League of Nations to settle the Silesian boundary, and M. Briand agreed to accept the award of the League on behalf of France.

Mr. Lloyd George's appeal showed quite clearly that the Supreme Council was no longer a body able to settle disputes between its members, in spite of the informal and unofficial character of its proceedings and of the close personal intimacy between its members. None the less two further meetings took place. That at Cannes (Jan. 6–13 1922) failed because M. Briand was overthrown by the majority in the French Parliament, while the Council was actually sitting (Jan. 12). A desperate effort by Mr. Lloyd George to retrieve the situation by summoning a new Council at Genoa (April 10–May 19 1922) failed because of French hostility to the proceedings.

The failure of the Supreme Council would appear to have been inherent in the very circumstances of its origin and constitution. Like the similar organism created by Castlereagh, it was evolved to meet a certain need, and decayed when that need ceased to be imperative. It was necessary at Vienna in 1814 and at Paris in 1919 to devise some method by which the work of the Peace Conference could be rapidly thrown into shape and decided without too many plenipotentiaries encumbering the discussion and too much outside pressure embarrassing the decision. During periods of stress of this kind, moreover, diplomats are much more ready to arrive at agreement than during periods of comparative peace. Hence so soon as the fear of the armed enemy disappeared, divergences began to appear among the Allies. This was the case in 1818 and again in 1921. The fact is that "Diplomacy by Conference" is a method, a system or a means for oiling the wheels and for easing the pressure. But it cannot, of itself, remove pressure or create harmony.

The history of the Supreme Council, alike in 1815 and 1919, shows that to eschew formalities and to decide great issues in

[1] The Japanese occasionally sent a representative when their interests were involved, thus making a fifth member.

secret is a good method for transacting the business of a Peace Conference. It is not, and cannot be, a permanent system for conducting the affairs of the world.

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(H. W. V. T.)

SURGERY (*see* 27.125).—In the art of surgery, almost every problem is relative. Surgical indications depend on many factors, the patient's age and general condition, and the presence of diseases other than that for which surgical relief is sought. It requires knowledge, judgment based upon experience, and sound common sense to reach a proper decision. There are exceptions to almost every rule and therefore, in the space allotted to this article, it will be impossible to qualify all statements as fully as in strictly professional writings. An endeavour will be made to furnish the lay reader with a brief summary of the present status and outstanding advances of modern surgery, both general and regional.

Since 1910 the physiological trend of thought has led to great improvements in diagnosis. The X-ray and tests in conjunction with it are perhaps the most outstanding examples. Operable conditions are determined earlier and with greater accuracy. Operations are conducted with correspondingly greater safety, lower mortality and proportionately better end-results. In other words the earlier that operation is undertaken in the course of a disease requiring surgical intervention, the safer for the patient; complications are less likely and the prospects of complete restoration to health more probable. Quite opposite is the case of those reaching the surgeon far advanced in their disease, but even for them much can be done. A measure such as transfusion (*see* TRANSFUSION OF BLOOD) prior to operation, may furnish just sufficient vitality to tide the sufferer over a brief but lifesaving operation. In the operating room the improved modern forms of local and general anaesthesia may be used in combination most appropriate to each particular case. Visibility in the field of operation has been greatly improved by better lighting, better retraction of tissues and the employment of suction apparatus for removal of obscuring fluids such as pus, blood and bile.

To lessen surgical risk certain operations may be divided into several stages, each stage being performed as the patient's condition permits. Once the operation is passed, a host of measures are available for sustaining life and increasing comfort. Notable examples among these are the semi-reclining position similar to that assumed in a steamer chair, various methods of administering fluids other than by mouth, transfusion where much blood has been lost and lastly the use of insulin combined with glucose for those having diabetes. Competent, intelligent nursing cannot be left out of this list. As convalescence goes on, physiotherapeutic measures, the value of which came into such prominence during and after the World War, are employed to hasten recovery and accelerate restoration of function. The intelligent lay public has come to appreciate the importance of early surgical intervention, an indispensable factor in the success of present-day surgery.

The X-Ray in Relation to Surgical Diagnosis.—Often the results of an X-ray examination can be given their correct diagnostic value only when taken in consideration with the history, physical signs and perhaps certain laboratory tests. (*See* DIAGNOSIS.) As a consequence of co-operation between various specialists, *e.g.*, the surgeon, the physician, the pathologist and the Röntgenologist, one sees refinements and advances in diagnosis, not attainable in the pre-Röntgen era. Operable conditions are recognised much earlier, and the patient often saved months of suffering. Unnecessary operations are avoided for those the X-ray shows to be beyond the aid of surgical treatment. Lastly, the ubiquitous functional neurotic whose symptoms so closely simulate organic disease is saved a needless operation, and is referred to the neurologist or psychiatrist for the rational care of his disabling condition. Furthermore, information obtained by the Röntgen ray is of the utmost value as a control in the course of surgical treatment and in estimation of end-results.

Exposures are taken from in front (antero-posteriorly) and from the side (laterally) whenever feasible, particularly in fractures. Stereoscopic views are especially valuable for depicting finer details in regions of the skull, thorax and pelvis; and also for more exact location of foreign bodies such as needles and bullets. (*See* RÖNTGENOLOGY.) The diagnostic and therapeutic uses of the X-ray are entirely different in matters of wavelength, duration of exposure and so forth. Photographic glass plates have been entirely supplanted by celluloid films, because of the obvious physical advantages of the films in being lighter, less bulky and non-breakable. To avoid repetition, special applications of the X-ray and other modern diagnostic methods will be mentioned as occasion requires in the next to follow.

Surgical Aspect of Tuberculosis.—In 1910 the curative value of rest and hygienic measures was well recognised in the treatment of this disease. Rest of the affected part as well as of the entire body was practised then. Tuberculosis of bones and joints was treated by long immobilisation in plaster-of-Paris casts, braces and so forth. Ankylosis (a stiff joint) in the most favourable (that is, the least disadvantageous) position was the goal sought at that time as it still is in far-gone cases. Nowadays in early stages, the Rollier method of heliotherapy has furnished a great advance. Casts holding the affected joint at rest have openings cut in them to permit exposure of the diseased area to direct sunlight. Furthermore, the treatment consists of gradually increasing the time of exposure and area exposed until the entire body except the head is accustomed to sunlight for long periods of time. This results not only in great improvement in general health but a regression of the local tubercular process with ultimate return of function. Essential factors of the Rollier method are: high altitude (about double the number of actinic rays are available at 5,000 to 7,000 ft. than at sea level) and sunlight without wind. The sanitaria lie in a high, sheltered Alpine valley where sunshine is very prevalent.

The sunlight treatment has also proved a most efficient means of curing other forms of so-called surgical tuberculosis; for example, tuberculous glands of the neck (tuberculous cervical lymph adenitis) in all stages. Nowadays it must be mentioned that this condition is far less common in the United States than formerly, owing to the great regression of tuberculosis in general and to the widely practised removal of diseased tonsils and adenoids in infants and children, the tonsil being the port of entry for the tubercle bacillus (tonsils removed from patients with tuberculous glands of the neck almost invariably show lesions of tuberculosis upon microscopical examination). Artificial sunlight in those countries where sunlight is infrequent has proven of great value. It must be emphasised that the improvement in the general health following exposure of the entire body is just as essential to cure as local exposure of the affected region. (*See* also HELIOTHERAPY.)

Another regional application of the principle that rest hastens healing in tuberculosis is the employment of artificial pneumothorax which allows collapse and inactivity of one lung by filling the pleural cavity of that side with nitrogen gas. Where this is not feasible because of pleural adhesions, a plastic operation (extrapleural thoracoplasty) accomplishes the desired purpose by diminishing the size of bony thorax.

Surgical Aspect of Syphilis.—Examination of the blood for the Wassermann reaction is a routine in every well organised hospital and clinic. When positive in an individual without obviously characteristic lesions, it generally indicates[1] latent but actively existent syphilis. Such knowledge is of the greatest

[1] Certain diseases like active malaria and leprosy also produce a positive Wassermann reaction. Sometimes the reaction is also seen during an acute febrile disease and for a day or so after administration of a general anaesthetic.

value. The late manifestations of syphilis often simulate cancer or tuberculosis, and while the presence of syphilis does not exclude either of these other diseases, further diagnostic measures and anti-syphilitic treatment are invariably indicated before operation is resorted to. X-ray pictures of bones affected by syphilis show characteristics quite different from the lesions of tuberculosis or cancer in osseous tissue. If after several weeks of anti-syphilitic treatment there is no apparent improvement, it is then time to consider surgical intervention.

In surgical emergencies such as strangulated hernia, perforated gastric ulcer or acute appendicitis, operation cannot be deferred, but in the presence of florid syphilis with obvious and active lesions, the greatest care must be exercised by surgeons and attendants to protect themselves against accidental wounds or inadvertent contacts. The mysterious failure to heal, noted in certain clean postoperative wounds in years gone by, is now largely explained by a positive Wassermann reaction in an apparently healthy patient. Other causes for the failure of clean wounds to unite also exist, but one must exclude syphilis before considering these. Long-standing syphilitic lesions of the oral cavity are not infrequently followed by a cancer in old scar tissues, so that one must be on the lookout for this concurrent incidence, the failure to recognise which has often led to diagnosis so late that surgical relief for the cancer was impossible and death almost inevitably followed.

Cancer.—Cancer often begins as a painless, hard, slowly growing lump. At first it remains localised, then as time goes on it spreads to the regional lymphatics (for example, cancer of the breast spreads to the lymph-nodes of the armpit) and finally it is found in distant parts of the body far removed from its original site. The surgical treatment consists in wide excision of the tissues around a primary cancer together with removal of the regional lymphatics. To use the same example, in cancer of the breast the lymphatics of the axilla are dissected out in one mass together with the affected breast. Likewise in cancer of the tongue, lips or cheek, the lymphatics of the neck are removed en bloc in addition to wide removal of tissues around the original focus of growth (*see* CANCER RESEARCH). If there is no recurrence within five years after removal, a cure is probable; most recurrences come on within three years; after five years they become less and less frequent.

Except for the treatment of a relatively benign type of facial cancer (basal cell carcinoma), radium is better reserved for the palliative treatment of inoperable cancer at least at the present writing. Radium is ineffective farther than 1 cm. from the point of application. X-rays are used with far more accurate control of therapeutic dosage both for preoperative and postoperative irradiation, and for the palliative treatment of inoperable cancers. Periodic physical examination at least once a year is the best means of safe-guarding the public, as early discovery and early removal offer the best hope of total eradication.

Surgical Aspect of Typhoid Fever.—Since the era of preventive inoculation typhoid fever is no longer the menace it once was. Nowadays surgeons rarely see its surgical complications of hemorrhage from the bowel, perforation of the small intestine and metastatic typhoid abscesses. (*See* TYPHOID FEVER.)

Tetanus or Lockjaw.—Tetanus is another disease one rarely sees now, thanks to routine injection of tetanus antitoxin in the presence of accidental wounds. Comparison of the medical reports on the incidence of tetanus in the World War with similar reports prior to the introduction of routine prophylactic injection will demonstrate the protection we now enjoy.

Gas Bacillus Infection.—Gas gangrene, as this is usually called, is characterised by rapid spread in the tissues, their typical brawny look and the tell-tale subcutaneous crackle felt by the examining fingers. Ruthless removal (including even amputation) of all diseased tissue and administration of a specially prepared serum must be carried out as soon as the diagnosis is made if life is to be saved. These cases were all too frequently seen in the World War; fortunately they are less common in civil life.

Surgical Aspect of Diabetes.—Operative treatment in the presence of diabetes is practically the same as in patients without this disease, except for the increased risk. The preoperative administration of insulin and glucose for the prevention of postoperative acidosis is a well recognised procedure. Prolonged anti-diabetic treatment before operation for conditions such as diabetic gangrene, carbuncle and acute appendicitis has not met with success. The patients have not improved as was hoped and the postponement of the operation has resulted in their being in poorer condition to stand it than if surgical measures had been taken more promptly. While it is true that insulin is a specific for diabetic coma, one often sees comatose diabetics who fail to react to insulin; the explanation of this is that the coma is of uraemic origin or, plainly put, the diseased kidneys have ceased to function adequately. (*See* also DIABETES; INSULIN.)

Preventive Medicine.—Present-day medicine and surgery are preventive in character. Nowhere is this better illustrated than in the modern care of children and infants. By timely and relatively simple methods, conditions causing deformity or systemic disease are checked in their incipiency; for example, infantile scurvy and rickets are rarely seen nowadays, and, if present, can be cured by simple diatetic and hygienic measures. Operations for rachitic deformities such as bow-legs are much rarer than in former years. The removal of diseased tonsils and adenoids has greatly diminished the incidency of quinsy, otitis media (inflammation of the middle ear), mastoiditis, acute articular rheumatism, endocarditis and tuberculous glands of the neck. Modern dentistry also has its share in preventing deformity and eliminating focal infection, in children as well as in adults. (*See* DENTISTRY.) The earlier recognition of such diseases as empyema of the thorax following pneumonia, foreign bodies in the bronchial tree (see *Bronchoscopy* below), intussusception (a form of acute intestinal obstruction especially prevalent in infancy) and acute appendicitis, has greatly reduced the mortality of childhood from these causes.

Hare-lip and cleft palate are congenital deformities which often occur together. The hare-lip should be repaired, under local anaesthesia within a few weeks after birth. This union of the lip causes the gap in the cleft palate to narrow as time goes on, facilitating surgical closure later. Even though the operative repair of cleft palates be successful, speech defects often remain in spite of training to overcome them.

Congenital pyloric stenosis (a narrowing of the lower or pyloric end of the stomach by muscular overgrowth of the pyloric sphincter) was formerly relieved by the operation of gastro-enterostomy, *i.e.*, anastomosing stomach with small intestine. This was designed to prevent death from inanition through failure of food to leave the stomach. More recently, the operation devised by Rammstedt, which consists in dividing this muscular constriction longitudinally down in the lining mucous membrane of the stomach, has effectively relieved constriction. The procedure is much shorter and may readily be performed under local anaesthesia upon the new-born; the mortality has been greatly decreased.

Transplantation of Tissue.—Transplantation of tissues is, on the whole, unsatisfactory *except when taken from the same individual.* The transplants when taken from others, even from blood relatives, may at first heal into place but ultimately disappear, leaving scar tissue behind. Taken from the same individual, the less highly organised tissue such as skin, fat, fascia, tendon, cartilage and bone are amenable to successful transplantation from one region to another. Skin transplantation is an old, well recognised procedure which has undergone considerable refinement of late years. For description of its manifold uses and many ingenious variations of technique now successfully employed, the reader is referred to standard works on plastic and cosmetic surgery. Indications for transplantation and choice of other tissues, the most suitable types of procedure, after-care and the criteria of success are so relative and manifold that space is lacking for adequate discussion. By no means has the last word been said upon this subject. (*See* also BURNS.)

Surgical Anaesthesia

General Anaesthesia (*see* also Anaesthetics).—Chloroform is practically obsolete, being used only upon the rarest occasions and then by skilled professional anaesthetists. In less experienced hands it has proved to be highly dangerous. Compared with ether, chloroform would represent the sharpest kind of a razor, while ether might represent a relatively harmless butter-knife. In obstetrics chloroform has likewise been supplanted by ether or nitrous oxide and oxygen because it has been proved that chloroform is harmful to the liver. Late chloroform poisoning coming on ten days after its administration is identical with hydrochloric acid poisoning. In eclampsia the liver cells are already greatly damaged and chloroform adds insult to injury. The deaths from eclampsia have greatly diminished since ether has been used to control the convulsions. Ethyl chloride may be called a highly volatile chloroform. It is extremely dangerous because of the ease with which an overdose may inadvertently be administered.

Until 1915 ether was the anaesthetic of choice, but since then nitrous oxide with oxygen has come into deserved popularity; with it ether is used in minimal amounts to afford greater muscular relaxation for a short period whenever this may be required by the operator. In some clinics ethylene has been found entirely satisfactory but has not received general adoption. Rectal anaesthesia, that is, the introduction of a certain amount of oil mixed with a given quantity of ether, introduced into the rectum, is employed at certain clinics in operations upon the jaws, tongue, larynx or that part of the gullet lying in the neck. In former years, various types of complicated, cumbersome differential pressure apparatus were used to prevent collapse of the lung and assure sufficient aeration when the pleural cavity was opened. Later intratracheal anaesthesia and still later intrapharyngeal anaesthesia was found to accomplish the same result in a far simpler manner. Nowadays the mask of a laughing gas-oxygen-ether apparatus is entirely adequate for this purpose. (*See* Thoracic Surgery.)

Local Anaesthesia.—When cocaine was practically the only substance known for this purpose, its field of usefulness was limited because of its high toxicity. Since then a host of less toxic substances have been discovered, chief among which is novocain, and the field of applicability has greatly widened. A solution of 250 c.c. of ½ of 1% of novocain may be used in an adult weighing 150 lb. without danger. Solutions of even 0·1% are effective. (See Gaston Labat and W. B. Saunders, *Regional Anaesthesia*, 1923.)

Regional Anaesthesia.—A local anaesthetic acts by virtue of its power to deaden nerve tissue, either at the sensory endings of nerve fibre (local infiltration), or along nerve trunks. For example, a few drops of solution in the eye renders the surface of the eyeball insensitive; or injected into the substance of the skin (raising a wheal) makes the injected area anaesthetic. For rendering greater areas insensitive it is more practical to deaden nerve trunks at a distance from the region to be operated upon (block anaesthesia) or even at their exit from the spinal canal (paravertebral anaesthesia; caudal or epidural anaesthesia). Carrying this principle to its logical conclusion, the anaesthetic solution may be injected into the spinal canal, thus rendering sensation of the entire body inactive from the level injected downwards. Spinal anaesthesia is applicable for the lower half of the body. It must not reach upwards because of danger from paralysing the vital centres in the medulla oblongata. The addition of adrenalin (epinephrin) to solutions of local anaesthetics is of advantage in that it lessens diffusion by local contraction of capillaries; in other words, keeps the solution at the place it should function and slows the rate of absorption by the tissues. Magnesium sulphate is advocated by some authorities as an adjuvant to local anaesthetics. The conscious patient's apprehension is the only disadvantage of local anaesthesia. This may be largely avoided by exhibition of morphine or codein in maximal doses shortly before the operation. Scopolamine, a drug in vogue a few years ago, has been gradually discarded. It was the drug employed for inducing " Twilight Sleep " in labour.

The combination of local anaesthesia, general anaesthesia and analgesia induced by such drugs as morphine is being more widely used as time goes on. The surgeon's experience dictates their indication or limitation in each individual case. For example, if a patient suffers from acute tonsillitis and acute appendicitis the abdominal wall may be opened under local anaesthesia, the appendix actually removed under general anaesthesia, and the abdomen closed under the original established local anaesthesia. Thus the chances of post-operative pneumonia are minimised.

Operative Technique

Aseptic technique, now universally adopted, has reached a high state of efficiency. Operators invariably wear caps and masks, sterilised long-sleeved gowns and rubber gloves. All skin is potentially infective, no matter how its cleansing be accomplished. In recognition of this principle, the surgeon after scrubbing and disinfecting his hands and forearms to well above the elbows, dons sterilised long-sleeved gowns and rubber gloves. Likewise it is often customary to fasten sterilised towels to the wound's margin, after incising the skin, to prevent possible contamination of the deeper tissues. The steam-pressure steriliser in which gowns, gloves, gauze and drapings are sterilised, may at times be carelessly operated by unskilled attendants. To make certain of absolute sterility at all times, steriliser controls are inserted in the centre of all packages before being placed in the steam-drum. These controls are sealed glass tubes containing small cylindrical red pellets of material fusible at a temperature somewhat higher than actually necessary for adequate sterilisation. The surgeon can thus determine whether sufficient heat to produce adequate sterilisation has reached all parts of the package.

The sterilisation of instruments is easily accomplished by boiling in water to which carbonate of soda has been added. The addition of soda prevents rapid rusting of steel upon exposure to air after being boiled. Usually instruments are sterilised for 15 minutes to assure absolute sterility. (The spores of tetanus and anthrax bacilli are capable of withstanding boiling water for at least three minutes.) Sterilisation of edged instruments like scalpels is accomplished in some clinics by boiling in paraffine oil, while in others, chemical sterilisation by means of carbolic acid or one of its derivatives, is customary. Keen-edged knives are somewhat dulled by boiling in soda solution.

Suture Materials.—Strands of sterile catgut in sealed glass tubes are universally employed throughout the United States. These are furnished in two varieties: in one, boiling does not weaken tensile strength; in the other it does, and the tubes of this variety must be sterilised by long immersion (storage) in strong antiseptic solutions. Absorbable suture material is used for repair of deeper structures, whereas non-absorbable material,[1] such as silk, silkworm gut and horsehair, is mainly employed for suturing the skin. On the continent of Europe, in many clinics, fine silk is still used for ligatures and sutures in the depths.

Clinical Antisepsis (*see* Antiseptics).—Alcoholic solution of iodine (tincture of iodine) or alcoholic solution of picric acid is now used for disinfection of the skin of operative fields, having supplanted the cleansing with soap and water followed by benzene, alcohol and ether. Some time before operation, however, it is necessary to shave and wash the operative field, thus allowing time for the skin to dry. This is essential to assure adequate penetration by the alcoholic solution of iodine or picric acid, which has been found much less effective when applied to the wet skin. Dakin's solution still holds a pre-eminent position in the antiseptic treatment of infected or potentially infected wounds. A host of other antiseptics, such as acriflavine, rivanol and mercurochrome, have many strong individual adherents, but not one has gained universal adoption.

The silver salts (silver nitrate, argyrol, protargol, collene and others) still hold their pre-eminent position in the treatment of infections of the mucous membranes of the eye, nose and throat,

[1] Also furnished in sealed glass tubes by manufacturers.

bladder and urethra and so forth. The greatly prolonged use of silver nitrate, either as a gargle when small quantities often are inadvertently swallowed, or for irrigation of large cavities lined with granulation tissue, may result in considerable absorption; as a consequence there is a general staining of the body tissues naturally most apparent in the skin and whites of the eyes. The staining is absolutely permanent and the condition is termed argyrosis, examples of which are sometimes seen in the "blue man" of the circus.

Bichloride of mercury (corrosive sublimate) is still used in disinfecting solutions for the surgeon's hands and forearms after thorough and prolonged scrubbing with soap and water. It has been abandoned, however, in solutions for irrigations and local wet dressings. Left in contact with the skin, it is apt to give rise to marked irritation, "bichloride dermatitis," and, if left filling large abscessed cavities, its absorption has given rise to systemic mercurial poisoning.

Carbolic acid likewise has been greatly restricted in its application. It is still used to disinfect sharp-edged instruments and in some clinics for its cauterising effect upon the stump of the appendix. In weak solution, as wet dressing for injured fingers, it is especially dangerous. Beneath this wet dressing the skin of the finger becomes insensitive and, if the solution be applied long enough the entire thickness of the skin or even the entire digit dies and eventually sloughs off. This condition is known as carbolic gangrene, pictures of which may be seen in the older text books on surgery. Carbolated vaseline may likewise cause carbolic gangrene. Absorption of weak carbolic solution by prolonged contact with raw surfaces may lead to absorption and general poisoning. Smoky urine, that is urine clouded with disorganised tissue and blood cells from the damaged kidneys, causing a brownish colour, is one of the typical symptoms of this condition. Hydrogen peroxide as an antiseptic in small accidental wounds is probably utterly valueless. Tincture of iodine, alcoholic solution of picric acid, acetic acid (even household vinegar which is diluted acetic acid), are far more effective antiseptics for accidental wounds.

Preparation for Operations.—In the presence of acute respiratory infections, general anaesthesia is contraindicated. During severe influenza epidemics, no operations except those of an emergency, life-saving nature should be undertaken. If the operation is not urgent, one waits until the coryza or bronchitis has subsided. On the other hand, if an operation is imperative, as much as possible is done under local anaesthesia and if general anaesthesia must be given, the use of nitrous oxide and oxygen would be least likely to be followed by post-operative pneumonia.

The stomach and intestines should be empty. If general anaesthesia is administered to a patient with a full stomach, he is sure to vomit while semi-conscious. Some of the vomited material may be drawn into the larynx, leading to immediate suffocation if the inspired material is a bolus of food. If the vomitus is fluid, it reaches the lungs and by infecting them may readily lead to pneumonia. For non-urgent operations, it is easy to have the alimentary tract empty by administering a cathartic and withholding food for a few hours before operation. Before emergent operations, the stomach is emptied by the passage of a stomach tube, followed by gastric lavage, and the intestines may be emptied by an enema. The bladder must be emptied either by the patient's own act or, if this is not possible, by catheterisation. A full bladder fills the pelvis and hampers proper exposure of the pelvic organs.

Upon completion of the operation, the patient is swathed in warm blankets to prevent chilling. Upon reaching his bed he is laid flat upon his back with head turned to one side to avoid possible aspiration of vomitus until consciousness is regained; only then may a pillow be placed beneath the head. In the presence of shock, the foot of the bed is raised to facilitate circulation to the vital centres in the brain. Warmth is maintained by hot-water bags wrapped in flannel, in addition to blankets. Particular care is taken that these bags are not so hot as to burn the unconscious subject. Stimulation is administered by a suitable hypodermic injection or by intravenous administration of normal saline solution or 5% solution of glucose. Transfusion of blood is also given if needed.

The administration of water is of prime importance. Usually within a few hours, small amounts may begin to be given.[1] At times, however, the nature of the operation or the condition of the patient forbids administration of water by mouth. The rectal administration of water either by a continuous drip or at the rate of one pint every two hours, slowly given so as to be retained, is an excellent means of furnishing needed fluid. Still another method is by hypodermoclysis; that is, under aseptic precautions, either normal saline solution or preferably sterile water containing 0·05% novocain (25 c.c. of 0·5% novocain in 500 c.c. of sterile water) is injected subcutaneously as often as may be needed.

Diet.—There is no urgent necessity for feeding the average patient for four or five days after operation, provided he gets enough fluid. Nourishment is gradually resumed, beginning with the more easily digested fluids and gradually coming to the customary articles of everyday character.

Treatment of Operative Wounds.—Clean wounds in the usual course of events are not disturbed until it is time to remove skin sutures. Infected wounds are dressed as often as required, at least once every day, sometimes more frequently. Under ideal conditions of drainage, all the discharges are to be found in the dressings, in other words there is no welling up of pus from the depths of the wound upon exposure. In short, the age-long rule of adequate drainage in the presence of infection holds to-day as it ever will. The continuous instillation of improved antiseptic solutions is often a distinct aid, but is of no avail unless retention of pus is avoided by the establishment of proper facilities for adequate drainage. The mechanical devices for providing rest and elevation without hindering access to the wound, particularly in surgery of the extremities, cannot be described for lack of space.

Post-operative accumulation of gas, causing abdominal distention and cramps, may be controlled by applying turpentine stupes, and inserting a rectal tube, and by giving hypodermic injections of pituitrin,[2] and enemas of varying composition and quantity. Under ordinary circumstances, after an abdominal operation, a patient may be allowed out of bed at the end of two to three weeks, depending on his personal condition and the nature of the operation. It is not uncommon for the feet and ankles to swell for a short time, a day or two after getting up. If warned of this possibility and its spontaneous regression, much unnecessary alarm may be avoided. Realising that few persons are physically capable of resuming their ordinary occupation immediately after leaving the hospital, the social welfare departments established in all large clinics arrange for post-convalescent recuperation of from one to several weeks, and thus assist the patient to resume his natural course of life in restored health and strength.

Neurological Surgery

With the exception of certain tumours of the cerebellar-pontine angle, the localisation of brain tumours was in an unsatisfactory state until the introduction of ventriculography by Dandy of Johns Hopkins. By means of this method, the ventricles of the brain filled with air may be depicted by Röntgen ray. Distortions from the normal, in size, symmetry and so forth, furnish most valuable clues regarding the site of the tumour although the growth itself is not visible. Combined with this great diagnostic advance, one sees wider exposure of the operative field and more radical and extensive intervention.[3] As material accumulates and experience grows, the classification of brain tumours is undergoing revision. The palliative operation of subtemporal decompression, designed to relieve increased intracranial pressure incident to a brain

[1] Water or tea as warm as possible, when given by mouth, is far less likely to cause gas pains than the ice-cold drinks which the patient so often requests.

[2] Pituitrin is a powerful stimulant of smooth muscle and must not be given in the presence of any mechanical obstruction to the passage of intestinal contents.

[3] Large sections of brain have been removed from so-called silent areas without affecting normal function.

tumour, is much less often practised than formerly. Several ingenious methods have been devised to reach the rather inaccessible pituitary fossa at the base of the skull. Operations for relief of enlargements of the pituitary gland show results which have mostly been palliative.

Surgical diseases of the spinal cord, in contrast with those of the brain, present fewer diagnostic difficulties and are much more easily approached. The operation of laminectomy consists of removal of vertebral spines and laminae in order to open the dural sheath longitudinally, and bring the spinal cord into view. Further operative procedure depends upon the conditions encountered. For relief of intractable facial neuralgia, extirpation of the Gasserian ganglion has now been supplanted by a simpler, safer, Frazier-Spiller operation consisting of simple division of the ganglion's sensory root. There is practically no mortality, in striking contrast to the method it has supplanted. Paralysis of the facial nerve may be relieved by anastomosis with some other readily accessible motor nerve in the neck. The paralysed half of the face regains its normal appearance in repose, but mimetic control rarely reaches perfection.

In surgery of the peripheral nerves (*see* also ORTHOPAEDIC SURGERY), the repair of damaged motor nerves constitutes the main part of this field. The nerve cells lie in the spinal cord and from there send their prolongations (aggregations of which constitute the peripheral nerves) to all parts of the body. If a severed nerve is reunited, the active nerve elements begin to grow from the point of division downwards along the paralysed peripheral trunk until they reach the motor end-plates in the muscles normally supplied. The rate of growth is slow, and meanwhile the paralysed muscles must be kept in a relaxed (not overstretched) state by suitable orthopaedic appliances (splints, braces and so forth). Severe injuries to nerve trunks of the extremities often result in considerable loss of substance; consequently the nerve ends may lie several inches apart

Approximation of the separated ends may be facilitated by suitable changes in posture; for example, flexion in defects of the median or musculo-spiral nerves, or extension for defects of the ulnar nerve, may overcome gaps of one or two inches. Position thus favouring approximation must be maintained for several weeks until healing is assured, and only then may there be a gradual relaxation to normal. Nerve cabling has been used to bridge longer gaps. Results are still inconclusive. A length of purely sensory nerve is excised; this is then divided into shorter lengths just sufficient to bridge the gap. These are laid together to form a cable of diameter equal to the trunk being repaired. If the torn nerve ends are buried in a mass of scar tissue[1] dissection is begun both above and below this point to expose the uninjured nerve in its normal relations, and from these points both ends are traced to their termination in the scar. They are then laid back and the scar itself is excised. If within the nerve ends themselves there is much cicatricial tissue, cross sections are progressively removed, until normal nerve tissue is exposed; only then should anastomosis be attempted. The recently revived and elaborated operations on the sympathetic system are still in the experimental stage. While the one devised to relieve the pain of angina pectoris accomplishes its purpose, it is to be remembered that the basic pathological changes in coronary arteries and heart muscle remain and pursue their course.

VARIOUS TYPES OF SURGERY

Surgery of the Face.—Cosmetic and plastic surgery, especially of the face, has undergone considerable improvement following our large experience in the World War. By transplantation of skin, cartilage, bone and fat, results have been accomplished which by ordinary plastic methods would have been impossible. Fractures of the jaws are best treated by dentists and oral surgeons whose mechanical appliances are most effective in maintaining correct alignment and approximation of fragments.

[1] It is unsafe to re-operate after prolonged suppuration for at least one year after healing. Viable pathogenic bacteria persist in the scar, and premature operation releases them with resultant infection and failure of the operation.

Surgery of the Nose and Throat.—Tonsillotomy, amputation of the projecting prominence of the enlarged tonsil, is obsolete, because it was found that the remaining deeper portion of the tonsil still acted as a source of infection. Tonsillectomy (enucleation, that is, shelling out of the entire tonsil from its bed) is now universally preferred. General anaesthesia is preferable for this in children. By means of a suction tip used throughout the operation, mucus and blood are constantly removed from the back of the throat and the aspiration of material into the bronchi and lungs prevented. Prior to routine use of suction, lung abscess following removal of tonsils and adenoids was not uncommon. Adenoids if completely removed in infancy occasionally recur in later childhood.[2] Tonsillectomy in adults is usually performed under local anaesthesia. Recovery requires more time than in children. Experience has shown that chronic infections of the upper respiratory tract (of the tonsils and adenoids and also of the accessory air sinuses such as the ethmoid and frontal sinuses and antrum of Highmore) lead to continual reinfection of the bronchi and lungs. Therefore in every case of so-called chronic bronchitis, all foci of infection in the upper respiratory tract should be found and treated. The lungs will then often heal of their own accord.

Use of the Bronchoscope.—The recent development of bronchoscopy marks a great advance in the diagnosis and treatment of pulmonary disease. The bronchoscope, a long smooth tube of suitable calibre, illuminated at its distal end by a small hooded electric lamp, is introduced through the mouth and larynx down the trachea to its bifurcation; deviation of the instrument to either side then permits further introduction and inspection of the bronchus and its smaller branches. By means of bronchoscopy the following may be accomplished: (1) removal of foreign bodies, some of which such as wooden objects are not revealed by the Röntgen ray; (2) recognition of growth, small pieces of which may be secured for miscroscopical examination and diagnosis; and (3) localisation and treatment of lung abscesses, especially those lying close to the root of the lung. By introduction of a suitable small tube through the bronchoscope into an abscess, its purulent contents may be removed by suction, and appropriate antiseptics in either powdered or liquid form may be injected under control of the eye. A certain proportion of lung abscesses heal spontaneously. Another group, especially those lying near the hilus, may be cured by the bronchoscopic treatment just described, while a third group, chiefly those lying in the peripheral lung tissue, finally require surgical drainage for their cure by approach and exposure through the thoracic wall and intervening lung tissue. (See *Surgery of the Thorax* below.) All lung abscesses should first be given the benefit of bronchoscopic treatment and only when this proves ineffective should operation be resorted to. After the World War quite a number of patients presenting symptoms of cough, profuse expectoration, fever and wasting, who were received at sanitaria for pulmonary tuberculosis, eventually proved to be cases of lung abscess. Mistaken diagnosis of this sort is not uncommon to-day.

Use of the Esophagoscope.—Esophagoscopy is identical with bronchoscopy except that the instrument is introduced into the esophagus instead of the trachea. By means of this the following may be accomplished: (1) removal of impacted foreign bodies, (2) recognition and exact localisation of diverticula (abnormal pouches or sacculations in which food may accumulate and stagnate) and (3) determination of the benign or malignant character of strictures. Intrinsic strictures of the esophagus may arise from one of three causes: (1) cardiospasm, a functional spasm of the cardia where the gullet enters the stomach; (2) cicatricial contraction of a healing or healed ulcer usually caused by accidental (or suicidal) swallowing of caustic alkalies or acids; and (3) narrowings from encroachment upon the calibre of the gullet by new growths usually cancerous. Extrinsic causes of esophageal obstruction, that is, pressure upon this tube from without, may be due to aneurism of the aorta, tumours of the mediastinum

[2] A child who is an habitual mouth-breather, especially while asleep, may reasonably be suspected of obstruction of the back of the nose by hypertrophied adenoid tissue.

and so f in which event the esophagoscope reveals normal conditiothin this passage.

Surgerthe Neck.—Local anaesthesia is much more extensively usan in former years for operations in this region. Since theoduction of diphtheria antitoxin and intubation, the occasfor tracheotomy have greatly diminished. (Up to the earlyties tracheotomy for diphtheritic laryngeal obstruction a common emergent procedure.) Laryngectomy for intrinarcinoma of the larynx affords an excellent prospect for nanent cure in early cases. Diverticula of the esophagusg in the neck are more easily located at operation by co-opein between bronchoscopist and surgeon, the former inserting lighted instrument into the pouch when the latter has reacheeper layers of the neck from without. Block dissection of fascia and lymph nodes of the neck is practised in conjunctioith operations for carcinoma of the face and oral cavity (s*cancer* above). Growths in this region tend to spread loc by way of the lymphatics (necropsy in cases of cancer in tegion rarely show extension to distant parts of the body). He it is logical to exert every means of preventing local recurre as just indicated.

Rupture the brachial plexus (of nerves) is most commonly seen as birtalsy. Exploration and exposure of nerves to the arm as themerge from the spinal column at the root of the neck, revealne of two conditions: either the nerves have been torn across some point between the spinal column and where they pass do to the arm under the clavicle, or their roots have been torn oof the spinal cord. In the former event, the torn ends may bnited with good hope of ultimate recovery. In the latter case, tinjury is irreparable. Surgical exposure offers the only means determining which condition exists.

Phrenicoty (division of the phrenic nerve in the neck) is said to parae the corresponding half of the diaphragm; it is sometimes ptised in conjunction with other means of putting one lung at r(*see* THORACIC SURGERY; also SURGERY OF HEART AND LUNGS). öntgenograms of structures in the neck may demonstrate succonditions as narrowing and distortion of the trachea by comession from enlargements of the thyroid gland, diverticula ohe esophagus, accessory ribs (occasionally causing neuralgia of e brachial plexus) and fracture or disease of the cervical vertcal structures. (J.C.A.G.)

Surgery of e Thyroid Gland.—The mortality of operation on the thyroid ghd compares favourably with that of any in major surgery. Statics show that, computing operations, a mortality rate of 0·95% as been attained, and computing cases, a rate of 1·2%. The deases of the thyroid gland amenable to surgery may be groupl under six headings: (1) diffuse colloid thyroid, (2) adenoma vhout hyperthyroidism, (3) adenoma with hyperthyroidism, (exophthalmic goitre, (5) thyroiditis and (6) malignancy. iffuse colloid goitre is a physiologic enlargement of the thyroid land occurring in adolescence, caused by insufficiency of iodin nd cured by the administration of iodin or thyroxin. Unless olloid goitre is associated with adenoma, or by its size causes presure symptoms, operative treatment is not indicated. Adenoa without hyperthyroidism should be treated surgically, partly for cosmetic purposes when the goitre is unsightly and forthe relief of pressure symptoms, and partly because a certain proportion of patients subsequently develop hyperthyroidism. The operative risk is less than 0·5%, and the operation results in cure in practically 100% of cases.

If adenoma of the thyroid gland is complicated by hyperthyroidism, the onset is usually so insidious that operative treatment is not sought until marked degeneration of important organs has taken place; this increases the operative risk and diminishes the chance for complete cure. The operative mortality in this stage has been found to be between 2 and 4%. Operation results in cure in about 83% and in marked improvement in another 5%. Exophthalmic goitre is a constitutional disease apparently due to an excessive (probably abnormal) secretion of the thyroid gland, and while its cause is unknown, treatment aims to diminish the activity of the gland. As a result of increased knowledge of the disease and of the dangers incident to operative treatment, and since patients with exophthalmic goitre are coming to operation earlier, before the development of changes in other organs, the surgical mortality has been reduced to practically 1% in terms of operation and 1·74% in terms of cases.

The natural fluctuating course of the disease makes it difficult to evaluate any form of treatment, unless sufficient time has elapsed to preclude the probability of recurrence. Study of the results about five years after operation shows that 90% of the patients were living, 79% considered themselves cured or greatly improved by the operation, 8% were improved but showed evidences of hyperthyroidism or its effect, and 3% were not benefited. On analysis, lack of improvement could be traced definitely to three causes: (1) incompleteness of operation, (2) the long duration of hyperthyroidism before operation and (3) failure to eliminate foci of infection after operation. Thyroiditis is rare, and operative treatment is indicated only in the tuberculous and suppurative types.

Malignancy occurs as sarcoma, carcinoma, malignant adenoma and malignant papilloma, in the ratio of one malignant case in 57, and the prospect of cure by operation and intensive treatment with radium and Röntgen ray varies with the type of malignant disease. (C.H.M.*)

Surgery of the Breast.—Cancer of the breast still takes its yearly toll of thousands. Statistics indicate that in cases where the axillary lymphatics are not as yet involved, prospects of cure are far more favourable. As said elsewhere, periodic physical examination, annually at least, is our best means of protection. In doubtful cases of tumour of the breast, the surgeon removes a small section of the growth for rapid microscopical examination (by the so-called frozen-section method) and receives a report within a few minutes. Local excision or radical amputation is accordingly carried out depending on whether the growth has proved benign or malignant. Small benign tumours of the breast may be removed without cosmetic deformity, either through an incision within the vermillion border of the mammilla (the pigmented area surrounding the nipple) or through a curved incision corresponding to the lower fold of the breast.

Surgery of the Thorax.—Röntgen-ray diagnosis of disease in this region has made great advances during the last 15 years. While nearly all the conditions about to be cited could be clinically recognised in earlier times, the additional knowledge furnished by the Röntgen ray is of such great value that it is practically indispensable. Lack of space forbids detailed discussion; however, among the more important conditions are: lesions (fractures, chronic inflammations or tumours) of ribs, spinal column, breastbone (sternum) or collar bone (clavicle); pneumonia, lung abscess, bronchiectasis, empyema (recent or old), tuberculosis, tumours, either originating in the lung or secondary to cancer elsewhere (for example, secondary to sarcoma of a bone or carcinoma of the breast), paralysis of the diaphragm, hernia of the diaphragm permitting partial escape of abdominal viscera into the thoracic cavity, enlargement of the heart, effusion in the pericardial sac, aneurism of the aortic arch, stricture and diverticulum of the esophagus, tumour of the mediastinum and, lastly, foreign bodies lodged in gullet or air passages by accidental swallowing or inhalation or introduced into the thorax as the result of external violence following shooting, stabbing, explosions and so forth.

Safeguards in Operations Upon the Opened Chest.—The thorax may be considered a bellows containing two collapsible bags, the lungs, between which lies a flexible partition, the mediastinum. If a sizable opening be made in one wall of this bellows, the exposed lung collapses, the to-and-fro action (respiration) goes on, but the amount of air drawn in and blown out of the remaining lung is greatly diminished, because on inspiration the mediastinum is drawn over toward the uninjured lung, and on expiration it is pushed over toward the opened side of the chest. To afford an adequate exchange of air a slightly increased pressure of air or diluted oxygen in the upper respiratory tract (mouth and nose)

[1] Intrinsic implies that the growth is still within the larynx, in contradistinction to extrinsic when the laryngeal growth has extended and involved soft parts of the neck as well.

prevents entire collapse of the lung and provides adequate aeration. (See also discussion of differential pressure under *Anaesthesia* above.) In emergencies, in the absence of differential pressure apparatus, this mediastinal flutter may be controlled by grasping and steadying the lung of the opened side; this prevents excursions of the mediastinum and permits air to be drawn into the lung of the opposite side. (For many years Australian surgeons have employed this measure when removing echinococcus cysts of the lungs, and more recently in the World War the French also used the same procedure when operating for removal of foreign bodies such as bullets and shell fragments.) Tight closure of the chest wall at the end of the operation is all that is requisite.

Compression pneumothorax may follow a smart compression not quite severe enough to crush the chest. Rupture of lung or bronchial tissue permits valvular escape of air into the pleural cavity with each respiration. As air accumulates, it not only compresses the lung on the affected side but also displaces the heart and mediastinum towards the opposite side and this interferes with the function of the other lung as well. Permanent suction applied by an aspirating needle thrust into the pleural cavity will control this condition (the blood-clots, sealing tears in lung tissue, are found to be especially tenacious). Sometimes rupture of bronchi from the same cause (compression of the thorax) results in escape of air into the mediastinal tissues instead of the pleural cavity, and by continued accumulation produces subcutaneous puffing of the neck and face. In a case of this sort a wound may be established in the episternal notch and a glass suction-cup arranged to connect it with a vacuum pump (Tiegel). In a few hours the condition subsides.

Empyema of the pleural cavity is a common sequel of pneumonia. Experience with large numbers of cases of empyema among the United States soldiers in the winter of 1917–8, during the great influenza epidemic, established a rule that while cloudy fluid should be removed by aspiration as often as necessary, actual operation should be deferred until pus has become thick and creamy. Nothing has been lost by such temporisation. The increased mortality from premature surgical drainage of accumulations of infected pleural fluid conclusively demonstrated this point. For the technique of open and closed drainage, various suction methods, sterilisation of the infected pleural cavity by Dakin's and other antiseptic solutions, and the use of " blowing bottles " to encourage expansion of the lung, the reader is referred to articles on empyema in the surgical literature.

Most empyema cavities gradually close as the lung expands, finally reaching the chest wall. In some, however, this expansion does not take place and a persistent cavity lined with granulations remains. The surgical obliteration of such cavities[1] constitutes a problem in itself. Decortication of thickened pleura covering partly collapsed lung (to permit it to expand) is rarely feasible, because dense adhesions with underlying lung tissue obliterate any plane of cleavage. Consequently mobilisation of the rigid chest wall is the method of choice. Removal (resection) of ribs from that part of the chest wall directly overlying the persistent cavity permits the soft tissues remaining to be brought into easy coaptation with the underlying lung. For details of operative procedure the reader is referred to textbooks and monographs on thoracic surgery.

Lung Abscess.—If medical and bronchoscopic treatment have not been successful, surgical drainage is effected (usually under local anaesthesia)[2] through an opening in the chest wall, by resection of a sufficient number of ribs (in part) to provide proper space for necessary manipulation. If pleural adhesions, that is, adhesions of lung to chest wall are present, the operation proceeds, the abscess is located by a long aspirating needle (upon withdrawal of pus), then, the needle left in place as a guide, the vascular lung tissue is slowly divided with a cry and the opening is deepened until the abscess is entered large drainage tube is then inserted. If no adhesions are pit (between lung and chest wall) and drainage of the abscesnot imperative, which is rarely the case, it is safer to wait several days until adhesions artificially produced by the sun are firm, after which drainage of the abscess may be esthed as just described. For other features of surgery of thag and such methods of inducing collapse as extrapleurabracoplasty, phrenicotomy and artificial pneumothorax.

Operations on the Esophagus.—The intrathoc esophagus lies in front of the vertebral column between the s and alongside of the aorta. For years, cancer of this stire was considered inoperable. In the light of present expace it can be stated that it is technically feasible to remove growth, provided it is in an operable stage, but most patie come to the operating table too late: the cancer is found have broken through the esophageal wall and to have involvdjacent vital structures so that its complete removal is impose. Generally the patient has disregarded his difficulty in swallog for months and only sought surgical relief when facing acl starvation. Thus, through ignorance, precious time has beost when the growth might have been found removable. Iroved results may confidently be expected in the cure of thitherwise fatal malady. Its palliative treatment consists in eslishing a gastric fistula (gastrostomy) through which the pent is fed by tube, as is customary in cases of benign strictures he esophagus.

Surgery of the Abdomen.—To no region of t body do the introductory statements regarding advances surgery apply more pertinently than to the abdominal cavity. tra-abdominal diseases which formerly masqueraded under a nuer of different names are now recognised to be one and the sameing. In X-ray investigation of the alimentary tract, suspensioof barium sulphate are administered by mouth in the form opaque meals which fill the stomach, outlining this organ a then, as time goes on, pass into the small and finally into tharge intestine. The large intestine, however, may be more clely depicted by means of a barium enema, and this method isreferable when chronic intestinal obstruction is suspected; t fluid barium meal taken by mouth loses much of its water as collects above a point of narrowing, and so is converted into putty-like mass which may block a narrow opening, thus suddly changing a chronic into an acute intestinal obstruction.[3] Th Graham method of depicting the gallbladder depends upothe functional ability of this organ to concentrate bile. Thsodium salt of phenoltetraiodophthalein administered by mouh is excreted in the bile and concentrated in the gallbladder. erations from the normal picture, when considered with the hiory and clinical findings, in many instances permit the accurate agnosis of cases in which it was previously impossible. In the inary tract, solutions of sodium iodide enable one to see the ouines of the bladder, ureters and pelves of the kidneys (*see* Urology). Free gas in the peritoneal cavity occurring in the courseof disease or following injury, indicates that an opening is presat somewhere in the walls of stomach or intestines. For examplein cases of acute perforation of a gastric or duodenal ulcer, röntenograms taken with the patient upright will show a thin crescntic layer of gas beneath the diaphragm and above the liver. Sch a finding may also occur after non-penetrating injury of the abdomen with rupture of intestine.[4]

It is a difficult matter at times to decide whether or not to operate in the presence of these abdominal contusions, and such an X-ray finding is of the utmost value. On the other hand, if an exploratory operation be decided upon, under conditions where the röntgenogram is not available, when the peritoneum is exposed, the wound is filled with sterile water so that when the peritoneum is nicked, the escape of gas may be seen immediately.

[1] Rigid-walled granulating cavities will not heal. One or another of their sides must be mobilised so that coaptation of lining granulations is obtained. The same principle applies in the treatment of chronic osteomyelitis with persistent sinuses.

[2] This is safer than general anaesthesia which may permit pus from the abscess to enter uninfected regions of the lung instead of being coughed out as usual by the conscious patient.

[3] Such a complication is most undesirable because operations for relief of acute intestinal obstruction are always associated with higher mortality and graver complications than those for chronic obstruction.

[4] Air anywhere within the body is absorbed within a few hours.

In all cases in which the abdominal cavity is opened surgically for relief of non-suppurative disease, it is customary for the surgeon to introduce his hand into other regions than that immediately concerned. This procedure requires but a few moments and is of the utmost value in determining the presence or absence of other intra-abdominal lesions. Naturally in the presence of acute or chronic suppuration, manual exploration of other regions is unwise for fear of spreading infection.

Hernia.—The abdominal wall may be considered to have three layers: (*a*) a smooth, glistening, internal lining of no intrinsic strength, the peritoneum; (*b*) a musculo-aponeurotic wall of great strength which has points of potential weakness (in the groins and in the region of the umbilicus, for example); and (*c*) the overlying elastic skin. A bulging of the distensible peritoneum through such an unduly weak opening in the strong musculo-aponeurotic wall, permits the protrusion of a peritoneal sac containing structures normaliy lying in the abdomen such as omentum and intestines. The potential danger of a hernia is the possibility of strangulation of its contents by the inelastic ring at the neck of the sac. Operation for the repair of a hernia consists in exposure of the parts, opening of the sac, replacement of the sac's contents within the abdominal cavity, closure of the sac at its neck, amputation of its now redundant portion and, last but not least, closure of the opening in the musculo-aponeurotic layer. The principle of overlapping tissue layers of the musculo-urotic wall, like buttoning a double-breasted coat, is generally accepted at present.

In large hernias especially those occurring in scars from previous laparotomy, the use of fascia lata from the outer side of the thigh, either as strips for suture material, when the opening can be closed without undue tension) or in sheets (when the edges of the hernial ring cannot be readily approximated), is gaining general adoption. The reader is cautioned not to consider the subject of hernia as covered by the above elementary remarks, and particularly not to draw conclusions from any single case until he has familiarised himself with all contributory and complicating factors of this field by a study of the technical literature.

(J. C. A. G.)

Surgery of the Stomach and Duodenum (*see* also APPENDICITIS).—Each year the surgical treatment of diseases of the stomach and duodenum shows, in some respects, definite progress. Much of the recent advance in the efficient management of gastric and duodenal disorders has been due to: (*a*) increasing ability to detect existing disease process; (*b*) better interpretation of the significance of the clinical findings; (*c*) better judgment in deciding on the management of the complicated cases; (*d*) quick recognition and control of serious complications, particularly gastro-intestinal stasis, and (*e*) increasing experience in the operative treatment of surgical lesions.

The diagnosis of benign lesions of the stomach and duodenum can be correctly made by a proper correlation of clinical and röntgenologic findings in about 96% of cases, and of gastric carcinoma in about 98%. The indications for operation in cases of uncomplicated chronic or recurring duodenal ulcer are positive when the symptoms cannot be relieved or controlled by medical means. In cases of gastric ulcer, operation is always indicated unless adequate contraindications exist, and in gastric carcinoma, exploration is advisable if the disease is not obviously irremovable or incurable.

There are various methods of treating ulcers because lesions of the duodenum unquestionably heal spontaneously under various forms of medical regimen; others continue into a chronic state which can only be relieved by surgical measures. The most commonly performed operation is gastro-enterostomy. This procedure insures a permanent cure in between 80 and 90% of the cases, and such a high percentage of cures accounts for such frequent recourse to this operation. There is, however, a certain percentage of failures, so that other types of operation have been devised. The more important of these are operations at the outlet of the stomach which remove the ulcer and part of the pyloric muscle, and provide for adequate drainage of the stomach. Recently the removal of part of the stomach has been advocated to prevent recurrence of ulceration. This operation has gained very little popularity because of its radical character, and because the general principle of removing a considerable part of the stomach for a lesion which is not in the stomach does not seem reasonable.

In chronic gastric ulcer prolonged medical treatment is justified only when surgical treatment is absolutely contraindicated by the age or the condition of the patient. As a temporary expedient, however, medical treatment may be not only justifiable but of marked value in improving the general condition when the surgical risk has been aggravated by repeated hemorrhages, extensive subacute local inflammatory changes, or toxemia from gastric retention. The danger of malignant degeneration of gastric ulcer should not be minimised, and it becomes imperative, therefore, to make a real effort to remove the lesion. This can be done either by local excision or by partial gastrectomy; and of the various procedures in common use excision of the ulcer combined with gastro-enterostomy and resection of a considerable portion of the stomach are the most widely advocated. The results of this form of treatment are excellent.

The successful treatment of gastric carcinoma depends on early diagnosis because of the insidious onset of the disease. Those which develop at the pyloric end of the stomach are most suitable for removal. They give the best prospects of cure and, fortunately, cause symptoms early. In almost half of the cases in which operation is advisable the growth can be removed and a prospect of cure assured. In over 50% of the cases in which the growth is removed and in which the disease is confined to the stomach there is an assurance of at least a three-year cure. In the treatment of acute perforation of duodenal or gastric ulcers the patient's life may be almost certainly saved if operation is carried out in the first few hours after perforation has occurred. Closure of the perforation is the only procedure necessary to save the patient's life; but if his condition warrants it at the time, other procedures may be combined with it to protect him against ulceration in the future. Operations on the stomach are also carried out for benign tumours, occasionally for foreign bodies (usually swallowed by insane persons), and occasionally for the curious hair-ball tumours which form in the stomachs of persons who are in the habit of biting and swallowing hair. (D.C.B.*)

Surgery of the Colon.—The colon is an important part of the intestinal tract, and yet any part or all of it may be sacrificed without serious consequences and without interfering greatly with the comfort of the patient. When it is removed its physiologic functions are compensated for to a certain degree. The many lesions affecting the colon may be grouped according to the nature of the condition, and for convenience of study as follows: (*a*) congenital deformities, such as extreme dilation of the colon resulting in Hirschsprung's disease or giant colon, and bands or kinks, which may have resulted from abnormal development; (*b*) inflammatory lesions (ulcerative colitis, tuberculosis, diverticulitis and actinomycosis); (*c*) benign tumours, either polypi, which occur singly or more often as multiple small tumours and sometimes as a diffuse polyposis, or, occasionally, adenoma of the lower colon, both seeming to have a tendency to develop into malignant tumours, and (*d*) malignant tumours, largely cancers. Cancer of the colon is common, and in the early stages can be removed satisfactorily.

Of the different tumours which may occur malignant tumours hold first place in importance because they are by far the most common tumours of the colon; operation affords the only prospect of cure, and surgical treatment is frequently difficult. The symptoms are usually manifested sufficiently early and are usually those of obstruction and of anaemia. The anaemia resulting from cancer in the cecum and ascending colon is frequently very marked, and may be so severe as to give rise to an opinion that the disease is incurable. Various methods have been devised for carrying out more extensive operations on the colon for malignant disease with the maximum of safety. Most of these are based on carrying out the operation in several stages. The prospects of cure in cancer of the colon are higher than in cancer in many other situations. About 50% of the cases of cancer of the

colon are found in the cecum and ascending portion, about 10% in the hepatic flexure, about 8% in the splenic flexure, about 13% in the descending colon, and about 20% in the transverse colon. Other diseases of the colon occasionally require operative treatment when they interfere seriously with its function, or resist medical treatment. The operation may consist of the removal of any part or all of the colon.

Surgery of the Rectum and Anus.—The skin about the anus is subject to lesions, more painful than serious, varying from slight cracks to fissures. Sometimes cleanliness and hot applications will cure them, but the ulcerated forms require excision. Fistula (fistula-in-ano) usually commences with inflammation of one of the crypts that surround the anus. The infection is trapped by the swelling and burrows along the side of the anal canal. An abscess may form in the loose tissue and may rupture into the rectum further up or externally on the skin near the anus. Tuberculosis is not nearly so common a cause as was supposed. The fistula must be opened, curetted and packed so that it heals from within outward. Usually this procedure cannot be carried out until the external sphincter has been cut.

Hemorrhoids may be either external or internal, or both. The external ones are covered by skin, the internal by mucous membrane. They are best treated by excision and ligature. The cautery is used for destroying internal hemorrhoids, but the painful after-effects make its use undesirable for external hemorrhoids. In certain cases injections of medicaments directly into the hemorrhoids are effective. Stricture results from injury, such as burning or unskilful operations, from infection, syphilis, tuberculosis and from new growths, especially cancer. Incision and gradual dilatation may cure, or the constricted zone may have to be resected and the ends anastomosed. Of all cancers in the colon, most occur in the rectum. Early diagnosis and prompt excision afford the only chance of cure. The operation is often performed in two stages. The signs of cancer of the rectum are similar to those of hemorrhoids, and in many cases of cancer the patient has undergone an operation for this apparently innocent manifestation of a serious disease. It is becoming a routine to examine the rectum and sigmoid with a proctoscope in all cases of hemorrhoids. (W. J. M.)

Surgery of the Liver and Bile Passages.—Symptoms of gallstones are often mistaken for those of gastric ulcer. Commonly, stones first form in the gallbladder and their presence is characterised by attacks of pain and vomiting without fever. A stone in any hollow organ of the body predisposes to subsequent infection, and gallstones follow this rule. As time goes on, stones are also found in the common duct (a much more serious condition), and jaundice is frequently observed following attacks of pain. There is a definite association between disease of the bile passages and acute hemorrhagic pancreatitis. The diagnostic value of the Graham test in pathologic conditions of the gallbladder has been outlined above in discussing X-ray diagnosis of intra-abdominal lesions. Cholecystectomy, that is, removal of the gallbladder, is the operation of choice when not accompanied by too much risk. Cholecystostomy, or opening and drainage of the gallbladder, affords temporary relief. It is an excellent measure under local anaesthesia for desperately sick patients who, however, generally require a secondary cholecystectomy for permanent cure. Conditions requiring operation on the common duct are of far more serious import than those on the gallbladder, generally speaking. The deep jaundice which so often accompanies obstruction of the common duct may lead to postoperative cholemic oozing, a most serious complication. Transfusion and the administration of calcium salts often but not invariably control this hemorrhagic condition which if unchecked results fatally. Stones may exist in the gallbladder and common duct without causing symptoms and the remarks made above apply only in the majority of instances.

Surgery of the Spleen.—The spleen is a very vascular organ. Its removal (splenectomy) for control of hemorrhage as the result of traumatic or spontaneous rupture, is an old, recognised procedure. Splenectomy is of benefit in the early stage of Banti's disease and in certain cases of hemolytic jaundice. In pernicious anemia it is of little value as the remissions following splenectomy are but little longer than those after transfusion. Of recent years a form of purpura has been recognised in which the blood platelet count is low and fragility of the red blood cells is markedly increased. Spontaneous oozing of blood from all mucous membranes as well as typical subcutaneous hemorrhages whose blue colour first gave the condition its name, are accompanied by rapidly progressing anemia which soon leads to death. The almost instantaneous cessation of oozing immediately following splenectomy (occurring even before closure of the abdominal wound) is one of the most dramatic events in modern surgery. Tranfusion before and afterwards is employed to sustain life and not to control the disease.

Gynecologic Surgery.—Refinements in operative technique have kept pace with those in other branches of surgery. Acute inflammations of the pelvis are conservatively treated. Indeed in many cases, pelvic inflammation may enjoy complete symptomatic recovery following sufficiently prolonged rest in bed and appropriate local measures. In the acute stage, if abscesses form they are drained, but otherwise nothing more radical is done. Operative removal of carcinoma of the uterine body gives excellent results. Regarding treatment of carcinoma of the cervix, a far more deadly form of the disease, there are two schools of thought at the present writing. One still favours operative treatment, while the other maintains that radiotherapy (by radium or the X-ray in massive doses) gives equally good late results. Regarding carcinoma of the cervix in stages beyond the possibility of operative intervention, there can be no question that radium is the means now universally adopted. The foul discharge dries up and the local tumour disappears and, although permanent cure is rare, the patient's existence is made infinitely more tolerable. Exposure of the ovaries to X-rays stops menstruation, and is often used in controlling excessive uterine bleeding. The Rubin test for determining patency of the uterine body and Fallopian tubes in cases of sterility is a recent innovation. When this test was introduced, air was injected through the cervic uteri and its presence or absence within the peritoneal cavity determined by the X-ray. Later experience showed that with a manometer to gauge the amount of air pressure employed, equally accurate determination could be made and X-ray control could be dispensed with. The use of foreign proteins in the treatment of pelvic inflammation is still in the experimental stage.

Surgery of the Extremities.—In the treatment of fractures (*see* ORTHOPAEDIC SURGERY) the time-honoured plaster cast still has its place. However, maintenance of proper alignment of fractures by suspension and traction has come into deserved repute, notably in fractures of the humerus close to the shoulder joint, and in the revived Hodgen's method for fractures of the femur. Skeletal traction, a further refinement, consists in metallic appliances (such as Steinmann pens, sharp-pointed tongs like ice-tongs, or Finochietto stirrups) which are attached to the bones at some suitable point below the site of fracture. By this means shortenings may be overcome which could not possibly be corrected by traction upon moleskin adhesive strips applied to the skin. These methods limit indications for open reduction[1] to those cases with interposition of soft parts between the fragments (*see* also FRACTURES). Disuse stiffens joints and tendon sheaths. Consequently the manifold physiotherapeutic measures[2] which encourage active motion within the limits of pain, have their distinct use in promoting and accelerating return of function (*see* also ORTHOPAEDIC SURGERY).

Amputation of the lower extremity, if possible, is so devised as to furnish stumps capable of bearing weight directly on their ends instead of on the bony prominences of the joint next above the site of amputation (see descriptions of the Hirsch-Bunge method in surgical literature). Early active mobilisation after

[1] An operation for exposing displaced fragments, correcting their alignment and retaining correction by suture, metal bands, vanadium steel plates held in place by self-tapping screws of the same material, and so forth (*see* also FRACTURES).

[2] Warmth by baking whirlpool baths, diathermy (*see* ELECTROTHERAPEUTICS) and, natural or artificial heliotherapy, and so forth.

operations on joints (for example, after operations for removal of the internal semilunar cartilage of the kneejoint) gives excellent immediate functional results and is being more and more widely practised.

The Willems treatment of acute joint suppurations, if instituted early, preserves function and constitutes a notable advance. In former times, the most that could be hoped for was a stiff joint after weeks and even months of precarious convalescence. With the Willems method, generous longitudinal openings are made on either side of the affected joint, but no drainage tubing, gauze or other material is introduced into the joint cavity; there is no irrigation, but simply active motion every two hours which permits the free escape of purulent secretions and preserves function. As time goes on, the secretions gradually lose their purulent character and finally become clear, and the wounds close of themselves leaving a free healed joint. The method is of no avail when infection has spread beyond the lining synovial membrane and has involved the soft tissues of the joint outside.

Infections of the hand and fingers comprise an important and relatively neglected field of surgery. The different forms of infection should be recognised early, the proper and least disabling drainage incisions should be made, and voluntary motion should be begun at the earliest suitable moment, long before the drainage wounds themselves have begun to close. In no region does the retention of pus more rapidly destroy essential structures than in the hand and fingers.

In conclusion the reader is again reminded that a cursory review of surgery is all the limitations of this article permit, and that almost no justifiable conclusions regarding any single surgical incident in the reader's experience can be drawn by him from the contents of this article, because of innumerable, relative, qualifying surgical factors which may exist, unknown to the lay mind. The mutual dissatisfaction of lawyer and medical expert so often seen in the courtroom furnishes an excellent example of this. It requires years to train a surgeon, and one cannot condense all the knowledge so acquired into a few minutes' exposition of the subject. *See* also HEART AND LUNG, SURGERY OF; ORTHOPAEDIC SURGERY. (J. C. A. G.)

SURINAM: *see* GUIANA, DUTCH.

SURVEYING (*see* 26.142).—As a result of the stationary character of the World War on the Western Front, surveying generally acquired a greatly increased importance from a military point of view, and the introduction of air photography (*see* AERIAL SURVEY) has given the surveyor a new and powerful method for use in official circumstances. In exploratory surveying the conditions have been simplified by the introduction of wireless telegraphy, for the determination of longitude, which is now little more difficult than taking a latitude. In the more regular branches of the subject the principal matter demanding attention is the development of accurate methods of levelling, particularly of precise or geodetic levelling.

I. SURVEYING IN WAR TIME

Topographical surveys have long been well known adjuncts to military operations. All other classes of land surveying, *i. e.*, geodetic triangulation, levelling and large scale surveying, now take their part in modern scientific warfare.

The Trigonometrical Control.—The extent of the Western Front made it necessary to provide a homogeneous and complete system of triangulation upon which to base the maps and the local surveys called for. Five separate and distinct triangulations already covered this area before the outbreak of war, and many of the stations of the triangulations had been destroyed or built over before the war and many were destroyed during its progress. Numbers of new stations had, therefore, to be established. This patched and reconstructed triangulation stood then as a basis for all the military surveys of the Western Front.

Provision of Maps.—A map of accuracy and adequate scale was required so that administrative arrangements, lines of fire and trench systems could be shown upon it. Such a map did not exist except in the Belgian area, and elsewhere had to be made. The earlier British war surveys were made upon the plane-table, on a scale of 1/20,000, and were completed up to the British trench lines. By means of air-photography, and the manuscript sheets of the cadastral communal surveys, reliable maps, of territory in British occupation and of all that portion of northeastern France occupied by the German armies were eventually compiled. The trench zone was mapped on a scale of 1/10,000, and forward and back areas at 1/20,000. In all 6,000 sq. m. were surveyed.

For the use of large scale maps in trench warfare it must be possible to read off, at sight, the co-ordinates of any desired point from a "grid" or network of lines printed on the map. For ease and accuracy of reference the "grid" should be in squares, the sides of which can be divided decimally by eye. The artillery often desire co-ordinates of the same accuracy as the surveyor—*i. e.*, on the scale of nature. The system adopted should, therefore, be based upon the co-ordinates used by the surveyor, with an easy form of abbreviation to be used by all arms to define map positions. Accuracy of bearing from any one position must be maintained together with as near an approach to linear accuracy as possible, whilst the system must allow of extension over the whole area of operations. An orthomorphic projection was therefore desirable, and for the conduct of surveys constantly in progress it was equally important. Computations must be cut down to the minimum. This can be done by working on a projection in which the position on the ground and the position on the map can be calculated in one process without sensible error.

Surveys for Artillery Purposes.—Other things being equal, that artillery will dominate its adversary which has the quickest and most accurate knowledge of hostile battery positions and which can open most quickly an accurate and unexpected fire upon them. The accurate survey of the relative positions of gun and target is essential.

The positions of British heavy batteries were, therefore, fixed with a theodolite, each battery was supplied with a chart or "artillery board" on which the map was pasted down, in sections, upon a zinc or three-ply wood surface, and special "bearing pickets" were inserted in numbers in the battery zone. The bearings from these pickets to surrounding objects, suitable as reference objects, were tabulated and distributed. The positions of hostile batteries were also surveyed with as much dispatch and accuracy as possible by one or other, or both, of the following methods:—

(*a*) Intersection of three or more rays observed upon the flash of discharge, the reflection in the sky of this flash, or, upon the smoke puff from the muzzle, an operation, commonly known as flash spotting, which, independent of the map, gave very good results but depended for success upon good visibility.

(*b*) Sound-ranging (*q. v.*)—a method which is naturally unaffected by bad visibility, but is put out of action by a moderate wind blowing from base to gun and is interfered with by any high wind. As in the case of flash spotting, a good telephone connection to the artillery headquarters is essential.

II. SURVEYING BY AIR-PHOTOGRAPHY

Optical Principles.—Provided that the optical axis of the camera is vertical at the moment of exposure, the resulting photograph of a flat level area will be an accurate plan at a scale determined by the equation.

$$\frac{f}{h} = s$$

where f is the focal length, h is the height of the camera above the ground at the moment of exposure, s is the representative fraction of the scale. Such photographs will be called vertical photographs. As a rule, however, the photograph is not exactly vertical, but the axis is tilted at an angle to the vertical. The photograph then becomes an inclined perspective view (see fig. 1.)

If the direction and magnitude of the tilt of the axis were recorded at the moment of exposure it is obvious that the photograph could be projected optically or photographically on to the plane of the map, although it would remain unfixed in position and orientation. If the direction and magnitude of tilt are unknown, then the projection on to the required plane, or

" rectification, " is secured by comparing the relative positions of four surveyed points on the ground and on the photograph, which is then also fixed in position and orientation. Two matters of importance are that (1) straight lines upon a plane remain straight lines upon any perspective view of that plane; (2) at any point, on any incline perspective view, the scale is not the same in directions parallel to and perpendicular to the axis of tilt.

Construction of the Map.—In order to explain how a map is built up, wholly or partly, from air-photographs it is advisable to take some illustrative cases. The simplest case is that in which it is desired to produce a map of an area in which a sufficient trigonometrical control already exists and of which there is available a complete collection of cadastral plans, which are, however, much out of date. Ground features are low and gently undulating, extreme difference of altitudes being two or three hundred feet only. In such a case topography can be brought up to date from air-photographs taken with the axis as nearly vertical as possible, and fitted upon the cadastral framework by one or other of the methods described below. When this is complete the map is contoured in the field, names are added and the topography examined for omissions or mistakes. The most difficult case arises when the area to be mapped is rugged and mountainous, and the inhabitants hostile: the positions and

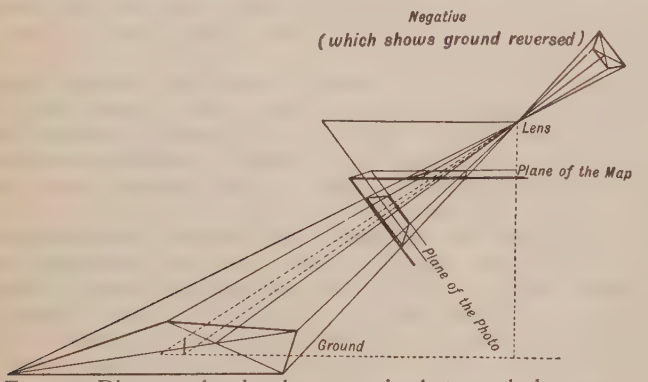

FIG. 1.—Diagram showing how an air-photograph becomes an inclined perspective view.

heights of a few peaks in it, visible from accessible ground, have been fixed trigonometrically, but no reliable map exists.

As a preliminary measure, oblique photographs are taken in the air from a variety of points of view. The positions of the camera in space are calculated, and from measurements on each photograph a number of rays are drawn to noteworthy points in the valleys and on the hills. Positions and heights are thus determined for a subsidiary control. With the axis vertical a series of photographs of valleys and of watersheds are taken, pasted together and fitted to the control. When the map has been thus built up, form-lines are added from the oblique photographs, based upon the fixed heights. In most air-photo surveys difficulties will be intermediate between the foregoing two cases.

Applications of Air-photography.—In any particular survey air-photographs may be used, then, for any or all of the following processes, viz.: (1) Air-photo control, (2) Air-photo topography, (3) Air-photo contouring.

In taking vertical photographs for air-photo control *in fairly flat country*, exposures are so regulated as to ensure a substantial overlap, generally amounting to 50% at least. Each successive photograph may therefore be fitted to its predecessor, and lines or traverses of photographs may be mounted and sealed between fixed points. Any two or more traverses of different and independent lines may be made to intersect over some topographical object, the position of which may be determined as the simple or weighted mean of the individual positions from each traverse. Traverses may also be made to converge and end upon some prearranged and hitherto unfixed object. This method has given fairly accurate results in flat country on the scale of 1/40,000, and is dependent upon the ability of the pilot to maintain an even keel and a constant height.

In broken and hilly country differences of altitude must be taken into account. The use of each photograph is thus limited to the measurement of horizontal and vertical angles and to fixing the positions of new points by intersections from two or more photographs. Where this principle is employed oblique photographs are preferred as covering larger area and allowing greater refinement in the measurement of vertical angles.

Where the area to be mapped contains a sufficiently close control the filling in of topographical detail is more easily done from vertical than from oblique photographs, providing that the area in question is not markedly hilly. The scale on which photographs are taken may be larger or smaller than that of the map, but it must be sufficiently large to allow of clear identification of detail. The area to be mapped is photographed from a prearranged height in strips allowing for an overlap in all directions. Much depends upon the training of the pilot in maintaining his height and his overlap. It is usual to arrange for a mechani-

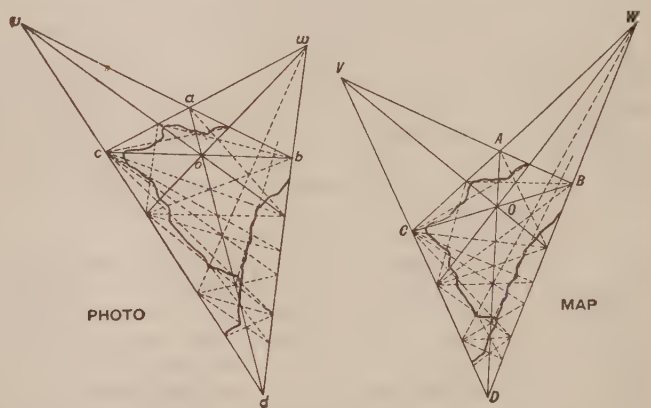

FIG. 2.—Diagram illustrating the graphic method of transferring detail from photo to map.

cal control of exposures regulated according to the ground speed of the aeroplane.

Detail Plotting.—The plotting of detail from air photographs would be simple if the axis of the camera could be maintained in a vertical position. It would then be necessary only to bring the photograph to the scale of the map. No means of ensuring this verticality has, as yet, been evolved. It often becomes necessary, therefore, to fit photographs individually upon the control points. This can be done graphically or optically by the *camera lucida*, or by the enlarging camera.

(1). The *graphic* method depends upon the principle that as straight lines on one plane remain straight lines on any perspective of that plane the position of a point which lies upon the intersection of two lines common to the ground and to the photograph may be readily determined. Within narrow limits the proportional compass set to the difference of scale between map and photograph at this point may be used to fix additional points. It is more accurate, however, to maintain the straight line principle and to cover the map and photograph with a " grid " of corresponding lines, as in fig. 2.

The photograph is mounted on a sheet of paper; a, b, c, d, and A, B, C, D are four points the positions of which are known and are also identifiable on the photograph. Subsidiary common points at oO are established by drawing the diagonals, and four subsidiary quadrilaterals may then be formed by drawing lines through oO from vV and wW—the intersections of the prolonged sides of the quadrilaterals. The same principle may be applied to any polygons formed by joining up any number of points (more than four) which are fixed on the ground and are identifiable on the photograph. Detail to any extent desired may be sketched in by eye.

A useful method of plotting, known as the four-point method, is as follows (fig. 3): Since the cross ratios of four points which lie upon a straight line are the same upon any perspective view of that line, we can readily plot the positions of a fifth point (S) if we know the positions of four points A, B, C, D.

Let A, B, C, D, be four known points on the photograph and a, b, c, d their positions on the map, and let S be a point on the photograph, the position of which on the map is to be found.

Join AB, AC, AS and AD, ab, ac and ad. Lay a piece of paper with a straight edge, in any position cutting the lines AB in B′, AC in C′ AS in S′ in AD in D′ and mark these cutting points on the paper. Now lay the paper strip on the map and fit it upon the lines ab, ac and ad, so that B′, C′ and D′ lie upon these lines. Mark on the map the position of a point s′ opposite the mark S′ on the paper strip. Join as′. Then s, the position of point S, upon the map, lies upon the line as′. Repeat this proceeding from B, C or D, and another line bs′, cs′ or ds′, will be secured, the intersection of which with as′ will define the position of s. (2) The *camera lucida* (*see* 5.104) has been used extensively for plotting. (3) Graphic and optical methods are tedious and lengthy compared with a *photographic rectification*. The ordinary enlarging camera can be made to answer the purpose with little modification. A coincidence can be obtained between the four control points on the map and on the photograph, and a " rectified " print may be obtained.

Ground Photographic Surveying.—Assuming that a photograph is a true perspective view, that the plate was vertical when exposed, and that the horizon line and focal length of the lens are known, it is clearly possible to determine the horizontal and vertical angles, from the point where the camera was set up, to all objects represented in the photograph, the horizontal angles

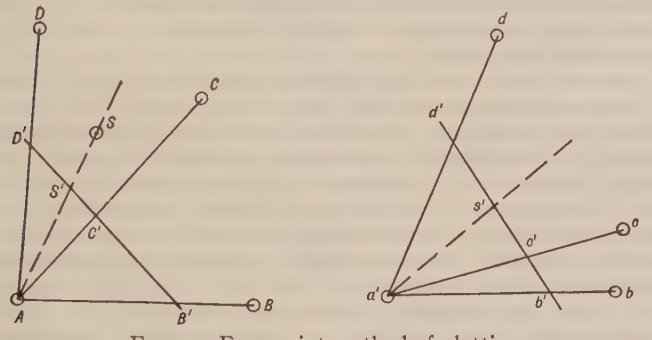

FIG. 3.—Four-point method of plotting.

being measured from some known represented object. If two such photographs are taken from two points of known lengths at known distance apart, we have the means of determining the distance and height of all points shown on both photographs.

It will, therefore, be necessary, in planning a ground photographic survey, to arrange for a triangulation to fix the relative positions at which the camera will be set up, and the first stage in the office work will consist in the plotting of the triangulation. A camera station need not, however, be a trigonometrical point, provided that its trigonometrical position can be measured from the photograph. To use the photograph for plotting the detail from each camera station A draw, at its correct angle, the central line of view. Along this line draw Ax, equal to the focal length of the lens; through x draw a line at right angles to Ax and plot from x the projections of the distant points, as measured on the horizon-line of the photograph. The intersection of rays from A to the points so obtained, with rays to the same objects from other stations, will give their position. A supplementary order of triangulation is usually added during the course of the field work, both to fix camera positions and to add a few bearings and vertical angles from which the photographic data may be checked. The office work takes two or three times as long as the field work and consists in plotting positions, calculating heights and drawing contours from the data measured on the developed plates.

Stereo-photo Surveying.—The most recent development of photographic surveying consists in the employment of the stereoscopic principle. In stereo-photo surveying two stations can be occupied on the same hill-top and their distance apart need only be some 50 to 300 feet.

In the simplest case let two vertical photographic plates be exposed from two points, say 100 ft. apart; let the plates be in the same plane and their centres on the same level. Then if these plates are put into a stereoscope provided with a system of lenses and prisms such that the eyepieces are brought to a convenient distance for seeing, we shall clearly get a very much magnified stereoscopic effect, as compared with what is obtainable with the unaided eyes. In the diaphragm of each eyepiece let there be a similar movable mark, or line on glass. On looking through the eyepieces the marks in question will appear as a single mark floating in space, and by vertical and horizontal adjustments this mark can be made to appear to touch any given object in the picture. We have, thus, a means of measuring small parallaxes and vertical angles, and these can be read off graduated micrometer heads.

A stereo-comparator as above described gives angles from the centre of the plate, distances and vertical angles; but the reading is laborious and the map has to be constructed point by point. In 1907 and 1911 Lieutenant von Orel, of Vienna, devised a stereo-autograph which permitted the automatic drawing of detail and contours. The latest machine of the class is the stereo-cartograph of Mr. Henry Wild, made at Heerbrugg, in Switzerland, in 1925. It promises well, but all these machines are very expensive.

Generally with stereo-photography we are not limited to a country with marked features, as is the case with normal photo-topography. Provided that the view is clear, gently undulating, or flat, country can be as well surveyed and contoured as a mountainous region. The method has some obvious applications, but it is difficult in forest-clad country or in towns and its value largely depends upon good view points. The old photographic surveying has as its chief field of usefulness a well-marked mountainous region. The new is not so limited but its rôle has not yet been fully determined.

Stereo-photo surveying, sometimes called stereo-photo grammetry, is to be seriously reckoned with in the future. Companies have been formed for the exploitation of this method in France, Germany, Spain and elsewhere. It is not only possible to make maps in this way, but also to construct plans and sections of existing buildings, and very successful results of this kind have been obtained, especially in Germany. A good account of the progress of the system will be found in " La Estereofotogrametria in 1924 " by J. M. Torroja, Madrid. There is a large literature on the subject.

III. LEVELLING

Since 1910 much progress has been made in the development of a sound system of levelling, especially with regard to precise, or geodetic levelling, which provides the framework on which all national levels depend. The now defunct International Geodetic Association laid down some wise rules on the subject. The admirable treatise of M. Ch. Lallemand, *Nivellement de haute Précision* marked a great advance on previous text-books; and the modern geodetic levelling instruments produced in France, the U.S.A. and Switzerland have greatly increased the accuracy of observation. The introduction, by the Ordnance Survey of the United Kingdom, of a specially devised kind of permanent bench-mark did away with a weak element in the old levelling, the instability of the ground marks.

New Instruments.—The prismatic astrolabe of Claude and Driencourt furnishes an instrument by which the observed local time and latitude can be determined by observations to at least three stars, using a constant altitude of about 60°. This method has been successfully employed in the Sudan and elsewhere. An attachment to an ordinary theodolite serving the same purpose, has been devised by Mr. E. A. Reeves, and has proved satisfactory. This does away with the necessity of taking out a special instrument. A very ingenious *direct-reading tacheometer* has been brought out by Mr. H. H. Veffcott by which the computations required with ordinary tacheometers are avoided. *See* ARCHAEOLOGY; GEODESY; GEOGRAPHY.

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(C. F., CL.)

IV. NAUTICAL SURVEYING

Naval hydrographic surveying has since the cessation of the World War steadily progressed in adopting the latest methods and instruments which have become available to the surveyor both on shore and afloat. It is not generally recognised, although it is a fact, that the hydrographic surveyor has to combine the work of the land surveyor with his own—in fact like the marine he is a "soldier and sailor too." The World War resulted in various scientific inventions which benefited the surveyors and of which they have and are taking full advantage.

Instruments.—Theodolites in current use (1926) are 4 in., 5 in. and 6 inches. The majority of these are micrometer theodolites read to 10 seconds. The use of the theodolite for astronomical and tacheometer work is now universal. Sextants for observing, with stand and artificial horizon, however, are still supplied, and improvements in this instrument such as an endless tangent screw and electric light for night work, have been adopted. More portable folding stands with slow-motion screws for movement of the sextant in azimuth and altitude are also supplied, and in addition amalgamated troughs, consisting of gold-covered plates on which a thin film of mercury is floated, have superseded the old artificial horizon consisting of a mercury bath; the new pattern is far less sensitive to earth tremors caused by surf, traffic, etc. It is, however, recognised that this instrument for work on shore is now superseded by other more precise and compact instruments.

The astrolabe a prisme, a very precise instrument, is one of these. It is used for finding position and enables altitudes of any stars at the altitude of 45° or 60° to be observed. The latest form of astrolabe enables observations of stars to be easily and accurately made as follows with the 60° instrument—one step of $7\frac{1}{2}'$ on either side of 60°, that is 3 observations of $59°52\frac{1}{2}'$ 60° $60°07\frac{1}{2}'$ can be taken of one star. With the 45° instrument—four steps of 5^1 on either side of 45°, that is 11 observations of $44°40'$ $44°45'$ $44°50'$ $44°55'$ 45° $45°05'$ $45°10'$ $45°15'$ $45°20'$ can be taken of one star. The great advantage of this instrument is that with one setting up of the instrument and without a number of necessary readjustments as in a theodolite both time and latitude can be determined, provided of course that the best and latest method of obtaining error of the time used (*i.e.*, wireless time signals) is adopted. When it is found necessary to measure bases the hydrographic surveyor uses the 500 ft. steel measuring tape and is provided with the Kew standardisation certificate. In surveying abroad where no local triangulation exists, the accurate measurement of a base is recognised as a most important step, second only to a satisfactory base extension.

Tacheometers and tacheometer staves marked according to the Admiralty pattern are used for measuring distances up to over 2,000 ft. where extreme accuracy is not necessary. One-metre base range-finders are useful in measuring short bases for plans of harbours, etc., when time or circumstances do not permit of a more accurate method. Of the various forms of heliostat the Galton sun signal has proved a most excellent instrument and fitted to theodolites it allows of the sun's rays being quickly and accurately directed to and kept on the station desired, whether the latter is visible or not.

Taut wire measuring gear is now fitted in all British surveying ships. This method of measuring distances at sea in comparatively shallow depths had proved most successful and was adopted after having been extensively used in connection with mine-laying during the War. The ship preserves a steady course and at a constant speed over the distance to be measured and at the same time runs out a thin piano wire from a drum which carries many miles of the wire. It is laid taut by means of a special brake device, the amount of wire out being registered on a dial. A correction (always subtractive) must be made for errors. This varies from 1,000 to 3,000 ft. in a distance of 100 m., and is governed by the contours of the sea bed upon which the wire has been laid. The dial registers 1,000 rev. for a mile of 6,080 ft., consequently when plotting in sea miles a second correction, for latitude, is necessary. This method of determining distance is specially useful when surveying out of sight of land, and is used in combination with astronomical observations and moored beacons.

Fixing Positions of Ships, Buoys, etc., by Subaqueous Sound-ranging.—This new method of accurately fixing the positions of buoys, etc., is carried out by dropping an explosive charge at the position it is required to fix. The sound of the explosion travels through the water to a number of hydrophones suitably placed, and the positions of which are accurately known. The differences between the times at which the shock reaches the various hydrophones are recorded photographically by a galvanometer on shore, to which the instruments are connected by cables. From these observations it is possible to calculate a position line for each pair of hydrophones. Three or four such lines from hydrophones suitably placed will give a cut, which is the position of the explosion. As in all surveying problems, the accurate fixing of a point from two others depends on the length of the base, that is, the distance between two known points, so does the accurate fixing by sound through the water depend on the hydrophones, or groups of hydrophones being such a distance apart, commensurate with the distance at which it is required to fix the buoy, etc.

Chronometers.—Surveying ships are now supplied with from 8 to 12 chronometers of the box type (pocket chronometers being used outside the chronometer room) selected instruments which have successfully passed most exhaustive tests at the Royal Observatory, Greenwich. For astronomical work on shore, the portable "Lindqvist chronograph" is employed. In this instrument, a chronometer fitted with special contact pieces automatically sends an electric current every two seconds through an electro-magnetic coil, and thus, by suitable mechanism records every alternate second as a perforation on a paper tape, which is kept moving at a uniform rate by means of clockwork. The closing of a switch by the observer operates a second coil, which records the instant of observation in a similar manner by making an additional perforation in the tape.

Wireless telegraphy for accurate time and obtaining meridian distances has been adopted. Amongst minor improvements in surveying appliances may be mentioned the standardisation of the markings of leadlines, improved buoys for beacon work, light filters for fitting to the eyepieces of sextant and theodolite telescopes.

In 1926 electrical lighting arrangements to sextants and theodolites had greatly improved. The arcless sextant which enables angles to be taken and read off (on a drum) without the necessity of removing the eye from the telescope; wireless telegraphy outfits for use of detached parties and the gyro compass (*see* GYROSCOPES), were all in use. For the measurement of velocity of tidal streams and current the Ekman current meter was generally in use.

In calculating triangulations considerable time is saved in correcting for false station by use of the station corrector diagram, by which the correction can be obtained very quickly to any accuracy required (generally about 5 sec. of arc) and the tedious trigonometrical calculation avoided. The slide rule has come far more into prominence for small rough calculations. As the result of modern inventions, special charts for the use of submarines and for other purposes in addition to the ordinary navigational chart have been produced. Charts for submarines indicate graphically the nature of the sea bottom, so as to indicate where vessels can rest with safety.

The introduction of wireless direction-finding stations as an aid to navigation has necessitated the production of charts drawn on the gnomonic projection, by the use of which positions can be more accurately determined. Additional charts are also required for testing range-finders and compass adjusting. Physical charts indicate the direction of prevailing winds and ocean surface currents at different periods of the year, localities and time where ice may be fallen in with, and the direction and

force of the stream and drift currents of the oceans. Considerable gain in accuracy and prevention of distortion has been obtained by printing charts by lithography, although the original charts are generally speaking engraved on copper. No more marked advance has been made in hydrographic surveying than in that most important work of all, viz.: ship and boat sounding, and reference should be made to the article on that subject (*see* SOUNDING).

(See John Ball and H. Knox Shaw, *A Handbook of the Prismatic Astrolabe*, Egyptian Govt., Cairo Government Press (1919); C. F. Close, *Text Book of Topographical Surveying* (1925).

(H. P. Do.)

SURVIVAL: *see* PSYCHICAL RESEARCH.

SUTTNER, BERTHA, BARONESS VON (1843–1914), Austrian writer (*see* 26.171), died at Vienna June 21 1914. See H. v. der Mandere, *Bertha Suttner* (1909).

ŠVABINSKÝ, MAX (1873–), Czech painter, was born at Kroměříž in Moravia. He studied at the academy of fine arts in Prague, where he eventually became a professor; and in Paris, Germany, Holland and Belgium. His first works were made to suit the poetical and symbolic mood prevalent at the time, but he soon turned his attention to realistic subjects, from which he derived the sources of an art intoxicated with the manifestations of life and nature. There is hardly any branch of painting which Švabinský did not practice with success. Of his large-sized canvases, special reference should be made to "The Sun Bath" (1908), "Summer" (1909), and "The Family in the Mountains," which provide typical examples of the vivid manner in which the artist seizes upon colour and form. As a portrait painter and etcher, Švabinský was remarkably active, his subjects including such prominent representatives of Czech public life as Mánes, Smetana and President Masaryk, while by his portrait of Maeterlinck he gained much appreciation abroad. Among his numerous other works should be mentioned the cycle of woodcuts entitled "The Sonata of Paradise" (1918–20).

SVEHLA, ANTONÍN (1873–), Czech statesman, was born at Hostivař, near Prague. From his youth he devoted himself to the movement for the emancipation of the Czech agricultural classes, rendering considerable services in founding and developing the Czech Agrarian party, of which in 1909 he became chairman, and which from 1908 he represented in the Provincial Diet of Bohemia. During the World War he played a most important part in Czech political life, bringing about the unity of all classes of the population and maintaining an undivided national front at the period of the greatest persecution. Contact with Professor Masaryk and those who worked with him abroad on behalf of Czechoslovak independence enabled him to complete the preparations for the final coup against Austria on Oct. 28 1918, when in his capacity as vice-president of the Prague National Committee, together with Dr. Soukup and J. Stříbrný, he took over the Government of the Czechoslovak State on behalf of the Czechoslovak National Council, which in the summer of 1918 had been recognised as the Czechoslovak Provisional Government. He became a member of the first National Assembly and was Minister for the Interior until Oct. 1922, when he undertook the formation of a new Czechoslovak coalition Govt. which he reconstituted after the Oct. 1925 elections. During his period of premiership he displayed admirable political and diplomatic abilities, notably by his skilful handling of the differences between the political parties.

SVENDSEN, JOHANN SEVERIN (1840–1911), Norwegian composer (*see* 26.175), died at Copenhagen June 14 1911.

SWAN, SIR JOSEPH WILSON (1828–1914), British physicist (*see* 26.179), died at Warlingham, Surrey, May 28 1914.

SWANSEA, WALES (*see* 26.181), the most important port of shipment in Great Britain for tin plates, patent fuel, etc., and the chief centre of the anthracite, spelter and copper trades, had a population of 157,554 in 1921, and an area of 21,600 acres. Oystermouth and a large part of the Swansea rural district were included in the borough in 1918. There are many manufactures, especially those concerned with metal working. A new dry dock was opened in 1924 in the harbour, which has 281 ac. of deep water in the docks, and over 6 m. of quays. Among the newer buildings are the Glynn Vivian art gallery in Alexandra road (1915); the large Dockers' Hall in High street (1913); the Y.M.C.A. centre in St. Helen's road (1913) and the chamber of commerce buildings (1915). In 1920 the technical college was made a constituent college of the University of Wales. Singleton House, with a park of 300 ac., presented to the municipality, is occupied by the college, pending the completion of new buildings in the park, of which the foundation stone was laid in 1920. Since the World War Swansea has become a centre for the distribution of oil, and extensive facilities for its storage and refining have been provided, tanks, refineries, pipe lines, etc. having been erected.

SWAZILAND, a British protectorate in South Africa (*see* 26.184). The population in 1921 was 133,563, of whom 2,203 were whites. The native population had increased by 5·34% since 1911. The state of chaos into which Swaziland had fallen owing to the indiscriminate grant of concessions was ended by 1914. Out of a total area of 4,275,000 ac., 1,635,000 ac. became Swazi reserves; in addition the Swazis bought 77,000 acres. A law suit arising out of these concessions led to a decision being given by the judicial committee of the Privy Council, in April 1926, that the crown had acquired sovereign rights in the disposal of the land of the protectorate—a right which the Swazis had challenged.

The Swazis own large herds of cattle and grow maize and other crops. Some 7,000 to 8,000 Swazis find employment in the Rand gold mines. The whites are mainly farmers. Gold mining has been practically abandoned. The maximum output was 14,781 oz. in 1911–2; in 1924 the output was 376 ounces. The coal deposits have not been worked. Tin (cassiterite) is found on the western border; the export varies from 200 to 400 tons a year; the total value of tin produced in 1915–24 was £510,000. From 1921 onward cotton growing was developed; in 1924 the value of cotton exported was over £10,000. The chief exports are slaughter oxen and tin. Revenue and expenditure balance closely. Revenue rose from £49,000 in 1911–2 to £89,000 in 1924–5, and expenditure in the same period from £45,000 to £87,000.

The administration is under the charge of a resident commissioner, with headquarters at Mbabane, a small, picturesquely situated hill village (altitude 4,000 ft.) overlooking the middle veld. The paramount chief and other chiefs exercise jurisdiction in all civil cases in which natives only are concerned. Labotsibeni, otherwise Naba Tsibeni, the "queen regent," a well-known figure in Swazi history, acted for many years as paramount chief, first after the death of her husband Mbandini in 1889, and later after the death of her son, Bhunu; her grandson, Sobhuza II., was installed as paramount chief in 1921. Labotsibeni died in Dec. 1925. Education is mainly in the hands of missionaries; Sobhuza was educated at a Government school at Labotsibeni's kraal, and afterwards at the missionary establishment at Lovedale. Like many other Swazis he adopted European clothing. Mr. de S. M. G. Honey, who had served in Swaziland since 1904, became in 1917 resident commissioner, and still held that office in 1926. In 1921 he set up an elected European advisory council to deal with purely European affairs.

The development of Swaziland, favourably situated midway between Delagoa Bay and the principal markets of the Transvaal, and itself potentially a very rich country, was greatly retarded by the lack of railways and good roads, for the building of which funds were not forthcoming. A railway built by the Portuguese from Delagoa Bay stopped at a dead end at the Swazi border. Continued through Swaziland, it would afford the shortest route to the Rand. Swaziland being under direct British administration, the South African Govt. gave no facilities for the building of the railway. Its construction was regarded as dependent upon Swaziland joining the Union. When the question of incorporation was raised definitely in 1924, it appeared that the white settlers were not willing to become part of the Transvaal province, but that if Swaziland were incorporated in the Union, it should be as a separate entity. The chief event in the Protectorate in 1925 was the visit of the Prince of Wales.

See *Official Year Book of the Union of South Africa* (Pretoria, 1925), the annual *Report* on the Protectorate issued by the Colonial Office, London, and *The Times*, April 16 1926, Sobhuza II. *v.* Miller (Privy Council Judgment). (F. R. C.)

SWEDEN (*see* 26.188), a kingdom of northern Europe and a member of the League of Nations. Its area is 173,105 sq. m. and the population (1924) 6,036,118.

I. POLITICAL HISTORY

On the death of King Oscar, Dec. 8 1907, his son became King of Sweden with the title Gustav V. After the dissolution of the union with Norway, sweeping reforms were introduced by the Liberal Ministry under Karl Staaff (1905–6) and the Conservative Ministry under Lindman (1906–11). The main problems were the extension of the political and municipal franchise and the adjustment of national defence. The franchise was reformed (1907–9), and the first elections for the Second Chamber under the new conditions took place in Sept. 1911. In 1905, the electorate numbered 402,000; in 1911, 1,066,000. The result of the election favoured the Left wing, and Karl Staaff formed his second Liberal Ministry, which in 1913, with the help of the other political parties, passed a law for national pensions insurance. The international unrest necessitated a complete overhauling of the national defence. The Staaff Ministry instituted a thorough investigation, and intended introducing a Government measure during the 1914 Riksdag.

At that time public opinion was much exercised over the military activities of Russia in Finland, which it was thought constituted a menace to Sweden. Staaff outlined his policy at the end of 1913 in a public speech, from which it appeared that the main question—the increase of the training period for the infantry—would be deferred until after elections to the Second Chamber in the autumn of 1914; the other items, however, were to be submitted to the 1914 Riksdag. These delays aroused much public feeling and in Feb. 1914, 30,000 peasants assembled in Stockholm to request the King that the whole question of national defence should be handled simultaneously. The King's answer was favourable, and this led to a conflict between himself and the Liberal Ministry, which resigned. The King commanded the *landshövding* Herr Hjalmar Hammarskjöld (*q.v.*) to form a new ministry. Herr Karl A. Wallenberg became Minister of Foreign Affairs. The Second Chamber was dissolved and the Riksdag reassembled after the election of May 1 1914. The supporters of the new Government won some seats but had no majority in the Second Chamber. In the First Chamber, however, they had a friendly majority.

National Defence.—Before the question of national defence could be handled the World War broke out. With the help of the Liberal party, the problem was solved by increasing the training period for recruits (in the infantry to 340 days followed by the usual annual training courses; for the other arms the increases were in some cases rather less, in others rather more). The system of maritime fortifications was strengthened and large grants were made for the fleet and for the provision of war materials. To meet the extraordinary expenditure a war tax was levied on all incomes above a certain amount. It was widely, but quite erroneously, believed that Sweden had entered into a treaty with Germany. Sweden immediately issued a declaration of complete neutrality, which she maintained strictly. Military patrols were stationed at all the more important points of communication and at certain points along the coast. The fleet endeavoured to prevent any military operations within Swedish territorial waters. Breaches of neutrality occurred, however, entailing complaints and sometimes apologies and compensation.

The Difficulty of Neutrality.—The difficulties of western trade over the North Sea increased. Many Swedish vessels were destroyed, with great loss of life, by German submarines and by mines laid by both belligerent groups. As the blockade against Germany was intensified, an increasing amount of Swedish goods were detained in England. The black lists of the belligerents, trade espionage and the attempt to force extensive undertakings from importers in neutral countries induced the Swedish Govt. to put a proposal for a War Trade Law before the 1916 Riksdag, under which no undertakings with belligerent Powers could be made without the sanction of the official Swedish authority (Trade Commission). If this officially recognised undertaking were broken the culprit was severely punished. Special arrangements were made with the belligerent countries regarding compensation for permission to transport goods. Britain desired to transport over Sweden goods necessary to Russia, and Sweden granted a transport licence in return for permission from Britain to import certain foodstuffs from the west. In Jan. 1915 the Government forbade the transport over Sweden of arms and other war material. Pourparlers between the Swedish and British governments with the object of improving trade communications between the two countries led to no result. Disputes arose over the British postal censorship and the closing by Sweden of a channel in Öresund. These difficulties brought the three Scandinavian countries into closer touch. In Dec. 1914, King Gustav invited the kings of Norway and Denmark to a conference in Malmö which inaugurated a period of greater friendship between the three countries.

Special War Legislation.—Many legal and administrative innovations were made. In 1914 a moratorium for debts was introduced, but was soon abolished. Special laws empowered the Government to fix a maximum price for food and other necessities and if necessary to commandeer them. The Government also exercised a certain control over the merchant service. A War Insurance Commission was set up to give state-aided insurance against loss at sea, a Food Commission to take over the import of grain, etc., an Industry Commission to report on industry and later to ration raw materials, etc., an Unemployment Commission, and a Trade Commission to carry out the war trade laws. In Nov. 1915 the first maximum prices were fixed (for grain). A bad fodder harvest and the difficulty of importing maize and other foodstuffs necessitated a great slaughter and export of cattle. The War caused a lull in internal party strife during 1915, but in the following year lively discussions took place as to how Sweden could best maintain her policy of neutrality. Some circles sympathised with Britain, others with Germany, but most desired neutrality. A little group of "activists" urged intervention on the side of Germany, but all political parties held aloof from them.

Pressure of the Blockade.—On July 7 1916 Britain and France ceased to apply the regulations of the Declaration of London regarding neutral trade. The difficulties already attending neutral trade were now multiplied. The German U-boat warfare was intensified; the closed areas in the North Sea and the blockade of the Central Powers by the Allies created a situation little in accord with the pre-war regulations concerning international law. The Premier, Herr Hammarskjöld, championed the preservation of international rights in the name of the Swedish Government. He met with small success, even although the three Scandinavian kingdoms combined in the protest. During the War 280 Swedish merchant vessels were sunk, chiefly by German submarines, but also by mines and from other causes. The English ports were crowded with confiscated goods. After the Russian revolution in 1917, Britain no longer needed to transport goods over Sweden to Russia, so this means of exchange fell away.

Negotiations with Britain for import licences led in the spring of 1917 to a temporary agreement whereby Sweden was guaranteed certain imports (including grain) in return for the release from the Baltic of a number of imprisoned vessels belonging to the Entente. The tonnage question played an important rôle in Entente policy, and Swedish vessels were requisitioned or were only allowed to sail in Swedish interests on condition that they were replaced by other vessels when required. Finally a commercial agreement was concluded in the spring of 1918, which enabled Sweden to import large consignments of goods in return for handing over merchant vessels up to 400,000 tons dead weight; a certain proportion of the Swedish iron ore export; longer credit for goods purchased in Sweden, and stricter

regulations regarding exports to Germany. The increasing difficulties of navigation in the North Sea and the insignificant export from Britain to Sweden, led to an expansion of trade with Germany. Before the War Sweden obtained 91% of her coal from England but during 1916–7 only 27–26%. The remainder was almost entirely supplied by Germany. The dislocation of trade thus largely influenced Sweden's policy, as in all her undertakings and agreements with the Entente Powers she had to reserve a considerable amount of commodities for exchange with Germany.

Import difficulties necessitated still more stringent state measures. In Oct. 1916 sugar was rationed. In 1917 bread cards were introduced together with State control of the whole grain trade. Before the War an average of 183 kilogrammes of wheat and rye were consumed per head. The harvest of 1917–8 produced only 84.4 kilogrammes per head. Finally, potatoes and many other commodities were rationed. There was a great shortage of meat and bacon, and milk was reserved for children and invalids. The price of food rose rapidly and large sums of money were set aside to provide the poorer classes with goods at cheap rates. As the import of coal decreased, special arrangements were made for procuring wood from the forests. All kinds of raw materials, especially lubricants, were scarce. The Hammarskjöld Ministry was formed against the wishes of the Liberals and the Social Democrats, and these parties commanded a majority in the Second Chamber of the Riksdag.

Changes of Government.—The Government only remained in power so long thanks to its firm neutral policy. Criticism of its trade policy increased, however, and in spite of a huge vote of confidence from 750,000 people, it was unable to co-operate further with the parties of the Left and resigned at the end of March 1917. A new Conservative Ministry carried on up to the new elections to the Second Chamber in the autumn. Herr Karl Swartz, a manufacturer, was Prime Minister and Adml. Arvid Lindman, a former Prime Minister, was Minister of Foreign Affairs. The food shortage caused considerable unrest and led to a demand for a constitutional reform of a democratic nature. At the autumn elections the Conservatives suffered several losses and Herr Swartz resigned. In view of the abnormal conditions, the King endeavoured to bring about a coalition government of all parties, but he was not successful and the Liberal leader, Prof. Nils Edén, formed a Ministry. He himself became Prime Minister and Lord Justice Johannes Hellnier, Minister of Foreign Affairs. The Ministry included five other Liberals and four Social Democrats. Among them were Herr Hjalmar Branting as Minister of Finance, and Baron E. Palmstierna, afterwards Swedish minister to London, as Minister of Marine. Branting soon resigned on account of illness. The main items in the programme of the new ministry were a great constitutional reform and a trade agreement with the Allies (*see* above). The Government motion on the question of constitutional reform was thrown out by the First Chamber during the 1918 Riksdag; but a law was passed instituting great educational and Poor Law reforms.

Finland and the Aaland Is.—In Jan. 1918, Sweden recognised Finland as an independent State. The Civil War in Finland created a critical situation. There was a demand for military support of the lawful Finnish Govt.; yet Sweden feared she might be drawn into the War if she assisted the Finns against the Russians and appeared to side with the Germans, to whom the Finnish Govt. had appealed for assistance. The Government acted with a circumspection which was rather resented by the Finnish middle classes. When the conflict was transferred to Aaland and its inhabitants voted for adherence to Sweden, Sweden sent a warship to the islands, and a small body of troops to maintain peace. These were, however, recalled when the Germans made the islands their centre for sending assistance to the "Whites" in Finland (*see* AALAND ISLANDS).

Swedish Relief Work in belligerent Countries.—The Swedish Red Cross was active in the adjacent belligerent countries, and Prince Carl, a brother of the King, took a prominent part in the work. Swedish delegates inspected the prison camps of Russia, Germany and Austria and distributed numerous gifts to the prisoners from their respective countries. Arrangements were made for the exchange of invalided prisoners and their transport over Sweden. After the War large numbers of German and Austrian children spent some time in Sweden renewing their health and strength, and Swedish help was given to the impoverished countries. When the great famine broke out in Russia a Swedish relief expedition was sent to Samara. The sum total of relief given by Sweden to the various countries amounted to 36,500,000 kroner.

Internal Conditions after the War.—The repercussions of the revolution in Central Europe reached Sweden. The Riksdag was sitting when the War ended and in order to keep in power, the Government hastened to put forward a programme embodying a far-reaching constitutional reform, which was carried, thanks to the close co-operation of the government parties. The graduated scale at the communal elections was abolished and equal and universal suffrage introduced. As the First Chamber is based on the communal vote, it became automatically more democratic. Women received full political franchise. The Social Democratic party consequently acquired a relative but not an absolute majority in each Chamber. Dissensions among the middle-class parties—the Conservative, Liberal and the new Bondeförbund (Farmers' League)—further increased the power of the Social Democrats; but lacking an absolute majority, they were obliged to act rather as a Radical middle-class party. The Edén Ministry remained in office until March 1920. The liquidation of war-time restrictions and the work of reform continued. A provisional law adopting an eight-hour day in industry and certain other branches of labour, not including agriculture, was passed. The Liberal and Social Democratic members of the Government disagreed on the reform of communal taxation, and the Ministry resigned after it had first laid before the Riksdag a proposal for Sweden's entry into the League of Nations.

Branting now formed his first purely Social Democratic Ministry with Palmstierna as Minister of Foreign Affairs. This ministry set on foot investigations into projects of socialisation, industrial democracy and control over trusts and cartels. At the Second Chamber elections the Conservatives and the *Bändeförbund* gained several seats; Branting therefore dissolved his Ministry on Oct. 22 1920. Baron Louis de Geer formed a moderate Conservative ministry, at the head of which Herr Oscar von Sydow replaced him in Feb. 1921. The Government granted large sums for relief work and the support of the unemployed. To carry out the new constitutional reforms fresh elections for both Chambers took place in the autumn.

Unemployment.—The result favoured the Socialists, especially in the First Chamber and in Oct. Branting formed his second purely Social Democrat Ministry, in which he himself was both Premier and Minister of Foreign Affairs. The economic crisis and the problem of unemployment were the vital questions at the moment, and at the instance of the Government the 1922 Riksdag granted what were, according to Swedish ideas, enormous sums of money for the relief of the unemployed. The Government finally fell over this question of unemployment. Swedish policy was to provide relief work whenever possible, otherwise to give monetary assistance. Wages for relief work were to be less than ordinary wages and assistance still less. Help was not to be given to workers involved in any conflict (strike or lock-out). The Government and the Riksdag interpreted this last clause differently, and Branting resigned in April 1923. During 1922 a referendum on the total prohibition of all alcoholic drinks was defeated.

Controversy on Defence.—Lord Justice Ernest Trygger, the old Conservative leader, now formed a new Ministry, whose special task was the solution of the national defence question. The 1914 army regulations had not been entirely carried out when the War ended and the Socialists, especially, felt strongly that the creation of the League of Nations and the fall of the Tsardom justified a reduction of armaments. During the 1924 Riksdag the Government had brought in a bill for this purpose,

but it was not sufficiently drastic for the Social Democrats and the *folkfrisinnade* (the Radical half of the old Liberal party; the rest still called themselves Liberals). The Riksdag threw out the bill, but the Government remained in office until after the Second Chamber elections in September. As the result did not strengthen the Government, it went out, and Branting formed his third Ministry on Oct. 18 1924, with Prof. Östen Undén as Minister of Foreign Affairs. The Government and the Social Democratic party suffered a severe loss in the death of Branting (*q.v.*) on Feb. 24 1925. Rickard Sandler, Minister of Commerce, succeeded him as Prime Minister. A Government measure, introducing shorter military service and a reduction of the army, was passed by the 1925 Riksdag.

Foreign Affairs.—When the question of the entry of Sweden into the League of Nations was broached there was considerable opposition, one reason being the non-entry of the United States. The decision to join was, however, carried by a large majority and in March 1920 her entry into the League was officially announced. Among the Swedish representatives at the League Assemblies were Branting, Trygger and Undén. In Sept. 1922 Sweden was given a seat on the Council.[1] The Aaland question (*q.v.*) was decided by the League in favour of Finland (June 1921) but the islands received guarantees for the preservation of their Swedish culture. An international Convention prohibited any fortification of the islands.

The co-operation established between the three Scandinavian States during the War was not continued in any definite form. There was much talk of a Scandinavian Alliance, but Norway was disinclined to join it. From time to time the Foreign Ministers of Norway, Sweden, Denmark and sometimes Finland, met to discuss foreign policy. Sweden concluded a trade agreement with Russia on March 16 1924. On March 5 1924, at Sweden's invitation, delegates of the Swedish, Norwegian, Danish and Finnish governments met and unanimously adopted a draft for setting up permanent conciliation councils for compulsory arbitration of differences not previously settled by diplomatic action or through the Permanent Court of International Justice. On June 27 six bilateral conventions based on this draft were signed between the States concerned. On Jan. 25 1925 Sweden signed a treaty with Norway making all differences of all kinds subject to arbitration.

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II. ECONOMIC AND FINANCIAL HISTORY

Population.—The population of Sweden at the end of 1910 consisted of 5,522,403 persons. By the end of 1925 it had risen to 6,053,562, representing a yearly increase of 6·12 per 1,000. The birthrate has steadily declined from 24·66 per 1,000 in 1910 to 17·53 in 1925, the lowest return for any European country. The death-rate has, however, also declined, viz.: from 14·04 per 1,000 in 1910 to 11·72 in 1925. During the five years 1909–13 emigration rose to 2·44 per 1,000 per annum, but sank to an insignificant figure during the War. Between 1921 and 1925 it again rose to 1·36 per 1,000 per annum. In 1910, 24·8% of the whole population were town dwellers. In 1924 the number had increased to 30·6%. The division of labour, according to the census of 1920, was as follows: agriculture 38·5%, industry 31·3%, trade and communications 12·9%, public services and professions (*fria yoken*) 4·6%, domestic service, retired workers, etc., etc., 12·7%.

Pre-War Period.—The period preceding the World War was characterised by greatly increased production and trade turn-over and by a marked growth of capital. From 1909, when trade depression reached its lowest level, to 1913 the industrial workers increased, according to statistics, from 320,000 to 360,000. The estimated value of the harvest rose from 778,000,000 kr. to 857,000,000, the total value of foreign trade from 1,087,000,000 kr. to 1,664,000,000, equivalent to 53% (imports by 38% and exports by 73%). Deposits in banks and savings banks increased from 2,207,000,000 kr. to 2,800,000,000.

Effects of the World War

Although Sweden took no active part in the War, it had, nevertheless, in many respects, a profound bearing upon the economic conditions of the country. The cost of living increased enormously. The Swedish index number for wholesale prices, reckoned at 100 for the period July 1 1913 to June 30 1914, reached, on an average, 339 in 1918. The number of bank-notes in circulation increased from 234,000,000 kr. at the end of 1913 to 814,000,000 kr. at the end of 1918. This was made possible by relieving the Riksbank from the liability to meet notes with gold. Incomes and property were naturally affected by the sudden inflation. Many new fortunes were made, but, at the same time, large numbers of well-to-do people—small investors and wage-earners were reduced to poverty.

War Scarcity.—The rupture of communications with foreign countries, as a result of the War, was of great import, especially as regards the maintenance of food supplies. The import of grain, which averaged 284,000 tons in 1911–3 was reduced to only 89,000 tons in 1917–8. The supplies of fodder and artificial manures almost entirely ceased, likewise the supply of fats and colonial goods. In order to exercise the greatest economy with the inadequate resources, maximum prices for agricultural produce were fixed. From the end of 1916 state rationing of sugar and wheat was introduced. Later on certain other foodstuffs, and even clothing, were rationed. The great reduction in the supplies of coal rendered necessary vigorous measures to provide home-grown wood for coal fuel, while the lack of lamp and fuel oils was supplied partly by the use of acetylene and partly by enforced development of electric power. Strenuous efforts were also made to utilise the native resources in order to replace imported raw materials necessary for industry.

Notwithstanding this, many industries, the textile in particular, were forced to limit their output owing to lack of raw materials. On the other hand, the War caused a boom in certain trades, expecially in the metal industries which had access to good raw materials in the country and whose manufactures were of great use in warfare. For example, production of pig-iron rose from 640,000 tons in 1914 to 829,000 in 1917 or by nearly 30%. The shipping trade flourished exceedingly and reaped immense profits.

Deflation.—War conditions and the inflation of the currency led to unprecedented speculation, the extent of which may be gauged from the figures of the transactions on the Stockholm *bourse* (in 1913, 638,000,000; in 1918, 5,726,000 kr. on an average per Exchange day). The boom came to a hasty end with the termination of the War. Rationing ceased, and foreign goods began to pour into the country. During the years 1914–8 there was a continuous excess of exports over imports. This was now changed to a considerable excess of imports over exports. From the year 1921 a violent deflation took place. The index number of wholesale prices fell successively from 366 in June 1920 to 150 in Dec. 1923, that is to say, by nearly 60%. The consequences of this were seen in the great increase in unemployment, which

[1] At the extraordinary session of the Council of the League called in March 1926, to consider the German application for the admission of the Reich, M. Unden, under instructions from his Government, declared, in face of the claims put forward by other countries for permanent seats on the Council, that Sweden would not consent to any immediate additions to the Council other than that of Germany. In the dispute which followed Sweden and Czechoslovakia offered, in the interests of peace, to resign their seats to allow of the election of two other Powers to non-permanent seats. This offer failed in consequence of the attitude of Brazil towards the admission of Germany.

reached its maximum figure in Jan. 1922 when 163,000 unemployed were registered. At the same time the statistics of the trade unions showed that over 30% of their members were out of work. The wise and energetic unemployment policy pursued by the State soon succeeded in surmounting the evil and by the end of 1923 the abnormal conditions were, in the main, overcome. The Swedish exchange during the years 1916–8 rose on occasions to over 20% above par in relation to the dollar, but, during 1919–20 fell considerably below; from 1921 onwards a gradual improvement took place and by the end of 1922 the krona was brought up to par and on April 1 1924 Sweden returned definitely to the gold standard, the first European nation to do so.

Post-War Conditions

Agriculture.—The extent of cultivated land has changed but little since 1911 (in 1911, 3,600,000 and in 1924, 3,800,000 hectares). On the other hand a certain displacement has taken place in the relation between the various crops. The harvest of different staple products for the years 1911–3 and 1923–5, reckoned in 1,000 metric tons, averaged: wheat 230 and 287 respectively, rye 596 and 527 respectively, barley and oats 1,922 and 1,899 respectively, potatoes 1,587 and 1,748 respectively, sugar beet 890 and 1,093 respectively, root fodder crops 2,693 and 2,924 respectively. The number of cattle in 1913 was 3,069,000, in 1920, 2,736,000; of sheep for the same years 1,205,000 and 1,568,000 respectively; of pigs 1,023,000 and 1,011,000 respectively. The import of wheat and rye during 1911–3 averaged 284,000 tons per annum (including flour), during 1923–5 374,000 tons. The export of butter which in 1913 amounted to about 20,000 tons (of which 16,000 were sent to England) ceased completely during the War, but in 1925 it amounted to 9,000 tons.

Industry.—The development of industry is best indicated by the number of workers employed; it had risen from about 360,000 in 1913 to 417,000 in 1920. The number fell to 326,000 during the trade depression of 1922 but rose again the following year to 358,000, about the same number as in 1913.

A great change-over also took place in industrial production with the result that the iron industry, one of the oldest staple industries of Sweden, became less important, while the wood trades, especially the wood pulp and paper industries, have come very much to the fore. During the years 1911–3 foreign trade showed a slight excess of imports over exports (an average of 26,000,000 kr. per annum); during 1914–8 inclusive a total excess of exports over imports for the five years of 1,345 million kr., *i.e.* 269 million per annum; from 1919 onwards, again an excess of imports. The most important exports were in 1925, timber (291,000,000 kr.), wood pulp (230,000,000 kr.), machines (138,000,000 kr.), paper (135,000,000 kr.), iron ore (122,000,000 kr.), iron and steel (69,000,000 kr.).

Communications.—The mercantile marine has been much increased; at the end of 1910 it comprised 1,047,000 tons gross weight, at the end of 1925 1,420,000, an increase of 35%. Steamship and motor-boat tonnage increased by 466,000 tons, sailing vessel tonnage decreased by 93,000 tons. The system of communications has also been much improved, the total length of the railways in 1910 was 13,829 km., in 1924, 15,710 kilometres. The number of telephones for the same years was 187,000 and 418,000 respectively, and the number of automobiles in 1919 was 8500, in 1924, 62,000.

Banking.—A very noteworthy process of amalgamation had taken place in the banking world. In 1910 there were 80 banks whose united capital amounted to 543,000,000 kroner. In 1925 the number had fallen to 32 with a capital of 804,000,000 kroner. The largest banks are Skandinaviska Kredit A.-B. (capital 182,000,000 kroner). Svenska Handelsbanken (capital 105,000,000 kr.), Stockholm's Enskilde Bank (capital 85,000,000 kr.), and A.-B. Göteborgs Bank (capital 79,000,000 kroner).

Finance.—In 1911 the state budget amounted to 243,000,000 kr., the budget year 1924–5 to 707,000,000 kroner. If the latter sum is reduced to the same money value as the former it will represent a rise of about 60% during the period and give an idea of the extent to which state activities increased during those years. The income and property taxes during the first mentioned year amounted to 14% of the whole revenue, during the latter year to 20%. The revenue derived from the customs and excise remained pretty uniform, namely 44 and 43% respectively. On the other hand that derived from state undertakings (railways, postal services, telegraphs, forests, landed property, waterfalls and the state bank "Riksbank") was reduced from 18 to 13%. The consolidated national debt at the end of 1910 amounted to 537,000,000 kr., at the end of 1925 to 1,717,000,000 kroner. A material change in its investment took place, however during the War. Until then 90% of the whole debt was placed abroad. By 1925 outstanding obligations had been redeemed, and new loans issued on the home market with the result that 80% of the total debt was in Swedish hands.

Social Conditions.—Since 1914 many important reforms have been carried out in all matters of social usage and legislation. At present Sweden must be acknowledged to stand on an equality with the foremost nations of the world. In 1912 an accident insurance law was passed giving a very wide interpretation to the Workmen's Compensation Act. An efficient factory inspection organisation was also set up. Later on (1919) a law was passed limiting the hours of work in industry and allied callings to 48 per week. In 1913 a law was passed instituting compulsory old age and disablement insurance and in 1916 an extended insurance law against accident during work. Legislation on intervention in labour disputes has been revised in 1920 and a law passed setting up a central arbitration court to pronounce judgment in judicial disputes concerning collective labour agreements. The Employers Central Organisation "Svenska Arbetsgivare föreningen" comprised at the end of 1924, 2,112 undertakings employing 231,000 workpeople. About 450,000 of these workers seem to have belonged at the same time to trades unions, and about 300,000 of these to the workers' unions which were branches of the central "lands organisation."

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(K. A.)

SWEDISH LITERATURE (*see* 26.214).—The years 1910–25 are not marked by the appearance of any writer of such individual prominence as Fröding, Strindberg or Almquist; nor did any very definite tendency declare itself which can be applied to the period as a whole. But several writers came to the front whose work deserves attention, and whose names, in two or three instances, were also known beyond the borders of Sweden. Apart from much ephemeral pamphleteering, the World War affected the literature of Sweden perhaps less than that of any other European country, its chief result being to turn the attention of thoughtful Swedish writers away from the present and back to the social life of their country during the 19th century. We shall find that many of the best books produced during this period are retrospective in subject. Gustaf Fröding died in 1911 and August Strindberg in 1912. The deaths of A. U. Bååth (1912) and Sophie Elkan (1921) have also to be recorded.

Not much need be added regarding the later production of authors already well established before 1911. They were either silent or worked on lines already familiar. Per Hallström began what will probably become the standard Swedish translation of Shakespeare. Selma Lagerlöf supplemented her romances with a volume of reminiscences centred round the old home of her family, *Mårbacka* (Eng. trans., 1924), in which the reader will find again much of the atmosphere of *Gösta Berlings Saga* (1891). Though the work itself does not fall within this period, perhaps the outstanding literary event was the publication (1908–11) of the *Memoirs, 1782–1861* in four vol. of Malla Montgomery-Silfvelstolpe. The circumstances of her life brought Malla Montgomery into contact with the most significant figures in the social and intellectual Sweden of her time, in particular with the eminent writer Erik Gustaf Geijer and his Upsala circle, and she was personally well qualified to be the intimate chronicler of the age. The charm and freshness of her writing make the book one of the most delightful in memoir literature, and as a document it is indispensable.

Among the more notable novelists we find on the whole more originality among the women than among the men, some of whom still reflect the influence of Strindberg in certain aspects of their work. Hildur Dixelius-Brettner in her trilogy of three generations, *Prästdottern* (1920), *Prästdotterns Son, Sonsonen* (1922) achieved an admirable unity of feeling, essentially tragic, but tempered by the humour of real life. Elin Wägner came to the fore with *Pennskaftet*, a bright and witty novel of feminist Stockholm; she later established a more permanent reputation with *Åsa-Hanna* (1918) and *Den namnlösa* (1922) which show a deep human sympathy and some tragic power.

The novels of Sigfrid Siwertz are studies in degeneration, marked by sure psychological insight. The most remarkable of them, *Selambs* (1920), Eng. trans. *Downstream* (1922), is a family history of the now classical Rougon-Macquart type, but

concentrated in a single generation; the workmanship is of high order, but the picture suffers somewhat from lack of relief. His later novel, *Hem från Babylon*, by drawing on the bizarre and fantastic, gives the impression of a paucity of human material. Among retrospective novels of Swedish life Erik Fahlman's *Firman Åbergson* (1914) stands out as the work of a true artist. The hero is a self-made provincial of the mid-19th century with all the virtues and limitations of his race and time. The texture of the book is extraordinarily light, and the subtlety with which the author has created his atmosphere is altogether admirable. K. G. Ossiannilsson, who began (in a way that is almost a tradition with Swedish writers) as a lyricist, later published a number of novels of contemporary life. He is a writer of originality who has the courage of his opinions and has not shrunk from exposing himself to attack and political isolation by his frankness. His *Bondlandet* (1919), a novel of country life, is a good character study, clearly treated. In *Förtrollningen* (1924) he deals with modern hysteria with some force.

Less clear in his method, but full of vivacity, is Ludvig Nordström, most of whose work bears the general title *Skildringar ur Svenska Nationens Lif*. He is most successful in *Landsorts-bohême* (1912), a thoroughly amusing satire on provincial bohemians, with the editor of the local paper for its central figure. A later work, *Döda världar i Samhällsrymden* (1920), is an ambitious attempt to deal in a fantastically satirical vein with the industrial evolution of Sweden and the effect of new economic conditions on the life of the country. Nordström is tempted by great problems, but seems to lack the balance for carrying them out; his doctrine of " totalism," as he calls the solidarity of the intellectual and the economic life of the nation, appears to have fallen on stony soil, and he is at his best when restricting himself to a smaller scene.

It may be said generally that Swedish humour has a tendency to run to irresponsible lengths and to substitute burlesque for satire. Though not entirely free from this propensity, Hjalmar Bergman in his best work, *Markurells i Wadköping* (1919), Eng. trans. *God's Orchid* (1924), succeeded in blending together tragedy, high comedy and farce while never outraging our sense of fitness and psychological probability. This book, the action of which is concentrated into a single day in the life of a provincial town, is something of a *tour de force*, but at the same time a remarkably trenchant study of character. Henning Berger (1872–1925) was a realist of pessimistic outlook, whose strength lay in the delineation of the life of great cities. His best work is the *Dreamland* trilogy, in which he depicts with great variety of treatment the loss of illusions suffered by Swedes of the educated class in America and the brutalising effect of standardisation on the mental and moral character of the individual. Returning to Stockholm in *Fata Morgana* (1911), his banker hero has renounced his ideals and settled down to a comfortable epicurean view of life. Berger's later work, in the more confined atmosphere of the Scandinavian capitals, lapsed into the novel of scandal, which considerably limits its interest. A lyricist of serious outlook and melodious quality arose in Anders Österling.

To sum up: While contemporary literature affords an admirable retrospect of 19th century life and manners, the future historian will only find in it fragmentary and distorted material for a picture of the 20th. Writers in their dread of the commonplace have exaggerated the exceptional and fantastic, thereby detracting from the documentary value of their work. But this is a fault which is not peculiar to the literature of Sweden.

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SWIMMING (*see* 26.231), a sport in which many changes have been witnessed since 1910. In 1910 F. E. Beaurepaire of Australia scored a series of remarkable victories in English championships, winning every event from 100 yd. to one mile inclusive. The following year an Hawaiian, Pau Kahanamoku, H. Hebner of Chicago and George Hodgson of Canada, set up world's records at the Stockholm Olympiad.

Apart from the prowess of the foregoing, the Stockholm fixture was noteworthy for the advent of women into Olympic swimming contests. Miss Fannie Durack of Australia won the sprint in record time, while a quartette of British ladies secured the team event. A year later J. G. Hatfield of England came to the front, and proved supreme in all distance events. Naturally, international swimming fixtures were completely suspended during the War period, yet marked progress was recorded in the United States and to a lesser degree in European countries.

Improvements in Method.—The American coaches, L. de B. Handley, New York, F. J. Sullivan, Princeton and Chicago, and W. Bachrach, Chicago, evolved a new variety of the crawl stroke which proved so effective over distances up to one mile that the trudgeon stroke has been rendered obsolete. Handley's experimental work was restricted to the members of the Women's Swimming Assn., New York, and within five successive years he was solely responsible for the development of five world champions, Claire Calligan, Ethelda Bleibtrey, Charlotte Boyle, Helen Wainwright and Gertrude Ederle. In the Middle West, Sullivan and Bachrach brought to light notabilities of the calibre of Perry McGillivray, Harry Hebner and Norman Ross.

Sweden also discovered Arne Borg and Ovar Trolle prior to the cessation of hostilities, whilst the appearance of the American-Belgian, Martial Van Schelle, in International contests against France, Sweden and Holland in 1919, proved a factor of progressive import.

Olympic Games.—The governing swimming associations in Great Britain ceased operations during the War; but in certain areas commendable efforts were made to keep the flag flying by intensive work among juniors, and the reward exceeded all expectations. Britain's only Olympic success at the Paris Games was scored by Miss Lucy Morton, who first came into prominence in 1915. Apart from Miss Morton the junior coaching propaganda was directly responsible for the rise to fame of Miss C. M. Jeans, Miss H. M. James, Miss I. Gilbert, Miss G. Carson, Miss M. Spencer, Miss D. B. Hart, A. Rawlinson, R. Flint and W. Stoney, all of whom won national titles in the post-War period.

The Olympic Games at Antwerp in 1920 supplied convincing proof of American supremacy, for the Stars and Stripes were carried to success in the free back stroke and team events in record time, but the breast swimming fell to Scandinavian contestants. New records were established with clockwork regularity. The Hawaiian-Americans, Kahanomoku, in the 100 metres (1 min. 1 2–5 sec.), Kealoha, in the back stroke 100 metres (1 min. 15 1–5 sec.), being the outstanding performers among the men, whilst Miss Bleibtrey set up new world's figures for 100 metres (1 min. 13 3–5 sec.), and 300 metres (4 min. 34 sec.).

The Antwerp Olympiad was noteworthy for the advent of mere school children into the Olympic Games. Nils Sköglund, a 14 year old Swedish boy, took second honours in the men's high diving event, and Miss Aileen Riggin, a 13 year old American, earned world fame by annexing the fancy diving contest against all comers, with her 14 year old countrywoman, Miss Helen Wainwright taking second place. Swedish nominees took the high diving for men and women, but the fancy diving fell an easy prey to America's representatives.

The Americans' speed, style and form, made a tremendous impression and their strokes were immediately copied throughout the world. Arne Borg, in Sweden, Andrew Charlton, in Australia and Miss Hilda James, in England, made noticeable improvement, whilst New Zealand developed a quartette of women who held forth the promise of rivalling the Americans. In 1922 Miss James visited America, but although she showed world record pace she was defeated by Miss Ederle and Miss Wainwright, the English girl's only important success being her victory in the National Medley Championship at Indianapolis. Arne Borg made a world tour in 1923 when he met the 16 year old Australian, Andrew Charlton, the latter proving successful in three contests, when new records were tabulated. Borg, however, eclipsed Charlton's figures later, when he had become acclimatised.

Under the mentorship of W. Bachrach of Chicago, the Illinois Athletic Club produced John Weissmuller, a well-set-up youth of Austrian descent. Weissmuller created world's figures for

every distance from 50 yd. up to and including 500 metres; he also proved equally skilful when swimming on the back, establishing world's record for 100 metres and 150 yards. Weissmuller won the 100 and 400 metres events at the Olympic Games at Paris in 1924, his respective times being 59 sec. and 5 min. 4 1–5 seconds. In the 400 metres Weissmuller was forced to his utmost to defeat Arne Borg and Charlton, as only 2 2–5 sec. separated the first three. Charlton, however, won the 1,500 metres in 20 min. 6 2–5 sec., breaking the Olympic and world's record of 22 min. flat created by the Canadian George Hodgson at Stockholm in 1920.

America almost swept the board at Paris, but it was noticeable that other countries including Sweden, Australia, England and Japan were rapidly closing up to the Americans. Takaishi, a tiny Japanese, returned 1 min. 1 2–5 sec. in the 100 metres, and in the 1,500 metres semi-final he returned 21 min. 58 3–5 sec. Japan took fourth place behind America, Australia and Sweden in the 800 metres Team race, finishing 14 1–5 sec. ahead of the British team. In August 1926 Gertrude Ederle of New York created a record by swimming the English Channel.

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SWINTON, SIR ERNEST DUNLOP (1868–), British soldier, was born Oct. 21 1868 and commissioned in the Royal Engineers in 1888. In the South African War he was first adjutant and then commander of the 1st Railway Pioneer Regiment. In 1904 Swinton produced *The Defence of Duffer's Drift*, a tactical study which became an unofficial textbook in the British and Indian Army, and an official one in the U.S. Army. In 1909, when an instructor at Woolwich, he wrote, under the pseudonym of Ole-Luk-Oie, a book of short stories entitled *The Green Curve*, which, by its combination of literary power and military imagination, gained a wide reputation. Appointed secretary of the historical section, Committee of Imperial Defence, in 1910, he compiled the official history of the Russo-Japanese War. This work, which led him to grasp the dominating rôle of the machine gun in future warfare, was to prove, in conjunction with his active interest in the early caterpillar tractors, a vital factor in the causation of the tank. Soon after the outbreak of war in 1914 he was sent out to France by Lord Kitchener as the official Military Correspondent ("Eyewitness"). In this capacity he was able to appreciate the complete paralysis of the offensive brought about by the defensive power of serried machine guns and aggravated by wire entanglements. Swinton was the first to diagnose and suggest the antidote to this tactical disease, and his proposals to Sir Maurice Hankey, Secretary of the Committee of Imperial Defence, in Oct. 1914 became the first link in the causation of the machine gun and wire destroyer, afterwards christened the tank (*q.v.*). In 1915 he returned to England to become secretary to the War Committee of the Cabinet. In this capacity he had much to do with the preparation of the first tanks. He was created K.B.E. in 1923 and in 1925 was appointed Chichele professor of military history at Oxford.

SWITZERLAND (*see* 26.238), a republic of Central Europe, bounded N. by Germany, E. by Austria and Liechtenstein, S. by Italy and W. by France. Its area is 15,975 sq. m. and the population (1920) 3,880,320.

I. POLITICAL HISTORY

Constitutional Changes.—The uncompromising nature of the Treaty of Confederation, 1815, actually caused the civil war of 1847, but the Constitution of 1848, amplified in 1874, has never been *entirely* reorganised. In 1891, however, the right of demanding *partial* reorganisation was conceded to any body of 50,000 Swiss citizens. This democratic measure, proposed some years earlier, had met with little opposition, and it soon proved of great value.

Proportional representation, on the contrary, though put forward at the same time, had a long and bitter struggle before it. Owing to the peculiar opportunities afforded them by the Federal System the cantons, individually, were able to demonstrate the advantages of the new method of representation by adopting it for the Cantonal Council elections. Between 1891 and 1905, therefore, proportional representation was adopted in several cantons, but the promoters of the whole movement were almost exclusively the Minority parties—Socialists, Conservatives and Liberal Democrats—whereas many of the Independent Radicals (in power since 1848) seemed more and more in favour of increased centralisation and extension of the powers of the Federal Assembly. These were inclined to oppose the adoption of the new method for the election of the National Council, and the struggle continued with more or less heat, until the reaction against the over-centralisation due to the temporary exigencies of war-time gave added strength to the movement, and proportional representation was adopted in 1919.

During this time direct popular election of the local executive authorities had been introduced in a good many cantons, but suggestions that the same method should be applied in the case of the Federal Executive met with no encouragement. As Switzerland has no so-called "Parliamentary System," her central government is very firmly established, and she is therefore able to carry out great public enterprises with the utmost thoroughness and consistency.

Social Legislation.—A striking example of this was the building up of the system of social legislation. A proposal for insurance against sickness and accident was rejected by referendum in 1900, but a clause in the same bill dealing with military insurance came into force in 1901. In 1911 the rejected clauses were submitted to the people on a new basis and this time accepted. The opening of the Swiss Accident Insurance Institute in Lucerne in 1918 was, however, merely a compromise; compulsory insurance against old age and sickness, and insurance in favour of surviving dependents were not secured until 1925, when, in order to forestall an extreme measure on the part of the Socialists, the other parties voted for the insertion of a suitable paragraph in the Constitution.

Another example of social legislation was the introduction of the eight-hour day or forty-eight-hour week (in certain exceptional cases fifty-two hours being allowed), by means of the Hours of Work Act of 1921, an extension of the Factory Act of 1914. Although this measure struck a decided blow at economic Liberalism, it was not a sign of State socialism; the Swiss nation has never favoured a tendency in that direction. Thus a motion for the introduction of a direct Federal Tax was defeated by a large majority in 1917, as was also a Property Tax proposed by the Left in 1922. The feeling against extreme centralisation was so strong that the Confederation never even succeeded in getting complete control over military affairs, and to this day the cantons still retain certain powers.

It was, however, otherwise with regard to the consolidation of the legal system, though that also, had been opposed in the past. After long and careful preparation, the Swiss Civil Code came into force on Jan. 1 1912, and, though the task of establishing a uniform Penal Code has not yet been brought to a successful close, a firm foundation has been laid for this also. The draft has been actively opposed in certain cases—for instance, the existing Penal Code of the Catholic Canton of Fribourg was revised a short time ago—so that there seems little likelihood of it being accepted in the near future.

Extension of Federal Powers.—Owing to this extension of their powers and the continual development of the administration, the strength of the Central authorities steadily increased. The Confederation was endowed with more and more power in matters calling for uniform treatment, such as the control of waters and forest throughout the country. By the year 1906 the scheme for the State purchase of the railways had already been suggested, and, when the Canton of Ticino proposed selling part of its water-power to a foreign country, the Federal Assembly decided to make the export of electric power, if obtained from the national waters, subject to the approval of the

Federal Council. The National Waters Act came into force on Dec. 22 1916, but its importance was not generally recognised until the Federal Railways were electrified.

Railway Purchase.—The State purchase of the railways, however, and the establishment of a bank of issue—the National Bank of Switzerland—tended more than anything else to strengthen the authority of the Confederation. The dislike of the people to any very great concentration of economic power in private enterprise had manifested itself more particularly in connection with these questions, but, on weighty economic grounds, the development of the railways during the latter half of the 19th century was only feasible by means of private capital. In the first decade of the new century conditions were very different, the various railway lines had already justified their existence and there was much less reason to fear rash and expensive undertakings. Notwithstanding all this, there was a good deal of opposition to the proposal of State purchase, but it was due less to economic considerations than to apprehensions of the ever-growing power of the Central authorities, which was felt in some quarters to be not altogether in accordance with Liberalism and Federalism. Indeed, in face of the deficit accumulated during the War years, the question of handing the railways back to private enterprise was mooted from time to time in the country.

Public opinion was excited most of all, however, by the St. Gothard Convention, concluded with Italy and Germany in April 1923, after three years of controversy. An agreement of some sort was inevitable, as these countries had subsidised the construction of the Swiss railways, but the terms of this Convention, which gave them most favoured nation treatment on all the railways throughout Switzerland, and restricted Federal rights in the matter of fares, was regarded by many as a serious limitation of the sovereignty of the State and of economic freedom. So strong was this feeling that the people demanded that, in future, no convention should be concluded by the State for a period exceeding 15 years, without being first subjected to a referendum. This proposal was adopted by plebiscite and consequently became law.

Neutrality.—When the World War broke out in Aug. 1914, Switzerland was confronted with new and difficult problems. The army was at once mobilised as a protective measure and on Aug. 4 the Federal Council issued a formal Declaration of Neutrality to those States which had guaranteed her inviolability and neutrality in 1815, and to some others, among them Italy. This declaration expressly stated that Switzerland would maintain the neutrality and inviolability of her territory with all the means at her disposal. The Federal Council, endowed with plenipotentiary powers in this respect also, took the necessary measures for securing the national credit and solving the serious economic problem. Agreements were made with the belligerents on either side with the object of ensuring a constant supply of foodstuffs, and, as a result, the "Société Suisse de Surveillance Economique" (S.S.S.) was established on the one hand, and a "Central Office" (Treuhandstelle) for trade with Germany and Austria on the other.

The newly founded "Agence des Prisonniers de Guerre" opened a fresh field of activity to the committee of the International Red Cross and rendered very great service to all the belligerent countries. Switzerland also acted as intermediary for the exchange of seriously wounded prisoners, and for the repatriation of interned civilians, while many of the sick and wounded, both prisoners of war and civilians, regained health and strength when transferred to the internment camps in Switzerland. (*See* RED CROSS.) During the War, too, the Swiss Legations in many countries took over the representation of the interests of foreign powers, and this work assumed such proportions that a special department was created to deal with it. The diplomatic representation of Liechtenstein was handed over to Switzerland permanently, a Customs Union was arranged between the two States in 1923, and the Confederation afterwards took over the postal, telegraph and telephone services of the Principality.

Relations with Russia.—A Soviet delegation visited Switzerland in 1918, but it acted mainly as an organ of propaganda and espionage, and the revolutionary tendencies of the general strike in that year were undoubtedly aggravated by its influence. The difficulties of the military in counteracting these tendencies, together with the suffering caused by a widespread epidemic of influenza, roused public feeling, and the delegation was requested to leave the country. The assassination of Vorovsky, the Soviet Minister to Rome, on Swiss territory in 1923 widened the breach and no diplomatic relations had been established between the two Governments up to 1926.

The Savoy Free Zones.—Under Art. 435, the Treaty of Versailles guarantees the perpetual neutrality of Switzerland but deprives her of the right of occupying Savoy, a right she had been unable to exercise since it was conferred in 1815, as the conditions of occupation had never been defined. Considering the political situation in Europe, the possible exercise of this right, or even its continued existence, would have been a menace rather than a safeguard, and might have involved Switzerland in international complications inconsistent with her neutrality. Under the same Article, the Treaty provides for a re-adjustment of the (Free Trade) Zones question by an agreement between France and Switzerland. France has since declared herself ready to accept the decision of an international Court of Arbitration, but the question still (1925) remained unsettled, nor has the neutrality clause yet been ratified.

Entry into the League.—The principle of neutrality played a great part in determining the entry of Switzerland into the League of Nations, and its influence was two-fold. On the one hand, it seemed to bind the country to steer clear of all international conflicts and thereby to debar her from joining the League, while, on the other, the interests of the Confederation, as a neutral State, were centred in the very objects which the League was called into being to attain. The Federal Council took keen interest in the new organisation from the outset, and tried by every possible means to ensure the entry of Switzerland. Moreover, Geneva had been selected for the headquarters of the League, and it would have appeared somewhat ungracious had Switzerland refused to join, and thus increased the difficulty of establishing the League. As the question was, of course, subjected to a referendum, the decision of the people in this instance became a matter of international importance.

The taking of the referendum was delayed, for, in a reply to an "aide-mémoire" sent by the Federal Council in Dec. 1919, the Great Powers stated that "a declaration of entry which was subject to the result of a referendum could not be regarded as an entry at all." Still greater uneasiness was caused, however, by another passage in the reply. This stated that the Conference of Ambassadors in Paris, under the presidency of M. Millerand, were deliberating as to whether the entry of Switzerland into the League would be consistent with the maintenance of her neutrality. After drawing up a Memorandum and sending a special mission to London, the Federal Council received a Note stating that the Allied and Associated Powers were bound by Article 435 with regard to the perpetual neutrality of Switzerland, and that all other questions had been referred to the Council of the League. A delegation from the Swiss Confederation obtained an audience of the Conference in Feb. 1920 and in the same month all difficulties were overcome by the decision that Switzerland should be required to co-operate in the case of economic sanctions only.

The fact that the independent existence of little nations side by side with great and powerful states is recognised, not as a mere matter of expediency but as their just due, is in itself a splendid tribute to the liberal and humanitarian tendencies of modern political thought. It behooves these little nations to participate in any international movement serving the interests of humanity, and the large majority, when the referendum was taken in May 1920, showed that Switzerland was ready and willing to take her proper place and enter upon the new phase of her history which began with her enrolment as a member of the League of Nations.

The Swiss delegation to the League maintained an attitude of extreme reserve with regard to all questions connected with the application of the Peace Treaties, with the exception of three which had a special interest for Switzerland. These were the Armenian question, on humanitarian grounds; the question of Minorities, which Switzerland was peculiarly fitted to deal with, and the reconstruction of Austria and Hungary, which naturally aroused her warm sympathy. The League appointed a Swiss to preside over the League Council at Danzig, and two Swiss acted for the League in the Saar basin. From the outset, however, Switzerland regarded the maintenance of peace as the primary object of the League and she therefore was a keen advocate of the Permanent Court of International Justice as the best means of attaining it. M. Max Huber, whose appointment had been moved by Switzerland and Austria, was made Judge of the Permanent Court in Sept. 1921, and in Sept. 1924 he was elected President.

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II. DEFENCE

The Swiss Army is a national militia. Its only permanent forces with the colours are the corps of instructors and the fortress guards. The Federal Council is the supreme head of the military administration and the Federal Govt. is in charge of all larger military questions, although the cantonal authorities exercise part of the administration and promote officers up to the rank of captain. Service is compulsory and universal. Liability to serve extends from the 20th to the 48th year, the first 12 years being passed in the "Auszug" or "Elite," the second eight in the Landwehr, and the last eight in the Landsturm (cavalry, 11 years in the Auszug, eight in the Landwehr). The recruits' courses last 90 days for cavalry; 75 for artillery, air force and fortress troops; 65 for infantry and engineers and 60 days for other arms. Troops in the Auszug then do annual "repetition courses" lasting 11 days (14 days for artillery and fortress troops). In the Landwehr there is only one course every four years.

Switzerland is divided into six divisional districts. The strength of the first line troops is six divisions and certain army troops. The 1st, 3rd, 5th and 6th Divisions consist of two brigades each of two regiments of three battalions, one brigade of mountain infantry, two cyclist companies, one machine-gun group, 12 batteries of field artillery, two field howitzer batteries, two squadrons of dragoons and one battalion of engineers. The 2nd and 4th Divisions have three infantry brigades and no mountain brigade. A cavalry brigade consists of two regiments. A mountain brigade consists of two regiments of three battalions of mountain infantry, two mountain batteries and one company of engineers. Altogether there are 110 battalions of infantry, 72 field batteries, 12 howitzer batteries, nine mountain batteries and six cavalry regiments (each of three squadrons), besides 12 squadrons of divisional cavalry (guides). There is a staff organisation for three army corps. The peace establishment under training in 1924 was 46,200. The fortress troops, mostly Landwehr, amount to about 21,000 men. The Landwehr is organised in 37 battalions and 36 squadrons. Altogether Switzerland can mobilise nearly 200,000 men (combatants), while the Landsturm amounts to about another 60,000. The air force consists of a flying group, composed of staff, five flights (first line), the pilot's corps, corps of observers, one company photographers and one air park company. The aircraft (including reserve, but excluding training, machines) consisted in 1924 of 60 fighting planes, 150 reconnaissance and nine captive balloons. (X)

III. ECONOMIC AND FINANCIAL HISTORY

The last years before the World War were perhaps the most prosperous in the annals of the Swiss Confederation. Foreign trade had by 1913 reached a *per capita* figure of 850 francs, which is more than 25% higher than the figure for the United Kingdom. The import and export figures clearly reflect the peculiarities of her economic structure. The imports were in 1911 to 1913 divided almost equally between foodstuffs, raw materials and manufactured products. Switzerland, which is after Great Britain the least self-sustaining country of Europe, imported grain from Russia, the United States, Argentina, Rumania and Germany, in the order named; meat, chiefly from France and Italy; sugar from Germany; malt and hops from Austria-Hungary and wine from Spain and Italy. For her raw materials, which made up about one-third of her imports, Switzerland was dependent mainly upon Germany (coal and iron), France (silk and iron), United States and Egypt (cotton about in equal proportions), Great Britain (iron) and Japan (silk).

Swiss exports, although they also had advanced rapidly and had reached their highest figure in 1913, had been relatively losing ground when compared to the imports. Nearly 75% of the export trade was in manufactured goods, raw materials representing little more than 10% and foodstuffs less than 15% of the total exports. The German Empire was before the war Switzerland's most important customer and by far her most important supplier. Great Britain, which before 1914 usually occupied the fifth place among the exporters to Switzerland, coming immediately after her four continental neighbours, was second as a customer and the only important customer whose purchases regularly exceeded her sales.

Public Finance.—The public finances were on the whole on a sound basis, and public indebtedness was not high. The revenue of the Federal Government was derived in the disquieting proportion of 85% from the customs, whereas the cantons and the municipalities relied mainly for their revenue on property and income taxes. This general division of indirect and direct taxation between the national Government and the local administrations was well adapted to the needs of peace, but proved untenable in time of war.

The War Period

Switzerland was peculiarly exposed to the repercussions of the War, not only on account of her geographical position, but also by reason of the composition of her population, the nature of her foreign trade and her system of public finance. The main demographical results of the War are apparent if we compare the results of the census of 1910 with those of 1920. The annual rate of increase which had been 12·5 per 1000 inhabitants between 1900 and 1910, fell to 3·3 per 1000 in the succeeding decennial period. The number of foreigners decreased by about 150,000 and dropped from nearly 15% to about 10% of the total population.

The position of Switzerland from 1914 to 1918 may be defined as that of a state politically neutral and economically dependent upon the goodwill of her warring neighbours. The Allies, from whom alone Switzerland could receive the raw materials and the foodstuffs without which her population would have been condemned to unemployment and starvation, consented to their entrance only on condition that they should not in any shape be re-exported to the Central Powers. Germany on the other hand, whose coal and iron Switzerland could no more forego than the Allies' grain and cotton, was not prepared to supply these commodities except in exchange for those she needed most, which were foodstuffs. Under pressure of these circumstances Switzerland sought to increase her production of wheat and fuel, while limiting to the utmost her internal consumption.

From 1914 to 1918 Switzerland's imports of raw materials fell from 4,600,000 metric tons to 2,800,000 and of foodstuffs from 1,300,000 to 700,000. The following figures relating to the two fundamental commodities of grain and coal show both the decline in quantity and the increase in value of Swiss imports during the War:—

	1913	1914	1915	1916	1917	1918
Grain (millions of metric quintals)	9	7	7	8	4	3
Value (millions of francs)	181	163	248	404	257	202
Coal (in millions of metric quintals)	34	31	33	32	23	21
Value (millions of francs)	107	100	125	151	159	312

While Switzerland's imports were then declining very appreciably her exports were on the whole rather increasing. The commodities, the export of which was most stimulated by the War, were embroideries, machinery, chemicals, silk yarn, wrought copper, iron forgings and aluminium.

The revenues of the Federal State, derived mainly from the customs and from the postal, telegraphic and telephone monopolies, declined *pari passu* with the volume of trade. Its expenditure was enormously increased by the cost of the mobilisation and by the measures taken to counteract the rise in prices. The figures relating to the Budget, given below, tell only a minor part of the tale of increasing financial distress because the cost of mobilisation, as also certain exceptional receipts, were not included in the Budget, but were charged to a special capital account.

With the outbreak of hostilities the army was mobilised for the defence of the neutrality and territorial integrity of the country and was partially maintained under arms throughout the War. The total cost of mobilisation, from Aug. 1914 up to the end of 1918, amounted to 1,076,000,000 francs. In order to meet this and other extraordinary expenditure and the rapidly increasing deficits due to secondary causes, new taxes were introduced, existing rates were raised, and loans were floated at home and in the United States. The new taxes were: (1) a general property and earned income tax levied in 1915; (2) a war excess profits tax, introduced in 1916 and (3) a federal stamp tax, which became payable from April 1918 onwards. By the end of 1918 these three sources had yielded about 345,000,000 francs. The surplus of expenditure was covered by 11 public loans, amounting to nearly 1,000,000,000 fr., all of which except 15,000,000 fr. were raised on the domestic market, at rates little exceeding 5%. The main effect of the War on the public finances of Switzerland was that, in spite of very heavy taxation, the debt of the federal State had increased about tenfold from 1913 to 1918, and that the total indebtedness of the cantons had nearly doubled.

The surplus of births over deaths, although somewhat less than it had been before 1914, is still (1926) between 6 and 7 per 1,000 inhabitants. As the population did not increase after the War in proportion, there must have been an excess of emigration over immigration.

An unemployment crisis which followed was for a time relatively more severe than the British, and similarly entailed state assistance to the unemployed. Fortunately for Switzerland it proved less persistent. By the end of 1923 the worst seemed to be over, and statistics for 1924 and 1925 showed a marked increase in almost all branches of manufactures and a corresponding decrease of unemployment.

But the great menace to the economic prosperity of Switzerland, which is so clearly dependent upon its export trade, is the recrudescence of protectionism all over the world, not least in Switzerland herself. No country can suffer more than Switzerland from the spread of economic nationalism and none should more warmly welcome a wholesome return to a spirit of real international co-operation in the economic field.

When the War was over, the general expectation in Switzerland was that public revenue would automatically increase with the return of economic prosperity and that public expenditure would no less automatically shrink with the decline in the cost of living and the diminution of state activities. In order to redeem the public debt the people, by means of a constitutional referendum, had, on May 4 1919, authorised the introduction of a renewed direct federal War tax on property and earned income. This tax was to be levied yearly until its yield, added to that of the already existing excess war profits tax, would have sufficed to pay off the mobilisation expenses. These expectations were not fulfilled. The ordinary annual revenue increased, it is true, from 101 million francs in 1918 to 283 million in 1924. But the ordinary expenditure increased at a faster rate than the ordinary revenue and the mobilisation cost, which disappeared from the so-called annual capital account, was almost equalled in amount by the extraordinary expenditure.

The public debt actually rose from 1,507,000,000 francs at the end of 1918 to 2,304,000,000 by the end of 1924. The increased general expenditure was due to the increased debt charges, which to-day far exceed the total pre-War budget, as well as to increased expenditure in all government departments, due to a larger number of state officials with more pay, and in general to higher administrative standards. In the Federal Budget for 1926, the ordinary revenue and expenditure at last almost balanced. A sinking fund was to be set up which should assure complete repayment of the public debt within 40 years.

Foreign Trade (in millions of francs)

	1913	1914	1916	1920	1922	1923	1924
Total imports	1920	1478	2379	4243	1914	2243	2504
Total exports	1376	1187	2448	3277	1762	1760	2070
Imports from:							
Germany	631	472	620	809	366	417	486
France	348	236	280	603	303	395	454
Italy	207	390	222	325	200	224	289
Austria Hungary	108	45	61	72[1]	25[1]	31[1]	34
Russia	71	..	..	8	9	4	10
Great Britain	113	160	248	466	174	182	184
United States	118	565	354	865	190	178	207
Exports to:							
Germany	306	709	445	252	193	123	328
Great Britain	236	424	268	646	348	363	395
France	141	401	466	522	240	214	206
United States	136	133	98	283	215	209	206
Italy	89	150	97	166	74	101	94
Austria Hungary	78	195	101	106[1]	48[1]	65[1]	90[1]
Russia	59	61	5	1	1	2	2

[1] Austria alone.

Revenue and expenditure (in millions of francs)

	Cantonal		Federal	
	Revenue	Expenditure	Revenue	Expenditure
1925	Not available		288.7	305.2[1]
1924	450.2	487.8[1]	256.9	285.2[1]
1923	505.0	528.2	253.4	298.9

[1] Budget.

Bibliography.—This study is based mainly on public documents which can be readily obtained from the official sources. A complete, thorough and recent work of the economic life and institutions of Switzerland is the following: *Volkswirtschaft, Arbeitsrecht und Sozialversicherung der Schweiz, im Auftrag des schweizerischen Bundesrates Herausgegeben vom Eidgenössischen Volkswirtschafts-department*, 2 vol. (Einsiedeln 1925.) (W. E. R.)

SYDENHAM, GEORGE SYDENHAM CLARKE, 1st Baron (1848–), British soldier and administrator, was born in Lincolnshire July 4 1848. Educated at Haileybury and Wimbledon, and afterwards at the Royal Military Academy, in 1868 he entered the Royal Engineers. Having served in various expeditions abroad, he returned to England in 1885, and was employed at the War Office until 1892. From 1894 to 1901 he was superintendent of the royal carriage factory at Woolwich. Sir George, who was created K.C.M.G. in 1893, earned a great reputation as an authority on military questions, particularly fortification. On his retirement from Woolwich he was made a member of the committee on War Office reorganisation. In 1901 he was appointed governor of Victoria (Australia), and on his retirement in 1904 he became secretary to the Committee of Imperial Defence. From 1907 to 1913 he was governor of Bombay. He had been created G.C.M.G. in 1905, and in 1913 was raised to the peerage. In addition to his classic work on *Fortification* (1890; 2nd ed. 1907), his publications include *The Navy and the Nation* (1897) and *Imperial Defence* (1898).

SYDNEY, Australia (*see* 26.278), the capital of New South Wales and the chief port of Australia, had in 1922 a population of 109,970 in the city proper, and 981,400 in the metropolitan area in 1923 (over a million in 1925). The city has an area of 3,327 ac., and the metropolitan area, which includes 40 neighbouring municipalities, Kuringgai, and the islands in Port Jackson, covers 185 square miles. The population increased by 42% between 1911–21, and the proportion borne by that of the metropolitan area to that of the whole State had risen to 44% in 1923. The death-rate is low, 8.9 per 1,000 in 1922 and 9.6 per

1,000 in 1923, and in 1922 the infant mortality rate fell to 56 per 1,000.

Since the World War many buildings have been divided into tenements and flats, owing to the scarcity of houses. To guard against the growth of slum conditions much has been done recently in town planning and the destruction of insanitary areas, and several model suburbs have been built. A large number (11.321) of new buildings were authorised in 1923–4. There are 647 ac. of parks and open spaces in the city and 3,700 ac. in suburban areas. Zoological gardens were opened in Taronga Park, to the north of the harbour, in 1916. Work on the city and suburban electric railway, begun in 1916, was stopped in the following year, and was not resumed until 1922. There were 292 m. of tramway track in 1923. Two large storage dams were in course of construction in 1925 and another was sanctioned. In 1923 Sydney possessed 4,173 industrial establishments, 62% of the total for New South Wales, manufacturing mostly clothes and machinery. About half the wool export of Australia is dealt with in the wool sales. In 1913 a Commonwealth bank was inaugurated and a mint for bronze and silver coinage in 1916. A State conservatorium of music was opened in 1915.

Since the foundation in 1901 of the Port Trust, which now controls 57.950 ft. of wharfage, a large reconstruction scheme has been carried out in the harbour. It includes the demolition of old buildings on the water front in order to widen streets and erect houses for harbour workers, and a new road 100 ft. wide along part of the front; also wharves, jetties and sheds and much work on dredging. There are now 136 berths (91 of them in Darling Harbour), equipment for wheat shipment on a spit called Glebe Island, an explosive store on Spectacle Island, fire-fighting apparatus on Goat Island, a coal and oil depôt at Ball's Head, and a naval depôt on Garden Island (Sydney being a first class naval station). Fort Denison is now a lighthouse. Of the 14,284 ac. of water in the harbour about 3,000 have a depth of 35 ft. and over. A contract was signed in 1924 for the construction of a bridge with an overall length of 3,370 ft. across the harbour from Dawes Point to Milson's Point, for rail and vehicular traffic. The foundation stone was laid in 1925 and the work was estimated to take six years. Sydney claims the largest tonnage in the British Empire after London, Liverpool and Cardiff. Trade had almost reached the pre-War level in 1923.

SYKES, SIR MARK (1879–1919), British traveller and politician, was born March 16 1879, the only child of Sir Tatton Sykes, 5th Bart., of Sledmere, Yorks. He was educated at Beaumont College, Windsor, and afterwards at the Ecole des Jesuites, Monaco, and Jesus College, Cambridge. He served in the South African War (1902), in 1904 became secretary to Mr. George Wyndham in Ireland and in 1905 went to Constantinople as honorary attaché to the British embassy, remaining there until 1907. Before this, however, he had begun a series of travels and explorations, especially in Turkey and the Near East, and published *Through Five Turkish Provinces* (1900); *Dar-ul-Islam* (1904); and *Five Mansions of the House of Othman* (1909). He also prepared maps of the northwestern region of Mesopotamia and of the southern districts of Palestine, and his knowledge of these regions proved invaluable during the World War. In 1911 he was elected to Parliament for Central Hull as a Conservative, and in 1913 he succeeded his father as 6th baronet. On the outbreak of War in 1914, Sir Mark Sykes raised a battalion of the Yorkshire Regiment, but did not proceed with it to France. He was sent on important special missions to Russia, Mesopotamia and Syria, and published in 1915 *The Caliphs' Last Heritage*. He died suddenly in Paris Feb. 16 1919.

SYMBOLISM: *see* PAINTING.

SYNGE, JOHN MILLINGTON (1871–1909), Irish dramatist, was born at Rathfarnham near Dublin April 16 1871. Educated at Trinity College, Dublin, he travelled for some years on the Continent, returning in 1898 to the Aran Isles. Here he wrote a number of sketches dealing with the life of the islanders, which were later collected in *The Aran Islands* (1907). When, in 1904, he became a director of the newly opened Abbey Theatre, Dublin, he had already produced two one-act plays, *The Shadow of the Glen* (1903) and *Riders to the Sea* (1904), published in one volume (1905). *The Well of the Saints*, a three-act play produced in 1905, was regarded by some as an affront to Irish morals, and when *The Playboy of the Western World* appeared in Jan. 1907, it was interrupted every night for a week by an organised disturbance. When the real merits of the play became known, it contributed largely to the fame of the Abbey Theatre. Synge's latest volumes were a collection of his poetical works entitled *Poems and Translations* (1909), and another play, *Deirdre of the Sorrows* (1910) which he all but completed before his death. Synge's greatest work is probably *The Playboy*, though some critics give pride of place to *Deirdre*. Synge died in Dublin March 24 1909.

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SYNTHETIC RESINS.—The nature of synthetic resins may best be realised from a consideration of the character, both chemical and physical, of natural resins (*see* 23.183).

Comparison With Natural Resins.—Synthetic resins possess all or most of the physical characteristics of the natural resins, and in some cases have in addition the distinctive property of hardening under the action of heat. Definite chemical resemblance is perhaps only clearly discernible between synthetic resins of phenolic origin and certain natural resins in respect to the presence of phenolic hydroxyl groups, *e.g.*, acaroid resin and Japan lac are natural resins containing phenolic groups. Synthetic resins are such resins as are artificially produced by the chemical interaction of substances of definite composition. The resins produced in this way are usually of complicated and indeterminate composition. Their importance lies in their industrial use, as substitutes for natural resins in the varnish industry, as insulating material in the electrical industry, and as the basis for the production of moulded articles for ornamental and decorative use, such as umbrella handles, buttons, beads, brush backs, doorplates and knobs, etc.

Formaldehyde-phenolic Resins.—The growing interest in synthetic resins may be said to date its rise from the activities, about the year 1910, of Dr. L. H. Baekeland in America, and the successful commercial development of a resin from phenol and formaldehyde known as bakelite (*q.v.*). This resin is representative of one main class of synthetic resin prepared to-day, in most countries, in one form or another, by the interaction of phenolic substances, such as phenol and cresol from coal-tar, and aldehydes, such as, particularly, formaldehyde, a derivative of methyl alcohol obtained either synthetically or by wood-distillation. A recent estimate of the world's production of this type of resin divides the monthly output thus: America, 500 tons; Germany, 300 tons; France, 100 tons; Great Britain not less than 10 tons.

Process of Manufacture.—The process of manufacture is one of condensation which involves chemical combination with elimination of water. It is usually facilitated by the use of a small addition of acid or alkali. The simplest condensation product of phenol and formaldehyde is saligenin or *o*-hydroxybenzyl alcohol. This is capable of further condensation giving syrupy products which polymerise to a resin somewhat akin to bakelite. No definite conclusions have yet been made as to chemical constitution, owing to the small reactivity of these resins. The fully polymerised formaldehyde-phenolic resin is insoluble in all the usual solvents except nitric acid and caustic alkali. It can only be analysed by combustion which determines merely the proportions of the elementary constituents, carbon, hydrogen and oxygen. Moreover concordant results with these resins are not easy to obtain. Values given by Baekeland for bakelite resin vary as much as from 75·6% to 77·9% for carbon and 5·4% to 6·0% for hydrogen. It is more than probable that the final fully polymerised resin prepared industrially consists, in addition to a polymerised molecule of high molecular weight, of a mixture of small amounts of other substances, which are retained by the

resin during hardening, such as, free phenols and formaldehyde and intermediates formed during the condensation reaction.

Coumarone Resins.—The industrial application of resinifying actions of other types has also been developed during the past 10 or 12 years. Coumarone resins, for instance, are prepared from certain fractions distilled from coal-tar naphtha and are used in varnishes. Their method of production involves no preliminary condensation but consists in direct polymerisation of coumarone, indene and cyclic compounds of this class, by means of strong sulphuric acid. Polymerisation is the process by which molecules of relatively simple type become complicated by mutual chemical combination. Resins having physical properties similar to those of the coumarone type can also be obtained by interaction of naphthalene and other aromatic hydrocarbons with formaldehyde in the presence of strong sulphuric acid.

Miscellaneous Resins.—Formaldehyde may also be condensed with urea to give transparent colourless resins. These resins have at present limited use in the production of ornamental articles. Colourless transparent resins from thiourea and formaldehyde are being commercially developed in Great Britain. The cheap production of furfural in America from corn cobs is leading to the use of this material as a source of synthetic resin. It condenses with phenol to give a dark and sometimes even black resin.

General Classification.—Resins may be grouped according to physical properties, such as solubility. Synthetic resins may be of the class which always remains soluble or of the class which is initially soluble but becomes finally insoluble under the action of heat. Formaldehyde-phenolic resins belong to the latter class of heat-hardening resins. Resins in the soluble class may be further grouped into (a) alcohol or spirit soluble resins, and (b) benzene and oil soluble resins. It is usually found that solubility in alcohol precludes solubility in hydrocarbons like benzene, turpentine and the fatty drying oils.

Varnish Resins.—The resins used for varnishes may be spirit soluble (chiefly the formaldehyde-phenolic type), forming substitutes for shellac and the softer varnish resins, such as elemi; or oil soluble (chiefly the coumarone type), forming substitutes for the hard resins like copal. The spirit soluble resins may sometimes be converted into the oil soluble type by a process of melting or " sweating " with a natural resin which acts as a solvent or flux in which further reaction can take place, *e.g.*, Albertol resins are prepared in this way from formaldehyde-phenolic resin and common resin.

Moulding Compositions.—The artificial resins used in moulding compositions may be of the heat-hardening or non-heat-hardening type. Moulding resins may be used as pure unmixed resin, when transparent mouldings are usually obtained, or incorporated with some inert " filling " material, such as, sawdust, asbestos or clay, or used for impregnating textile fabrics, particularly paper. In the two latter applications the resin acts as a binding agent for the " filler " or fabric and a particularly durable material can be made in this way when the heat-hardening type of resin is used.

Such material has important use for insulators in the electrical industry, having high dielectric strength, of the order of glass or mica.

Chemical Classification.—Two main classes may be distinguished (a) condensation resins, such as those of the formaldehyde-phenolic type, and (b) polymerisation resins, such as those of the coumarone type. The term *polymerisation resin* is used to distinguish a resin which is formed directly by the polymerisation of a chemical compound, without passing through a preliminary stage of condensation. Polymerisation is usually initiated by the action of light, heat, strong acids or alkalis.

Principles of Resinification.—Resins appeared to require for their formation the presence of unsaturated atomic groups in the resinifying substance. The well-known drying of linseed oil and other similar unsaturated fatty acid derivatives is a case of resinification due to unsaturation. Chemically speaking, the simplest resinifying group may be considered to be the vinyl-group, which forms monosubstituted ethylene compounds—$CH=CH_2$, and examples of resinifying substances containing this group are styrol or vinylbenzene, *iso*safrol, *iso*eugenol, etc.

Acrolein Resin.—Acrolein, $CH_2=CH\cdot CHO$, is readily resinified and has been proposed in France as a source of synthetic resin for industrial use. Glycerol and phthalic acid react to give a commercially used resin, this reaction being one in which acrolein may be considered to be the intermediate product. Vinyl acetate is being suggested by German workers as a basis for useful resins.

Artificial rubber is a product of the resinification of a vinyl hydrocarbon, isoprene, $CH_2=C(CH=CH)CH_3$. Unsaturation is not alone responsible for resinification; for instance safrol does not resinify in light, whereas *iso*safrol does, although the constitutions are identical except for the position in the molecule of the unsaturated carbon atoms, *iso*safrol containing the vinyl group attached to the benzene nucleus. Coumarone resin results from the polymerisation of the pentamethylene derivative, coumarone, which may be looked upon as derived from a compound containing the vinyl grouping. It is possible also to consider fully polymerised formaldehyde-phenolic resins as products derived from the polymerisation of compounds containing vinyl groups, attached to the benzene nucleus, and introduced into the phenolic molecule by means of formaldehyde.

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SYRACUSE, N.Y., U.S.A. (*see* 26.302), had a population of 171,717 in 1920, an increase of 25.1% over 1910, of whom 32,383 were foreign born; in 1925 (State census) 182,003. The land area in 1923 was 17.78 square miles. Syracuse is situated on the New York State barge canal, opened in 1918, and in 1925 was a terminal for 34 motor-truck lines and six interurban electric lines. Its accessibility and its large hotels and halls (including the coliseum at the State fair grounds, seating 10,000) make it a natural choice for many State conventions. The output of its highly diversified factories was valued at $49,435,000 in 1909, $150,091,000 in 1919, $149,144,581 in 1923. The salt industry, of great importance in earlier years, had disappeared. The consumption of hydroelectric current for industrial purposes (from Niagara and Salmon rivers) was 147,597,039 kw. in 1923. Bank clearings (1924) amounted to $261,665,876; the assessed valuation of taxable property was $235,987,840. The public school buildings, including those under construction, had a valuation of $12,500,000. The acreage in public parks, including the beautiful Onondaga Park, was 460, and there were 47 ac. in playgrounds. Syracuse University had in 1925–6 a faculty of 500 and an enrolment of 5,250 matriculated students.

SYRIA (*see* 26.305), a State of Western Asia administered by France under a mandate which became effective on Sept. 29 1923. It was definitely detached from Turkey, of which it had previously been a part, by the Treaty of Lausanne, signed July 24 1923. Syria is bounded west by the Mediterranean, south by Palestine and Trans-jordan, east by 'Iraq and north by Turkey. The total estimated area is about 60,000 sq. m. and population (1925) about 2,500,000, the bulk of which is of Arabic origin.

Syrian Nationalism.—One result of the Turkish revolution of 1908 was to give an impetus to the Nationalist movement which had begun some years before to gain ground in the Arabic-speaking provinces of the Turkish Empire, and more especially in Syria. Like other parts of the Empire, Syria was at first disposed to take at their face value the liberal professions of the Committee of Union and Progress. The Nationalists were ready to believe that their aspirations were to be realised, and only awaited a conciliatory gesture. The history of the years 1910–4 is largely the history of their gradual disillusionment, as the atti-

tude of the Young Turks hardened into an intolerant chauvinism. Among the Syrian Nationalists two main tendencies may be distinguished. The more advanced party, which worked through a secret society known as "*Al-Ahd*," preached an Arab war of liberation with a view to the complete independence, not only of Syria, but of the Arabic-speaking provinces as a whole. On the other hand, there was a larger body of opinion which was less interested in Arab independence than in Syrian autonomy, and which put forward a milder programme of practical reforms —administrative decentralisation, the replacement of Turkish by Syrian officials, and the recognition of Arabic as an official language. The Young Turks, however, were in no mood for making concessions.

Turkish Conciliation.—It was not until 1912, when Turkey was reeling under the shock of the Balkan wars, that it was thought that something should be done to conciliate the Arabs. Kiamil Pasha, who became Grand Vizier towards the close of the year, allowed a national assembly to be convened at Beirut for the purpose of formulating the Syrian demands. The assembly met in Jan. 1913, but its proceedings were annulled by Mahommed Shevket Pasha, who succeeded Kiamil a few weeks later. The Decentralisation League, which had been founded at Beirut, was suppressed, and the demonstrations of protest which followed were met by the arrest of the ringleaders, which led in turn to a serious outbreak of disorder. In June 1913 a so-called Arab congress was held in Paris. The members were drawn mainly from what may be called the French sphere of influence in the Lebanon and Beirut. The congress adopted a comparatively moderate programme, including the usual demand for decentralisation, and resolved that it should be communicated, not only to the Turkish Govt., but to foreign Powers in friendly relations with Turkey.

The Turkish Govt. was sufficiently impressed to invite three Moslem members of the congress to visit Constantinople. Another conciliatory gesture was the recall of the Vali of Beirut, an uncompromising opponent of concessions to the Arabs, and the appointment of a more liberal-minded successor. A little later a number of Arabs, including some of the militant reformers, were given seats in the Turkish Senate or lucrative appointments in the Civil Service. By these means the Turks succeeded in buying off some of their opponents, but on the main points at issue they continued to temporise, and the Syrian demands received no substantial satisfaction. Thus, those reformers who were in earnest were gradually driven into the arms of the separatists, and on the eve of the war a variety of revolutionary forces were at work in Syria. The malcontents were actively supported by members of the Syrian colony in Egypt, who in turn did their best to establish contact with the representatives of European Powers.

The situation in Syria was watched with special vigilance in Paris. On Dec. 21 1912 the Prime Minister, M. Poincaré, declared in the Senate that "we have traditional interests in the Lebanon and Syria, which we intend to have respected." The Arab congress held in Paris in June 1913 has already been mentioned. Towards the end of 1913 a powerful French squadron visited Beirut. On the eve of the World War France was busily engaged in strengthening her position in the Levant against German competition, and was negotiating for the acknowledgment, on a *do ut des* basis, of her prior claim to railway and other concessions in Syria and Palestine.

Allied Agreements During the War.—With the entry of Turkey into the War in Oct. 1914 the future of the Arabic-speaking provinces became a question of immediate concern to the Allied Powers. France promptly asserted her claims in the Levant, and so far as Syria was concerned, as distinct from Palestine, they were never questioned. As between Great Britain, France and Russia the matter was disposed of in the spring of 1916 by a tripartite agreement, which was elaborated as between Great Britain and France by the so-called Sykes-Picot agreement. This agreement, which was concluded on May 16 1916, gave France what was virtually a free hand on the Syrian coast, together with a veiled protectorate over the interior. The situation was, however, complicated by the undertakings already given by Great Britain to the Sherif of Mecca, who was treated as the spokesman of the Arab National Movement. In the autumn of 1915 Great Britain had agreed to "recognise the independence of the Arabs" within certain territorial limits, which did not include the coast of Syria but which clearly included the interior. Not only so, but while the Sykes-Picot agreement laid it down that France should provide any advisers whom the Arabs might require in Inner Syria, the British undertakings to the Sherif could be read as implying that these advisers should be British. There were here the seeds of a misunderstanding which was to have serious consequences.

War Conditions.—In Syria itself it looked at first as though the outbreak of war had given the nationalists their opportunity. In the early days of the War the reformers were active in pressing their demands and received some encouragement from a sympathetic Vali. But the tide soon turned against them. Among the French consular archives which were seized in Syria the Turks claimed to have discovered evidence of treasonable dealings with France on the part of a number of the Nationalist leaders. This was the signal for a series of executions and deportations, which began in the summer of 1915 and continued for the next 12 months. For the time being, at least, the Nationalist agitation was completely cowed, and though the Emir Feisal visited Syria just before his father, the Sherif of Mecca, raised the standard of revolt, the Syrian Arabs remained submissive to the end of the War. They had, indeed, little chance of giving trouble. On the one hand, Syria was the base of the Turkish IV. Army, and though it was not always heavily garrisoned, it remained throughout under the shadow of a powerful Turkish force. On the other hand, except for an occasional raid on the coast, Syria did not become a theatre of war until the eve of the Armistice and had no opportunity—even if it had the desire—to co-operate with the Allies. In the autumn of 1918 General Allenby, at the head of the British forces in Palestine, having expelled the Turks from Palestine, swept on after them through Syria. Damascus was occupied on Oct. 1. On Oct. 31 the British cavalry were 15 miles north of Aleppo, and the Armistice which then came into force left the whole of Syria in the hands of the Allies.

Post-War Settlements 1918–24.—On Nov. 7 1918 the British and French Govts. issued a joint declaration, in which they announced their intention of establishing, both in Syria and Mesopotamia, "national governments drawing their authority from the initiative and free choice of the native populations." Meanwhile, it devolved upon Lord Allenby, as commander-in-chief, to make temporary arrangements for the administration of Syria as occupied enemy territory, pending the conclusion of peace. The Syrian sea-board, including Beirut, was placed in charge of the French, while the interior was handed over to an Arab Govt. which was set up at Damascus under the Emir Feisal. The sit-

uation thus created was unsatisfactory to the French, who pressed their claims under the Anglo-French Agreement of 1916. On Sept. 15 1919, the two Powers signed a convention by which the Syrian sea-board came under the direct and exclusive control of France. The interior remained under the administration of the Emir Feisal, but it was now brought within the French sphere of influence, and ceased to be under the general control of the British commander-in-chief. The anti-French agitation conducted by the Arab Nationalists came to a head in March 1920, when an Arab congress met at Damascus and declared "the complete independence of Syria, without any form of foreign interference." At the same time, Feisal was proclaimed King of Syria. Great Britain and France united in refusing to recognise the Syrian kingdom, but the Damascus Nationalists remained defiant and the French found their position untenable. The end came in July 1920, when a French ultimatum to the Arab Govt. was followed by an advance into the interior, the flight of the Emir Feisal, and the entry of French troops into Damascus.

Meanwhile, Syria had been under discussion at the Peace Conference in Paris. On Feb. 6 1919, the Conference heard an Arab delegation, headed by the Emir Feisal, who pleaded the cause of Arab unity and independence. This was followed by complicated, and at times acrimonious, discussions between Great Britain and France. It was eventually agreed in principle that the situation in Syria should be examined on the spot by an international commission of inquiry, but all that actually happened was that two American delegates, Dr. King and Mr. Crane, spent a few weeks in Syria in the summer of 1919. They reported that a French mandate would be wholly unacceptable and recommended that the mandatory Power should be the United States, with Great Britain as a second-best. The King-Crane report, however, had no influence on the course of events, and on April 25 1920 the Supreme Council of the Allies formally agreed at San Remo that the mandate for Syria should be allotted to France. The terms of the mandate were approved by the Council of the League of Nations on July 24 1922, but further delays intervened, and the mandate did not become fully effective until Sept. 29 1923. The situation was finally regularised by the formal detachment of Syria from the Ottoman Empire under the Treaty of Lausanne, which came into force in Aug. 1924.

French Administration.—It was, however, the French occupation of the interior in the summer of 1920 which marked the opening of the new régime by bringing the whole country under direct French control. The Lebanon, which the French had occupied at the Armistice, was recognised in Sept. 1920 as a separate "State," with an area considerably larger than that of the pre-War province of the same name. The Lebanon was predominantly Christian, and its administration involved the absorption of a large number of unwilling Moslems. Inner Syria was divided into the "States" of Damascus and Aleppo, together with the "Territory of the Alawiyin," with its capital at Latakia. Syria was thus broken up into four distinct units, each of them with a separate administration of its own, the only connecting link being the French High Commissioner. In July 1922 the three divisions of Syria proper, as distinct from the Lebanon, were given an opportunity of co-operating in matters of common concern through the medium of a Federal Council. In May 1923 Gen. Gouraud, the first High Commissioner, was replaced by Gen. Weygand, who was responsible for a further rearrangement. By a decree dated Dec. 5 1924 the Federation was dissolved, the States of Damascus and Aleppo were amalgamated into the State of Syria, and the State of the Alawiyin was reconstituted as a separate unit. In the meantime, some progress had been made, at least on paper, with the development of self-governing institutions. The Lebanon was provided with a representative council in 1922 and the three states of Syria proper in 1923, though in each case the powers of the Council were restricted and were consequently criticised by the nationalists as inadequate.

The Druse Rebellion.—Syria contains many turbulent elements, and the French had repeatedly to deal with unrest in various parts of the mandated territory. In 1919–20 they met with determined resistance in the Djebel Ansariyeh, the northern neighbour of the Lebanon. There was serious rioting at Damascus in 1922 and again in 1925. In the Alexandretta district, in the extreme north of Syria, the French were constantly harassed by Turkish raids across the border, while they also had some trouble with the tribesmen of the desert frontier on the East. In the Druse country in the Hauran there was scarcely a quiet year until 1923, and it was here that the signal was given for the widespread rising which closely followed the arrival of Gen. Sarrail as High Commissioner, in succession to Gen. Weygand, at the beginning of 1925. The Druses rose in open rebellion in July. Their initial successes brought to the surface the latent discontent which existed in other parts of Syria, and it looked for the moment as though the French would be faced with a general rising. A serious situation developed at Damascus, and on Oct. 18–20 the French took the extreme measure of subjecting the city to a 48-hour bombardment. By the end of 1925 the weak French garrison in Syria had been considerably strengthened, and the insurrection had been checked, though by no means completely suppressed. In Dec. 1925 Gen. Sarrail was superseded as High Commissioner by M. Henri de Jouvenel, whose policy was one of conciliation. M. de Jouvenel was not, however, immediately successful. Nationalist opposition defeated his attempt to form a provisional Syrian Govt. under the Sheikh Taher ed-Din, while in some parts of the country, notably at Damascus, the population boycotted the elections which he ordered to be held as a first step towards a *modus vivendi*. By the end of April normal conditions had been partially restored, but Damascus was still in a state of siege. By June 1926, the Druses were mastered, but there is still much underlying unrest.

Report of the Mandates Commission.—The circumstances of the rising were closely investigated, on behalf of the League of Nations, by the Permanent Mandates Commission at a special session held in Rome in Feb. and March 1926. The Commission, in its report to the League Council, convicted the French of serious errors of policy and severely censured the conduct of Gen. Sarrail, though at the same time it recognised the difficulties of the mandatory power in dealing with a peculiarly intractable problem, took note of its declared intention to give Syria the fullest possible measure of self-government with a view to its eventual independence, and called upon the Syrian leaders to desist from sterile obstruction. (L. St.)

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SZINYEI-MERSE, PAUL DE (1845–1920), Hungarian painter, was born at Szinyeujfalu and studied art at the Munich Academy. His first pictures, "The Faun and the Nymph" (1868) and "The Evening Star," were characterised by gay and graceful colouring, a lyric view of nature and a simple mode of placing the elements of the picture. Szinyei soon abandoned the traditional brown undertone and worked with unbroken colours, embraced in a cheerful and suggestive composition. In 1869 he produced his "Mother and Child" and in 1873 finished the masterpiece of his life "May Festival," which was criticised at the time for its alleged "delirium colorans." This so embittered Szinyei that he retired to his country house and for a time produced very little work. "The Woman in Lilac" (1874) and the "Lark" (1882) are products of this period. On returning to work with renewed enthusiasm, he exhibited "Rococo," "Oculi," "Snow-melting" and "Poppies" at Budapest in 1894–5. He afterwards gave successful exhibitions at Munich (1909), Berlin (1910) and Rome (1911). In 1905 he was appointed director of the Hungarian National Academy of Arts. He died in 1920.

See Béla Lázár, *Paul von Szinyei-Merse* (1911); Alexius Petrovics, *Szinyei Pál* (Arts Lexicon, 1926).

TABLE TENNIS (*see* PING-PONG, 21.626).—Table tennis or ping-pong is a game played by striking a small celluloid ball over a net fixed across a table. The ball must be between $4\frac{1}{2}$ in. and $4\frac{3}{4}$ in. in circumference and between 2/27 oz. and 2/25 oz. in weight. The net is $6\frac{3}{4}$ in. high and fixed across the middle of a table 9 ft. long and 5 ft. wide in such a way as to project 6 in. on either side. The upper surface of the table lies 2 ft. 6 in. above the floor, and must be of such resilience that a standard ball when dropped upon it from a height of 12 in. shall rebound to a height of from eight to nine inches. The racket may be of any material or shape. The server projects the ball from behind his end of the table in such a way that it bounces first upon his side, then upon his opponent's side of the table. Thereafter it is struck to and fro to pass directly over the net, very much in the manner of lawn tennis, except that volleying is not allowed. The scoring is by points (a single service counting as a point), 21 in each game; the service changes every five points until the score twenty-all, when the players serve alternately and, as at score deuce in tennis and lawn tennis, the winner is then he who first scores two points more than his opponent.

The game began to revive in England about 1921, at first through the machinery of the old Ping-Pong Association. The following year that organisation was abandoned and a new body was formed under the title Table Tennis Association. The most important centres of the game in England, loosely knit in the fabric of the T.T.A., are the London and Home Counties T.T.A., the Birmingham and District T.T.A., the Northern Counties T.T.A., the Bristol T.T. League and the Sunderland and District Ping-Pong Union. The English T.T.A. is federated to the Table Tennis Associations of Germany, Austria, Hungary, Sweden and Czechoslovakia, in all of which countries its rules are observed with but slight modification. The Table Tennis Association of Wales (founded 1923) has certain rules of its own, among which notably is a prohibition of all but wooden rackets, a rule which is copied locally in Bristol and Sunderland.

The modern attacking game is very fast, probably the fastest in the world except ice-hockey. The attacking stroke is usually made with considerable top-spin, the defensive stroke with under-spin. This predominance of varied kinds of spin in the technique of the game has made the rubber-faced racket the favourite among the younger school of players. Various modifications of the game have been introduced from time to time, but the rules remain to this day substantially the same as those provided for by the old Ping-Pong Association rules of 1913. Notable reforms which have now been rejected by all table tennis players were the attempt, in 1923, to popularise lawn tennis scoring, and the attempt about the same date to introduce a form of play in which volleying was permitted (table lawn tennis). A doubles form of the game in which a white line is drawn down the centre of the table, the server serving the striker-out diagonally opposite to him, and thereafter each partner striking the ball alternately—is sanctioned by most national associations. There is already an etiquette of the game which discourages such practices as wearing white clothes, which may tend to unsight the opponent. It should be noted that the margin in singles at table tennis between a man and a woman of equal class is as great as at lawn tennis—about half the game. The following are the results of the English singles championship since 1922:—

	Gentlemen	Ladies
1922	A. Donaldson	Mrs. Scott
1923	M. Cohen	Miss Berry
1924	Percival Bromfield	Miss Berry
1925	P. N. Nanda	Miss Berry
1926	S. Suppiah	Miss Vasey

Results of Other Matches.—1923—England beat Wales in London. 1924—England beat Wales at Cardiff. 1925—England beat Wales in London. 1926—Wales beat England at Cardiff. 1926—In Berlin, Hungary beat Germany and English T.T.A. team. Germany beat English T.T.A. team. 1923—Cambridge University Club beat Oxford University Club at Cambridge. 1924—Cambridge University Club beat Oxford University Club in London. Winners, International Tournament in Berlin—1925, P. N. Nanda (London); 1926—M. Mechlowits (Budapest).

See P. Bromfield, "The Flick Stroke," essay included in *The A.B.C. of Table Tennis*, by J. J. Payne (London, 1924); Ivor Montagu, *Table Tennis To-day* (Cambridge, 1924). (I. Mo.)

TABRIZ, Persia (*see* 26.341), with a population over 200,000, is a commercial centre, and a seat of the carpet-making industry. Trade has been depressed in recent years, though a revival of the export of piece goods through Turkey has brought the route from Hamadan, which connects with the Turkish trade route through Trebizond, into use again to some extent. A railway to Julfa (on the Persian-Russian frontier), where connection is made with the Caucasian lines, was built by a Russian company, opened in 1916 and transferred to Persia in 1921. In 1923 the line was in very bad repair, and trains were only run occasionally when sufficient freight was forthcoming. Tabriz became involved in the World War owing to Turko-Russian conflicts in the vicinity of Lake Urmia, and was occupied first by Turks and then by Russians in 1915.

TACHOMETER: *see* SPEED INDICATOR.

TACNA-ARICA QUESTION.—The war between Chile and Peru, begun in 1879, was terminated by a treaty of peace Oct. 20 1883, known as the Treaty of Ancon. Article 3 provided that the Peruvian provinces of Tacna-Arica should be held by Chile for 10 years, after which a plebiscite would determine the sovereignty of those provinces. The country winning the provinces would pay to the other 10,000,000 Chilean silver pesos or Peruvian soles; a special protocol would prescribe the manner in which the plebiscite would be carried out. In 1892 negotiations were entered into between Chile and Peru for carrying out the plebiscite, but these and subsequent ones were unsuccessful. In 1922, however, at the invitation of the United States, issued at the suggestion of Chile and Peru, both governments sent representatives to Washington, and a protocol of arbitration was drawn up on July 20 1922 which set forth that the only outstanding questions between the two countries were those relating to the unfulfilled provisions of Article 3 of the Treaty of Ancon, which should be submitted to the United States for arbitration. A supplementary act provided that in case the arbitrator ordered a plebiscite he was empowered to determine the conditions thereof. The arbitrator's award, dated March 4 1925, decided that a plebiscite should be held, set forth the conditions thereof and the plan for the payment of the 10,000,000 pesos and decided the definite boundary of the territories involved.

1:10,000,000

Plebiscite Ordered.—In considering whether or not a plebiscite should be held the arbitrator had to determine: first, whether the parties had acted in good faith in not coming to an agreement regarding the special protocol determining the terms of the plebiscite; and, second, whether Chile's administration of the provinces had been such that a free and fair election could be held. The arbitrator decided the first question in the affirmative; and respecting the second, although far from approving the course of Chilean administration or condoning the acts committed against Peruvians, found no reason to conclude from the evidence submitted that a fair plebiscite could not be held under proper conditions.

In order appropriately to supervise and have general control

over the plebiscite, the award set up a plebiscitary commission acting by majority vote, consisting of three members, one each appointed by Chile and Peru and the third, who should be president, appointed by the President of the United States. Registration and election boards were also provided. The arbitrator also reserved the right to entertain an appeal from the acts of the plebiscitary commission, which was to assemble at Arica not later than six months after the rendition of the award, and proceed at once to formulate rules for its own procedure and regulations governing the plebiscite and to fix the time and places for voting. The arbitrator provided that the 10,000,000 should be paid: 1,000,000 within 10 days after the arbitrator's proclamation of the result of the plebiscite, a second 1,000,000 within the following year and 2,000,000 at the end of each of the subsequent four years. The customs revenues of Arica were assigned as security. The arbitrator decided that the Peruvian provinces of Tacna-Arica as on Oct. 20 1883 constituted exclusively the territory in dispute, and that no part of the Peruvian province of Tarata was included therein. Tarata was transferred by Chile to Peru on Sept. 1 1925, the definite boundary being left for determination to a boundary commission.

Objections of Peru.—On April 2 Peru objected to the finding of the arbitrator for a plebiscite, maintaining that the meaning of the Spanish text of the Treaty of Ancon was "upon," "at" or "immediately after" the expiration of the 10 years. Peru also requested guarantees for the voting, including immediate evacuation of the territory by the Chilean civil and military authorities and their replacement by Americans. The arbitrator replied on April 9, pointing out the agreed finality of the award and that the translation complained of was the one submitted by Peru. The problem before him was one of substance, of construction rather than of translation, a problem which had been debated by the parties long before the arbitration gave rise to any question of English translation. As to Americans taking over control of the provinces, the arbitrator found that this request went beyond the scope of his authority under the terms of the submission and the findings of the award.

Meeting of Commission.—The plebiscitary commission met at Arica on Aug. 4 1925 and drew up its rules of procedure. On Dec. 16 Chile appealed to the arbitrator from a resolution of the commission making the date of the plebiscite, she thought conditional upon Chile complying with certain regulations of the commission. Chile took the position that by these regulations the commission exceeded its power and infringed upon her administrative control of the provinces and that the commission's control over the plebiscite began only with the registration of voters. Chile later withdrew the appeal regarding dates, and the arbitrator, in a decision dated Jan. 15 1926, permitted its withdrawal. He pointed out at the same time that the submission agreed that the arbitrator should determine conditions of the plebiscite; that he had established a plebiscitary commission for this purpose whose requirements had the same binding effect as if prescribed by him; and that conditions for holding a fair plebiscite became the primary concern of the commission from the very moment of its organisation.

The arbitrator held that while the territory remained in Chile's possession and subject to Chilean laws and authority pending the plebiscite, the possession and administrative authority were subject to the provision for holding the plebiscite, the award having stated that the exercise by Chile of legislative, executive and judicial power should not go to the extent of frustrating the provision for a plebiscite. The execution of the requirements of the plebiscitary commission was therefore but the exercise by both parties of their jurisdiction respectively in accordance with their agreement, and was not in derogation of the administrative authority of Chile.

On Feb. 16 1926 the American Govt. proffered its good offices to Chile and Peru in an endeavour to adjust the differences, on the understanding that pending such an adjustment the authority of the plebiscitary commission should be maintained unimpaired. The American offer was accepted by Chile on Feb. 19, with the proviso that the arbitral award must be submitted for approval to the respective constitutional bodies. Peru was unable to accept the offer, and on March 11 the American Ambassador at Santiago submitted a further memorandum to the Chilean Govt. explaining his Government's interpretation of the term "good offices." Chile reiterated her acceptance of the offer, and Peru having accepted, the Secretary of State, through the American Ambassador, on March 25, suggested that the plebiscitary proceedings should be temporarily suspended, to be resumed later if the differences could only be adjusted by holding the plebiscite.

Chile and Peru appointed plenipotentiaries who met with the Secretary of State on April 6. The Secretary made proposals for the division of the territory between Chile and Peru, for the neutralisation of the provinces, for the transfer of the provinces to a third party and finally a proposal for a corridor to the sea for Bolivia, the territory to the north thereof to go to Peru, to the south thereof to Chile, equitable compensation being made for improvements, et cetera. None of these proposals were accepted by both parties. The last proposal was accepted by Peru, but Chile desired something more definite, namely, the defining of the boundaries of the corridor, and made a proposal setting forth the limits of the corridor. This last proposal was rejected by Peru.

In the meantime conditions in the provinces had not been improved and the plebiscitary commission, being pressed by the Chilean member to fix the date for the elections, voted a resolution on June 14 declaring that Chile having failed in its obligation to create and maintain conditions proper and necessary for the holding of a free and fair plebiscite, the commission found that this failure had frustrated the efforts of the commission to hold the plebiscite as contemplated by the award and had rendered its task impracticable of accomplishment. The commission therefore decided that a free and fair plebiscite as required by the award was impracticable of accomplishment and that the plebiscitary proceedings be terminated. The commission thereupon closed up its work and left the territory after providing that subsequent meetings might be called by the president. (F. WH.)

TACOMA, Wash., U.S.A. (*see* 26.347), had a population of 96,965 in 1920, of whom 21,705 were foreign born, including 1,067 Japanese. The population (1925), was estimated at 104,455. By 1925 the harbour provided berthing space for 60 large vessels; 56 steamship lines made it a port of call; exports and imports had about doubled since 1921, both in tonnage and in value (total handled, 1924, 4,156,590 tons, valued at $162,317,610); and the publicly owned and operated facilities on the Tide Flats, commonly known as Portacoma Piers, were in process of development. Industrial development also was rapid.

TACTICS (*see* 26.347).—The article TACTICS in the 1911 Edition of the *Encyclopædia Britannica* epitomised the two outstanding features of modern warfare on land as "the development of fire-power" and "the improvement in communications"—brought about by the railway. The experience of the World War fulfilled and amplified this judgment. The following article traces the development of tactical science since 1914. The stages in that development are sufficiently well marked to justify the division of the article into five sections, namely: I. The Effect of Modern Weapons; II. Tactics in 1914; III. The Artillery Bombardment; IV. The Surprise Attack; and V. Post-War Tactics.

I. THE EFFECT OF MODERN WEAPONS

The early fighting man had his sword for offensive use, his shield for protection, and used his legs for movement. The soldier of 1914 had weapons—the gun and the machine gun—infinitely more deadly than his prototype, but he had discarded his protection and he still depended on his legs for tactical movements, *i.e.*, on the battlefield. The consequence was to tilt the scales heavily in favour of the defending side, and this adverse balance was increased by the improvement in communications—for the railway enabled the defenders to rush vast numbers of static fire weapons to any threatened point, and so

bar the attackers' path. Fighting or tactical power is fundamentally a compound of power to move, power to hit and power to guard; hence the responsibility for the bloody stalemates of 1914–8 lies with the general staffs of Europe, in their failure to realise that the development of one element without regard to the others made inevitable the breakdown of the war machine. Faced with the deadly reality of modern fire-power, the troops of the warring nations, for want of any form of mobile protection, were forced to fall back on an immobile form—that of entrenchments. And because of the swollen armies which were the outcome of the Teutonic " Nation in Arms " theory, these entrenchments soon stretched from frontier to frontier, rendering offensive action as nugatory as it was costly.

Stalemate Predicted.—This blindness of the general staffs is the more remarkable in that a civilian, M. Bloch of Warsaw, had predicted such a result as long ago as 1897. In the preface to his book *The Future of War* he had said: " At first there will be increased slaughter—increased slaughter on such a scale as to render it impossible to get troops to push the battle to a decisive issue. They will try to, thinking that they are fighting under the old conditions, and they will learn such a lesson that they will abandon the attempt forever. Then, instead of a war fought out to the bitter end in a series of decisive battles, we shall have as a substitute a long period of continually increasing strain upon the resources of the combatants. The war will become a kind of stalemate, in which, neither army being able to get at the other, both armies will be maintained in opposition to the other, threatening each other, but never being able to deliver a final and decisive attack. It will be simply the natural evolution of the armed peace, on an aggravated scale. Everybody will be entrenched in the next war. The spade will be as indispensable to the soldier as his rifle. The next war will be a long war, because all wars will of necessity partake of the character of siege operations."

The experience of the war in South Africa led some students but few soldiers to lend an ear to the forecast of M. Bloch. But despite the still stronger confirmation given by the Russo-Japanese War, the general staffs scorned this " amateur " opinion, and continued to predict and prepare for a short and decisive war of rapid movements.

Early Lessons of the World War.—Within a few months of the outbreak of War in 1914 not only had M. Bloch's major predictions—stalemate and siege operations—been fulfilled, but also a host of his detailed forecasts. He had declared that after a battle the victors would not be able to pursue and the retreating force, falling back on new positions a few miles to the rear, would entrench themselves for fresh resistance; that frontal attacks would be impossible without great superiority of numbers; that the loss in officers would be disproportionately great; that cavalry would not even be able to fulfil adequately their rôle of reconnaissance; that the bayonet combat would be almost unknown; that the commanders would not be able to overcome the problem caused by the very magnitude and unwieldiness of the machine which they had created, and that the whole tendency of modern tactics was such as to prevent the nations reverting to armies of a manageable size. " The unwieldiness of the modern army has never been adequately taken into account."

The fundamental defects which have been discussed were, moreover, aggravated by reactionary tendencies which made worse the difficulties already inevitable through the disproportionate improvement of fire-weapons and communications. A study of the French official *règlements* from 1875 to 1914 sheds a significant light on this point. The doctrine of 1875, issued while the battlefield experience of the Franco-German War was still fresh in the memory, approximated more closely than any of its successors to the lessons learnt by the end of the World War. At the end of a war the test imposed by the bullet and the shell has displayed the weak points in the doctrines based on the unreal conditions of peace-time manoeuvres; the methods in use have been hammered out of the molten ore of battle experience. With every fresh *règlement* subsequent to 1875 there was a swing of the pendulum back towards density of formation, a greater reliance on mere weight of numbers and a disregard of the effects of fire—forgetting that in face of machine-guns density of numbers simply means density of corpses killed by concentrated and relentless fire.

As a result the French infantry went to war in 1914 trained on a doctrine which cost them appalling and futile casualties in the early battles. So also with the Germans. And the root cause of this homicidal reaction was lack of imagination. Not merely the failure to visualise the presence of hostile bullets, but still more the average inspecting officer's dislike of training ground manoeuvres where he could not see the troops, his feeling that an invisible attack was no attack. Thick waves of advancing men and massed assaults have both a pageantry and a force which impress a mind incapable of picturing the stream of bullets from concealed attacking groups as it is of visualising those waves turned into swathes of dead.

II. TACTICS IN 1914

Let us trace the tactical doctrines on which the chief Powers went to war in 1914. Infantry was regarded as the decisive arm, and the artillery as primarily for its support during the attack rather than to pave the way for and make possible the infantry attack. To quote the French *règlement* of 1913: " Artillery no longer prepares the infantry attack but supports it." The object in the infantry attack was to build up as strong a firing line as possible, by the infusion of reserves close to the enemy's position and then, having gained superiority of fire, to deliver a general assault with the bayonet. The unreal idea of a fire fight on a definite line followed by a synchronised assault made by troops in the open was embodied in the manuals and practised on the training grounds. For the cavalry, shock action by large masses was still believed possible, especially in the French Army, and it is a curious reflection that the one cavalry—the British—who were effectively trained for dismounted action, should have furnished the only, rare, examples of shock action. They at least had recognised that attack mounted could only be by small, dispersed bodies.

The Firearms of 1914.—As regards weapons, only the Germans had adequately appreciated the importance of the machine gun, although the British partially offset their lack of these new automatic firearms by the exceptionally high standard of rifle-shooting developed in their professional army. In field artillery France had the advantage with her famous 75-millimetre, unique in its rate of fire, and the German " 77 " compared unfavourably even with the British 18-pounder. On the other hand Germany alone had really developed the heavy howitzer and the high explosive shell, rather because her general staff planned the rapid reduction of the frontier fortresses than because they foresaw trench-warfare. All armies in fact shut their eyes to the lessons of Manchuria and neglected the study of field entrenchments, expecting and preparing for a war of rapid movement and speedy decision. This decision the Germans hoped to achieve by a grand enveloping manoeuvre, with the mass of their forces on the right wing; moving through Belgium and Northern France with Thionville as the pivot of this vast " wheel."

Partly because the younger Moltke had whittled away the original plan of Schlieffen, partly because the German High Command lost all touch with and control of their wheeling armies, and partly because the rapid advance of such masses proved too great a strain on the supply services, the ponderous machine was thrown out of gear by a relatively light jar on the Marne. The German right fell back to the Aisne line, and there the Franco-British pursuit quickly came to a stop in face of entrenched machine-guns and barbed-wire entanglements—the superiority of the defensive over the offensive became manifest. The so-called " Race to the Sea " ensued, with the rival armies in turn vainly seeking to find and turn the opponent's exposed flank. By Oct. 1914 these flanks reached and rested on the sea, and the repulse of the second great German effort, at Ypres, established the trench-barrier firmly from the sea to the Swiss frontier.

The Triumph of Defensive Action.—The tactical significance of the next four years lies in the unceasing attempts, French, British and German, to discover the key to unlock this barrier. While the high commands sought the key in a progressive development of gun-power and its employment in varied forms, certain more original minds endeavoured to find a revolutionary rather than an evolutionary solution. In the words of Field Service Regulations, " Victory can only be won as the result of offensive action "—a phrase which embodies the experience of war throughout the ages. Yet the outstanding fact at the end of the first clash of the World War was the paralysis of the offensive brought about by the defensive power of modern weapons, especially machine guns, and aggravated by wire entanglements. M. Bloch had prophesied this paralysis, the Russo-Japanese War had foreshadowed it, but the military physicians of Europe had refused to listen to warnings from one whom they regarded as a mere " quack " intruding on professional preserves.

But as official historian of the Russo-Japanese war, Col. Swinton, a well-known military writer, had grasped the tendencies of modern warfare, the dominating rôle likely to be played by trenches and the machine gun. By a coincidence he had also taken an active interest in experiments with " caterpillar " tractors. In the early months of the War he was sent out to France as official " Eyewitness " at G.H.Q., and was thus in an exceptional position to diagnose the conditions that had arisen. His previous study gave him the source from which to seek the antidote, and his suggestions to Sir Maurice Hankey, Secretary of the Committee of Imperial Defence, became the first link in the causation of the armoured trench-crossing " machine-gun and wire destroyer," afterwards christened the tank. The receptive mind of Mr. Winston Churchill, then First Lord of the Admiralty, fastened on the idea, already considered in a more limited form, and his driving force carried it through a period of ineffectual experiment and official opposition, until at last it took shape in the original " Mother " tank of 1916 (*see* TANKS).

Meantime, however, on the battlefields of the Continent, there were a long series of attempts to find a more orthodox solution by the " weary process of trial and error." In this article we necessarily exclude those which were made to seek a decision in other theatres of war—expeditions such as that to the Dardanelles which were aimed at the strategic flank of the Central Powers, far distant from the barred front in France—as these fall under the head of strategy, not of tactics. Nor can the limits of space permit us to dwell on innumerable minor innovations in weapons and organisation, most of which tended to still further technical augmentation of fire-power. Among these were the development of the hand and rifle grenade, of many types of trench-mortar, the vast expansion in heavy artillery and the replacement of shrapnel by high-explosive shell, the increase of engineer and signal troops—all of which were the product of conditions which approximated to siege operations rather than to mobile operations in the open field. Even more noteworthy was the vast and rapid progress in the use of aircraft (*see* AIR WARFARE), first for reconnaissance in all its forms, then for artillery observation, later for bombing and fighting, and to some extent for attacking troops on the ground.

III. ARTILLERY BOMBARDMENT

The first tactical attempt of note to find a solution to the trench deadlock was at Neuve Chapelle, March 10 1915. By hoarding his slender stock of ammunition, the British Commander-in-Chief, Sir John French, was able to open a short but violent bombardment on a sector of the German position. Surprise was achieved for the infantry assault which followed immediately, but the opportunity was lost by the failure to bring up reserves in time and because of the narrowness of the front attacked—the narrower the breach the easier it is to close.

German Experiments.—It is a curious reflection that while the British thereafter discarded this promising method in favour of prolonged bombardments which negatived the possibility of surprise, the Germans should have profited by it. Meanwhile, however, they essayed a more radical departure from normal methods; on April 22 at Ypres they discharged waves of chlorine gas from cylinders against a sector of the French front where it linked up with the British. Overwhelmed by a weapon against which they had no protection, the French sought escape by flight, and for a time a complete breach lay open in the Allied line. But the surprise was double-edged, for the German military authorities had not anticipated the success and had no reserves at hand to exploit it. The stout resistance of the Canadians on the flank of the breach, and their prompt reinforcement, warded off the danger—and the Germans lost a golden opportunity.

They were more successful in the development of a borrowed method. Foiled the previous autumn in their plan of crushing France while holding Russia in check, the Germans had resolved to seek a decision on the Eastern Front. Here, with the breakdown of the much heralded Russian steam-roller, a trench stalemate had set in also, though not as firmly knit as that in the west. Falkenhayn, who had succeeded Moltke as chief of the Great General Staff, transferred reserves from France and thus assembled a new XI. Army of 10 divisions on the Dunajec front, between the upper Vistula and the Carpathians at Gorlice. This was placed under Mackensen, with Von Seeckt, the head of the German Army, as his chief of staff. Four hours' intensive bombardment from some 1,500 guns of all calibres ushered in the infantry assault—or rather procession. Stunned and surprised, the Russians could offer little resistance and by nightfall their front was broken through. Prompt exploitation, both in depth and by the other armies on the flanks, led not only to immense captures of prisoners—170,000 in a fortnight—but to a Russian retreat which like a snowball grew and gathered momentum until by the autumn it had rolled back to the line Riga-Pinsk-Dubno. Had Falkenhayn acceded to Ludendorff's pleas and sanctioned his scheme for striking towards Minsk, at the main communications of the enemy, Russia might have been put out of the War that year, and even as it was the loss of nearly a million men in prisoners alone inflicted irreparable damage on Russia's fighting power.

Champagne and Artois.—On the Western Front the Entente armies made their next attempt to solve the stalemate, in September. The object was still a rapid break-through, but the method differed, and in fact abandoned the essential element—surprise—for such a purpose. A bombardment of three days' duration—five in Artois—certainly reduced the resisting power of the enemy's advanced troops, but it also gave them ample warning for the concentration of reserves. If the " wheel had come full circle," reviving in a more powerful and prolonged form the " artillery duel " of earlier days, it was a vicious circle. The plan was for the main blow to be delivered in Champagne while a subsidiary attack was launched in Artois, thus menacing the southern and western sides respectively of the German salient Lens-Noyon-Reims. It had two further inherent weaknesses: the first, that the fronts of attack were still too narrow; the second, that they were too widely separated to react on each other.

The double offensive was launched on Sept. 25. In Champagne the Germans' first positions were quickly penetrated, but in proportion as the advance progressed its own force slackened and that of the defence waxed stronger. In Artois, the French attack south of Lens was soon checked, but that of the British at Loos came closer to a break-through. It failed owing to loss of control among the leading troops, the difficulty of communication between the infantry and their supporting artillery once they had penetrated beyond the enemy's first position, and, above all, because the reserves were held too far back. Behind the fronts of attack cavalry masses waited, as at each subsequent offensive, to pass through the breach and carry out the exploitation—which was to prove yet another mirage in the tactical desert of 1914–8. The delaying power of even a solitary machine gun, the extreme vulnerability of the cavalryman, combined to make such exploitation an impossible, though sedulously cherished, ideal.

Doctrine of the Limited Objective.—The failure of the Sept. offensives of 1915 widened the cleavage, already apparent, of military opinion into two schools—those who argued that a break-through was still possible if the right lever were found, and those who contended that in default of a genuine new key the

nations must reconcile themselves to a war of attrition. For 1916, however, a common ground was found in the adoption of the doctrine of methodical advances with limited objectives. This was the natural sequel of the new maxim "Artillery conquers defences, infantry occupies them," a tacit recognition that artillery had supplanted infantry as the decisive arm. The depth of ground which could be effectively bombarded fixed the limit of the occupation, and the infantry thus had to halt until the guns could be moved forward. The Germans gave the method its initial trial in the Battle of Verdun, and it had distinct success in the later months, largely because they regained some measure of surprise by increasing the rapidity of fire and decreasing the duration of the bombardment compared with the Entente forces the previous September. An additional reason was their choice of a sector suitable to the method.

For the Entente offensive on the Somme, beginning July 1 1916, the British command also adopted the "limited objective" method, combining it with an artillery preparation even longer than before, and so abandoned any chance of surprise. The Battle of the Somme may also be said to have been the low-water mark of infantry tactics in recent history, the infantry attacking in dense unarticulated lines, or waves, in close succession—which prevented any possibility of manoeuvre, easily lost direction, and were little better than swathes of human grain to be mowed by the enemy's bullets. In many units it was even a mistaken pride to maintain the "dressing" of these lines. There was one new tactical feature, the "creeping barrage," by which the artillery lengthened their range progressively according to a time-table based on the calculated rate at which the infantry could advance. The infantry moved as close as possible to the wall of bursting shells, and were thus virtually subordinated to the artillery, being little better than mere "barrage-followers." The tactical low-level of the Somme was raised somewhat at Verdun in the autumn. Here, on Oct. 24 and Dec. 15, the French, under the direction of Gen. Nivelle and the executive command of Gen. Mangin, made two *ripostes* which achieved a high ratio of prisoners and ground captured at a most economical cost. The reason lay partly in exceptional staff-work, partly in a high concentration of artillery with a minimum of infantry, and partly in a greater elasticity of the limited objective attack with a creeping barrage.

IV. THE SURPRISE ATTACK

The chief tactical significance of 1916 lies, however, in the début of the tanks, in the Somme battle on Sept. 15. Contrary to the advice of their sponsors, the tanks were used in driblets as soon as they were available, instead of being kept until a large quantity were ready to attempt a surprise on a large scale. As a result of minor technical faults and tactical mishandling they achieved only a limited, though promising, success. In a memorandum of Feb. 1916, Col. Swinton had outlined their correct employment and tactics, but nearly two years were to pass before this was put into practice, at Cambrai.

1917.—The opening of 1917 saw a reversion to the "break-through" idea. The contrast of the bright autumn successes at Verdun with the duller and slower progress, at heavy cost, on the Somme, had thrown the "limited objective" method into public disfavour. Joffre was superseded as Generalissimo by Nivelle, who, on the Aisne in April, tried to apply the Verdun method to a large-scale attempt to breach the German defences "at a rush." Its inherent fault was that the decisive blow was aimed before the enemy's reserves had been "fixed" or worn down. The experiment failed, and Nivelle gave way to Pétain. For the remainder of the year the British Army bore the brunt. The Battle of Arras showed little originality and the initial profit was squandered by continuing the offensive too long. The capture of the Messines ridge was a perfectly executed model of the "limited" method, but was only intended as a prelude to the offensive which began on July 31.

Tactically, this grim struggle is distinguished by two features. The first was a positive development in defensive tactics by the Germans, who based their resistance on a framework of machine guns in concrete pill-boxes, replacing quantity of man-power by quantity of fire-power, and the old linear defence by a dispersed system of strong points disposed in great depth. The men, thus saved, from the wasteful rôle of acting as human stop-butts for the attacker's bombardment, were held in reserve and used for counter-attacks. Deserved success crowned the originality of this break-away from the pernicious idea of sacrificing men rather than lose a yard of ground, and the substitution of an elastic method, which by combining the principles of concentration and security was better economy of force.

The second feature was the negative lesson that the more prolonged the bombardment the more it stultified its own object, by rendering impassable the ground which the advance was to traverse. The bombardment destroyed the intricate drainage system of the Ypres area and so converted it into a swamp.

Tanks.—The outcome of this lesson was the new method initiated by the British in Nov. (*see* CAMBRAI, BATTLE OF), whereby the vital element of surprise was regained through the release of a swarm of tanks without a preparatory bombardment. If the astonishing initial success was not exploited, owing to lack of reserves, the Cambrai method supplied the long-sought key to the trench deadlock. Eight months were to pass, however, before the key was to be turned in the lock, and in the interval the tactical interest shifted to the German side.

German Abandonment of the Mass Attack.—With Russia out of the struggle, the German command sought a decision in the West before the swelling volume of American reinforcements could redress the balance, now against the Entente. Lacking tanks, Ludendorff was compelled to attempt a solution by the improved use of existing methods—wider frontages of attack, the prompt infusion of reserves, new infantry tactics, and an artillery preparation which should be short enough to ensure surprise but compensate its brevity by its intensity. The keynote of the new infantry tactics was infiltration and manoeuvre by the little dispersed groups of automatic riflemen and machine-gunners. Instead of thick lines breaking themselves against the defender's posts, these groups penetrated between and pushed rapidly on, while the "islets" of resistance, cut off from help by the advancing flood, were outflanked and reduced by fresh troops from the reserve. Instead of the old massed blow the object was rather the filtering of the attacking force into the enemy's defensive system, crumbling it away. The concentration of troops acted as a reservoir for supplying the multiple jets, not as a wave to sweep over the defence.

The first offensive was launched on a 47 m. front north and south of St. Quentin, on March 21, after an intense bombardment of only five hours, in which full use was made of gas and smoke-shell. The able organisation of the attack and the rapid infantry exploitation resulted in a real break-through. The assaulting divisions were only brought up the previous night, for secrecy, and a continuous "leap frogging" of reserve divisions through exhausted leading divisions maintained the momentum of the advance. But the new tactical doctrine of reinforcing along the line of least resistance led, as it happened, to an alteration in the strategical direction—towards Amiens, with the object of separating the British and French Armies. As it approached Amiens, the German flood lost impetus, largely through the difficulty of supply across the old Somme battlefields, which was accentuated by the harassing operations of the British aircraft. And, in face of stiffening resistance, the Germans made the mistake of prolonging the offensive—an unprofitable drain on their strength. (*See* GERMAN OFFENSIVE.)

On the Lys in April, the Aisne in May, the method was repeated, each time with brilliant tactical success but without attaining a strategic decision. The interval, both in time and space, was too great for one thrust to have a direct effect on the other. None of the thrusts had penetrated quite far enough to sever a vital artery, and this strategic failure left the Germans with a series of huge salients, difficult to feed, wasteful to hold, and inviting a convergent counter-stroke.

Ludendorff made his last attempt on both sides of Reims, July 15, but surprise was lacking. East of the town he was foiled by Gouraud's large-scale improvement on the method of elastic

defence, whereby the thinly held forward positions dislocated the attack, and the Germans arrived in face of the strong main position with their initial momentum spent. West of Reims their penetration across the Marne merely enmeshed them more deeply to their undoing, for on July 18 Foch's counter-stroke fell on the west flank, first, of the salient created by the April offensive. Here the Cambrai method was repeated, a surprise blow led by masses of tanks.

Mobility Regained by the Allies.—An even better example was to follow, on the Amiens front, Aug. 8, where Rawlinson's army effected both a strategical and a tactical surprise—by misleading ruses, consummate precautions to ensure secrecy, and the use of 456 tanks. This blow convinced the German command of the hopelessness of victory, and it now fell to Foch to convert this loss of hope into the conviction of defeat. The new grand tactical feature of the last phase (*see* VICTORY, ADVANCE TO) was what may be termed the fluidity of attack, in contradistinction, as it was a counter to the elastic method of defence. Each attack was broken off as soon as its initial impetus waned and each was so aimed as to pave the way for the next, at some other point; the blows were close enough in time and space to have a reaction on each other. By this means the defender's power of transferring reserves to menaced points was checked, as his balance of reserves was drained.

The progressive decline in the German resistance enabled this process to continue despite the diminution and ultimate disappearance of the Allies' slender stock of tanks. The trench deadlock had definitely collapsed, and in the mobile conditions thus recreated their infantry, developing the new tactics of infiltration and manoeuvre, were able to press back the German rearguards. The gradual slowing down of the advance was due, not to the resistance of the enemy, but to the difficulty of supply through the devastated zone, a defect inherent in lines of communication which depend on a fixed and prepared track. But at the moment when this problem became serious, Foch was ready to launch a decisive blow through Lorraine, and the Germans, stripped of reserves, capitulated. It deserves note, however, that the Allies were at no time on the verge of a strategic break-through. Infantry had not the rapidity of movement essential if retreat is to be converted into rout, cavalry had not the protection necessary to preserve their mobility, and tanks were still immature, even had they been available in adequate numbers.

The Tank Plan for 1919.—The tactical history of the World War is not complete without mention of an original move intended for the 1919 campaign if the War had continued. Reflection on the disaster of March 1918 suggested to Col. Fuller, chief general staff officer of the Tank Corps, that its extent was due far more to the breakdown of command and communication than to the collapse of the infantry resistance. He evolved a scheme to launch a fleet of light fast tanks, under cover of a general offensive, which should pass through the German defences, and, neglecting the fighting troops, aim direct for the command and communication centres in rear. These destroyed, it was calculated that the disorganisation and capitulation of the combatant units would follow. This plan, adopted by the Allied command for 1919, is of profound significance in taking a mental and moral instead of a physical target.

V. POST-WAR TACTICS

With the coming of peace, war weariness and financial exhaustion paved the way for the inevitable reaction which has followed every great conflict. If there was some tendency towards greater density and linear formations, the reaction was far more marked in regard to the new arms which had been born during the conflict. National conditions also had an influence. The German Army was prohibited the use of tanks and aircraft, and so could do no more than study them theoretically. The French, still preoccupied with a recurrence of the German menace, reconstructed their tactical doctrine strictly within the limits of their recent war experience. True, such outstanding personalities and profound thinkers as Foch and Buat Berat—post-War chief of the general staff—recognised the likely predominance of aircraft and tanks, but immediate needs left no money for experiment, and thus while progressive in thought the French have been somewhat static in practice and design. In the United States, on the contrary, design has made greater progress than tactical thought. The British Army, influenced by the varied conditions and problems which face it in so scattered an empire, has treated trench-warfare as a phenomenon rather than a normal future condition, and has trained for open warfare. For several years, however, the higher command looked back to 1914 for its model, rather than forward in order to gauge the future.

Growth of the Mechanical Army.—While seeking to quicken action and infantry movement, and discarding much of the paraphernalia of trench-warfare—*e.g.*, cable communication and mortars—it failed to recognise that the inherent check on mobility was the vulnerability of infantry and cavalry in face of modern weapons, as demonstrated from 1914 to 1918; also the slowness of infantry, accentuated to-day through the substitution of muscle-power by mechanical-power in other departments and through air attack. The tendency to regard tanks as a transitory device for trench-warfare soon passed, but the idea that they were a mere aid to infantry remained. In the last year or two, however, the arguments put forward by a small band of thinkers have gradually permeated the army, and coupled with technical development have brought it about that to-day Great Britain is making more progress than any other country towards a mechanicalised army. On the horizon lie perhaps complete tank armies, or rather fleets—for then would be reproduced on land many of the tactical conditions of naval warfare. But for the present the practical problem is to fit the tanks into the framework of tactics and readjust the rôles of the older arms accordingly.

The New Functions of the Tank.—The greatly increased speed of the latest tanks makes close co-operation between them and infantry impossible; as complete a violation of economy of force, indeed, as it would be to yoke a race horse to a cart horse. Throughout the World War, infantry was called, illogically, the decisive arm, yet in practice it was dependent, first on artillery, and later on tanks, in order to act at all. Now that tanks can no longer be used to bolster up this fiction, infantry must stand or fall on their own merits, and the whole theory of modern tactics must be recast.

History gives us the clue to the solution of this problem, for until modern fire-weapons made mounted action impossible, cavalry was always the arm of decision and exploitation—because of its suitability for rapid out-flanking movements, the devastating momentum developed during its charge, and the demoralisation its furious onset inspired in exhausted or shaken troops. When its vulnerability nullified its battlefield mobility, and the cavalry charge disappeared, war became lopsided and the stalemates of modern times inevitable. Infantry aided by artillery could fix the enemy, disrupt and disorganise his screening forces, but there was no effective means of completing their efforts by a decisive blow such as cavalry had formerly delivered. This deadlock was broken by the coming of the tank, which through the protection afforded by armour gained scope for its mobility. The deduction is that tanks are the modern substitute for cavalry as an arm of decision and exploitation. They have their limitations—certain types of ground on which they are handicapped and certain defences against which they are helpless—but so had the cavalry of old. These qualities and limitations must be weighed and their tactical use decided accordingly, as was that of cavalry by the great captains.

Infantry in the Mechanical Army.—The tactical rôle of infantry needs to be readjusted similarly. Their qualities are their ability to make use of broken or close country to obtain cover, and to traverse ground which is too rugged or wooded for the other arms. Their limitations are their slowness and lack of direct protection, and the latter is accentuated by the fact that to-day, for mobile warfare, they can only count on a fraction of the artillery support they enjoyed in the World War. To cover the whole front with infantry, spread like butter on bread, irrespective of the type of ground, is no longer feasible. An advance over bare and flat country in face of machine guns is merely suicidal, and, instead,

infantry sectors of attack should be chosen with as much calculation as is given to the other arms. The "universality" of infantry action is as out of date as its decisiveness. When the tactical rôles of the different arms have been recast and fitted together, we shall have restored the lost balance between offensive power, protection and mobility—and thus have recreated a flexible instrument of generalship and the art of war. For in the years 1914–8 the tactical artist was supplanted by the machine-tender.

(B. H. L. H.)

TAFT, LORADO (1860–), American sculptor (*see* 26.354) was elected to the National Academy in 1911. He was director of the American Federation of Arts from 1914 to 1917 and in the latter year was appointed a member of the Board of Art advisers for the State of Illinois. He received a silver medal at the Panama-Pacific Exposition, San Francisco, 1915. His later works include: "Black Hawk" (1912), figure of an American Indian, at Oregon, Ill.; Thatcher Memorial Fountain (1918), at Denver, Colo.; and "The Fountain of Time" (1920), at Chicago. In 1920 he published *Modern Tendencies in Sculpture;* and in 1924 a new edition of *The History of American Sculpture.*

TAFT, WILLIAM HOWARD (1857–), 27th President of the United States (*see* 26.354), endeavoured in 1911 to secure reciprocity in tariffs with Canada. The measure was approved by the Congress of the United States, but in Canada it was defeated. Meanwhile wide public interest has been awakened in the conservation of national resources and the President's attitude was attacked by the Conservationists. In 1909 Gifford Pinchot, chief forester, charged Richard A. Ballinger, Secretary of the Interior, with being opposed to conservation. A Congressional committee, after investigation, exonerated the Secretary, but he later resigned. The attack upon Ballinger was denounced by the President, who continued to be criticised in connection with the sale of public lands, and who dismissed Pinchot from office. The President lost ground as a result of a breach of friendship between himself and Theodore Roosevelt, who supported Pinchot. In 1912 the President signed the Panama Tolls Bill, exempting American coastwise shipping from tolls, affirming that it did not violate the Hay-Pauncefote Treaty and that the United States had the right to fortify the canal. At the same time he expressed a readiness to arbitrate the question with Great Britain, who had protested.

Cleavage within the party was crystallised at the Republican National Convention in 1912. In the pre-convention campaign Roosevelt came forward as leader of the progressive wing against Taft as leader of the conservative or "stand-pat" wing, and the mutual recriminations were bitter. At the convention, however, the conservatives controlled the party machine, and the committee on credentials excluded the Roosevelt contesting delegates. Taft was renominated on the first ballot, receiving 561 votes, 21 more than the required majority. Roosevelt denounced the action of the convention and later was nominated by the newly formed National Progressive party. In the ensuing election Woodrow Wilson, the Democratic nominee, won an overwhelming victory, securing 435 electoral votes to 88 for Roosevelt and 8 for Taft. President Taft carried only two States, Utah and Vermont, and those only by small pluralities. The general feeling throughout the country was that President Taft had shown a lack of administrative firmness, his good nature having caused him to vacillate. On retiring from the presidency in 1913 he became Kent professor of law at Yale, but devoted much time to lecture engagements. In 1913 he was elected president of the American Bar Association, and in 1914 first president of the American Institute of Jurisprudence, organised to improve law and its administration.

After the outbreak of the World War in 1914 he supported President Wilson's strong stand for neutrality. In 1915 he approved the Army League's campaign for preparedness. He was an active promoter of the League to Enforce Peace, but after America's entrance into the War he argued that victory was necessary for attaining lasting peace. In 1918 he was appointed by the President a member of the National War Labour Board for arbitrating labour disputes during the War. In 1919 he endorsed the Peace Treaty of Versailles, regarding its most important part to be the Covenant of the League of Nations. He spoke throughout the country on behalf of the league urging reservations if these would secure ratification. He supported Warren G. Harding, the Republican candidate for President in 1920. On June 30 1921 he was appointed by President Harding Chief Justice of the Supreme Court to succeed Edward Douglas White, deceased. An insistent advocate of legal reform, particularly in regard to the reorganisation of the Federal Courts, he also urged the appointment of additional judges and the provision of machinery for speeding up the procedure. He also drafted a code of canons of conduct for the guidance of the judiciary, which obtained the endorsement of the American Bar Association.

Taft was the author of *Popular Government: its Essence, its Performance, and its Perils* (1913); *The Anti-Trust Act and the Supreme Court* (1914); *The United States and Peace* (1914); *Ethics in Service,* Yale lectures (1915); *Our Chief Magistrate and His Powers,* Columbia lectures (1916) and *The Presidency: its Duties, its Powers, its Opportunities and its Limitations,* lectures at the University of Virginia (1916).

TAGORE, SIR RABINDRANATH (1861–), Indian poet and author, was the youngest son of Maharshi Devendranath and grandson of Prince Dwarkanath Tagore. After a private education in India he was sent to England to study law, but soon returned to India, and while still quite young commenced writing for Bengali periodicals. In 1901 he established the famous Shantiniketan, or "abode of peace" at Bolpur, 93 m. from Calcutta, which developed into an important instructional institution. Originally organised as an *asram,* or retreat, by the Maharshi, it was developed by Rabindranath into a school conducted on unconventional lines, and he aimed at enlarging it into an international university which should comprehend the whole range of Eastern culture. Rabindranath published some 30 poetical and 28 prose works in Bengali, many of which are regarded as classics. The more important of them were translated into English and gained a wide popularity. The author visited Europe on several occasions and travelled also in Japan and the United States. In 1913 he was awarded the Nobel prize for literature, and utilised the amount £8,000 for the up-keep of the school at Bolpur. He accepted a knighthood in 1915, but in 1919 resigned it as a protest against the methods adopted for the repression of disturbances in the Punjab. In later years, however, he offered no objection to the use of this title.

His volumes of poems, with the dates of their English translations include *Gitanjali* (1913); *The Crescent Moon* (1913); *The Gardener* (1913); *One Hundred Poems of Kabir* (1915); *Fruit-Gathering* (1916); *Stray Bird* (1917); *The Lover's Gift and Crossing* (1918). Among his novels are *The Home and the World* (1919); and *The Wreck* (1921). He also published several plays and volumes of short stories, letters and lectures. In 1917 appeared his *My Reminiscences.*

(F. H. B.*)

TAJIKSTAN (*see* Tajik 26.365), an autonomous Socialist Soviet Republic within the territories of Uzbegistan. It lies to the north of the Oxus, opposite Badakshan in Afghanistan. (*See* TURKESTAN.)

TANGANYIKA TERRITORY (*see* GERMAN EAST AFRICA, 11.771).—During the World War German East Africa was conquered by British and Belgian troops. The mandate to administer the country was given in May 1919 by the Allied and Associated Powers to Great Britain, but by an agreement of Sept. 1919 between Great Britain and Belgium the mandate for Ruanda and Urundi, the northwestern parts of the former German colony, was transferred to Belgium, while Portugal was given the small area at the mouth of the Ruvuma river known as the Kionga triangle. The area of Tanganyika Territory is about 373,000 square miles. The population (1921) was approximately 4,107,000 natives, 2,400–2,500 Europeans, some 10,000 Indians and 4,000 Arabs. Ruanda-Urundi, with an area of about 20,000 sq. m. only had about 3,500,000 inhabitants. The three districts of Tanganyika Territory adjoining Ruanda-Urundi, namely Bukoba, Mwanza and Tabora, had over 1,500,000 inhabitants; the rest of the Territory is sparsely populated. The capital is Dar es Salaam (population 1921, about 25,000, including 555 Europeans).

Political History

The years immediately preceding the outbreak of the World War in 1914 had been a period of much administrative and commercial activity in German East Africa, the principal achievment being the completion in Feb. 1914 of the railway from Dar es Salaam to Kigoma-Ujiji on Lake Tanganyika. There was a flourishing European settlement in the Usambara Highlands and, as far as civil administration was concerned, the colony had become self-supporting. The budget for 1914–5, the last framed by the Germans, balanced revenue and expenditure at £1,023,000, with £165,000 as an imperial grant for military purposes. (The story of the military operations is told elsewhere, *see* East Africa.)

The British and Belgians established their own administrations in the districts they conquered. It was not until March 22 1921 that all the districts which Belgium had occupied but which fell within the British mandated area were transferred to Tanganyika Territory, the name officially given to the British area in Jan. 1920. A civil administration had been set up while the War was in progress, Mr. (afterwards Sir) Horace Byatt being the first administrator—a title changed in Aug. 1920 to that of governor. The country had suffered severely from the ravages of war and the work of reconstruction was difficult and prolonged. All the German settlers were repatriated and their estates sold. Up to the end of 1924 these estates had realised £1,221,000. Until this process was nearing completion few new land grants were made and agriculture for a time was practically at a standstill. Moreover both the planters and the commercial community complained, with some show of reason, that the Government was indifferent to their needs. Complaint was also made by the Europeans of the competition of the Indians. As to that the administration was tied by the terms of the mandate (which were approved by the Council of the League on July 20 1922). The mandate enjoined equality of treatment to nationals of all members of the League in matters of "residence, trade and commerce." The administration was hampered by lack of funds and the necessity of rebuilding a large part of the Central Railway (the Dar es Salaam-Tanganyika line); and it had as its first duty the care of the natives, many of whom were restive and demoralised by the War. It had its hands full; nevertheless it might have paid greater attention to the needs of planters—and the Amani Institute for scientific research, which was one of the best works of the Germans, was allowed to go nearly to ruin.

In Nov. 1924 Sir Horace Byatt was transferred to Trinidad and Sir Donald Cameron succeeded him as governor of Tanganyika. Meanwhile attention had been called to the suitability of the highlands in the southwestern parts of the territory for white

settlement and a number of Europeans subsequently bought farms there. This region, however, lacked means of communication; to open it up, and at the same time to provide an outlet for the trade of northern Nyasaland and northeastern Rhodesia, it was decided in 1926 to build a railway crossing the highlands and extending to Lake Nyasa. The project to link up Uganda an Tanganyika by a railway had been abandoned. The only route for such a line was through a part of Ruanda, and that part had therefore been retained in British mandated territory by the 1919 agreement with Belgium. This arrangement had, however, led to a division of the native State of Ruanda and had caused inconvenience. By a new Anglo-Belgian agreement of 1923 the strip of Ruanda which had been in Tanganyika was assigned to Belgium. The connection of Lake Victoria with the Tanganyika system by a railway from Tabora to Mwanza was, however, decided upon in 1926.

The importance of Tanganyika as a vital link in the chain of territories in East Africa under British administration was clearly recognised by the Parliamentary Commission which visited East Africa in 1924. It was emphasised at an unofficial conference of delegates, representing the settlers of four territories interested, held in 1925 at Tukuyu (formerly Neu Langenburg) and at a conference of East African governors held at Nairobi in 1926. Both conferences were concerned principally with questions of economic development. Political federation was not favoured. By this time (1926) the era of transition after the War had ended and it was announced that Tanganyika would be given a legislative council. Ex-enemies were allowed to enter the Territory.

Economic Conditions

Tanganyika depends mainly on agricultural and jungle produce. The considerable sylvan wealth is undeveloped and rubber has ceased to be exported. Gold is worked on a small scale and diamonds have been discovered near Mwanza. Mica, too, is worked—but the mineral resources of the territory were but partially known up to 1926.

Commerical depression and currency difficulties, the enforced change as in Kenya Colony (*q.v.*) from rupees at 15 to the £ to florins and then shillings, added to the cost of restoring the devastated regions, reacted unfavourably both on trade and revenue. The volume of trade increased however from £3,098,000 in 1922 to £5,451,000 in 1924. In the last-named year commercial imports were valued at £1,901,000 and exports at £2,695,000, while the transit trade, mainly with the Belgian Congo, was worth £693,000. Cotton-piece goods, foodstuffs and iron and steel manufactures were the chief imports. The principal exports were sisal (worth £644,000 in 1924), ground-nuts (£359,000), coffee (£352,000), cotton (£373,000), copra, hides, skins and grains. Ivory worth £120,000, gold valued at £30,000 and mica at £27,000 were exported in 1924. Nearly all the gold was alluvial, from the Lupa river washings. By 1925 trade had recovered to the level reached in 1913. Some 75% of the cotton was raised by natives.

Revenue increased from £669,900 in 1919–20 to £1,315,000 in 1923–24. Expenditure in the same period rose from £790,000 to £1,901,000. The bulk of the excess of expenditure was on railways. The deficit on the working of the railways had been reduced to £92,000 in 1923–4, as compared with £158,000 in 1919–20, while in 1925 the railways paid their way. The chief sources of revenue are the house, hut and poll tax and customs. About half the revenue in 1923–4 was paid by the natives.

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TANGIER (*see* 26.397), a town and district of Morocco (*q.v.*) which enjoys a neutralised and internationalised régime under the sovereignty of the Sultan of Morocco. Its area is 200 sq. m. and the population (1920) about 50,000 for the town and 70,000 for the town and district.

History, 1911–23.—The Franco-German crisis of 1911 which had threatened to disintegrate Morocco, if not to lead to an European War, left Tangier practically unaffected, and the Franco-German treaty which ensued included amongst its clauses the article which had appeared in every earlier treaty since 1904, that Tangier was to receive in due course of time a special régime. While in 1912 France and Spain began the occupation of their respective zones, not without recourse to arms, for the natives did not always acquiesce, Tangier remained a part and parcel of the old Morocco under the direct rule of the Sultan and his Maghzen, modified by a system of rights of intervention on the part of the European Representative.

The declaration of a French Protectorate over Morocco did not alter the situation at Tangier, which was understood to fall outside the effect of that declaration. If by this isolation Tangier escaped being drawn into the fighting which spasmodically occurred as the French and Spaniards advanced to occupy new districts of their zones, it suffered from the fact that, abandoned to a continuance of corrupt and unprogressive government, no amelioration in its situation was possible. The jealousies of the Powers and of their local representatives, the obstruction with which certain Governments never ceased to meet every proposition of progress, prevented Tangier from benefiting from its superb position and becoming a place of commercial and maritime importance. So loud grew the complaints of its population that the Governments of Great Britain, France and Spain decided in 1913 to draw up a convention and introduce the special régime which the treaties accorded.

After long months of negotiation the representatives of the three Powers concerned were on the point of signing the Convention in 1914, when the War broke out, and the Spanish Govt. refused to sign. No doubt Spain preferred to await the results of the War before she definitely signed away her hope of one day possessing Tangier herself. So the status remained unapplied and the Convention disappeared in the pigeon-holes of the Foreign Offices. Tangier's sufferings were thus prolonged and its fate left unsettled. The construction of the port which had been decided upon in 1910, when an international company was formed for that purpose, was again postponed and obstruction to progress and prosperity was once more the order of the day. While the towns of the Atlantic Coast, under the very able administration of Maréchal Lyautey, were becoming both large and prosperous, Tangier remained stationary.

Tangier, like the rest of Morocco, was little affected by the War. Food was plentiful, restrictions few. During that whole period there was but one incident of importance, the expulsion of the German and Austrian chargés d'affaires and the personnel of their Legations. The internationalisation of Tangier rendered it doubtful what steps the Allied Governments would take on this question, but the Sultan of Morocco, under whose direct jurisdiction Tangier lay, was himself an Ally and the Governments interested did not hesitate to act. At the conclusion of the War Europe was too occupied to give thought to Tangier and the policy of obstruction continued to the lasting detriment of the place. Peace was seldom disturbed, though the fighting in the neighbouring Spanish zone impeded trade and closed the roads.

The Statute of 1923.—It was not until 1923 that the question of Tangier's future was once more taken into active consideration. The situation had now changed. France's position had become stronger since the Sultan had recognised her protectorate. The British Govt. was, however, still determined that an international form of government must be adopted, and Spain, having failed to benefit by the War, supported this demand. It was a question difficult of solution and a preliminary conference in London in July 1923 failed to bring about any settlement. It served, however, as a useful exchange of views and in the following Oct. British and Spanish delegates proceeded to Paris where the negotiations were continued. On Dec. 18 1923 the Convention was signed by the representatives of France and Great Britain and on Feb. 7 1924 by Spain.

The new status of Tangier is based upon a charter of permanent neutral internationalisation, under the sovereignty of the Sultan of Morocco, who maintains his control over Moslem and Jewish Moroccan subjects. The Sultan is represented by a high Moorish official, the Mendoub. The administration of this town and its zone rests in the hands of an Administrator and two Assistant-Administrators, who carry out the decisions of the Legislative Assembly, subject to their ratification by the Committee of Control. The Convention laid down that during the first six years the Chief Administrator should be a French subject and his assistants a British and a Spanish subject. After that period they should be chosen by the Assembly. A French and a Spanish engineer should superintend the public works. The Committee of Control, consisting of the Consuls of all the Powers—except ex-enemy Powers—who signed the Algeciras Act has power, by majority decision, to veto the acts of the Legislative Assembly. The Legislative Assembly consists of 26 members, chosen from the subjects of the Powers represented in Tangier and from the Moorish and Jewish population. The number of members representing each nationality is regulated by the local importance in population, trade and influence of the nationality in question. Clauses have been introduced into the Convention and in the legal codes for progressive modifications at specified periods of time should modification be deemed necessary or advisable.

Special legal codes have been drawn up based on those in use in the French and Spanish zones. Justice is to be administered in mixed tribunals by judges of different nationalities. A gendarmerie of 250 men, natives of Morocco, is placed under the command of a Belgian captain with French and Spanish assistants. It is quite evident that such a scheme is far more difficult to put into practice than to put upon paper, and even two years after its signing in Paris the status had not become a going concern. Its initiation was rendered far more difficult than would otherwise have been the case by the refusal of Italy and the United States of America to accept the conditions it introduces, and by the delays of Portugal to adhere. A certain confusion resulted, for the dissenting Powers refused to allow the operation of its edicts upon their subjects. Consequently while the subjects of all the assenting Powers passed under this new régime, those of Italy, America and Portugal retained their old status, under which they were not legally bound to pay the new forms of taxation and other charges imposed upon the less fortunate subjects of the adhering Powers. (*See* also MOROCCO.)

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TANG SHAO-YI (1858–), Chinese statesman, a native of Kwantung, became notable as the first foreign-trained Chinese to rise to high office, and one of the leaders of the Chinese nationalist movement which adopted the cry of "China for the Chinese." He was educated in the United States at Columbia University and received his first important post in 1898, when he became consul-general in Seoul in succession to Yuan Shih-kai. Gaining the favour of that rising statesman, he was appointed director of the Northern Railway and customs Taotai, and undertook important missions to Tibet (1904) and India, the result of which was the Tibet Convention of 1906. His ability and friendship with Yuan Shih-kai brought him a number of lucrative posts, but his radical sympathies and progressive policy earned him the dislike of the reactionaries, and he was impeached on the grounds of "self-sufficiency and the employment of unsuitable persons." Recovering from this set-back, he was appointed special envoy to Europe and the United States (1908). He played an important part in the negotiations that followed the revolution of 1911, and in 1912, became Premier under Yuan Shih-kai. But in June of that year he fell, and though he held office several times during the succeeding decade, he never played the great rôle for which his ability once seemed to single him out. In 1919 he was one of the four directors of the Canton Govt. and was minister of finance at Canton 1919–22. Though a strong nationalist, Tang never showed hostility to foreigners, but, on the contrary, protected them at much risk during the Boxer rebellion (1900).

TANKS.—The name tank was given during the World War to the bullet-proof, armed vehicle, driven by mechanical power and capable of crossing rough country and obstacles by the use of caterpillar tracks. The name was first used in Dec. 1915 as a blind to conceal the true nature of the experimental fighting machine then being secretly constructed in England; after the first appearance of the machine in the field the name was universally adopted. To the British is due the credit of first conceiving and introducing this weapon which was destined to exert a decisive influence on the course of the War.

I. THE INVENTION OF THE WEAPON

The Tank Idea in History.—From the earliest times men have attempted to find methods whereby they might move under some form of protection while they delivered blows at the enemy. Vehicles of many different types have been constructed throughout the ages with a view to solving these first principles of war and those vehicles were the forerunners of the tank. The earliest fighting vehicles of which there is a record, date back to 1200 B.C. when the Chinese made use of protected vehicles propelled by man or horse-power and to the use of war chariots by the Assyrians. In the 15th century the Tudor "war carts" appeared and fighting vehicles were constructed which were the exact counterpart of the modern tank except in motive power; and numerous examples of fighting vehicles appear throughout history, all aiming at the provision of mobile protection for the fighting man.

The introduction of rifled breech-loading firearms led to the disuse of all forms of fighting vehicle. The weight of armour which was necessary to provide protection was such that no armoured vehicle could be propelled across country by man-power or horse-power. The necessity for a fighting vehicle still existed and was in fact accentuated, especially with the introduction of the machine-gun; there was, however, at the time no apparent solution to the mechanical construction of such a vehicle. As time progressed two inventions were developed and it was the combination of these that led to the construction of the tank. The two inventions were the caterpillar track and the high-speed internal-combustion engine. The former enabled heavy vehicles to cross soft ground by the use of a track or endless belt so that the weight was distributed over a large area of ground; the latter provided a light compact power unit by means of which the vehicle could be propelled. The combination produced tractors such as the Holt, invented and in common use in America before the War. Between 1907 and 1914 several inventors suggested that tractors of this nature should be constructed and provided with armour for use as a fighting vehicle in war. No official action was, however, taken in this direction. The prevailing military opinion among all nations prior to 1914 was that any future war would be mainly a war of movement, and although it was realised that a frontal attack against a defensive position would be costly, it was considered that such an attack would be greatly assisted or even avoided entirely by envelopment or flank action.

The opening phases of the World War appeared to confirm these views, but in Sept. the Germans fell back and took up a defensive position on the Aisne and it was then that the great strength of modern field defences became apparent. The main source of strength of these defences lay in the machine-gun protected by an extensive use of barbed wire entanglements, and they proved to be impregnable to attack by troops, equipped as they were in 1914, without the most prodigal loss of life. The efforts of the British troops early in Oct. to outflank the Germans in the north, led to an extension of these defences right up to the sea. The Allies were then faced with a continuous defensive position without flanks that could be turned and they possessed no means of penetrating such defences. One solution of the difficulty appeared to be a large increase in the available artillery resources, particularly in the larger pieces and the provision of high-explosive shells. This solution was acted on at once and although no result could of course be expected for many months, it was hoped that sufficient artillery and ammunition would eventually be available to blast a way through the enemy defences and so re-establish the power of mobility.

Col. Swinton's Proposal.—Early in Oct. 1914 an officer of the Royal Engineers, Lt.-Col. (later Maj.-Gen.) E. D. Swinton, Royal Engineers, formed the opinion that a frontal assault against prepared positions, especially with limited artillery support, had become impossible, and that some form of power-driven protected machine which could traverse trenches and barbed wire was necessary to enable the attack to overcome the power of the defence. On Oct. 20 1914 Col. Swinton saw Col. (later Sir Maurice) Hankey, Secretary of the Committee of

Imperial Defence, and put forward his scheme which was briefly to develop the Holt tractor and produce a mobile armoured machine which should lead the assault and act as a machine-gun destroyer.

As a result of the interview described Col. Swinton took up the question with G.H.Q. in France and Col. Hankey put the idea before Lord Kitchener; but in neither case did it lead to any result. Col. Hankey however also submitted the scheme to the Prime Minister as Head of the Committee of Imperial Defence, and this reached Mr. Churchill who was already experimenting with armoured cars for the naval detachment of the Belgian coast. On Jan. 5 1915 Mr. Churchill wrote to the Prime Minister emphasising the importance of Col. Swinton's suggestion. This letter was sent to Lord Kitchener, and at the same time Col. Swinton called at the War Office to discuss his proposals. As a result the matter received some attention and a few trials were carried out, after which the whole question was dropped. In the meantime Mr. Churchill formed a committee at the Admiralty under the chairmanship of Mr. (later Sir) Tennyson d'Eyncourt, to investigate the problem. They carried out trials with large wheeled machines, coupled steamrollers, pedrail and caterpillar tractors, single and articulated, the underlying idea being the production of a machine for the conveyance of troops and not a machine-gun destroyer.

In the meantime Col. Swinton took his proposals to the commander-in-chief in France with the result that the specification of the type of machine required was sent to the War Office. By that time a joint naval and military committee had been formed and they were now able to work to a specification which detailed the military requirements. The result was the production—first of "Little Willie" which just failed to reach the standard required, and later of "Big Willie" or "Mother" as it was christened, which passed all tests at Hatfield on Feb. 2 1915. The chief point in the design, and on which it differed from other caterpillar machines, was its rhomboidal shape and all round track which were the invention of Lt. (later Lt.-Col.) W. G. Wilson, working in conjunction with Mr. (later Sir) W. Tritton. This machine, afterwards known as the Mark I. tank, was the prototype of all British machines used during the World War.

In the meantime normal trench warfare had been proceeding in France. The artillery had been considerably strengthened, but even then it was found at the battle of Loos that large numbers of enemy machine-guns would survive the heaviest bombardment and cause prohibitive casualties to the attacking infantry. G.H.Q. France therefore ordered 40[1] of these experimental tanks, and this number was increased by the War Office to 100 machines. A tank supply committee was formed under the Ministry of Munitions with Major (later Sir) Albert Stern as chairman. Orders were placed on Feb. 12 and production started at once with utmost secrecy, and under great difficulties of labour and material owing to the great national effort to produce munitions of every kind.

The First British Tanks.—The Mark I. tank was built in two types, "male" and "female"; both types had "sponsons" mounted on the sides to carry the main armament. On the male tank this consisted of two 6-pdr. guns and on the female tank of four Vickers machine-guns. The idea was that the tanks would work in pairs, the male tank being more capable of dealing with defences behind brick walls or steel loophole plates and the female tank having greater man-killing fire power. The total number under construction was 150, half being males and half females. The Mark I. tank was 26 ft. long, weighed 28 tons and carried a crew of eight men. The maximum speed on the level was 4 m.p.h. and the tank could cross a trench 10 ft. wide. Reference has already been made to the track which was carried all round the tank; this track was driven from the engine through a two-speed gear box (controlled by the driver) and then through a differential which carried a second gear box at each outer end of the half shafts. These secondary gears were operated by hand levers and necessitated a gearsman on each side of the tank in addition to the driver. From these the drive was carried by chain to the driving sprockets in rear. As the original idea of the inventors had been that the tank should be used as a surprise on a large front the armour was for most part only proof against ordinary rifle ammunition. It was realised that it might be necessary, as was indeed the case, to increase the thickness of the armour, in later models, to withstand armour-piercing bullets, when the enemy had had time to produce large quantities of these bullets. The male tank carried 324 rounds of 6-pdr. shell and 6,272 rounds of S.A.A. The female tank carried 31,232 rounds of S.A.A. Both types carried sufficient petrol for about 15 m. on a cross-country course.

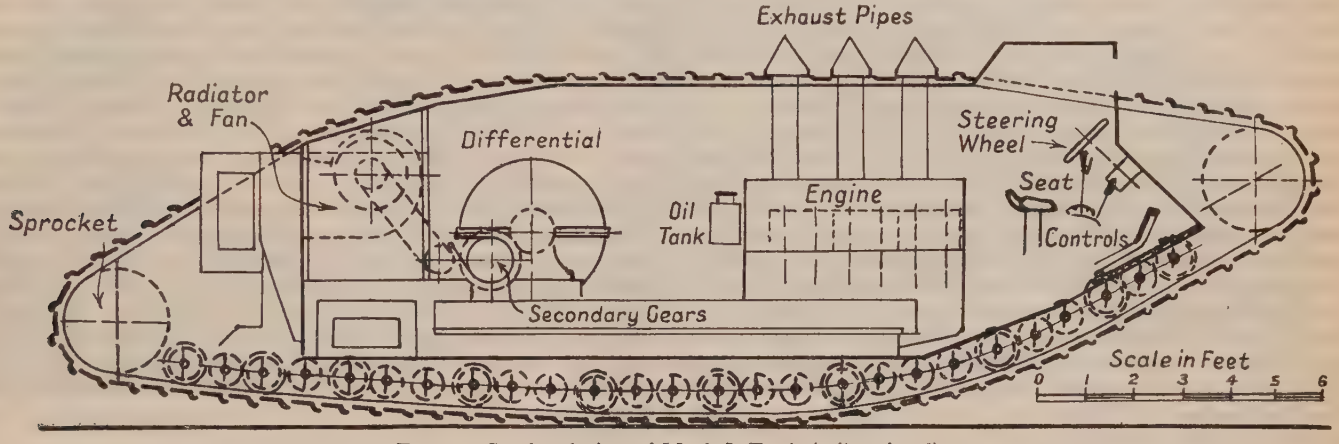

FIG. 1.—Sectional view of Mark I. Tank (tail omitted).

A feature of this tank was the tail which consisted of a pair of steel wheels hinged on to the back of the machine and pressed down on to the ground with powerful springs. The wheels could be steered from the driver's seat and in this way the tank could negotiate easy bends; the wheels improved the balance of the machine and also slightly increased the trench crossing capacity. In order to take a sharp bend or swing round on its own axis, the wheels were raised by a small hydraulic ram and secondary gears placed in neutral on one side of the tank. The power of the engine was then transmitted to one side only and the tank would take a sharp bend, or if a brake was applied on the same side as the gears were in neutral, then the tank would swing on its own axis.

In March 1916 a unit was formed to man these first tanks: For the purpose of secrecy the unit formed part of the Machine Gun Corps and was known as the Heavy Section, Machine Gun Corps. This name was later changed to Heavy Branch, Machine Gun Corps. The unit was commanded by Col. Swinton and contained sufficient personnel to man the 150 tanks under construction. The unit was organised in six companies of 25 tanks each. As soon as the tanks began to arrive from the contractors

[1] The first order placed by the French Army Headquarters, without awaiting the construction of an experimental machine, was for 400 machines, and this was increased to 800 machines.

the unit encamped at a secret area near Elvedon in Suffolk and started driving and gunnery practice.

II. THE TANK IN ACTION

First Engagement on the Somme.—In the meantime the Somme offensive in France had come to a standstill. The right wing of the attack between the Somme and the Ancre which had met with some success at the start was definitely held up. The very heavy bombardments of the greatly increased artillery force had enabled the attackers to make some headway, but in the end the artillery fire had shelled away the barbed wire and replaced it by a worse obstacle, namely shell torn ground over which the infantry could only advance with difficulty, especially in wet weather. Moreover, this ground was quite impassable to transport and any question of pressing forward at some point where an attack had met with success was rendered impossible, as no ammunition or supplies could be sent up until new roads had been constructed. It was at this stage that it was decided to use the first two companies of tanks in an attempt to resuscitate the advance between the Somme and the Ancre. These two companies were accordingly sent to France at the end of August.

On Sept. 15 1916 the first tank attack took place. The IV. Army was to attack and advance on the line Morval, Les Boeufs, Guendecourt and Flers and the V. Army on the left of the IV. Army was to advance on Martinpuich and Courcelette. A total of 49 tanks were to be used, the majority with the IV. Army. They were to advance in small detachments of two or three machines against the enemy strong points. The general idea was that they should advance so as to reach the objectives just before the infantry. In some cases lanes were left in the artillery barrage up which the tanks were to advance ahead of the infantry. The tanks advanced at dawn in a slight mist and came as a complete surprise to the enemy; the results were, however, disappointing. The tanks had been constructed to traverse wide trenches, banks and barbed wire obstacles, but not the shell torn ground which was the result of prolonged bombardment on a small area. Of the 49 tanks which were employed, 32 reached the front line. Of these nine went ahead of the infantry and rendered valuable assistance; nine kept up or followed just behind and helped in reducing strong points where the enemy were still holding out. The remaining 14 broke down or sank and became ditched in the soft shell torn ground shortly after the battle had commenced. One tank in front of Flers gave remarkable assistance to the infantry and caused the surrender of 300 Germans. On Sept. 25 and 26, 13 tanks were employed on the same front and a few were employed later, on Nov. 13. In each case a large proportion of the tanks were unable to negotiate the shell torn ground, but those that did rendered valuable assistance to the infantry, causing heavy casualties and the surrender of a large number of Germans.

The employment of the tanks in Sept. 1916 was contrary to the views of those who had originated the arm and were responsible for its production. They considered that the tanks should be kept as a secret and used in large numbers as a surprise on a new portion of the front so as to give a chance of achieving decisive success. By using the tanks in small numbers a repetition was created of the error made by the Germans when they released gas on a small scale on April 22 1915. It was done in order to resuscitate the Somme offensive and raise the morale of the troops, but it is doubtful if the value so gained was equal to the loss of surprise in the use of a new weapon which it entailed. It did however prove that the tank was a very definite reply to the machine-gun and barbed wire and that infantry accompanied by tanks could attack defended positions with every prospect of success.

Improved Types.—As a result of these trials it was decided that the arm should be expanded to a force of 1,000 tanks. The tanks were not to be used again until the spring and the winter was to be spent in re-arming and training. The original six companies were expanded to nine battalions and the force in France was to become three brigades, of three battalions each, under the command of Lt.-Col. (afterwards Major-Gen.) H. J. Elles, R.E. Each battalion was organised in three companies and one mobile workshop, and each company was composed of four sections of four tanks each.

Although France had asked for 1,000 tanks, the design of the tanks had not been settled. There was much discussion as to whether a completely new design should not be introduced; suggestions were made that a type with much wider tracks, or possibly equipped with more than one pair of tracks, should be tried. In the meantime 100 machines were ordered which were to be similar to the Mark I. machine, but with certain minor improvements. These were known as the Mark II. and Mark III. machines. Other than the obvious fact that tanks had difficulty in crossing the pulverised ground on the Somme which was covered with craters and shell holes, the only military lesson that had been learnt as regards tank construction was the fact that it was not worth while fitting the tail to the tank; owing to its vulnerability and complications, it was constantly out of action and was of little value. The Mark II. and III. machines were therefore both very similar to the Mark I., the main differences being the provision of stronger rollers, and stronger armour to withstand the armour-piercing bullets which the Germans would be fairly certain to use in the next battle.

In the meantime the authorities in England who were responsible for the production of tanks were becoming perturbed about the delay over a decision as to the design of tanks for the order of 1,000 machines. For the original idea of fighting a surprise battle on a new front the existing design was suitable, but to produce the ideal machine for traversing the shell torn ground of an old battlefield, a new and special design was necessary and this would mean a complete new series of experimental trials, involving much delay. It was not till the end of March, involving the loss of five valuable months, that a decision was reached and it was then decided that the 1,000 machines should be of a type known as the Mark IV. This type was again very similar to the Mark I., using the same engine and transmission and the same shape of hull. It included the minor improvements already incorporated in Marks II. and III. and in addition had sponsons which could swing into the body for travelling on a railway, and so saved the labour of detaching and remounting these heavy sponsons for every railway journey. Another feature of this tank was that it carried an unditching beam which could be fastened when required on to the tracks to extricate the tank from a ditch. The Mark IV. tank was the main machine used throughout 1917 and the early part of 1918.

The next action in which the tanks took part was the battle of Arras on April 9 in which the I., III. and V. Armies attacked with a view to penetrating the German defences and allowing an Army Corps and two cavalry divisions to break through. Only 60 tanks were available for this attack and they were again used in the minor rôle of assisting the infantry to "mop up" machine-gun nests and small posts that had been passed over by the artillery barrage and the assault of our leading troops. The tanks were of the Mark I., II. and III. pattern and some of them suffered heavily from armour-piercing bullets. In many cases the tanks rendered valuable assistance, overcoming enemy machine-guns and barbed wire with ease. Although there had been a heavy preliminary bombardment the ground was not torn up to the condition in which it had been on the Somme and the result was that comparatively few tanks became ditched and most of these were soon extricated. The cavalry were prevented from breaking through owing to the usual obstacles—barbed wire and machine-guns—the tanks being far too few in numbers and too dispersed to be able to keep up the pressure and assist in further operations. The lessons were the same as before, namely that tanks should not be dispersed, but used in large numbers and further that succeeding waves were necessary to keep up the pressure and achieve decisive results.

Messines.—The next attack was against the Messines-Wytschaete Ridge on June 7 in which 76 Mark IV. and 12 supply tanks were used. The latter were made from old converted Mark I. or II. tanks and were used to keep the fighting tanks supplied with petrol and ammunition—a need which had been

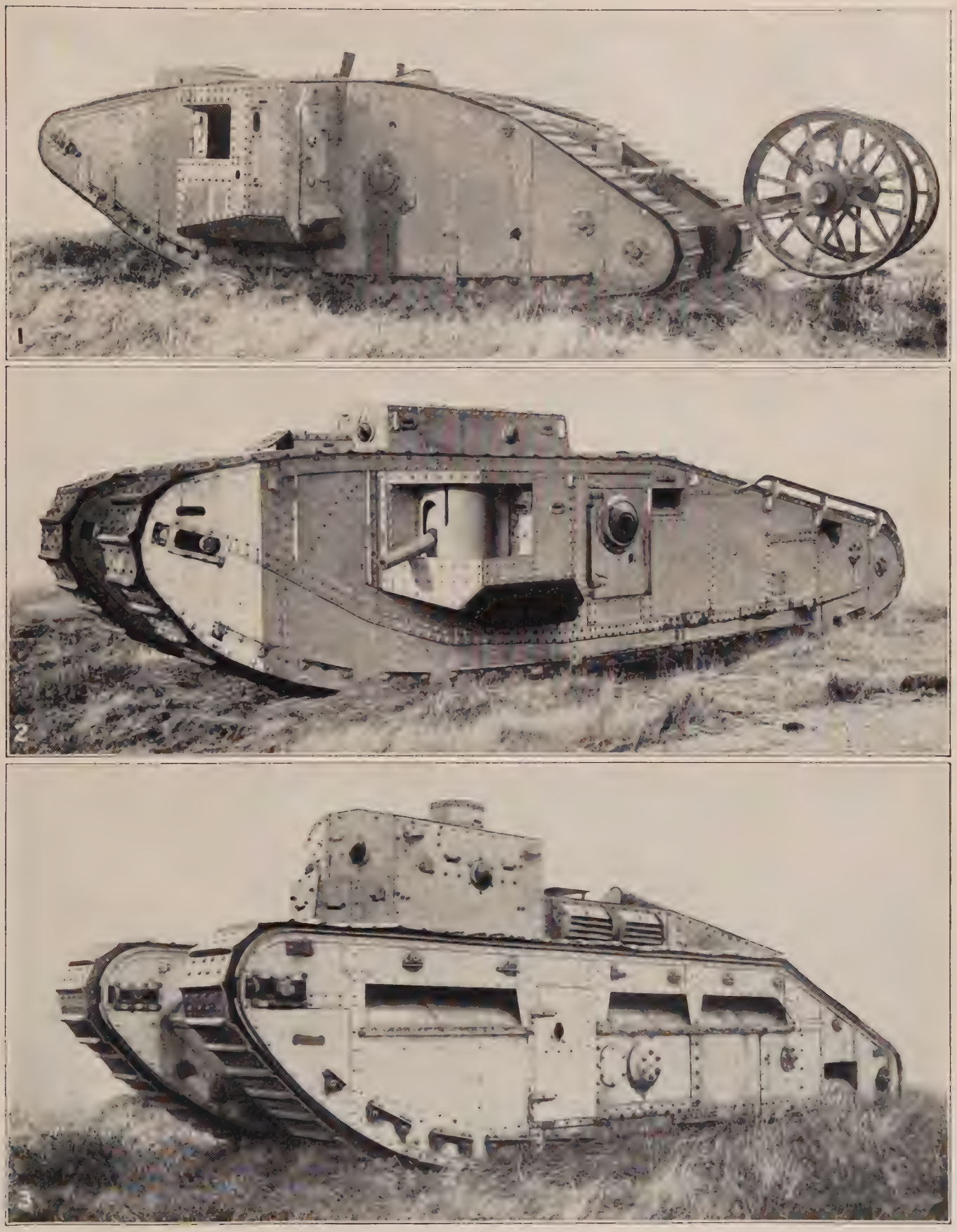

FIG. 1. British Mark I. Tank, with gun dismounted. FIG. 2. Allied Tank (known by British as Mark VIII., and by Americans as the Liberty Tank). FIG. 3. British Medium C Tank.

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FIG. 4. Vickers Light Tank (Mark II.). FIG. 5. French Renault Tank.

much felt in former battles. The attack was in the nature of an assault in the old form of siege warfare. The result was a complete success in which the tanks only played a small part, though in a few individual cases they rendered valuable help. The ground was completely pulverised by the preliminary bombardment but very few tanks became ditched, mainly owing to the fact that there had been no rain for many weeks and that there had been time to make a close reconnaissance of the ground and pick out the best lines of advance for the tanks. After this attack the arm was renamed as the Tank Corps.

Failure at Ypres.—On July 31 the third battle of Ypres was launched. As the preliminary bombardment had been so successful at Messines it was decided again to use a long preliminary bombardment lasting 10 days. The danger of thus rendering the ground impassable to tanks, especially if it rained, was explained by those responsible for the action of tanks, but it was considered that the value of the bombardment more than balanced the possible loss of the use of tanks; this did not prove to be the case as the Germans adopted a defence distributed in depth which did much to discount the value of the bombardment. Unfortunately it rained on the first day of the battle and although the tanks rendered much assistance in individual cases during the early stages of the attack, the ground soon became quite impassable to tanks, and later it became impassable to infantry as well.

Success at Cambrai.—Although the failure of the tanks at the third battle of Ypres was through no fault of the officers and men and those who commanded them, it led to much discussion as to whether tanks should be retained at all. The Germans formed the opinion that the tank was practically useless, and many British officers held the same view. Fortunately this view was not unanimous and on Nov. 20 permission was obtained to launch an attack at Cambrai, in which the tanks were to be used in the way in which their originators had intended that they should be used. This was the turning point in the history of the Tank Corps. The action as fought was in almost every detail the execution of the plan put forward officially for the employment of the tanks by Col. Swinton in Feb. 1916, seven months before the first tank action. The attack was to be a complete surprise and no preliminary bombardment was to be used. Three brigades of tanks (nine battalions) were to take part with a total of 378 Mark IV. tanks and 98 administrative machines (*see* CAMBRAI).

The attack was launched at 6:20 A.M. in a slight fog, Maj.-Gen. Elles leading the attack in a vanguard tank with the centre division. The operation was a complete success; the enemy were taken absolutely by surprise and most of the infantry bolted or surrendered. Within 12 hrs. the infantry had advanced 12,000 yd. on a front of 13,000 with only 4,000 casualties. A similar penetration at Ypres had taken three months, with enormous loss of life and morale. The preliminary bombardment which had cost some £22,000,000 at Ypres was dispensed with and a further advantage was gained in that the roads had not been torn up with shell fire and were available for use almost at once. And this had been achieved by the Tank Corps using great mechanical power, but numbering only 4,000 of all ranks.

As regards tank design three main lessons were learnt from the battle of Cambrai. First of all the tanks required to be handier, and controlled by one man, without the assistance of any gearsmen, and to meet this requirement the Mark V. tank was produced. This design had been suggested but not accepted almost a year previously. Outwardly the tank had the same appearance as Marks I. to IV., but the engine and transmission were much improved. The engine developed more power and the steering was effected by using epicyclic gears on the transmission to each track; this was the best tank produced during the War. Then the difficulty of crossing the wide trenches of the Hindenburg line had been considerable, and a certain number of special long tanks were ordered for this purpose. These were made from Mark V. tanks by adding a section in the centre to obtain the required length, and were known as Mark V.* tanks. Later an improved type was made with a more powerful engine known as the Mark V.** The third lesson was the necessity at times for a much more mobile tank for use beyond the main trench systems. These tanks would not need to cross wide trenches and hence they could be shorter and lighter and more mobile. One type, known as the whippet, had already been constructed experimentally. These lighter tanks became known as "medium" tanks, and the whippet was named the Medium Mark A.

German Offensive of March 1918.—The Tank Corps was now expanded to five brigades of 13 battalions with 320 Mark IV. machines and 50 Medium A. machines. During the winter of 1917–8 all units were training and being equipped with new tanks. No further offensive operations were in view and there ensued a period of preparation for the expected German attack in the spring of 1918. To assist in repelling such an attack the Tank Corps was distributed in detachments on a front of some 60 miles.

The attack was launched on March 21 and the Germans advanced rapidly. The tanks took part in many improvised attacks in attempting to stem the German advance. Some of these met with fair success and caused heavy casualties but the tanks were too few and too dispersed to make their real weight felt. It was during this retreat that the Medium A. tanks were first engaged in action and they met with considerable success, their additional mobility being of great assistance in this type of warfare. The attack fought itself to a standstill within a month, immobility being caused more by the difficulties of transport than by the resistance offered by the Allies. The supply of ammunition and food to the advanced German troops, especially where the lines of supply crossed the old battlefields, became exceedingly difficult, and it was at this stage that the necessity for some form of cross-country transport to enable an army to pursue across the devastated country left behind by the opposing force, began to be realised. The Tank Corps had already foreseen its own requirements by the provision of supply tanks and sledges drawn by tanks, and later by moving signalling equipment in special signal tanks. A small number of gun carrier tanks had also been constructed at an earlier date for the transport of the heavier guns and ammunition, though these had not been found very satisfactory mechanically. At a later date large numbers of tractors were ordered for every type of transport work, with the idea that at any rate a portion of the army could be made mobile and independent of made roads for its line of supply, but none of these were received before the date of the armistice.

In the meantime a reaction had set in as regards the estimated value of fighting tanks. The critics asserted that the battle of Cambrai could never be repeated and pointed to the lack of decisive results achieved by the tanks during the German advance. The proposed expansion of the Tank Corps was postponed and the existence of the corps seriously threatened. Fortunately the Mark V. tanks were now arriving at the rate of about 60 machines per week, and on July 4 one brigade of tanks equipped with these machines carried out a surprise attack on the Germans at Hamel in conjunction with the Australians. The attack was a complete success. The extra handiness and mobility of this machine enabled it to be used very effectively against machine-guns, many of which were crushed and rolled into the ground.

The Triumph of the Tank.—The great French victory of Soissons on July 18 1918 marked the turning point of the War; the victory was largely due to the use of French tanks employed in much the same way as the British had used their tanks at Cambrai. This was followed by the opening of the British strategic offensive on Aug. 8 with the battle of Amiens. In this attack the tank tactics were those of Cambrai modified by recent experience and adapted to the improved machines available. The attack was carried out by three army corps, a cavalry corps and 11 tank battalions; nine battalions were equipped with Mark V. tanks and the remainder with Medium A. tanks. For the first time since tanks had been used for an offensive it was possible to keep some in reserve and 42 tanks were kept in hand.

The attack was a complete success, the greatest penetration of the tanks being 7½ miles. The tanks continued in action till Aug. 11.

From that date until the Armistice tanks took part in every main attack and in no case, where tanks were properly employed in conjunction with the other arms, did the attack fail. During this period the tanks co-operated in the battles of Bapaume, Epehy, Cambrai, St. Quentin, the Selle and Mauberge. Tanks came to be looked upon as essential to the success of any attack, and in his final dispatch the commander-in-chief stated that the successful attacks which won great victories at Amiens and afterwards would have been impossible without tanks. The Germans also confessed that it was the tanks that had caused the downfall of their armies in the field. An expansion of the Tank Corps to 34 battalions had been sanctioned if the War continued into 1919, and the Ministry of Munitions in England had hoped to produce a total of 6,000 machines in 1919.

III. FRENCH AND AMERICAN TANKS

Independent Invention by the French.—The French were faced with the same difficulty as the British in the early stages of the War, and their attacks were held up by machine-guns and barbed wire although they were often well supported by artillery using high-explosive shells. It was Col. (later Gen.) J. B. E. Estienne of the artillery who first perceived the necessity for some mechanical machine which could cross the trenches and barbed wire in the face of machine-gun fire, and when this officer saw the Holt caterpillar tractors at work behind the British front for hauling guns, it occurred to him that the solution might be found in an armoured caterpillar machine. On Dec. 1 1915 Col. Estienne put forward his idea officially to the French commander-in-chief and asked for an interview. Thus the ideas which had been thought out by the British originators in 1914 were reinvented separately and independently by the French in 1915. As the result of Col. Estienne's interview, 400 tanks were asked for and the design was to be prepared jointly between Col. Estienne and M. Brille of the Schneider Works. Later a further order for another 400 machines was placed with the St. Chamond Works.

In June 1916 French Headquarters received information from British G.H.Q. as to what was being done in England. Col. Estienne visited England and saw the Mark I. tanks in training. He expressed the view that the two countries should collaborate as regards the production of tanks and that as the British had progressed with the design of a large heavy machine, the French might specialise with a light machine for more mobile warfare. Colonel Estienne was specially insistent in the view that neither country should forestall the other in the use of tanks, but that they should co-operate and launch a great offensive in which both British and French tanks might obtain full value from surprise.

French Light and Medium Tanks.—The first light tank was produced by the Renault firm in Nov. but the production of these small machines did not receive official support. The French classified their tanks or "chars d'assaut," as they were called, in three categories, and this classification was generally accepted. The light tanks were under 10 tons in weight and were to be transported over long distances in lorries. The medium tanks (St. Chamond and Schneider) weighed between 10 and 30 tons and could be transported by rail on ordinary trucks. The heavy tanks, of which the British Mark I. formed the only example at the time, were machines weighing over 30 tons and required special railway trucks for transport.

A training centre was now formed at Marly-le-Roi and later an additional centre was started at Champlieu. On Sept. 30, the artillerie d'assaut, which was the counterpart to the British Tank Corps, was formed under the command of Colonel Estienne. The French medium tanks now began to arrive. The Schneider tank was six metres in length and driven by a 60 H.P. engine. It was armed with a short 75 mm. gun and two machine-guns. The St. Chamond tank was somewhat larger and heavier, being 8 metres in length and driven by an 80 H.P. engine through a petrol-electric transmission. The armament was one 75 mm. gun and four machine-guns. Both machines differed radically from the British tank in that the track was not carried round the machine but consisted of the ordinary short type used on tractors. This resulted in the machines having very limited climbing power out of shell holes or craters. The artillerie d'assaut was organised in "groupes"; each "groupe" had four batteries of four tanks each. The light Renault tank was used as a "command" tank and one was allotted to each "groupe."

The delivery of both types of tank was very slow and instead of 800 tanks being ready for the spring offensive in 1917 only 250 had been received. The result was that only 10 "groupes" were able to take part in Gen. Nivelle's offensive. The French high command had grave doubts whether to make use of so small a number of tanks, but eventually decided to do so. The offensive was unsuccessful and although the tanks did good work in isolated cases, the result was disappointing. The employment of tanks in this manner was a repetition of the mistakes made by the British. The attack was not launched as a surprise and the tanks were dispersed and used in small detachments. The tanks showed certain faults but mainly mechanical troubles that were already known. The main fault was lack of climbing power owing to the body projecting beyond the front end of the tracks.

Success of the Renault Type.—Between this date and the end of the year 1917, the French tanks were again used on several occasions with similar results. On Oct. 23, five "groupes" took part in the battle of La Malmaison and met with much success though the battle was not launched as a surprise and was preceded by an artillery bombardment. During this period much discussion took place and designs were prepared for improved medium tanks and for heavy tanks. Finally in Dec. 1917 it was decided to concentrate on the Renault light type; this was the machine that Col. Estienne had asked for in 1916. Some of these tanks were already on order but production had been very slow. In Jan. 1918 it was decided to increase the orders to a total of 4,000 light tanks, of which 1,000 were to be ready by the end of March. The Renault tank was a small machine weighing 6½ tons. The length was four metres and in addition there was a short skid tail in rear to assist in trench crossing. It was driven by a 35 H.P. engine. There were two types, one being armed with a 37 mm. gun and the other with one machine-gun. The crew consisted only of two men, one driver and one gunner.

The French had hoped to use their tanks in mass in a great offensive in the spring or summer of 1918, but the German advance on March 21 upset all these plans. Instead the tanks were used piecemeal and in local counter-attacks to stem the German advance. In May and June tanks were used on occasions and the Renault tank made its first appearance in battle on the east of the Forest of Retz. During this time the Artillerie d'assaut was reorganising and rearming. On July 18, the battle of Soissons took place and the French tanks came into their own. It was in many ways a repetition of the battle of Cambrai but as the warfare had been of a semi-mobile nature for some months, the wide trenches of static warfare were non-existent. This suited the Renault tanks. The attack was launched as a surprise using a total of 120 medium tanks and 700 Renault tanks. The attack was a complete success and definitely established the value of the tank in the French Army. From that date until the Armistice, the French tanks—mainly Renault tanks—took part in practically every attack and contributed largely to the success of the final French offensive.

American Tanks.—The Americans were quick to grasp the great possibilities of tank action on the Western Front and this form of mechanical warfare appealed to their national characteristics. Officers were sent to study the employment of tanks and questions relating to their construction and design. As a result the Americans decided to adopt the British heavy type of tank and the French light type known as the Renault tank. In Dec. 1917 an allied commission was formed and it was decided to construct a tank known as the Allied tank; this was a heavy tank similar to the latest British type and was to be the Mark

VIII. tank for the British Army. It was designed to use the Liberty aero engine and was known in America as the Liberty tank. A factory was erected at Neuvy Pailleux which was eventually to be capable of constructing and assembling these tanks at the rate of 1,200 a month and the first 600 were to be used for equipping the first American tank units. A large constructional programme was also started in America to produce both this type and the French Renault tank. The first tanks of this type were not constructed until just after the end of the War, but several American tank units equipped with British and French tanks took part in the latter phases of the War and met with marked success. If the War had continued the American tanks would have come in with an overwhelming effect in 1919.

Anti-Tank Defence.—The Germans never made any attempt to construct tanks in large numbers, partly due to the restricted manufacturing power possessed by Germany compared with the Allies, and partly due to the comparative failure of the British tanks at Ypres in 1917. A rather clumsy type of heavy tank known as the A.Y.V. was constructed in small numbers. These and a number of captured machines were formed into units and used in small numbers in a few isolated cases during 1918, but owing to the way in which they were employed and handled they met with little success.

On the other hand the Germans made continual attempts to introduce some form of anti-tank defence, but as the British tanks met with comparatively small success in the early stages, these measures were only developed half-heartedly. The first step was the introduction of armour-piercing bullets which was countered by the use of thicker armour on the Mark IV. tank. Next the Germans turned their attention to the employment of field guns specially allocated for anti-tank defence and often dug in or concealed in the forward areas. The employment of field guns in this way seriously depleted the power of the German artillery for other purposes, but they were meeting with considerable success until the introduction of the Mark V. tank, which, with its increasing mobility was able to reduce very largely the value of this field gun defence.

In addition the Germans often employed obstacles such as pits and barricades or mines. The former required a large amount of material and labour in construction, and could usually only be made in isolated places or in defiles, and did not seriously trouble the allied tanks. The latter were a source of danger to friend and foe, and required much time and material before a continuous line of minefield could be constructed. Although tanks were blown up in isolated cases by German mines the danger was never serious. The Allies made preparations to meet enemy tank attacks with field gun fire and in some cases by the use of male tanks kept in hand for this purpose. The latter is the most certain method of secure defence against tanks but was never adopted by the Germans. In 1918 the Germans evolved a heavy anti-tank rifle which was capable of penetrating the armour plates of the tanks, but the rifle had a heavy recoil and was difficult to handle and did not prove successful as an anti-tank measure.

After the success of the Allies at the battles of Soissons and Amiens in July and Aug. 1918 the Germans were awakened to the great danger in which they stood from tank attacks. They then constructed a heavy machine-gun firing a 13 mm. bullet and capable of penetrating 30 mm. of armour. The gun was known as the Tuf, and great efforts were made to construct it rapidly and secretly, but none were ready till after the Armistice. The Allies knew of the construction of these guns and realised the value which they would possess for frontal defence. They hoped however that the increased mobility of at any rate a proportion of the tanks in 1919 would enable them to penetrate and attack the enemy in the rear or along his communication and thus discount to a large degree the increased defensive power of the Germans against a frontal attack by tanks.

IV. PROGRESS SINCE THE WORLD WAR

Since the War progress has followed similar lines. Some nations have adopted a special anti-tank gun and others a heavy machine-gun but the most secure method is still the employment of some form of gun on a vehicle which can travel cross-country, and this in effect becomes a tank, though it may be a tank specially designed as a tank destroyer.

Experimental Patterns.—With the exception of the Germans, who are prohibited by the Peace Treaty from doing so, all great nations now employ tanks as part of their military force. The French have retained the Renault tank as the main armament of their tank corps and although they have carried out much experimental work with heavier tanks, no models have been considered sufficiently advanced to standardise and construct in any large numbers. The Americans have also constructed many experimental patterns but have retained the Mark VIII. or Allied tank as the heavy tank with which their tank units are equipped and the Renault as the light tank.

The British, as the originators of the tank, have made great efforts to maintain their lead. Some months before the conclusion of the World War, when preparations were being considered for a great offensive in 1919, the specification was drawn up for a tank which was to be a great advance on the existing patterns. It was to have a speed of 20 m.p.h. and be capable of floating and propelling itself across water. Enough petrol was to be carried to travel 200 m. cross country and the tank was to be long enough to cross a trench 12 ft. wide. This tank was to be used for attacking the enemy communications and headquarters while the more conventional tanks were attacking the main armies in front. The first experimental model was actually completed just after the Armistice. The tank used a system of spring suspension on a cable and hydraulic power for control. Although the machine attained a speed of 28 m.p.h. and swam successfully across a narrow river on several occasions, it proved to be unreliable owing to the many new devices which it contained and which required further development. The next step that was tried was to produce a machine with an improved form of steering. Up till then tanks had been steered by locking one track and skidding round to the desired direction. This method of steering absorbs a large amount of power and brings large and unnecessary strains on the track and transmission. The device now tried was to produce a track with lateral flexibility so that it could be laid in a curve and enable a tank to take ordinary curves in the same way as any other vehicle. The problem however was found to present many mechanical difficulties and, although much work has been done, no satisfactory solution has yet been found as far as tank construction is concerned.

The Vickers Light Tank.—In the meantime the British Tank Corps which was reduced to four battalions after the War, was armed with the Mark V. tank and the Medium C. The Medium B. replaced the Medium A. at the end of the War, but very few of this model were made and the units were equipped with an improved type in the Medium C. This machine had a maximum speed of 12 m.p.h. and a radius of action of 70 m. and would have been a very useful tank in France. But by 1920–1 these machines were becoming worn out, and, although much knowledge had been gained, the experimental machines aiming at far higher achievements, and which have already been referred to, were not yet in a satisfactory state for production. A tank was therefore designed which was constructed on conventional lines and aimed at obtaining a high degree of mobility, if necessary at the expense of trench spanning capacity. The machine was known as the Vickers light tank. It is 18 ft. in length and weighs 10 tons and is armed with one 3 pdr. gun and two machine-guns. It can attain a speed of 20 m.p.h. and travel 150 m. on the petrol that it carries. Owing to its short length the tank has poor obstacle-crossing capacity, but in other respects it has proved very satisfactory.

The Future of the Tank.—Since the War there has been much discussion on the subject of mechanical warfare, initiated mainly by books and essays written by Col. J. F. C. Fuller[1] who acted as General Staff Officer to the Tank Corps in France. The great

[1] These include *Tanks in the Great War*, *The Reformation of War* and the Gold Medal prize essay for 1919 in the *Jour. of the R.U.S.I.*, May 1920.

saving in man power that can be effected by using mechanical power instead of men and horses for transport purposes is now fully realised. Reference has already been made to the necessity of using tractors to render an army capable of cross country movement independently of roads and much has already been done in mechanicalising the transport of artillery in the British service. A detailed consideration of this subject is, however, beyond the scope of an article on tanks. More recently attempts have been made to produce a force composed of infantry, tanks and artillery, the whole force being capable of moving 100 m. in 24 hours by means of mechanical power. Such a force would have a value in war far beyond its numerical strength in men. Preliminary trials of this nature have already been carried out on manoeuvres in England but the whole subject is at present in its infancy.

More recently experiments have been carried out in England with very small tanks with a crew of either one or two men only. The one man tank[1] is constructed from the type of engine and transmission in normal commercial use and the tank is therefore both cheap and easy to obtain in large numbers for war. The control is so arranged that one man can fire the machine-gun at the same time that he is driving the tank. Tactically the object of employing such small tanks is twofold. In the first place they are required for scouting and reconnaissance duties. A commander who uses ordinary tanks for such purposes risks losing his tanks on minor enterprises before the main battle takes place; on the other hand infantry are slow in performing these duties and cavalry are often too vulnerable. The small cheap tank possesses none of these disadvantages. The second object is to obtain increased safety against anti-tank fire by the use of dispersion. As many as 20 of these small machines can be provided for the cost of one large tank, and by the use of large numbers it should be possible to advance in the face of anti-tank fire where a small number of large machines would fall an easy prey. These small tanks are capable of traversing any ordinary country at an average speed of 10 m.p.h. and can cross a trench about 4 ft. 6 in. wide. If warfare continues to be a serious possibility between great nations in the future, the development of great tank armies is certain. Heavily armoured tanks carrying large calibre guns will be the main arm in the battle, and these will be assisted by larger numbers of small tanks for reconnaissance and protective purposes. In addition there will be the administrative tanks or tractors for communications, engineer work and supply purposes.

See D. G. Browne, *The Tank in Action* (1920); E. G. Beck, *Tank Construction, etc.* (1921). (G. le Q. M.)

TANNENBERG, BATTLE OF.—No portion of the earth's surface has been more fought over than East Prussia. It was in 1410, on the field of Tannenberg, that the Teutonic knights were utterly routed by their enemies the Poles and Lithuanians, and German victory of 500 years later was in some degree the reversal of this defeat.

I. THE GENERAL SITUATION IN AUGUST 1914

The Tannenberg of 1914 was the greatest victory achieved by any of the combatants at the commencement of the World War, and its strategic and moral effect upon the succeeding years of the struggle were far-reaching. France and Russia had been joined by military convention since 1892 and their Chiefs of Staff had made careful arrangements for concerted action. In case of war with Central Powers it had been agreed that Germany was the main enemy and that the principal military effort must be made against her. She was to be attacked in East and West as nearly simultaneously as possible, so that she might not be in a position to reap the advantage of her central situation. Her preparedness and offensive military spirit made it tolerably certain that she would attack France first, leaving her ally Austria to hold Russia in check, until troops from the West could be made ready to crush Russia in her turn also.

[1] The inventor of this new machine which, if its promise matures, may be epoch making, is Major Martel.—(Ed. *E.B.*)

Owing to the vastness of her territory and to the comparatively undeveloped state of her railways, Russia's rate of concentration was considerably slower than that of France, so much so that there was a danger of the latter being crushed before the attack on Germany in the East could commence to exert its effect. Unfortunately, under the pressure of French insistence, the good will and optimism of Russia's military leaders exceeded practical possibilities and the outbreak of war found her military plans in some disorder. Austria was regarded by the mass of the Russian people as the main enemy, for it was she who had attempted to dragoon the Southern Slavs, and the Russian General Staff found themselves unable to alter their main advance to one against Germany. All their initial operations in East Prussia were in fact hasty improvisations.

Geographically, East Prussia points forward into the heart of Slavdom and constituted a difficult problem of defence for Germany. True to her policy of concentration of force at the decisive point, she had decided to advance against France with her main forces whilst maintaining only a minimum of strength in the East. Not wishing to abandon national territory without a blow, she had decided to concentrate this minimum strength in East Prussia, despite the dangers involved in such action. Germany's strength in the East was to consist of 11 divisions, six first-line and five second-line, with but a single cavalry division.

Taking the East Prussian front as it appeared to the Russians, we can divide it militarily as follows:—

(*a*) *Königsberg Area.*—A more or less fortified area extending over the Königsberg peninsula, of a depth of 19 m. from north to south. In the centre lay the obsolete fortress, strong against anything but heavy artillery. The area could be reinforced by sea through the canal from Pillau. It formed a strong flanking position from which to attack any force attempting to pass it to the south.

(*b*) *Insterburg Gap.*—A gap of 43 m. of open country, down which ran the main Insterburg-Allenstein railway. The River Angerapp running north and south blocks this gap. It formed an excellent line of defence with the right flank resting against the impassable Lake Mauer.

(*c*) *Masurian Lakes.*—A line of continuous lakes from Angerburg to the Russian frontier at Johannisburg, a distance of 50 miles. The narrow gaps between the lakes could be held with few troops, and the whole line presented an almost impregnable front behind which the Germans could operate to either flank.

(*d*) *Johannisburg–Dziatdowo (Soldau) Front.*—A distance of 75 m. running east and west. On the Russian side the country had been left a desert as a defence against Germany

II. THE RUSSIAN PLAN OF INVASION

The Russian plan for the invasion of East Prussia was to advance with two armies north and south of the line of lakes, with the object of enveloping the German forces supposedly concentrating behind this line. The northern army under Rennenkampf was to advance first, towards the Insterburg gap, with the object of drawing the Germans as far to the east as possible. The southern army under Samsonov was to advance to the line Rastenburg-Allenstein, with the object of striking the rear of the Germans opposing Rennenkampf.

Rennenkampf's army crossed the frontier on Aug. 17 with a strength of $6\frac{1}{2}$ divisions and $5\frac{1}{2}$ cavalry divisions. On the 20th an action was fought with the German VIII. Army at Gumbinnen. Von Prittwitz, the German commander in the East, had concentrated his main strength to meet Rennenkampf, six divisions and a cavalry division, whilst leaving some two divisions to face Samsonov's army, which was concentrating on the River Narew but was not considered to be ready to advance.

Rennenkampf had moved off without a great portion of his transport and found himself forced to halt on the 20th. Prittwitz advanced to attack him. There were serious miscalculations in the German movements, with the result that the action was indecisive, both sides suffering heavy losses. That evening the news arrived that Samsonov had not only started to advance, but that two of his corps were already close to the frontier and that he had at least five corps with him. The German commander abandoned all hope of defeating Rennenkampf on the 21st and ordered a withdrawal to the Vistula. He and his Chief of Staff were at once superseded.

Hindenburg Takes Command.—The new commander, Hindenburg, had not yet been employed in the War. His Chief of Staff, Ludendorff, reached Supreme Headquarters at Coblenz on the 22nd and the situation in the East was explained to him. He immediately ordered the troops retreating in front of Rennenkampf to halt at once and to prevent him from pursuing, and issued instructions for a concentration against Samsonov. General Hindenburg joined Ludendorff's train at Hanover and took over the command in this area at Marienburg on the afternoon of the 23rd.

Luckily for the new command, Hoffmann, the chief of the operations section under Prittwitz, had already carried out many steps facilitating the concentration desired by Ludendorff, and the situation, though alarming, had not grown worse since the supersession of Prittwitz. Samsonov's right was indeed well over the frontier near Ortelsburg and his left between Neidenburg and Działdowo (Soldau) but the Russian advance appeared to be slowing up. The German XX. Corps had taken up a position north of Neidenburg and was awaiting attack. The leading units of the I. Corps were detraining south of Deutsch Eylau and were moving up on the right of the XX. Corps. The 3rd Res. division had detrained at Allenstein and was moving up on the left of the XX. Corps. A Landwehr division and units from the Vistula garrison troops were also coming up. Thus, a strength of about six or seven divisions had been collected to oppose 10 divisions and three Cavalry divisions of Samsonov's army.

No decisive results could be expected from such strength, and decisive operations were the Germans' only hope. The most important feature of the situation, however, was that Rennenkampf had made no forward move since Gumbinnen and had lost all touch with the enemy in front of him. Ludendorff therefore conceived the idea of withdrawing all the troops from Rennenkampf's front, with the exception of the cavalry division, and of directing them against the right flank of Samsonov's army. Another four divisions thus obtained would give him an actual superiority over Samsonov and the direction of their attack might indeed be decisive.

III. AN ACCOUNT OF THE BATTLE

Samsonov, who in peace time was the Governor-General of Turkistan, had arrived from sick-leave in the Caucasus on Aug. 12. He had seen neither his subordinate generals nor his staff before, and his immediate superior Jilinsky, the commander of the northwestern front, was urging him forward to cross the frontier on the 19th. The original concentration areas of his army behind the Bobr and the Narew had been considered to be too far to the east and a general move of all corps to the west was in progress. By the 20th, the right wing (VI. and XIII. Corps) had reached the frontier, with the 4th Cav. Div. well behind on the right. The left wing (XV. and I. Corps) was just short of the frontier, with the 6th and 15th Cav. Divs. covering it. Of the XXIII. Corps, one division was two days' march behind the left wing and the other had not yet detrained at Warsaw. The troops had been marching for a week across the desert area north of Ostrołeka, over execrable roads in very hot weather. Much of the transport had been left behind, the men were tired and unfed and numbers had been much reduced by sickness. No contact had been gained with the enemy and the army was already more than 24 hours late in crossing the frontier. Reports from Rennenkampf of his victory at Gumbinnen and, during his advance westwards on the 24th and 25th, of the signs of a hurried retreat on the part of the Germans, brought further urgings from Jilinsky to Samsonov to hurry. Samsonov obeyed to the best of his ability, and by the morning of the 26th his position was as follows:—

His centre of two corps (XIII. and XV.) was advancing northwest and was close on the line Allenstein-Hohenstein. On his right was one corps (VI.) and the 4th Cav. Div. at Rothfliess, at two days' march from the centre. On his left was a corps (I.) and the 6th and 15th Cav. Divs. near Koschlau, at one day's march from his centre. The XXIII. Corps troops which were up were moving into the gap between the centre and the left. His forces were thus much dispersed.

Reconnaissance had been bad and he had little information as to the enemy's dispositions. He seems to have thought that the Germans flying in front of Rennenkampf had already crossed his front in their march to the Vistula and that he was too late to cut them off. He had deviated from his instructions to advance with his left on Allenstein and now had practically the whole of his force to the west of that town. He had no knowledge of the whereabouts of Rennenkampf's army and did not realise that he was increasing the space between the two Russian armies and thereby facilitating the German operations. His supply system had broken down utterly and his men were half-famished and worn out with the fatigue of excessive marching. The signal service had also broken down and orders had been sent out to corps by wireless. The Russian signals were easily read by the Germans, who thus had absolutely accurate information as to their opponent's dispositions and intentions.

Germans Attack Samsonov.—The new German Command had galvanised the dispirited VIII. Army from the first and hope of success ran high. The attacks on Samsonov's two flanks were to be launched simultaneously on the 26th. On the right, the German I. Corps, strengthened by the Vistula garrisons, attacked only half-heartedly. Von François, the commander of the I. Corps, was short of some of his heavy artillery and he contented himself with driving in some of the Russian outposts. On the 27th, however, he launched his attack in earnest. At dawn a hurricane bombardment was opened on the Russian I. Corps' positions on either side of Uzdowo. The famished Russians did not wait for the infantry attack but broke and ran. By 10 P.M. that night there was nothing left of the Russian left wing except a small rear-guard just north of Działdowo; and that too had disappeared before the next morning.

The rear of the Russian centre was now completely exposed and François directed his march on Neidenburg. Opposition there was none, and by the night of the 28th his leading troops had reached Muschaken, eight miles east of Neidenburg. By the night of the 29th the whole length of the road from Neidenburg to Willenberg was held by a line of entrenched pickets. The Russian retreat to the south was completely blocked. During the 30th François was attacked at Neidenburg by fresh Russian troops coming up from Mława and actually lost the town for a time. He held stoutly on to the line of his pickets, however, and on the 31st Neidenburg was reoccupied.

On the left, the German XVII. and I. Res. Corps, having turned their backs on Rennenkampf and marched due south, had arrived within striking distance of the Russian right at Rothfliess on the night of the 25th. Their attack on the morning of the 26th came as a complete surprise. The Russian VI. Corps withdrew in confusion, losing 6,000 men and 16 guns. By the night of the 27th the Russian right was 32 m. to the south of Rothfliess and in a state of hopeless demoralisation. The rear of the Russian centre was now exposed on its other flank. The German XVII. Corps continued its march to the south, whilst the I. Res. Corps moved in closer towards Allenstein. The story of the fighting in the Russian centre is not so inglorious as that on the two flanks. In accordance with Samsonov's plan the centre (XIII. and XV. Corps) continued their advance on the 26th towards the line Allenstein-Hohenstein. The XIII. Corps encountered no opposition, but the XV. had to fight its way steadily forward. For the 27th, the advance was to be continued.

Second German Blow.—Ludendorff, with his accurate information of the events on either flank, now decided that the German centre had retired enough. The reinforced XX. Corps was therefore ordered to attack on the 27th. The battle which ensued between the Russian XV. Corps and the German XX. Corps was particularly fierce, the Russians holding their own and even advancing a little on their left. The Russian XIII. Corps rendered no help to its neighbour. On the 28th the Germans renewed their attacks and this time the hardly-tried Russian XV. Corps commenced to break. The XIII. Corps, moving down to assist, found itself assailed in rear by troops arriving from Allenstein and for the second time brought no help.

When night fell the two Russian Corps were on a line from Grieslienen to Waplitz and in close touch with the Germans. Hoping to escape from pursuit, they commenced to withdraw during the night. The withdrawal soon became a rout, and a mass of troops and transport, both unfed and unwatered, became inextricably mixed in the depths of the Forest of Grünfliess. Determined attempts were made during the 29th to break through to the south of Muschaken and to the north at Kaltenborn, but the German ring held fast. Only some 2,000 men effected their escape. The greater portion of these two corps surrendered to the German parties, clearing the forest during the 30th and 31st.

The End of Samsonov.—Samsonov himself had moved up to Neidenburg on the 27th in order better to control the battle. He was greeted with the news of the disaster to both his flanks and met streams of stragglers coming into the town. He decided to go to the headquarters of the XV. Corps and take personal charge, and left Neidenburg on the morning of the 28th with a small staff, all mounted on horses. At once he became mixed in the mass of transport in the forest and could exercise no effective command. He then decided to ride to the south, but during the night of the 28-29th he became exhausted after having walked for some distance. He drew aside in the darkness and his staff heard a single shot. A careful search brought no result and the staff continued their way, certain that their unfortunate commander had taken his own life in his despair at the turn which events had taken.

Results of the Battle.—The practical result of the fighting from Aug. 26-30 was the total annihilation of two Russian corps and the reduction of three other corps to half their strength in numbers. The whole Russian II. Army was so demoralised and was so deficient in essential material, such as artillery and transport, that it was no longer of any fighting value. The Germans claimed 125,000 prisoners and 500 guns. It is certain that their booty was very great, for 60 train loads of captured material left Puchallowen after the battle and the captured horses were driven in herds to improvised camps at Neidenburg. Although greatly inferior in the whole Eastern theatre, the Germans had yet managed to concentrate a superiority on the field of battle. The Russians had 132 battalions, 96 squadrons and 620 guns, including 12 heavy, whilst the Germans had 155 battalions, 48 squadrons and 818 guns, including 128 heavy.

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TAOISM (*see* 26.402).—The term Taoism has two meanings: (1) the philosophical system attributed to Lao Tze (b.604 B.C.) and Chuang Tza (b.330 B.C.); (2) the popular religion of the Chinese.

Taoism as a Philosophical System.—The term Tao originally meant the revolution or the way of the heavens about the earth. This movement of the heavens was regarded as the cause of the phenomena on earth. The Tao was located about the celestial pole which was considered to be the seat of power because all revolves about it. In the course of time this concrete expression became abstract, and the Tao was viewed as the universal cosmic energy behind the visible order of nature. This cosmic energy (*see* CONFUCIANISM) regarded as *being* is impersonal, omnipresent and eternal; viewed as *becoming* it works spontaneously, orderly, unselfishly and continuously for the highest good of all beings.

The Tao produced the *yin* and the *yang*, the negative and the positive principles of nature. These by their interaction brought forth heaven and earth. Heaven and earth gave birth to all beings. The human order is the product of the eternal energy.

Philosophic Aspect.—Taoism has usually been regarded as a mystic religion, but it was also an economic and political philosophy. It advocated frugality, simplicity and the joys of the peasant life in contact with the soil. It opposed the educational programme of the Confucianists, and advocated the theory that the people should be kept in innocence (not in ignorance). The Taoist philosophy is responsible for that remarkable trait of the Chinese, namely, their contentment in situations which offer a minimum of comfort, and their prizing of culture above possession.

Political Aspect.—In politics Taoism opposed a highly centralised government and favoured the maximum autonomy for the people. Lao Tze and his successors promoted the small village state which enjoyed full autonomy and lived in harmony with its neighbours. All forms of bondage and legal restraints were opposed. Non-resistance was exalted and militarism was condemned.

The ethics of Confucianism met with the strongest opposition on the part of the Taoists. Such virtues as love, justice, reverence, wisdom and sincerity were regarded as the first steps departing from the harmony of the simple life in the Tao, and producing the distracting contraries which marred the purity of life.

The Taoists were mystics, but they were practical mystics, who hoped to realise the best social order through a harmonious relationship with the Tao. Their ideal was "this worldly." Their mysticism had three stages: (1) the purgation, casting out selfishness and self-seeking; (2) union with the Tao, by which the individual lost his individuality with the distraction of the contraries; (3) power, which enabled the individual merged with the Tao to escape the limitations of time and space.

Taoism as a Religion.—Taoism as a religion is inherent in Taoism as a philosophy. The early mystics practised breathing and abstaining from food, and sought longevity and a future life in the Taoist paradise. The religious aspect did not become prominent, however, until the Han dynasty (206 B.C.–221 A.D.), when the Taoists occupied themselves in compounding the elixir of life and in making journeys to the Isles of the Immortals. They also developed several sects which practised exorcism and fortune-telling and exercised considerable political power.

The rise of Taoism as a church is attributed to Chang Tao-ling (b.34 A.D.), who developed a high degree of magic power which he transmitted to his heirs, together with the political prestige which reputation for such power brought. These took part in a successful rebellion in the latter part of the 2nd century, and established a state in Szechwan based on Taoist principles. The descendants of Chang Tao-ling were recognised by the Government and in 1016 were given a fief at Lung Hu Shan in Kiangsi,

Their function consisted of a general oversight of the Taoist priests and monks and the rule over the world of the gods. The system developed a hierarchy among the gods which corresponded to that of the Govt. of China. At the head was Yü Huang Shangti, the Pearly Emperor, who presided over an elaborate pantheon.

Buddhist Influence.—Through contact with Buddhism in the first six centuries of our era the Taoists appropriated the Buddhist world view, adopted the monastic system and imitated the Buddhist pantheon. Lao Tze was deified and was associated with Pan Ku and Yü Huang Shangti in the Taoist Trinity patterned after the Three Jewels of Buddhism. Present day Taoism is a conglomeration of animism, polytheism and magic.

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(L. Hs.)

TARDIEU, ANDRÉ PIERRE GABRIEL AMÉDÉE (1876–), French politician and writer, was born in Paris Sept. 22 1876. Educated at the Ecole Normale Supérieure, he became *chef de cabinet* of Waldeck-Rousseau in 1899 and retained the post until 1902; between that year and 1914 he taught at the Ecole des Sciences Politiques and the Ecole Supérieure de la Guerre, and also acted as foreign news editor on *Le Temps*. From 1914–24, as deputy of the Chamber, he fulfilled the functions of French special commissioner in the United States (1917–8), of French plenipotentiary at the Peace Conference (1918–9), and Minister of the Liberated Regions (1919–20). As captain of Chasseurs between 1914 and 1916, he was wounded and three times mentioned in despatches. At the Peace Conference (1919) he was largely concerned with the proposals for the political and territorial clauses. He presided over the Committee of Five entrusted with the work of drafting the Allied Reply to the German Observations on the draft terms of the Peace Treaty. Tardieu also presided over the Alsace-Lorraine Committee, the Committee of the Saar and that of the execution of the Treaty.

Tardieu's political attitude was characterised by his inflexible attachment to the policy of Clemenceau, with whom he was associated in the closest collaboration for war and for peace. Three times in succession, between 1919 and 1924, he refused to enter the Government, in order to maintain his independent defence of this policy. As director of the *Echo National*, the daily paper founded by Clemenceau and himself, he waged a fierce war, in foreign affairs, against the successive revisions of the Treaty of Versailles; and in internal affairs, against the acts which paved the way for the victory of the *cartel des gauches*.

Tardieu was the author of the following historical works: *Questions Diplomatiques* (1905); *France and the Alliances* (1908); *La conférence d'Algésiras* (1909); *Le Prince de Bulow* (1909); *Fürst v. Bulow* (1910); *La France et les alliances* (1910); *Le mystère d'Agadir* (1912); *Notes sur les Etats-Unis* (1917); *L'Amérique en armes* (1919); *La Paix* (1921); *Le Slesvig et la Paix* (1925).

TARDIVEAU, RENÉ: *see* BOYLESVE, RENÉ.

TARIFFS (*see* 26.422).—The history of commercial tariffs during the first quarter of the 20th century divides itself into three periods: the years prior to the World War, those covered by the conflict itself, and the years of readjustment that followed.

I. THE PRE-WAR AND WAR PERIODS

The early years of the 20th century had found France, Germany and the United States definitely committed to protection, while in England the free-trade policy, though still dominant, was beginning to be seriously criticised. In the first three countries, the tariff schedules were already distinctly protectionist in character, the United States leading the way among these three in the application of high tariff rates for the encouragement of domestic manufactures, and France and Germany, in addition to industrial protection, endeavouring to assist home agricultural production. The institution of imperial preference by Canada (1897) soon to be followed by similar measures on the part of other self-governing colonies and by Chamberlain's advocacy of reciprocity by England, unloosed a potent force toward protectionism. Not since the repeal of the Corn Laws had conditions appeared so favourable for a change in the free-trade policy of England.

The German Tariff.—Among the four countries above mentioned, the first after 1900 to effect a general amendment of its tariff was Germany. The agrarian interests, especially the large-scale producers of cereals, felt that their advantage had been sacrificed to that of the manufacturers and merchants in the commercial treaties negotiated by Count Caprivi in 1891–4.

The new tariff of 1902 provided for equal protection of manufactures and agricultural commodities, but on the whole support to the latter was the more conspicuous feature. Especially significant in this regard were the minimum tariff rates for certain agricultural products (*i.e.*, rates below which the Government might not make reductions in its negotiation of treaties), and the fact that the products thus particularly protected were rye, wheat, spelt, malting, barley and oats—the articles in which the large-scale producers were peculiarly interested. Industrial protection was enhanced in the law, however, and a much greater differentiation of rates was introduced. Objections had been raised to the whole system of "general" and "conventional" tariffs on the ground that concessions in the latter often affected a wide variety of articles, since the individual items in the tariffs often covered broad classes of goods. As many as 1,446 items were separately enumerated in this Act, whereas the older law had specified only 387 items. It was thus possible to limit the scope of concessions.

The French Tariff.—The increased height and the greater specialisation of the German tariff formed one basis for agitation in France in favour of a modification of the tariff law of that country. Further, it was held that for bargaining purposes the spread between the French minimum and the general or maximum tariff schedules—25 to 40% *ad valorem* in typical cases—should be increased. Finally, the French tariff had remained substantially unchanged since 1892, and in the interim new industries and new branches of old industries had arisen for which protection was believed advantageous.

In 1910 a new Act was passed which increased appreciably the protectionist character of the French tariff law. The rates of the maximum tariff were generally raised, new items were added to the law and numerous old minimum rates were increased or differentiated in a greater degree than before. Higher duties on special types of steel, on iron and steel products, especially tools and certain machinery, and on boots and shoes were typical and important alterations in the new Act. In marked contrast to the earlier German Act, the Act of 1910 was chiefly a vehicle for expanded protection to French manufacturers.

The United States Tariff.—The United States tariff of 1909, amending that established in 1897, failed appreciably to change the situation. It made certain reductions in duties, such as the rates on hides, wool tops and various iron and steel products; but, except in the case of hides, the reductions were in most cases more nominal than real. The lower rates were substantially as protective as the higher ones had been. Furthermore, the Act included various increases in duties, *e.g.*, on silk fabrics, certain forms of cutlery, hosiery and the like. The net result was to leave the general height of the tariff at much the same level as had previously ruled. The revision of 1909 in the end proved a political blunder as far as the Republican party in power was concerned. In the next presidential election (1912), the Democrats gained control of both the executive and legislative branches of the Government for the first time since 1892–4. Immediately the Democratic leaders began the revision of the tariff law. Most raw materials, including the most-favoured raw wool, were placed upon the free list; the complicated specific and compound schedules that had grown up in the Republican tariffs were largely scrapped; and the effective protection upon semi-manufactured and wholly manufactured articles was markedly de-

creased. The new Act had not been in operation a year when the World War broke out, and under the stress of that conflict the course of production and trade began to change rapidly and decisively. Not only was there no adequate test of the lower rates, but the conditions ultimately reached were so dissimilar to pre-War conditions that hopes of permanently lower tariff rates built upon the latter were rendered illusory.

The War Period

With the outbreak of the World War came a break in the tariff experience of most important countries, especially those belligerent. Not only was the whole structure of conventional arrangements destroyed, but in the tariff legislation of the War years exigency replaced rational policy as the guiding motive. In part such legislation was dictated by desire for increased revenue. Examples are the increase in the Canadian tariff in 1915, the Australian advance in 1917 and the additions to pre-existing rates in England, France and Germany. Many alterations, however, in tariff arrangements, especially in Europe, were made for the control of commerce in the interest of the most effective prosecution of the War. In Germany, rates were lowered or abolished to facilitate the import of essential commodities. In France the executive was authorised (1916) to increase import duties upon any or all goods, and even to prohibit wholly the importation of articles in the interests of the country. Similarly, Great Britain in 1915 enacted the so-called McKenna duties: imposts of 33⅓% upon a number of luxury articles —pleasure cars, motor-cycles, watches and clocks, musical instruments and cinematograph films. These duties were partly devised for fiscal purposes, but in part also for economy in tonnage.

Ultimately, as the War dragged on and the strain upon national resources increased, import duties were found to be inadequate for the commercial control desired, and nations resorted to direct governmental supervision of the export and import of essential materials and foodstuffs. Licensing systems, supplementing governmental control of shipping and governmental bulk purchases, were adopted. The consumption of luxuries was thereby curtailed, cargo space in national and neutral ships conserved and the upward movement in the price of essential commodities somewhat restrained. Thus the declaration of peace found commerce trammelled by a multitude of restrictions and regulations.

II. THE PERIOD OF RECONSTRUCTION

The direct and indirect effects of the World War, including those flowing from the War-time tariffs and War-sprung "controls," were of such magnitude that at the conclusion of peace a commercial and industrial situation largely novel confronted the nations of the world. The pre-War balance between industry and agriculture within nations had frequently been upset; old industries had been stimulated to expand and new industries had been born during the War's upheaval; while the prolonged rupture of pre-War commercial connections and the disturbed conditions of currency and exchange made it extremely difficult to gauge the strength of post-War basic forces.

Moreover, the War revealed many weaknesses in the organisation of industrial nations. England and Germany were hard pressed for food; most belligerents were forced to seek substitutes for essential raw materials; and at times even the lack of certain manufactured articles was annoying or really embarrassing. The last was especially true in cases where whole industries were throttled by scarcity of quantitatively minor elements: needles for knitting machines, dyestuffs for the textile manufacturers, gauges or chemical glassware for many sorts of work. National acquisition of such "key" industries seemed desirable.

Finally, the peace treaties brought into being a group of new nations, largely constituted out of portions of pre-existing nations. Upon separation, both the older nations and the newer areas—*e. g.*, Austria-Hungary, Czechoslovakia and Yugoslavia—found themselves with unbalanced economic interests. The old markets for their surplus products were now on foreign soil. Furthermore, since many of the new nations were fired with an intense nationalistic sentiment, they were inclined to adopt measures to secure increased self-sufficiency. Similar ideas dominated the economic policy of countries whose power had increased, such as Australia, Italy and Turkey, or of countries which had gained more self-government, such as Ireland and India.

Removal of Control.—The first difficulty in the way of reconstruction—the licensing systems and other arbitrary methods of commercial control—was the easiest to surmount, although various restrictions were maintained for several years. In England the change was rapid. The spring of 1919 found War-time restrictions still hampering British trade in 260 classes of goods, but Sept. of that same year saw the last of these restrictions wiped away. France moved in the same direction in the summer of 1919, but for a period in 1920 felt it necessary to reimpose control with respect to 175 articles. Germany and other countries, on the other hand, made progress more slowly, and the first seven years after the Armistice were marked by the frequent reintroduction of restrictions in various commodities. By 1926 interference with international trade by governmental systems of specific-commodity control had been largely eliminated.

The re-establishment of a new network of commercial treaties (*q. v.*), especially with a general use of the unconditional M.F.N. clause, proved a more arduous undertaking. For a time after the peace it seemed possible that no re-establishment along these lines would be effected. To the pre-War scepticism as to the general advantage of such engagements were added the uncertainties of economic conditions in the post-War period, some remnant of conviction among the Allied nations that the Central Powers should be treated for an indefinite time in a hostile manner, and the constraint placed upon independent action by Germany by the provisions of the Versailles Treaty. Yet, despite these handicaps, the project of renewing relations upon somewhat the same grounds as erstwhile had prevailed was initiated and slowly gained ground, first between Allied states, then between "enemy" states, between an Allied or "enemy" state and a neutral, or among the new nations created by the treaties of peace.

While the process of "de-control," and the re-establishment of conventional tariffs and treatment upon the basis of the M.F.N. clause, modified interference in international commerce, the characteristic feature of the reconstruction period remained the trend toward increased protectionism. The movement was broader and seemed more profound than anything which preceding decades knew.

Great Britain.—Colonial preference appeared for the first time in the British tariff system when in 1919 a reduction of a sixth was granted on dutiable goods (one-third off the McKenna rates above mentioned) which were the product or manufacture of British colonies; and in 1925 the preference on certain commodities, especially sugar, tobacco and dried fruits, was increased. In 1922 the Safeguarding of Industries Act was passed, levying duties of 33⅓% upon a number of "key" articles such as optical glass, scientific instruments, hosiery latch-needles, metallic tungsten and synthetic chemicals. Attempt at further advance along such lines was temporarily blocked when in 1923 the Conservatives appealed to the country and lost. However, after a short interval of Labour Government, during which repeal of the McKenna duties and a reduction of colonial preference were carried through, the Conservatives were again brought into power. The McKenna duties were re-established, additional Empire preferences approved and arrangements provided whereby the needs of individual industries (except the production of foodstuffs) could be given separate consideration with a view to tariff protection. (*See* Safeguarding of Industry.)

The United States.—Little was heard of tariff change in the United States for a year or two after the War. Then the conjunction of the severe crisis of 1920 with the return of the Republican party to control led to a renewal of tariff legislation. The crisis bore with somewhat exceptional severity upon the agricultural areas of the West, and for the first time in American tariff experience there appeared a broad group of agricultural interests asking for protection. At the same time industrial interests asked for a revision of the tariff, emphasising the increased competition of Germany and Japan, the need of protection for the industries initiated or expanded by the abnormal War-time conditions of commerce and manufacture, and the necessity of special defence against countries with depreciated paper-money currencies. First the farmers were partially satisfied by an "Emergency" tariff law (1921), which carried enhanced duties for a half-dozen important agricultural commodity classes. Then in the Tariff Act of 1922 protection was carried out more broadly than ever before—not unaffected by the circumstance of legislative "log-rolling." Agriculture secured duties higher than had ever been enacted; the "war babies," such as toys, tungsten and dyestuffs, secured specially high rates; and

manufacturing industries generally obtained something approaching the level of duties carried in the Payne-Aldrich Act of 1909, though with some exceptions. A few of these exceptions, *e.g.*, cotton yarns and certain steel products, were reductions from the 1909 rates, although usually these reductions were more nominal than real; while the increases included some duties, such as those on cutlery and laces. The rate upon laces, 90%, was the highest simple *ad valorem* rate ever enacted for purely protective purposes.

France.—France established in 1919 a system of "co-efficients," multiples by which the pre-War specific duties should be multiplied. In this way depreciation of the paper franc could be kept from weakening the protective wall. Then, two years later, a new maximum tariff was introduced, increasing the spread between minimum and maximum schedules. Whereas the difference had previously not been in excess of 100%, it became in some cases as much as 300%. Other countries followed the lead of France in the adoption of the co-efficient system: Belgium, Italy, Czechoslovakia, Poland and Turkey. *Germany* delayed the enactment of any general tariff law until 1925, when an Act was passed which placed the general level of the German tariff above that of the pre-War tariffs. Certain manufactures received increased support in the new duties, but especially notable was the restoration of the system of protective duties upon agricultural commodities approximately to the pre-War standard.

Industrial protection spread in less developed nations. Indeed, in one way or another, such protection coloured the post-War tariff enactments of Ireland, India, South Africa, New Zealand, Australia, Hungary, Lithuania, Czechoslovakia, Yugoslavia and Poland. In fact, scarcely a country of the world escaped the influence of the prevailing spirit.

The course of tariff history in the early years of post-War reconstruction manifested a trend in some respects more pronouncedly toward high and widespread protection than had been exhibited before the War. With the extension of the movement to the newer countries, and with the possibility of the downfall of free trade in its oldest home, the policy of Hamilton, List, Carey and Wagner seemed to carry everything before it.

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(A. H. C.)

TARKINGTON, NEWTON BOOTH (1869–), American author, was born in Indianapolis, Ind., July 29 1869. After studying at Phillips Academy, Exeter, Mass., he entered Purdue University, Lafayette, Ind., but later transferred to Princeton where he graduated in 1893. He was elected to the Indiana House of Representatives for the term 1902–3. His first story, *The Gentleman from Indiana*, was published in 1899, having appeared as a serial in *McClure's Magazine*. In 1900 his reputation was established by *Monsieur Beaucaire*, which he dramatised (with E. G. Sutherland) in 1901. In 1919 he was awarded the Pulitzer Prize for his novel, *The Magnificent Ambersons* (1918).

His other stories include *The Two Vanrevels* (1902); *Cherry* (1903); *The Conquest of Canaan* (1905); *Guest of Quesnay* (1908); *Beauty and the Jacobin: an Interlude of the French Revolution* (1912); *Penrod* (1914); *Penrod and Sam* (1916); *Ramsey Milholland* (1919); *Alice Adams* (1921); *Fascinating Stranger and Other Stories* (1923); *Women* (1925). His plays include *Cameo Kirby* (1907); *Your Humble Servant* (1908); *Mister Antonio* (1916); *The Country Cousin* (1917), with Julian Street; *The Gibson Upright* and *Up From Nowhere* (1919), both with Harry Leon Wilson; *Clarence* (1919); *Seventeen* (1925).

TASMANIA (*see* 26.438), a state of the Australian Commonwealth. The island of Tasmania, the smallest of the Australian States, has an area of 26,215 sq. miles. Its population in 1925 was 211,906, an increase of 20,695 since 1911. Hobart (population 56,507) is the capital and chief port. Launceston (population 28,000) is the principal town in the north. Overseas mail steamers do not call at Tasmania, but there are regular shipping services with Melbourne and Sydney. The states returns six Senators and five members of the House of Representatives to the Federal Parliament. The Legislative Council has 18 members and the House of Assembly 30. Since the War political power has fluctuated between the Nationalists and Country party on the one hand and Labour on the other. The state owns and controls a hydroelectric undertaking, a shipping service and an insurance office

Production and Industry.—Tasmania reproduces many of the natural features of England, and its climatic conditions closely resemble those of western Europe. Drought is unknown, and the fruits, flowers and vegetables of the temperate zone are successfully grown. In 1924, 34,076 ac. were under cultivation as orchards and fruit gardens, of which 25,681 ac. were devoted to the production of apples. Oats, beans, peas and potatoes are other crops and hops are grown.

Minerals to the value of £1,154,397 were produced in Tasmania in 1923. In that year copper was the principal product, with tin, lead, limestone, flux and silver following in the order named. Tasmania is the largest producer of "free" osmiridium in the world: in 1920, 2,009 oz., valued at £77,114, were produced. The development of secondary industries during the post-War period was due, to a large extent, to the utilisation of the Great Lake waters to develop electric power. In 1924 the state hydroelectric department had available from this scheme 63,000 H.P., capable of development to 500,000 H.P. Foremost among the industries is that of the Electrolytic Zinc Co. of Australasia. Messrs. Cadbury, Fry and Pascall established a joint factory at Hobart in 1922, and several woollen manufacturers from Great Britain have established factories at Launceston (*see* AUSTRALIA).

TATA, SIR DORABJI JAMSETJI (1859–), Indian capitalist, was born at Bombay on Aug. 27 1859, being the elder son of the famous Parsee industrial pioneer, Jamsetji Nasarwanji Tata (*see* 26.448). Upon leaving Cambridge, he entered his father's business and pursued his father's great conceptions until they culminated in striking advances in Indian industrial development and also in the establishment in 1905, by means of generous endowment, of the Indian institute of scientific research at Bangalore. He was actively assisted by his brother Sir Ratan Tata (1871–1918) and after many disappointments he secured by the end of 1911 the establishment of iron and steel manufactures on a large scale with Indian capital and under Indian control. From the jungle of a remote Bengal district there sprung the town of Jamshedpur, so named (like the adjacent Tatanagar) after the originator of the project. A population of over 80,000 is there engaged in steel manufacture and many subsidiary industries.

Sir Dorabji, who was knighted at the beginning of 1910, showed pertinacity in carrying to realisation a succession of schemes for harnessing the heavy monsoon rainfall of the Western Ghats to provide the hydroelectric energy which has vastly increased the productive capacity and transformed the industrial conditions of the city and neighbourhood of Bombay. Altogether the Tata concerns support 250,000 wage earners and their dependents, and represent a capital commitment (almost entirely Indian), estimated at £50,000,000. Suffering from the reactions of the speculative boom of the post-Armistice period, and from severe external competition, the parent steel company sought and was the first Indian industrial concern to receive, by legislative enactment in 1924, the discriminating protection recommended as a suitable policy for India by the Fiscal Commission of 1921–2. Sir Dorabji's cousin, Sharpuji Saklatvala, was the first Communist to be elected to the British House of Commons, being returned for Battersea in 1922 and again in 1924.

TAUSSIG, FRANK WILLIAM (1859–), American economist (*see* 26.456), was during 1917–9 chairman of the U.S. Tariff Commission. In March 1919, he was called to Paris to advise in the adjustment of commercial treaties, and in Nov., attended the second industrial conference in Washington for promoting peace between capital and labour. He was a strong supporter of the Covenant of the League of Nations.

Taussig wrote, *Principles of Economics* (1911; 3rd ed., 1921); *Some Phases of the Tariff Question* (1915); *Investors and Money-Makers* (1915); and *Free Trade, the Tariff, and Reciprocity* (1919).

TAXATION (*see* 26·458).—In a post-War discussion of the fundamental principles of taxation Mr. Andrew W. Mellon, Secretary of the Treasury of the United States, said that a sound tax policy should (1) produce sufficient revenue for the Government; (2) lessen as far as possible the burden on those least able to bear it; and (3) remove influences which retard the development of business and industry. In substance that programme is merely another method of stating the canons of taxation laid down by Adam Smith—equality or ability, certainty, convenience and economy. One authority has suggested that these in turn resolve themselves into one grand principle of economy. In this connection, however, economy is a highly technical term, and not the mere reduction of expenditure which is the misleading feature of much of our popular debate.

Views of Tax Authorities

Mr. Mellon also argued that a tax system should be designed not for one or two years, or from the standpoint of any given class; it should apply to a long period, and with a view to its effect on the prosperity of the country as a whole. While his appeal was addressed mainly to the American public grappling with what he considered the high income-tax following the World War, and was certainly influenced by the unmistakable tendency in the United States to make ever larger investment in the remarkable volume of tax-exempt securities, the message was regarded as one equally appropriate in Great Britain, certainly in the conditions which had followed the European conflict. In any review of British taxation in the period since 1910 the practical revolution in finance after 1914 must be the dominating feature; but however great the spectacular changes fundamental principles remain. Mr. Mellon's contribution was necessarily general. It was perhaps too strongly an appeal from the bosom of large-scale business, with the almost exclusive suggestion that taxation had only to be reduced to make the desert blossom as the rose.

In his Newmarch lectures for 1919 Sir Josiah Stamp went very much nearer to realities. Concentrating on the four points that taxation is to-day a dominating feature of daily life, that there is much greater complexity in modern economic conditions, that there is now a growing field of State activity, and that above all there is the financial legacy of the World War, he proceeded to a three-fold analysis from the standpoint of the taxpayer, of the Govt. acting for the community in its State organisation, and of the community as a producing or economic society. Such a method would enable us to understand the principles and the trend of taxation at any time. But it is specially valuable in an effort to understand the period 1910–26. For that period is in many respects a vivid illustration of the truth of his statement that most taxes in practice represent the best practical compromise in the three standpoints that can be arranged in the particular circumstances of the time.

The Principle of Ability to Pay

The largely increased burden of taxation in Great Britain that followed the Boer War and to a greater extent the European conflict suggested fresh analysis of the principle of ability to pay. It has not in practice done more than modify to a small extent the methods previously in force. The benefit principle (or the payment of taxation in proportion to benefit derived from public service of one kind and another) appealed to many who were influenced by new doctrines affecting the recognition of personal and public sacrifice in post-War conditions. Natural but impracticable was Sir Josiah Stamp's summary of the principle; and events confirm the impression that even in times of great financial upheaval the principle must be regarded from the standpoint of what is practicable. Recourse to the principle of ability to pay is inevitable; but ability must be measured by something more than the mere possession of monetary resources. That test should be supplemented by reference to the consumption of certain commodities which, if not among the strict necessaries of life, have been regarded by Marshall and other leading economists as among the conventional necessaries or minor comforts.

Broadly speaking the period 1910–26 has witnessed a desire to relieve necessaries, and to-day the proportion of revenue raised from indirect as compared with direct taxation is 36·64, as against the pre-War tendency to raise revenue as far as possible on the basis of 50·50. No particular reason or merit attached to that apparent equality. Indirect taxation is not so strictly related to ability to pay; but, assuming for the moment inability to pass on to consumers more than a limited part of direct taxation, indirect taxes are defended on the ground that they reach the masses for a reasonable contribution which can be collected by direct taxation only with very great difficulty, who under a much more comprehensive scheme of income tax than anyone is prepared to propose would in any event have been liable for little or no direct taxation, and who prefer to pay in the price of the commodity in the belief (however unsound economically) that the indirect impost is not so heavy a burden. Advocates of the "free breakfast table" are still alive, and reasonably active. They cannot, however, ignore the appalling load the State has to carry, and their effort now is not so much to get rid of indirect taxation altogether as to see that it falls on commodities hich can always be regarded as quasi-luxurious or definitely luxurious in character.

Personal Taxation.—In the same period there has also been definite consolidation of the movement away from real or specific taxes (that is, on property or annual valuation) to personal taxes, described by most writers as the transition from objective to subjective. The objective is still powerful in local rating, by no means a negligible aspect of present-day taxation. In the country as a whole the movement to "sensitive subjective taxation" is undeniable. These principles were abundantly illustrated in the proceedings before the Royal Commission on the Income Tax in 1919, in its report of the following year, and in many of the parliamentary discussions on the application of tax-concessions which it recommended. Early approaches to personal taxation broke down. Proper taxation on income is impossible in a community not reasonably advanced in people and government. The evidence tendered to the Royal Commission, together with much of the recent analysis of British economic organisation, shows that the foundations for personal or subjective taxation are now broad and secure. The administrative and other machinery is ample.

Although in many respects Great Britain lags behind the United States and certain other countries, her statistical measurement of social and industrial conditions has made progress. In industry the elimination of small-scale production and inefficient bookkeeping, and the appearance of public company, combine and trust—all involving some progress in the publicity which Mr. Sidney Webb among others has urged as desirable—have made it easier to ascertain the precise allocation to individuals. And the movement tends to be further consolidated by administrative practice like deduction of tax at the source, that is, before the dividend reaches the taxpayer at all, giving the State on the one hand its revenue at an earlier moment, and with greater security, and on the other awakening the interest of the taxpayer in the general system at all events in claiming the refund of something less than deduction at the maximum scale, which is for him the effective rate.

But in spite of all the developments of recent years there is still no country in the world in which the system of taxation is strictly true to first or fundamental principles. In Great Britain, as elsewhere, there are many of the accidents of commercial and political conditions. There are innumerable curious historical survivals. One by one, like inhabited house duty, they tend to disappear. All that can be said with firm accuracy is that, everything considered, the tendency since 1910 has been towards a certain simplification in the midst of a quite definite hardening in favour of personal or subjective tax.

Methods of Assessment.—Turning now to the strictly individual standpoint of the British taxpayer, the facts are plain and even simple. The method of regarding income by the year remains subject to the modification of quarterly assessment for weekly wage-earners. That is one concession to the shorter period. There is fresh insistence on the rule that tax should follow closely the period of computation. The Royal Commission on the Income

Tax recognised that deduction at the source, covering a large part of the aggregate income yearly brought under review, formed a great safeguard for the revenue; but it also recommended that in the wide sphere of business profits, commonly known as schedule D, the three years' average should be abolished. Undeniably the year of assessment is the ideal basis; as a matter of practical politics the commission proposed the preceding year, and that recommendation was embodied in the Finance Bill of 1926. No real inroad has been made on the principle of annual value in this country. America emphasises capital value; only to a very limited extent is that found in the British system. Nor is there definite tendency to bring within the scope of income tax the profits of occasional transactions in stocks, shares or other classes of property. Only when such transactions become so regular as to amount to settled business do they take their place in the taxable material of the time.

For large numbers of individual taxpayers there has been more controversy regarding the suggestion that the dividend resulting from co-operative trading should be taxed. That the gain derived from mutual trading should be regarded as a profit in the ordinary commercial sense has been hotly disputed. Most Governments have come to the conclusion that, whatever the economic merits of the dispute, any attempt so to tax the dividends of nearly 5,000,000 of the community is not worth the candle, mainly because the great majority would be entitled to refund as not coming within the present range of income-tax after family and other allowances have been conceded, and partly because the co-operative movement has but to lower the prices of its commodities to eliminate any distribution at all in dividend form and therefore to take away the taxable material. Comparisons of municipal trading with ordinary private trading profits have been erroneous; most of them have suggested that income tax enters into costs, a contention which is still generally regarded as unsound.

Progressive taxation on income (that is, increasing in rate as the income increases) is now universal; practice in the period under review has been all in the direction of entrenching it more firmly than ever in the British system. McCulloch took the odd view that taxpayers should be left in the same relative position in which they had been found! Not even the strongest opponent of direct taxation would to-day offer that argument on a public platform. Most of the economists have reminded us that progression rests on the diminishing utility of money or wealth to its possessor; and to that basic principle there is no real challenge in the argument that wants satisfied by early increments to income are of more importance than wants satisfied by late increments, an argument advanced apparently by way of modification. But for present-day purposes the practical justification of progression is usually its place in the campaign for social improvement. Professor Marshall spoke of the State using its powers for prompting such economic and social adjustments as will make for the well-being of the people at large. Much has been made of the doctrine of least aggregate sacrifice.

Perhaps the only check has been the economic effect of excessive taxation on capital accretion, and the danger that that may in turn react upon the people in their employment and industrial progress. At certain levels taxation may amount to confiscation; and it is sometimes contended that the doubts entertained by some of the opponents of graduation last century have been justified. The reply is probably complete. There is first the general desire to reduce taxation; secondly, a mass of concessions covering business and family life; and thirdly, especially since 1915, growing recognition of the fact that at best taxation is only a limited and sometimes even a dangerous instrument for the readjustment of social conditions. On the last point the emphasis now laid on all manner of schemes for the alteration of ownership, in the sense of diffusion, cannot escape observation. And it is also recognised that there is an everlasting conflict of principle in the measurement of taxable ability by income and the economic and social importance of not discouraging (under any system of industrial ownership) the accumulation of capital.

Reference has been made to the taxation of special ability to pay. Since 1910 this problem has been represented in efforts to impose duties on the increment value of land. The common argument is that that increment, especially in large centres, is not due to the work or sacrifice of the owner, but almost entirely to the enterprise and growth of the surrounding community; that in effect the value is publicly created, and should be in the main publicly appropriated; and that the case for such appropriation is all the stronger when such steps will promote or hasten schemes of civic betterment and force land into remunerative use. More cautious minds have tried to plead that the increment may be in many cases the "accumulation of compound interest on a site that waited a long time before ripening into full salability." Here the analysis need not be pressed, for even if such an element is admitted it is true that there is much increment which is clearly the property of the community. The period in question witnessed a complicated attempt in Great Britain to secure a considerable proportion of this increment for the people, but the attempt, now abandoned, perhaps owed its lack of success mainly to failure to apply the system effectively to the remarkable complexity of the laws affecting real property.

During the World War that form of taxation was in difficulty and there was much keener interest in the discussion of corporation profits tax, taxation of war wealth, excess profits duty and capital levy, all of which represented efforts to secure for the community (partly as an immediate contribution to revenue and in the case of the capital levy for the specific reduction of war debt) some portion of the windfall or special gain which war conditions had brought to certain sections of the people. To a Select Committee of the House of Commons the Inland Revenue authorities stated that a tax on war wealth was administratively practicable. The Labour movement in particular pleaded for a levy on capital. Both proposals were rejected by successive Govts.; but excess profits duty and corporation profits tax were applied.

The former tax took a basic or standard year in the profits of the business brought within the duty; above that standard percentages of the war profits were taken in taxation; but in Finance Acts following the War firms were allowed the set-off of subsequent loss, with the result that the net yield to the Exchequer must in the long run be comparatively small. Corporation profits tax was a tax on the undistributed profits of certain companies. It has been abolished. It would, however, be wrong to suggest that these facts are due entirely to the difficulty of introducing any form of taxation on windfall or special ability to pay in Great Britain. They were powerful in doctrine and revenue during the War; but like many other special devices they could not survive industrial depression. In other words, British economic conditions were not favourable to their obtaining a permanent place in our fiscal system. Meanwhile there were constant references to the taxation of special ability abroad, notable in the public imposts on cash prizes in Australian lotteries; and eventually, in 1926, the Chancellor of the Exchequer announced a 5% duty on betting turnover in Great Britain, not, however, so much on the basis of windfall or special ability to pay as on the suggestion that betting was a luxury which anyone could give up at will and was, in the special circumstances of the time, appropriate taxable material.

Indirect Taxation

Side by side with the tendencies described there has been unwearying analysis of indirect taxation. In taxation on expenditure it is recognised that no duty on commodities can be properly progressive; that if articles in common use are taken, as they must be to give security to the revenue, the system is generally regressive; and that countries which have extensive tariffs are generally rich in illustration of the manner in which the burden varies inversely to ability to pay. But, as has been already suggested, indirect taxation cannot in debate stand by itself. If that were possible there would be no economic defence. For all practical purposes to-day and this has been specially emphasised in the remarkable revenue conditions since 1910—it must be regarded as a preferably minor part of a wider general scheme of taxation,

always to be carefully scrutinised, and calculated to reach an area which cannot be effectively tapped by direct taxation. This has suggested the selection of a wide list of commodity taxes which attack the non-functional element in spending (or the element not strictly necessary to the discharge of duty by the individual affected) in a manner which income tax could not attempt. But from the sphere of income tax, where regard is had to the family as a unit for fiscal purposes, there is some encouragement of this doctrine in the indirect area.

A tax on turnover (*see* TURNOVER TAX) is large-scale application of taxation to expenditure, but while it is taken as the basis for the British betting duty proposals it is not elsewhere practical politics. Few taxes are so thoroughly unfair in their incidence, and few lend themselves so readily to evasion, so that the fundamental arguments against the device are at all times powerful. Broadly speaking, therefore, in indirect taxation there had been a movement away from the 50% allocation of burden in raising total revenue in Great Britain; concessions have been given on the strict necessaries of life; indirect taxation has been centred on minor comforts and on luxuries; and under the Govt. which took office in 1924 there has been substantial recourse to the non-functional surplus in spending.

Concluding this summary from the standpoint of the individual it may be said that there has been little or no taxation of capital as such. In certain wasting assets, such as leaseholds, there is in practice some mixture of taxation of income and of capital; but this tendency, limited as it is, should be corrected when the British Parliament adopts the programme for the treatment of wasting assets which was recommended by the Royal Commission on the Income Tax in 1919.

SOME GENERAL PRINCIPLES

Since in Great Britain the movement towards personal or subjective taxation is pronounced, the review must be devoted very largely to that aspect. The standpoint of the state and of the community is, however, of importance. Sir Josiah Stamp has summarised the questions which confront the community in asking whether the proposed tax is economical, workable, specially open to evasion or dishonesty, likely to dry up the source and prove abortive to the revenue, raise political difficulties and create unrest or raise international problems and provoke conflict with other taxing jurisdictions.

Since 1911, but more especially in the international issues raised after the World War in interminable debt adjustment, these questions have occupied a large place in domestic fiscal legislation. Domestic imposts and the problems raised by fiscal relationships with other countries are, of course, very closely related. The whole range of discussion is in fact raised in the simplest issues. Of late the community has had to consider carefully the incidence of taxation. Will a tax of certain weight on tea diminish consumption and encourage the use of substitutes? Will a turnover tax play into the hands of larger firms which control the various stages of production and distribution, to the disadvantage of their smaller competitors? Is there a case to-day for the special taxation of certain industries? Or will such taxation in practice cause a fall in the value of their stocks such as will amount to capitalisation of the tax? The consideration of such questions has helped Great Britain to preserve reasonable balance of direct and indirect taxation, with a tendency to reduce the latter; to avoid the dangers of turnover taxation; and, in the main, to avoid differential taxation. For it is clear that the last is in reality a form of confiscation for present owners, just as differential exemption or privilege tends to be a bonus to present owners.

But there is still much differential privilege, as in the concessions to agriculture and the method of assessing the profits of farmers, now on the basis of the annual valuation of their holdings. Recognising the danger of this underlying doctrine the Royal Commission on the Income Tax unanimously recommended that farmers should be brought under schedule D for taxation on actual profit like other trading classes of the community. So far that recommendation has not been adopted. Still, it is a definite statement of sound economic practice in the field of differential treatment, even if it must be admitted that the Finance Acts of recent years in Great Britain contain many minor concessions which, taken together, come dangerously near to substantial attack on the principle.

Certain old taxes like some of the land taxes are, so to speak, no taxes, since they have been capitalised. Of the economic effect of the death duties, which are admittedly a tax on capital, the reasoned conclusion appears to be that at worst "a new capital form has been prevented from coming into being," that much depends on what the Govt. does with the money, that if the use is remunerative the net effect on national capital is nil, and that the real problem is not so much any immediate adverse effect of the death duties as the dynamic aspect (from the standpoint of accumulation) over a series of years. Practice since 1910 has again entrenched such duties; economically the argument that they should be specifically allocated for debt reduction is both creditable and sound, since they are of the nature of capital levy; but on the other hand the British Exchequer has generally supported the growing objection to anything of the nature of an assigned revenue, an attitude strikingly illustrated in the proposals affecting the Road Fund in the Finance Bill of 1926.

The ulterior objects of taxation vary; most of the critics regard them as allowable, subject to the condition that they are always secondary. In so far as they attempt the redistribution of wealth, for example, they should be limited by the doctrine of fair progression. In so far as import duties—a growing phase of the British fiscal system since 1910—are imposed the argument is that they should not reduce the aggregate volume of trade; but in that connection the ulterior object is much more debatable. In the period under review there has been no substantial modification of Britain's system of free imports. The War and post-War programme has been first of all an effort to safeguard, by uniform duty, certain industries believed to be vital in time of emergency; and secondly, again as a rule, by uniform duty of $33\frac{1}{3}\%$, to give a form of protection to home producers against imported commodities enjoying the export advantage of depreciated exchange, produced under conditions abroad calculated to give unfair advantage to the country of origin, or reaching Great Britain in such quantities as to amount to "dumping" in the sense of being retained within these islands in competitive sale with British goods.

Finally, post-War financial conditions have revived discussion of many of the intricacies of the limits of taxable capacity. It is one of the abiding problems of taxation, but the large budgets of recent times, the difficulties of the repayment of Govt. debt, and the question as to how far Germany could be made to pay for the War (including the searching analysis which preceded the introduction of the Dawes scheme) have led to much wider discussion. It has proved remarkably hard to arrive at the relative capacity of different countries to bear taxation, but the ultimate test has been what is left to the inhabitants together with what they derive from outside their own borders. The manner in which wealth is distributed is a material factor, and there is always the duty of observing a close relationship in consumption and production levels. In Great Britain much has been made in debate of "pre-War standards," a basis which is often irrelevant and misleading in the changed conditions which confront national finance. But broadly there is now much better recognition of the fact that the limit of taxable capacity is not absolute or fixed. The essential considerations are that much depends on the uses to which the revenue is put; great importance must be attached to the spirit of the people who are bearing the taxation, and the manner in which they regard it; the way in which the taxation is raised may of itself largely influence the position; and effective use can be made of the truth that great advantage is to be derived from the employment of resources for the reduction of debt, especially external debt.

These principles underlay the determination of the British Govt. in 1922 to fund, under arrangement with the United States of America, what was by far the largest part of their post-War external indebtedness. To a country depending largely on overseas trade, and therefore committed to a long view of the exchange problem, such a course was inevitable. But it had to be supported

by drastic taxation at home, and by the rigorous balancing of budgets, together with reasonable provision for debt redemption, all of which were linked up with the preparation for return to the gold standard and the re-establishment of London as the financial centre of the world. To that end the system of taxation, especially since the conclusion of the World War, has made remarkable contribution. (*See* also CAPITAL LEVY, EXCESS PROFITS, INCOME TAX, TURNOVER TAX and the sections on finance in the articles GREAT BRITAIN; ITALY; UNITED STATES, etc.)

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TAYLOR, FREDERICK WINSLOW (1856–1915) American engineer, was born March 20 1856, at Germantown, Pennsylvania. Prevented by impaired eyesight from entering Harvard University, for which he had prepared, he in 1874 began an apprenticeship as pattern-maker and machinist in a small Philadelphia shop. In 1878 he entered the employ of the Midvale Steel Co. as yard labourer, but was promoted rapidly to timekeeper, gang boss, assistant foreman, foreman, assistant engineer and chief engineer (informally in 1884, formally in 1887). In the meantime, his eyesight having been restored, he earned by night study the M.E. degree from Stevens Institute. In 1898 he was employed by the Bethlehem Steel Co., and after 1901 he devoted his entire time to forwarding by educational means the principles of scientific management (*see* article). As early as 1880 or 1881, while gang boss, controversy with workers had led him to realise the necessity of accurate measurement of what constituted a day's work on any operation. This in turn led to a series of careful experiments resulting in important achievements in two fields; in mechanical engineering, the discovery with Maunsel White of a new method of tempering tool steel permitting metal-cutting operations at high speed (1898); and in the field of management, perfection of that system of shop management which came later to be known as scientific management. He died March 21 1915, at Philadelphia.

Taylor's publications include *Notes on Belting* (1893); *The Adjustment of Wages to Efficiency; A Piece Rate System* (1896); *On the Art of Cutting Metals* (1906); *Shop Management* (1911); *The Principles of Scientific Management* (1911); and with S. E. Thompson, *A Treatise on Concrete, Plain and Reinforced*, 3rd ed. (1916). See F. B. Copley, *Frederick W. Taylor*, 2 vol. (1923).

TEA (*see* 26.476).—In 1925 the International Institute of Agriculture at Rome estimated the world production of tea at between 1,750 and 2,000 million pounds. The area under tea in India was in 1924 computed at 716,300 ac. of which 83% was in Assam, Darjeeling and Jalpaiguri. Of the 375,000,000 lb. produced in 1924, Northern India accounted for 329,000,000 lb. and Southern India for 46,000,000 pounds. Four hundred and twelve thousand ac. produced in 1925 209,500,000 lb. of tea. In the same year the production in Java amounted to 94,500,000 lb. from about 220,000 ac. and in Sumatra the produce of 30,000 ac. totalled 17,000,000 pounds. As regards China which, unlike India and Ceylon, is a country of small producers, statistics of production are necessarily vague. The total production is estimated at about 1,000,000,000 lb. annually, less than 100,000,000 lb. of which are exported.

In Japan 115,000 ac. are under tea, producing some 75,000,000 lb. annually, almost all being unfermented green tea, two-thirds of which is consumed in the country, the remainder being sent to the United States and to Canada. The island of Formosa has about 90,000 ac. planted, and produces from 30,000,000 to 35,000,000 lb. each year, most of it going to the United States. In Africa, the Natal tea industry is declining; but in Nyasaland it is increasing, 5,000 ac. being planted on the slopes of the Mlanje Mountain: about 1,000,000 lb. were exported in 1925. In Uganda and Kenya experimental planting shows promise. A small quantity of Annamese tea has appeared on the London market. In Brazil attempts are being made to grow tea from Assam seed, and in Transcaucasia tea-growing is becoming an important industry.

Increase of World-Consumption.—The world-wide consumption of tea is increasing. The United Kingdom is the largest consumer—during 1925 duty was paid on over 400,000,000 lb. for home consumption, equal to nearly nine lb. per head of the population. Canada, Australia, and New Zealand show an even larger consumption per head. Other countries are slowly acquiring the taste for tea, and energetic efforts are being made to develop the markets both in the United States and in France. In March 1924 the Indian planters voted £20,000 for promoting the sale of their tea in France, and £40,000 for similar propaganda in the United States. It is expected that prohibition in the latter country will stimulate the demand for tea.

Before the War Russia was a large consumer; her imports of other than China tea during the period 1909–13 averaging over 157,000,000 lb. per annum, of which 50% came from India, 25% from Ceylon, and 25% from Java. During 1925 direct shipments and re-exports to European Russia totalled only 16,250,000 lb., of which about 45% came from India, 35% from Ceylon and 20% from Java. It is known that Russia is taking large quantities from China overland. The Soviet Govt. by her trading system is securing large supplies, China being the main source. The method of financing the Russian buying is not easily traceable on the market. The official buying organisation puts its business through brokers on a cash basis to some extent, but needing credit it also buys through groups of financiers in various countries who, in turn, operate through brokers or dealers.

Distribution of Exports and Imports.—The exports from producing countries in 1925 were as follows:—

	lb.
Northern India	304,544,265
Southern India	43,948,848
Ceylon	205,493,536
Java	94,037,988
Sumatra	16,654,053
Nyasaland	1,114,633
China (estimated)	86,000,000
Japan	27,759,600
Formosa	20,842,800
Total	800,395,723

Imports into the principal consuming countries during 1925 were as follows:—

	lb.
Great Britain	491,000,000
Irish Free State	23,305,000
United States of America	100,962,000
Australia	48,833,000
Canada	35,785,000
New Zealand	18,764,000
Morocco	10,199,000
S. Africa	9,387,000
Germany	8,934,000
Egypt	8,229,000
Chile	4,460,000
Argentina	4,370,000
France	3,654,000
Poland	3,194,000
Algiers	1,677,000
Denmark	1,436,000

The British Market.—During the World War a Board of Control was instituted under which distributing firms balloted monthly for the tea available, this being divided according to quality into three grades. The producer was granted a fair price as shipments from India and Ceylon were arranged by the Government, and imports from China and Java were prohibited. The retail distributor was rationed as to the quantity he might draw and it was required that the retail price to the public should not exceed 2s. 8d. per lb., even though the duty was, in Sept. 1915 increased to 1s. per lb. and the stocks in the United Kingdom reduced by Dec. 1917 to 37,500,000 pounds. It was also required that tea should be sold retail by net weight—a requirement still in force. After the conclusion of peace, decontrol gradually took place. In 1919 imports from all sources were again permitted and the free marketing of tea resumed. The trade was, however, confronted with some difficulties, the chief being a glut of tea on the market due to a record supply being available and the absence of a demand from consuming countries. Free shipping and supplies available from all places, aided by large re-exports from the United States, resulted in the import of over 500,000,000 lb. during 1919. Stocks grew to over 210,000,000 lb. and the expectation that these could be liquidated by the demand

from other consuming countries than the United States proved illusory. These factors influenced prices and common tea was in 1920 sold down to 5¼d. per lb., a price below producer's costs. Subsequently prices gradually improved, until in 1924 a new high record for common tea was created when the price touched 1s. 8½d. per pound. The average prices of British-grown teas on the London market were as follows:—

	1924	1925
Assam	1s. 7·84d.	1s. 9·04d.
Darjeeling	1s. 9·97d.	1s. 9·63d.
Duars	1s. 3·77d.	1s. 7·41d.
Cachar and Sylhet	1s. 2·15d.	1s. 6·29d.
Ceylon	1s. 11·85d.	1s. 10·72d.
S. India	1s. 10·32d.	1s. 9·03d.

To these prices must be added the import duty which, early in 1926, was 3⅓d. per lb. for Empire-grown sorts and 4d. per lb. for foreign-grown. (C. L. T. B.)

TEACHING.—The period 1910–25 was one of unexampled educational activity and development, not confined to the Western nations but almost world-wide in range. While most of the ideas now taking shape in the national systems were active on a small scale before 1914, the moral shock of the World War was undoubtedly the cause of their present influence. This is seen particularly in Germany, the land where the older educational tradition was fullest developed and most firmly established, which has, since the revolution, been the theatre of a remarkable educational ferment productive already of far-reaching changes. Education in Russia has undergone a still more dramatic upheaval; but the transformation of the schools under Soviet rule though known to be very great, has as yet been insufficiently observed by competent Western critics. In the countries where educational methods were less well defined and less rigid, and where there has been less political disturbance, the changes, though not so conspicuous, are still highly important both in actuality and in potentiality for the future; and Belgium, England, France, Italy and the United States have all made significant contributions to a truly international movement.

The Pre-War Movement.—Before the War zeal for national efficiency was, on the whole, the dominating motive in education. Under modern conditions economic prosperity was perceived to depend increasingly upon the spread of knowledge among the masses of a people, and upon the production of men, well informed, trained and disciplined, capable of exercising leadership in the several branches of its affairs; and the trend of political changes conspired with industrial and commercial developments to make sound education a national necessity. Largely under the stimulus of this motive, elementary education became, in all the progressive countries, at once more liberal in scope and more practical in outlook; and countries like England, which had done comparatively little for their secondary schools, began to foster them sedulously (*see* SECONDARY SCHOOLS). Everywhere attempts were made to bring school teaching into closer touch with the facts and needs of ordinary life and with the national interests.

Many important advances in teaching and teaching methods thus came about: for instance, a notable extension of practical teaching in science, especially in England, a treatment of geography which made it a rational discipline helping the student to understand essential features of the modern world, the "direct method" of teaching foreign languages (*q.v.*) which sought to make the study of a tongue a key to the life and mind of the people who speak it, and the development, particularly in America, of instruction in manual and domestic arts. And side by side with these advances in the teaching of the elementary and secondary schools there was a corresponding growth of technical education (*q.v.*), which aimed still more directly at national efficiency, and led to much useful experimenting in the methods of teaching and training young people for industrial, commercial and domestic occupations.

Post-War Changes.—Since 1918 the pre-War movement has been resumed, but other ideas than national efficiency are conspicuous, and seem likely to produce profounder changes in school organisation and teaching. These derive their force ultimately from the democratic faith that the purpose of education should be to secure for every person the fullest life of which he is capable, and their operation has been directed by the wider and deeper psychological knowledge that has become available. In brief, education tends increasingly to start from Rousseau's position that youth is not a preparation for life but a part of life, and seeks to make that part as rich as possible in itself in the belief that this is to make it as fruitful as possible in subsequent values. And with this attitude is combined the psychological doctrine that life is essentially spontaneity or "self-activity," which is always motived from within though its course is necessarily determined largely by environment and external guidance.

Montessori and Other Systems.—Dr. Maria Montessori's methods in the education of young children offer a simple model of the way in which these ideas work out. (*See* MONTESSORI SYSTEM.) The essence of her scheme is to provide for a group of children a series of carefully devised occupations and then to leave the individuals of the group to educate themselves by self-chosen activity under the eye of a "directress," whose function is to watch carefully the progress of her charges and to interfere with them as little as possible. The occupations are believed all to contribute to the child's mental and moral development, and are designed so that he can observe his own progress and success in them; they range from simple exercises for training senses and movements up to self-initiation into the arts of reading, writing and reckoning.

While Montessori's system as a whole has not been very largely adopted, her cardinal idea, under the name of "individual work," has spread widely in infants' schools in England and elsewhere, modifying or replacing the tradition of the Froebel kindergarten. It has also helped to inspire numerous attempts to break away from the old-fashioned routine of class-instruction in the education of older scholars, and to give, in both elementary and secondary schools, a larger place to individual and self-directed study and practical activity. Some of the more systematic of these attempts (*e.g.*, the "Dalton Plan," the "Winnetka Plan," the "Howard Plan") have been studied more widely than they have been imitated, but the general influence of the ideas they incorporate is unmistakable, and in spite of some short-lived extravagances has been salutary and vivifying.

The Influence of Dewey.—Long before Dr. Montessori gave fresh vigour to the notion of individual self-education, Professor John Dewey, then of Chicago, had worked out his doctrine of education not merely *for* but *through* activities of social value. This doctrine, like Montessori's, opposes to the ideas underlying the conventional methods of class-teaching a conception of educational activity much more free and natural; and it has had much influence upon educational thought and practice, more immediately in the United States, but in a less direct way also in Europe. In the United States it is expressed partly in efforts to bring the activities of school into as close relation as possible with those of the outer world; elsewhere it has helped to form the broader view that the school should be a place where the young may come into effective contact with the great cultural traditions that have shaped modern civilisation. Dewey's pragmatism has also done much to further the mode of teaching known in the United States as the "project method." By this term is meant that the scholar should acquire his knowledge, say in mathematics, science, geography, or history, in the attempt to achieve some interesting purpose or to understand how certain problems of practical and social importance are solved. To learn the rudiments of trigonometry in order to carry out a survey of the home district would be an instance of the project method.

The "New School."—The foregoing tendencies and ideas are reflected in many ways in the schools of Europe and America. In England there have been numerous educational experiments (*q.v.*)—some bold and even daring adventures in unconventionality, others more cautious, tempering the new ideas with what is soundest in the older traditions. The schools founded by Reddie (1899) and Badley (1902) were pioneers of a movement which, under the name of the "new school," has spread into several Continental countries. Among the "thirty points"

of the movement the more essential are that a "new school" is a boarding school, preferably for both sexes, that it should be in the country and be conducted as a free, co-operative society in close contact with nature, and that it should give a large place on the one hand to manual work, the cultivation of the soil and the breeding of animals, and on the other hand to the practice of the arts and the pursuit of science. Decroly's school in Brussels, whose programme has been in effect approved by the State, is a special type of "new school" in which the curriculum is presented through a study of primitive man. In England there are or have been schools (*e.g.*, Oundle, under Sanderson) pursuing the main purposes of the "new school" by less unconventional methods.

German Reforms.—In the educational reforms in Germany a large part is played by the "activity schools" (*Arbeitsschule*) inspired by the veteran Kerschensteiner of Munich. The term meant originally a school in which manual work was the core of the curriculum, but its significance now includes "project" methods in all subjects. Service of the community is the objective of the education, and "creative learning" its fundamental principle—that is, learning motive by the pupil's own interests and initiative and his instinct for social co-operation. Under this scheme the timetable and the conventional division of the curriculum into subjects tend to disappear, for all instruction becomes "incidental." Accordingly, what is called "integrated instruction" (*i.e.*, teaching which ignores subject-divisions) is largely the rule in the *Arbeitsschule*, and has even been, in some German states, prescribed by law for the first four school years. (*See* EDUCATION.) (T. P. N.)

TEA ROOMS: *see* FOOD SERVICE.

TECHNICAL EDUCATION (*see* 26.487).—The tendency in recent educational administration has been increasingly to focus phases of industry in particular institutions.

I. IN THE BRITISH EMPIRE

The statutory duty of local education authorities to co-ordinate all forms of education within their area has led them, since 1909, to develop technical education by a progressive delimitation of the functions of rival schools. Secondary education (*q.v.*) and, to a less extent commercial education (*q.v.*) are being removed from technical schools and concentrated elsewhere; similarly, adult education (*q.v.*) now being developed at evening schools for men and women and at literary institutes, is being taken away, by degrees, from the technical schools to utilise accommodation for the teaching of scientific and technological processes.

In large centres of population, technical instruction is grouped around the major technical schools within the area, minor or junior technical schools being affiliated to a parent institution. In 1913, the evening school system of London was re-organised by the London County Council on these lines, and a similar re-organisation has been effected in other large towns. The present system is designed to encourage boys and girls on leaving the elementary schools at the age of 14 to enrol in junior technical schools or junior commercial schools for a course of study until the age of 17 or 18 is attained, provision being made by most authorities for trade scholarships at the age of 13 for children of exceptional ability. At the age of 17 or 18 the junior students can be transferred to the appropriate senior school, free places being awarded to those who have given promise of assiduity or ability.

The need, especially in rural districts, for the old type of elementary instruction for more or less illiterate adults has practically disappeared, and, in the opinion of the Board of Education, the tendency to concentrate classes and to reduce their number has on the whole been beneficial. In recent years, the function of evening schools has considerably changed; and, although the number of students has been diminished by schemes of re-organisation, a general raising of the standard of attendance and of work has been achieved. The modern type of evening school or institute is more closely in touch with industrial and commercial requirements than formerly, and the enrolment of serious students steadily increases, notably among women and girls by reason of the development of trade schools for girls and of women's institutes.

Special Schemes.—In London and elsewhere special schemes have now been drawn up for technical education in textiles, mechanical and electrical engineering, chemistry, technical optics, architecture and the building trades, furnishing and furniture making, flour milling, retail distribution, banking and secretarial occupations, grocery and provision trades and the boot and shoe trades. Recent advances include the institution of national certificates by the Board of Education in conjunction with professional associations dealing with mechanical engineering, chemistry and the gas industry, and the extension of the day training of apprentices in various trades, *e.g.*, the rubber trades, music trades, printing and gas fitting. Consultative Committees have been appointed, either by the Board of Education or the local education authorities, to co-ordinate the details of technical instruction with trade requirements.

Monotechnic Institution.—The monotechnic type of institution has shown great potentialities in pushing forward education for specific trades, particularly in towns with a population or an industry large or important enough to support a technical institute of this type. Comparatively new industries have tended to go forward in education more rapidly than old industries, but, gradually, the application of scientific principles is extending through the medium of specialised technical training. Technical institutes in Great Britain may now broadly be divided into three categories:—(1) The monotechnic type which deals with everything in relation to one particular trade; (2) the polytechnic which provides instruction in practically all subjects of local importance; (3) junior technical schools and trade schools.

The monotechnic type of technical institute has achieved its greatest development in London, the largest institute of this type being the London School of Printing and Kindred Trades with 2,500 day and evening students. Other monotechnic institutions have been provided in London for the building trade, the meat industry, lithography and photo-engraving, and for the leather and boot and shoe trades. Printing schools are also maintained at the École Estienne in Paris, and at Utrecht, Brussels, Amsterdam, Zurich, Leipsic, Vienna and other European centres. Economic depression arising from the Great War restricted the development of technical education abroad. One effect of the War was a world-wide reaction in favour of the humanities, but later economic stress led to a more insistent demand for technical education.

Canada.—In Canada subventions have been voted for the improvement of technical and agricultural education, and in Denmark also development has been very largely in favour of agricultural education. In Australia technical education is being increasingly modelled on British lines. Lower commercial instruction has been organised in Norway and a number of agricultural continuation schools have been opened in Austria.

Statistics.—In England and Wales in 1922–3, there were 4,129 schools providing technical education. The enrolment at these schools was 659,936, of whom 23,317 were in day continuation courses. The enrolment was greatest in London which had an average of 4% of its total population under technical instruction; the average for the county boroughs was 2%, and for the administrative counties slightly over 1%. These percentages do not, however, represent the effectiveness of the instruction, since there is considerable divergence in local regulations governing the opening of classes and the attendance of students.

Post-War conditions caused violent fluctuations in the number of students receiving technical education. The highest attendances were recorded in 1921; subsequently economic duress and unemployment caused a decline, but in 1924 and 1925 enrolments began to increase again in many towns, notably in London which had an increase of nearly 20,000 students in two years in its day and evening technical and continuation schools. The average number of student hours worked by each student rises steadily; in 1923 it was 76 hours per student for the county boroughs, 61 hours for London, and 56 hours for the other administrative counties. The total public expenditure from rates and

taxes on technical education in Great Britain in 1925 was slightly over £3,000,000. For bibliography, *see* EDUCATIONAL LITERATURE. (G. H. GA.)

II. IN THE UNITED STATES

Agriculture was the first subject in which technical education was provided in the United States, because the country was long an agricultural country. The Congress of the United States made appropriations for agricultural education during the Civil War, and at later periods gave large grants to support schools of agriculture and divisions of agriculture in state universities

Congressional support was extended in 1914 through the Smith-Lever law to what is known as agricultural extension. Under this law agents are distributed through the various states operating from the agricultural colleges, and promoting the development of popular courses in agriculture for adults and also courses in the high schools. The development of high school courses in this line has been so rapid that the colleges of agriculture find their student bodies seriously falling off in numbers because the subject-matter which they used to teach has been taken over by the high schools. The registration in all day agricultural schools under the supervision of the Federal Board for Vocational Education is indicative of the growth in interest in such courses at the secondary level. The details of this expansion are as follows:—

Number of Pupils in all-day Agricultural Schools

1918	15,453	1922	52,961
1920	31,201	1925	65,945

Engineering.—The development of engineering schools in the United States came much later than the establishment of schools of agriculture. In recent years, various types of engineering have come to be an important part of university curricula, especially in the great state universities of the Middle West and West. Furthermore, the larger cities have organised technical high schools in response to the demands of industry. These were originally thought of as schools for the training of mechanics. Experience has shown, however, that a relatively small percentage of the graduates of these schools actually work in the trades. Most of them enter upon higher careers as managers or follow the high school training by study in higher institutions. In the technical high schools and in the so-called mechanic arts courses of the ordinary high school, the pupils who are preparing to enter the trades usually remain only for one or two years. The short-period pupils in the technical courses constitute the group who are receiving what is commonly defined as industrial training rather than technical education.

Part-time Plan.—A method of relating theoretical training in the technical arts to practical operations in the world of industry was devised and first practised at the University of Cincinnati. This method is called the part-time plan, and provides for a periodical shift of students from school to factory and back again. The period of stay at school and factory varies in different institutions from one week to a month. Usually two equal groups of students alternate with each other, so as continuously to provide the industrial plant and the school with classes for the type of work which it is the share of each to contribute. The early experiments with the part-time plan demonstrated the necessity of a careful correlation of the work carried on in the two institutions concerned. The advantage of such a plan is that it releases the school from the necessity of equipping itself with the tools and machines demanded by modern mechanics. The learner gains the advantage of contact with current methods in industry and with the results of science. The plan is so successful that it has been imitated in commercial schools and in some of the lower industrial schools.

The larger industrial concerns have found that it is necessary for their success to carry the training of some of their employees to levels which equal those reached in college and university laboratories, and have accordingly established research laboratories and schools for the training of engineers.

The effort is being made on an increasing scale, especially in urban centres, to train all the people in matters mechanical through industrial museums and exhibitions. The purpose of such institutions is to satisfy the popular desire for mechanical knowledge which has been stimulated by the extensive use of the automobile and the electrical contrivances and machines which are now common in homes. The successful example of Europe in this line has undoubtedly contributed to the development of such experiments in America. (C. H. J.)

TEETH: *see* DENTISTRY.

TEHRAN, Persia (*see* 26.506), with a population of about 200,000, has, like the rest of Persia, seen little change. The Lalazar, the centre of the city, has some well-built shops, and in the suburbs are wide shady roads, lined with houses in large gardens. There are no factories except those for making carpets, but Tehran is one of the chief commercial centres of Persia, and an exhibition, with the object of increasing trade, was held in 1923. A police force, trained by Swedish officers, was organised in 1911 to try to enforce law and order in Tehran and southern Persia. The lightly metalled road from Tehran to Khanaqin on the Persian frontier, which was made by the British during the World War, has been kept up since by means of heavy tolls on traffic, and has become one of the main trade routes, as Khanaqin is linked with Baghdad by rail, and the northern trade routes have been closed. A road fit for light traffic has recently been made to the Caspian, and a motor service to Resht was started in 1924; it is also planned to metal the route to Bushire on the Persian Gulf, which carries a large proportion of the foreign trade, but is only a caravan track. No railway had been built to Tehran up to 1925.

TEISSERENC DE BORT, LÉON PHILIPPE (1855–1913), French meteorologist, was born in Paris Nov. 5 1855, the son of an engineer. He began his scientific career in 1880, when he entered the meteorological department of the Bureau Central Météorologique in Paris under E. E. W. Mascart. In 1883, 1885 and 1887 he made journeys to North Africa to study geology and terrestrial magnetism, and during this period published some important charts of the distribution of pressure at a height of 4,000 metres. In 1892 he became chief meteorologist to the Bureau, but resigned in 1896 and founded a private meteorological observatory at Trappes, near Versailles, where he carried out investigations on clouds and the problems of the upper air. In 1898 he published an important paper in *Comptes Rendus* detailing his researches by means of balloons into the constitution of the atmosphere. His discovery of the so-called isothermal layer, or stratosphere, as it is now generally called, will always stand out as one of the most important events in the study of the upper atmosphere. He also carried out investigations in Sweden and over the Zuider Zee, the Mediterranean and the tropical region of the Atlantic, and fitted out a special vessel in order to study the currents above the trade winds. He was elected a fellow of the Royal Meteorological Society in 1903, hon. member in 1909, and was awarded the Symons gold medal of the society in 1908. He collaborated with Hugo Hildebrandsson in *Les bases de la météorologie dynamique* (1900–5). He died at Cannes Jan. 2 1913.

TELEGRAPHY (*see* 27.510).—The two outstanding features in the art of telegraphy since 1910 have been (1) the widening application of printing telegraph systems, particularly those using the Baudot or five-unit code, and (2) development of carrier telegraph systems.

It has been found feasible to transmit alternating currents of frequencies as high as 30,000 cycles per sec. over open wire metallic return telephone circuits, and by means of thermionic valves or vacuum tubes to amplify the feeble received currents and retransmit or relay them into connecting circuits. As the voice range in ordinary telephone transmission requires only a band width of 2,000 or 3,000 cycles at the low end of this range, the remainder may be used for carrier telegraph and carrier telephone (*see* TELEPHONY).

A circuit from which telephone and direct current telegraph channels are derived, the telegraph employing the frequency range between zero and the lowest frequencies required for telephone purposes, is termed a composited circuit. The separation

is effected by means of simple electrical filters which are generally referred to as a "composite set." The compositing idea has been carried still further by superposing a high frequency carrier telegraph system upon a telephone circuit, the two being separated as before by more elaborate filters, which are sometimes referred to as a "high frequency composite set." A carrier telegraph circuit provided with equipment for utilising the alternating currents within the voice range for telegraph purposes is termed a "voice frequency carrier telegraph circuit."

Methods of Transmission

Composite Telegraph and Telephone.—Considerable advance has been made in the technical knowledge of simultaneous telegraph and telephone operation over the same wires. The fundamental idea was that of Van Rysselberghe of Belgium. By means of electric wave filters, consisting of condensers and inductance coils, a line circuit is bifurcated at the terminals into two circuits, one offering low impedance and attenuation to the low frequency telegraph signals and high impedance and attenuation to the higher frequency telephone currents, the other offering high impedance and attenuation to the low frequency telegraph signals and low impedance and attenuation to the higher frequency telephone currents. The telegraph may be operated as a two-wire metallic return circuit, or as two separate grounded circuits. The former is the method used on small gauge circuits in cables, whereas the latter is the standard practice for open wire lines. Fig. 1 shows the separating filters or, as they are termed, the

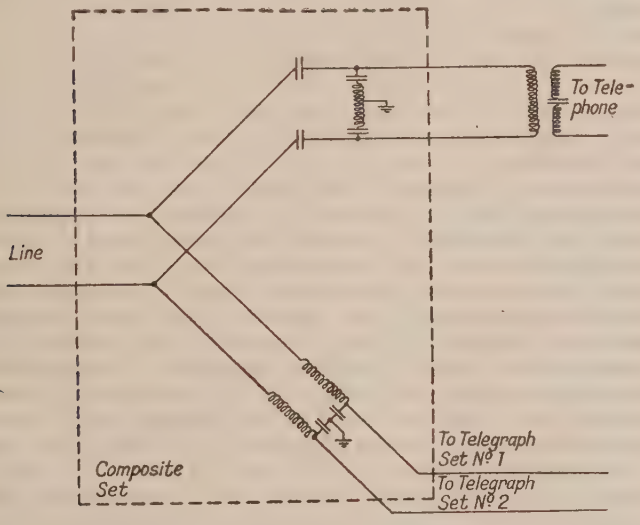

Fig. 1.—Schematic of Composite Set for grounded telegraph system.

"composite set." Where it is desired to use two telephone circuits in tandem to provide long telegraph circuits, the telephone circuits are connected together through intermediate composite sets which permit the telegraph currents to pass but effectively separate the circuits for telephone communication.

Carrier Telegraph Systems.—The greatest contribution to the art of telegraph transmission over land lines since 1910 has been the application of vacuum tubes and the electrical filter which have made practicable the carrier current systems. Two carrier systems have been developed, one the high frequency system for use on open wire lines over which it is possible to transmit alternating currents of frequencies above the voice range, and another system for use over land cable circuits, which utilises the voice range of frequencies and so is called the voice frequency system.

High Frequency Carrier Telegraph System.—The high frequency system has been designed for operation over one pair of wires. Transmission in both directions is obtained by dividing the band of frequencies available (3,000 to 10,000) at about 6,000 cycles, and using one portion of the band for east to west transmission and the other portion for west to east. This separation is achieved by suitably designed electrical filters termed "directional filters." To obtain a number of telegraph channels, it is necessary to split up these wide bands—3,000 to 6,000 and 6,000 to 10,000—into narrower bands, but still of sufficient width to enable telegraph signals of good quality to be transmitted. Within the frequency range mentioned, 10 telegraph channels in each direction are obtained. An east to west channel is associated with a west to east channel, thereby providing the equivalent of a duplex circuit. A carrier system thus provides the equivalent of 10 duplex circuits.

Each channel of a high frequency carrier system comprises a vacuum tube oscillator, tuned to a particular frequency, the steady output from which is applied intermittently by the actuation of the sending key or other transmitting device used. These trains of alternating current waves are amplified, pass through a tuned selective circuit, combine with the signals from other channels and thence flow into the line. At the receiving end they enter a selective circuit which, being tuned to the same frequency, offers a path of low impedance to them but a high impedance to all other frequencies. The signals are then amplified and rectified, the rectified signals actuating a relay. To separate the carrier currents as a group from the currents used for ordinary telephony and telegraphy, "high pass" and "low pass" filters are used. This combination of filters is sometimes called a high frequency composite set. To separate the voice frequency currents from the currents of still lower frequencies used for the ordinary telegraph circuits, the ordinary composite set is used.

Carrier circuits of this type provide high grade signals, are very stable in operation and are free from the balance troubles of direct current duplex systems. This system has enabled the following communication facilities to be obtained commercially from a single pair of open wires: 20 one-way carrier telegraph channels, 4 one-way direct current telegraph channels, and 1½ telephone circuits including the phantom.

Voice Frequency Carrier Telegraph System.—The heavy telephone traffic in thickly populated territories has led to the use of cable circuits in place of open wire lines. To provide telegraph facilities over such routes, it would not be possible to use the high frequency carrier system because of the great attenuation of high frequency currents in cable conductors. The need for such facilities led to the development of a carrier system using frequencies within the voice range. This system has been designed particularly for use over four-wire telephone circuits so that the same frequencies may be used in each direction. Although fundamentally the same principle as the high frequency system, this system differs in a number of details. One multifrequency generator, furnishing currents of 12 frequencies from 425 to 2,295 cycles per sec., spaced 170 cycles apart, is the source of power, and is capable of feeding as many as 20 separate carrier systems, *i.e.*, 240 carrier channels. The steadily applied carrier current of each channel is interrupted by actuation of the transmitting key or other sending device.

This interrupted carrier current passes through a sending band filter constructed as to permit relatively free passage of current of frequencies slightly above and below the carrier frequency for which it was designed. To currents of other frequencies it offers a high impedance, and this practically excludes them. After passing through the filter, the current combines with currents of other frequencies from the other channels and passes over the line as a composite current. As the over-all range of frequencies and the energy levels are about the same as those of telephone circuits, standard telephone repeaters are used to relay the currents. At the receiving end, the carrier currents are separated by a group of receiving band filters, each of which offers a low impedance path to a relatively narrow band of frequencies comprehending that of a particular carrier frequency and acts substantially as an open circuit to other frequencies. After passing through the receiving filter, the current is amplified and then rectified, the rectified or direct current signals actuating a relay. An east to west channel and a west to east channel are combined to furnish the equivalent of a duplex circuit.

The above description applies particularly to a system developed in the United States. In Germany a somewhat similar system has been developed. The German system uses a separate vacuum tube oscillator for each channel and interrupts the

carrier currents to form telegraph signals, no sending filters being used. At the receiving end, four-electrode vacuum tubes are used for amplifying and rectifying the signals. Over a four-wire circuit, six telegraph channels in each direction are provided.

Direct Current Metallic Telegraph System.—The increase in knowledge of the fundamental requirements of simultaneous telephone and telegraph operation has enabled a direct current telegraph system to be developed for operation over long small-gauge telephone cable circuits. This system is arranged for metallic circuit working using a relay operating with a current of

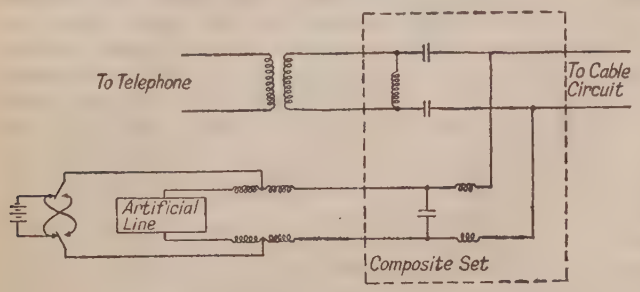

FIG. 2.—Schematic of Composite Set for metallic return telegraph system.

approximately two milliamperes. The general circuit arrangements of this system are shown in fig. 2. The cable circuit is divided by a composite set or filter into two branches, as has been described under *Composite Telegraphs.* All metallic circuits in a single office are supplied from a common battery. The type of sensitive polar relay, which was specially designed for this service, is shown in fig. 3. The relay is provided with four accurately balanced line windings and two additional windings for use

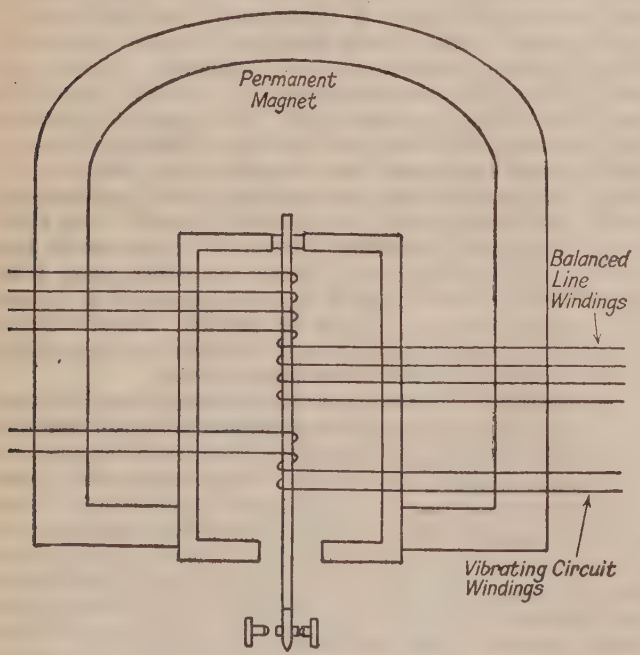

FIG. 3.—Polar relay for metallic return cable system.

in a Gulstad vibrating local circuit. The armature is a reed, fixed at one end, and forms the cross piece of a magnetic bridge. The six windings surround the armature. Current in one direction causes that end of the armature carrying the contacts to move towards one pole, and current in the opposite direction causes it to reverse its motion.

PRINTING SYSTEMS

Creed System.—This system, which came into use early in the present century, has been improved by simplification of apparatus units and elimination of need for air pressure. The new machines are actuated electrically and are capable of operating at much higher speeds than the earlier models.

Baudot.—Use of the Baudot multiplex printer system has been widely extended in Great Britain, and the system modified by British engineers. It has been duplexed, thereby doubling its traffic carrying capacity. Transmission is controlled by perforated tapes actuating automatic transmitters, instead of by direct keyboard operation, thereby permitting the rate of operation to be increased about 50%. Electrical vibrating reeds and phonic wheel motors are used to drive the distributors, ensuring stable synchronism.

Murray Multiplex.—This system of multiplex is based on the Baudot. Operators prepare messages by perforating paper tapes by means of keyboard perforating machines having a keyboard similar to a typewriter. Each key of the machine, when depressed, perforates a particular combination of holes in accordance with

FIG. 4.—Murray multiplex tape, showing perforations for word "TELEGRAPH."

the arrangement of the five-unit code adopted by Murray. Fig. 4 shows a portion of tape perforated to transmit the word "telegraph." From the perforating machine the tape passes directly into an automatic transmitter which has five selecting pins, each controlling a contact lever resting normally against a busbar connected to the spacing pole of the line battery. When a selecting pin passes into a hole in the tape, the associated contact lever moves over and makes contact with a busbar connected to the marking pole of the battery. The positions of the contact levers are therefore determined by the perforations in the tape. Each lever is connected to its own particular segment on the sending ring of the distributor, the five segments associated with a transmitter usually being placed in sequence around the ring, so that as the brushes pass over the segments a particular combination of signals representing a letter, comprising positive and negative impulses, is sent out to line. Immediately the brushes have passed over the last of the segments associated with a particular transmitter, a local current impulse is sent from another ring of the distributor through a "cadence" electromagnet in the transmitter, which when operated withdraws the selecting pins, feeds forward the paper tape and sets up the next letter combination. Provision is made to prevent the transmitter overtaking the perforating operator by causing a taut tape between the two machines to move a light lever and so open the circuit of the "cadence electromagnet," thereby stopping the operation of the transmitter. As soon as the tape slackens the lever is restored to normal and the transmitter starts again.

American Multiplex Systems.—The Western Electric and Western Union Telegraph companies jointly developed a multiplex printer system primarily to meet the needs of the Western Union Telegraph Company. It resembles the Murray system as regards use of keyboard perforators, rotating distributors and page printers, but differs from the Murray in many details. Instead of transmitting extra signals per revolution of the distributors to maintain synchronism, correcting impulses are generated from the character signals, thus saving line time. A large vibrating fork is used to drive a phonic wheel motor, which is the motive power for the distributor. Various types of printer units have been successfully used with this system. All circuits are operated duplex, and double, triple and quadruple channel systems are in service. Speeds as high as 50 and 60 words per min. per channel are maintained by operators. Another American multiplex printer system has been developed by the Morkrum-Kleinschmidt Company. This system does not differ radically from that described above except for the utilisation of cam-controlled contacts in place of segmented ring distributors with rotating contact brushes.

Siemens and Halske Automatic System.—This system is a single channel high speed synchronous printer system, using a five-unit code. At the sending end the operations are practically identical with those of the Wheatstone, Creed and Murray Automatic. A number of operators prepare perforated tapes which are passed to an operator who feeds them into the transmitter. The hole combinations are arranged across the tape as in the Murray multiplex, but the tape has two rows of feed holes, one along each edge. The tape is not stepped forward but moves uniformly, the transmitter being geared to the distributor brushes. No special signals are transmitted to maintain synchronism, correcting impulses being derived from the message signals. When no messages are being sent, provision is made for sending a signal once per revolution to maintain synchronism. The sending distributor brush arm is driven by a shunt wound motor, having a heavy flywheel mounted on the same shaft.

The receiving and translating arrangements of the receiver are almost entirely electrical. The brush arm of the receiving ring is mounted on the same shaft as the typewheel. The exact position of the typewheel when the paper tape is momentarily pressed against it to print a letter is determined by the particular signal combination set up in one or other of two groups of storing relays. Synchronism is maintained by varying a resistance in the field of the driving motor of the distributor. The printed tape is pasted on message forms, as is the practice with all tape printing machines. Provision is made for receiving messages as perforated tapes by associating one of the keyboard perforators with the receiving ring segments. The system may be worked simplex or duplex, and is capable of operating at a maximum speed of 1,600 letters per min. in each direction, *i.e.*, 166 words in the English language.

Start-Stop Printer System.—A "start-stop" system is one which provides for the transmission of one message over a circuit, or, when duplexed, one message in each direction simultaneously. The term "start-stop" has been adopted because the distributor brush or equivalent rotating mechanism is started and stopped once per revolution. Start-stop sets are in wide use in the United States, where several types have been designed. One type comprises a keyboard transmitter, a motor-driven brush distributor and a printer. In some cases the keyboard is arranged to control a perforator, so that messages may be transmitted either direct from the keyboard, or set up as perforations in a tape and so control the operations of an automatic transmitter.

The distributor brush arms (one on each face of the distributor), driven through a friction clutch, are normally held stationary by a latch and make one rotation for each character transmitted or received. The start impulse releases the sending start-latch and actuates a relay at the distant station to release the receiving start-latch, so that if the rotation speeds are approximately the same the transmitted impulses are distributed properly to the selecting magnets or elements of the printer at the receiving station. In duplex operation, the sending brush arm and receiving brush arm rotate independently of each other. Close synchronism is not required, since the distributors are stopped and caused to start from the same initial position for each character. This feature automatically takes care of line lag and renders the system well adapted for use on circuits having a number of stations operating simultaneously. These systems have been used to a considerable extent over telegraph circuits obtained from telephone circuits and have a maximum speed of about 360 letters or characters per minute.

Another type of set has a battery of cams mounted within the printer to take the place of the brushes and segmented rings of the distributor. Either a page printer capable of operating at 360 letters per min. or a tape printer at about 270 letters per min. may be associated with this set.

Cipher Printing System.—A printing system for rapidly enciphering and deciphering telegraph messages has been developed by the engineers of the American Telephone and Telegraph Company. It was successfully applied by the U.S. Army Signal Corps during the World War, when enciphering and deciphering were performed with increased speed and accuracy.

Gulstad Relay.—In 1898 Gulstad of Copenhagen invented a modified form of polarised relay known as a vibrating relay, the use of which has enabled much higher speeds of working to be attained on all types of telegraph circuits using polar or double current transmission. The principle of the relay may be understood by referring to fig. 5. It will be seen that the ends of the local windings are joined to terminals B and C and their centre to terminal A, which is connected through an adjustable resistance Y to the relay tongue. This resistance is for regulating the local current so that the magnetic effect produced thereby is less than that produced by the steady line current through the line windings. Terminal B is connected to ground through a condenser K and terminal C through a resistance X. Generally, resistances X and Y are made equal.

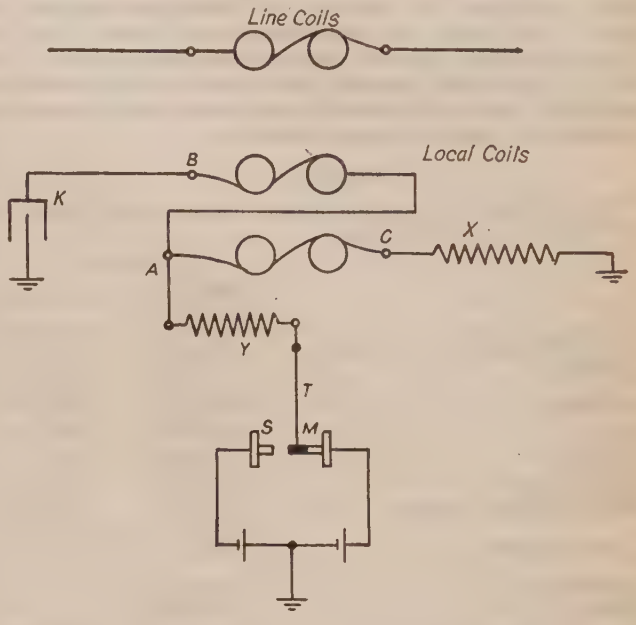

FIG. 5.—Schematic of connections for Gulstad relay.

Assuming that there is no current in the line windings and the relay tongue has just reached the contact M (Marking), there will then be a momentary rush of current through the winding AB to charge the condenser K, in a direction to keep the tongue to the marking side, thus preventing any tendency of the tongue to rebound. This charging current quickly ceases as the condenser becomes charged and directly its intensity falls below that of the current flowing through the winding AC, the preponderance of the latter causes the tongue to move toward the spacing contact S. Immediately the tongue leaves the marking contact, the condenser K discharges through both windings BA and AC in such a direction as to accelerate the movement of the tongue, so that its transit time from one contact to the other is thereby lessened.

When the tongue reaches the opposite contact, the condenser K is again charged, but this time from the other pole of the battery; a similar cycle of effects therefore takes place on that side, and the tongue moves in the reverse direction. In this manner the relay tongue is kept vibrating at a speed depending on the values given to the condenser and resistances and the distance of travel of the tongue between its contacts. In practice, the adjustments are such that the rate of vibration of the tongue under the control of the local current is approximately equal to the rate at which the transmitter at the distant station sends reversals at working speed. When this obtains, the signals passing through the line windings merely determine the length of time that the tongue remains in contact with either stop, its movement therefrom being effected by the local current through the local windings as soon as the strength of the line current falls below that of the local current in the winding AC.

Interference.—Ground return telegraph circuits are subject to three sources of interference which impair or degrade them,

namely, induction from AC power lines, induction from other telegraph circuits along the same route and differences of direct current earth potential between the terminal stations. In the first case, where the frequency is not too close to that of the telegraph, the interference can be considerably reduced by the provision of tuned drainage shunts, high impedance anti-resonant series devices and by reducing the responsiveness of the receiving circuits to the interfering current by balancing arrangements. Where possible, it is usually preferable, however, to locate and eliminate the source of the induction. This is particularly true in the case of high-speed telegraphs, where the above methods are generally inapplicable. In the second case, the interference is usually mutual between several conductors and is more generally experienced on cable circuits. This interference can be greatly diminished by coupling the duplex sets together by means of condensers and transformers so as to neutralise the current introduced through coupling between the lines. The effect of local ground potential differences can be overcome by supplying a counter electromotive force from a special generator automatically adjusted for neutralisation.

Statistics

The following table gives the miles of telegraph wire throughout the world, Jan. 1 1924 and 1910.

	Single Wire Jan. 1 1924	Jan. 1 1910
Great Britain and North Ireland	299,307[2]	311,942[2]
Denmark	9,352	8,048
France	495,000[1]	379,888
Germany	484,514	388,412
Italy	255,000[1]	126,505
Norway	20,138	13,120
Sweden	51,967	40,171
Switzerland	25,318	16,336
Other countries in Europe	936,416	826,730
Total Europe	2,577,012	2,111,152
British India	347,295	..
China	87,000[1]	..
Japan	162,397	97,300
Other countries in Asia	175,487	399,030[1]
Total Asia	772,179	496,330
Egypt	23,067	..
Union of South Africa	44,912	46,853
Other countries in Africa	118,618	110,000[1]
Total Africa	86,597	156,853
United States	1,875,000	1,480,000
Canada	270,782	153,000
Mexico	76,105	..
Other countries in North America	48,345	78,000
Total North America	2,270,232	1,711,000
Argentina	175,875	..
Brazil	95,463	..
Chile	38,090	..
Other countries in South America	50,759	..
Total South America	360,187	143,590
Australia	97,438	92,909
New Zealand	23,067	20,188
Philippine Islands	9,200	..
Other places in Oceania	21,678	14,700
Total Oceania	151,383	127,797
Total world	6,317,590	4,746,722

[1] Partly estimated. [2] For Great Britain, exclusive of Ireland.

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TELEGRAPHY, SUBMARINE (*see* 26.527).—Improved methods of working have been introduced and apparatus has been invented with the object of increasing speed and reducing error in transmission and reception.

Signalling Difficulties.—One of the factors which limit the speed of signalling over a submarine cable of any considerable length is its inductive capacity due to which the impulses forming the letters, which are transmitted into the cable lose their definition and appear at the receiving end distorted and attenuated in what might be described as a spread out condition. The maximum speed of signalling is therefore that at which it is possible to distinguish between the various impulses or sets of impulses in order to make the signals readable.

The siphon recorder is still the instrument generally employed for recording these signals, but whereas in the past the messages were written up by hand, the recorder is now usually employed for watching the shaping of the signals and for adjustment purposes, the signals actuating a train of automatic apparatus by which the messages are typed or printed. By the introduction of appropriate capacity and inductance into the sending and receiving circuits it is possible to improve greatly the received signals which although reduced in size are much more clearly defined, thus allowing an increase in the speed of transmission.

Magnifiers.—By the use of a magnifier the received signals can be increased in size and, in turn, the speed of transmission may again be raised. Magnifiers can seldom be employed to their full advantage on account of imperfections in the duplex balance and local disturbances due to induction from other circuits and electric tramways or power mains, but their introduction usually permits an increase of speed of about 30%. In order to minimise the disturbances compensating devices are employed necessitating the use of twins or tricore shore-end cables, the actual point of earthing the circuit usually being some miles out at sea. Several forms of magnifier are employed which depend on the movement of a suspended coil as in the case of the siphon recorder, but the movement is utilised to bring about the operations described hereafter instead of deflecting the glass tube. An ordinary siphon recorder is usually employed in conjunction with the magnifier to register the resulting signals.

The Heurtley Magnifier.—This operates by upsetting the equilibrium of a Wheatstone bridge balance, two arms of which are composed of extremely fine wires. The wires carry current and, in the earlier form of the apparatus, are moved by the action of the coil so that they become immersed in or shielded from a current of air. The resulting change in temperature causes an alteration in their resistance values and thus affects the recording instrument connected in the cross circuit of the bridge. In a

later form a pair of hot wires carrying current are moved towards or away from a similar but fixed pair thus varying their temperature and in consequence, their resistance.

The Judd and Fraser Magnifier.—This instrument depends on the movement of an electrode between two fixed ones immersed in an electrolyte such as dilute sulphuric acid. The resistances of the electrolyte between the moving and fixed electrodes form two arms of a Wheatstone bridge the remaining arms being adjustable resistances. Thus, any displacement of the movable electrode from its symmetrical position between the fixed ones consequent upon deflection of the suspended coil has the effect of upsetting the balance, thereby causing a current to flow through the coil of the recording instrument which is connected in the cross circuit of the bridge.

In order to avoid the production of gas and a polarising of the electrodes the current which is passed through the electrolyte is an alternating one. This is brought about by the use of an electrically driven reed carrying a contact head so designed that the positive and negative poles of the battery are rapidly reversed. Simultaneously the current in the recording instrument is rectified by means of a second set of contacts mounted on the same reed. A blocking condenser is included in the circuit to prevent the passage of any direct current through the electrolyte. In a later form a three-electrode valve and transformer are introduced to amplify further the current before rectification.

The Cox Magnifier.—In this type a specially constructed selenium cell is divided into two sections which form two of the arms of a Wheatstone bridge. A beam of light is passed through a metal comb and reflected on to the cell by a small mirror mounted on the suspended coil. A deflection of the coil causes one portion of the cell to become darkened and the other to become increasingly illuminated thus bringing about a change in the resistance values of the two sections of the cell and operating the recording instrument or relay in the cross circuit.

The Orling Magnifier.—A jet of liquid, such as acidulated water, is deflected by a fine wire attached to the suspended coil, which wire intersects or penetrates the stream. A slight movement of the coil and wire will cause a considerable deflection of the stream which may complete a recorder circuit by coming into contact with one or other of the two conductors situated one on each side of the initial and normal position of the axis of the stream. Alternatively, the stream when deflected may provide a temporary bridge between one or the other of the two pairs of contacts.

Thermionic Valves.—These have also been used very successfully in connection with cable circuits for amplifying purposes.

Relays (Repeaters).—If, instead of tracing the signals by means of a glass tube as in the case of the siphon recorder, the moving coil be employed to make electrical contacts, retransmitting apparatus taking current from a local battery may be operated, thus repeating the weak incoming impulses into a second cable as strong signals. An instrument of this description is known as a relay and on a long cable such an instrument may be used in conjunction with a magnifier. The speed at which a cable may be worked depends very largely on its KR, this being the product of its inductive capacity (K) expressed in farads and its ohmic resistance (R). It is, however, dependent to a certain extent on the voltage employed for transmitting, an increase giving a somewhat higher speed. It is usual to consider that the speed at which cables may be worked varies inversely as their KRs and if, therefore, a cable, say, 3,000 m. in length and having a KR of 6 could be diverted into an island situated half way along, the KR of each section would then be 1·5 since both the resistance and capacity values are reduced by one-half. The through speed of working could then be increased four times if an automatic relay were installed at the intermediate station.

Relays by Dr. Muirhead and S. G. Brown are in considerable use and the "Jockey" relay introduced by the Eastern Associated Telegraph Companies is now almost exclusively employed in their service. This relay permits of the use of ordinary shaping conditions and does not, as in other cases, necessitate the use of an unshunted receiving condenser in the coil circuit in order to block out earth currents which would otherwise involve a disturbance of the zero position of the coil thus causing bias or thickening of the signals on one side and thinning on the other.

When an unshunted condenser is employed to obviate this trouble a "local correction" is necessary to counteract the overcurbing or falling away of the received signals consequent upon the use of the condenser. This is usually applied by means of a second winding on the suspended coil, the current through which is adjusted to vary at the correct rate and strength to hold up the signals. With the "Jockey" relay a correction of this sort is unnecessary since by the use of a resistance shunt over the receiving condenser the overcurbing or falling away of the signals is obviated. The relay contacts are mounted on a frame suspended on a pivot and free to move as the contact tongue attached to the main coil is deflected by the earth current. The frame or "jockey" carrying the contacts is so damped by means of vanes immersed in oil that it is not displaced under ordinary signalling impulses but is nevertheless able to respond to the relatively slow changes of coil zero brought about by earth current variations, thus keeping the contacts symmetrically disposed with regard to the contact tongue operated by the coil.

Bruce Relay.—In a relay introduced by W. M. Bruce, a contact tongue attached to the suspended coil rests on a revolving drum divided into three insulated contact sections as in the case of S. G. Brown's relay. Each of the two outer sections with which the tongue makes contact when the coil is deflected to one side or the other, is connected to the grid of a three-electrode valve in the anode circuit of which the windings of a translating device or relay are included. Since it is only necessary to transmit potential to the grids in order to allow of the passage of anode currents to operate the translating device, the resistance of the contact between the tongue and revolving drum is not of great importance, and light contact pressure may be employed, thus reducing the mechanical damping of the coil and allowing of increased speed of signalling.

Automatic Working.—Automatic working has resulted in a very great reduction in the time of transmission of traffic and also in improved accuracy. The monthly statistics carefully compiled by the Eastern Associated Telegraph Companies show that the error percentage for automatic working is approximately one-fifth to one-sixth of that for manual working and except for the initial operation of preparing the perforated tape for transmission the system adopted on nearly all main line cables is entirely automatic. As an example, a message handed in in London is dealt with by an operator who by means of a perforator, the keyboard of which resembles that of a typewriter, prepares a perforated paper tape which is run through a transmitter thus sending into the cable electrical impulses corresponding to the perforations in the tape. These signals are automatically repeated by apparatus installed at the various stations along the route so that a message for Australia, India, South America or China arrives at its destination without any further reperforating or retransmitting by manual means. At the terminal station an automatic perforator produces a tape which is a replica of that originally prepared in London. This in turn passes through a printer which types out the message in the form in which it is delivered.

Distortion Effect and Remedy.—The signals received from a cable of any considerable length when working at a speed approaching the maximum, are somewhat distorted and it is undesirable to retransmit these signals through a number of cables linked together by relays since the distortion is cumulative. Certain stations along the route are therefore provided with automatic receiving perforators in place of simple relays so that a perforated tape is prepared and immediately passed through a transmitter thus sending perfect signals into the next cable and thereby ensuring accuracy and avoiding a reduction in the through speed of transmission.

The Regenerator.—The delay introduced by this method of working, known as tape-translation, is small but the recent advent of a system of retransmission employing an instrument known as the "Regenerator" allows of the direct linking up by

relays in conjunction with this apparatus of a greater number of cables, thus decreasing the total delay as well as reducing the chance of error by the retransmission of perfectly corrected signals at each stage. The comparatively large tolerance of the regenerator for correctly interpreting distorted signals depends to a great extent on the fact that it is running at exactly the same speed as the transmitter at the distant end of the cable; further, it is also able to follow any slight alteration in the speed of transmission. This is effected by taking the average time of arrival of the signals and comparing it with a predetermined position of a point on the shaft of the retransmitting apparatus. If this time differs, corrections are caused to occur to increase or decrease either momentarily or permanently the speed of the shaft so as to maintain the operative parts on the shaft in constant relation to the incoming signal. Special precautions are, however, taken to ensure constant speed and both transmitting and receiving instruments are run by phonic motors which are controlled by electrically driven reeds or tuning forks. Although the frequency of vibration of the type of reed employed is for nearly all practical purposes constant, a high grade electrical clock is in many cases used to control the reed in order to eliminate any small variation due to temperature changes or other causes.

Performance.—As an example of the speed of transmission, His Majesty the King's message comprising 12 words announcing the opening of the British Empire Exhibition at Wembley on April 23 1924 was flashed round the world by the submarine cable systems in 80 seconds. The route was as follows:—

The Stadium-Penzance-Fayal-Halifax by the Imperial (British Government System). Halifax-Montreal-Vancouver-Bamfield-Fanning-Suva-Auckland-Sydney by the Pacific Cable Board's system. From Sydney by two routes, both of the Eastern Associated Companies' system as follows: (1) Sydney-Adelaide-Perth-Cocos-Rodriguez-Durban-Capetown-St. Helena-Ascension-St. Vincent-Madeira-Porthcurnow-London. (2) Sydney-Adelaide-Darwin-Singapore-Madras-Bombay-Aden-Suez-Alexandria-Malta-Gibraltar-Porthcurnow-London. The messages arrived in London simultaneously at 11:50–55 A.M. having been despatched from the Stadium 80 seconds previously at 11:49–35 A.M. The total distance traversed via the South Africa route was, in round numbers, 32,300 m. made up of 26,000 m. of cable and 6,300 m. of landline. By the Indian route the total was 30,000 miles including roughly 8,200 m. of landline.

At the end of 1924 there were some 3,500 submarine telegraph cables in operation, having a total length of over 332,000 nautical miles, approximately 77,700 m. being administered by the various governments and the remainder by private companies. Of the latter approximately 144,000 m. are owned by British Companies, 83,000 m. by American Companies and the remainder by Companies of other countries. Since the above date several additional cables have been laid and no less than 26,000 m. were contracted for in the twelve months following June 1924.

Superposing.—By means of a system introduced by Dr. Pernot and L. Rich three messages are transmitted simultaneously over submarine cables and good results have been achieved on one approximately 1,100 m. in length. The cable is worked duplex in the ordinary manner and in addition, signals are transmitted in one direction by means of an alternating current of a frequency of the order of 40 cycles per second. The direct current for the ordinary duplex working is provided by a small motor-generator the generator field of which is excited from a battery joined up through the contacts of an automatic transmitter. Connected in series with the armature of this generator is the stator of a small alternator the field of which is energised from a battery through the contacts of a second transmitter.

Suitable tuned circuits and filters are included in the circuit at the sending and receiving stations in order to avoid interference and to separate out the alternating and direct currents. The former are amplified by means of thermionic valves and eventually operate ordinary telegraphic apparatus as employed for direct current working. This system which is a form of "wired wireless" was first installed with very satisfactory results on one of the Eastern Telegraph Company's cables between Gibraltar and Malta.

The Loaded Cable.—The submarine cable of the future undoubtedly will be of the new loaded type. The number of words per minute that can be sent through an ordinary submarine cable is limited owing to the signals being distorted as they pass through the cable, so that at a certain speed they become unreadable. In the loaded cable this distortion is very largely eliminated and on a long cable a working speed in one direction of as much as ten times that of an ordinary cable of similar length may be attained. The loaded cable is so named because of its peculiarities being similar to a certain mechanical analogy. The ordinary cable can be likened to a light rope stretched tightly in water and the process of signalling to lateral movements at one end that cause waves to pass along the rope. These waves will rapidly diminish in size due to the friction of the water, but if the rope be weighted or "loaded" with weights at short intervals, the waves will travel along the rope with much less loss of size, owing to there being more energy associated with the waves. The loading of a cable is obtained by increasing its inductance or electrical mass.

One method of accomplishing this is to insert at intervals along the cable loading coils comprising an insulated conductor wound around a metal that will become magnetised when a current is passing through the cable and winding. The insertion of these coils presents mechanical difficulties, especially where the cable is to be laid in deep water as would usually be the case where a long cable is concerned, and the necessity for an increase of speed most apparent. It may, however, be possible to introduce inductance in this form, known as "lump loading" into existing cables which are not laid in very deep water. The possibilities of loading have been realised for many years, and cables loaded with soft iron wire were laid over twenty years ago for telephone purposes. The small increase of inductance due to soft iron makes it unsuitable for use for long telegraph cables and it is the recent development of nickel-iron alloys that has made the loaded telegraph cable a successful project. (*See* TELEGRAPHY.)

Continuous Loading.—The introduction of these nickel-iron alloys of high permeability for low magnetising forces has made it possible to employ "continuous loading" which does not alter the present regular form of the cable or add to the difficulties of laying or raising for repair. This alloy is employed in the form of a fine wire or tape which is wound continuously and directly around the copper conductor before the gutta percha insulating sheath is applied. The first telegraph cable of this description was manufactured in England and laid for the Western Union Telegraph Company in Sept. 1924 to connect New York with Horta in the Island of Fayal, Azores. Another cable was laid in March 1926 for the Eastern Extension Company to connect Cocos Island with Perth, Western Australia.

A cable of this type can work at a very high speed when compared with an unloaded cable of the same length and having similar weights of copper and gutta percha per mile. On such a cable the actual speed in letters per minute attainable is above that of any automatic receiving apparatus at present available for directly printing the received traffic or for producing a perforated tape which can be utilised for operating a printer. The use of receiving apparatus comprising thermionic valves and a specially constructed high speed siphon recorder would necessitate the introduction of a manual operation for preparing the message for retransmission or delivery, such as perforating, writing or typing from the tape on which the signals are recorded and this would undoubtedly result in delay and increased percentage of error.

It therefore appears likely that a multiplex system such as employed on fast landlines will eventually best meet the requirements, so that several messages will be transmitted to all intents and purposes simultaneously. For example, by adopting the Baudot or similar system it would, no doubt, be possible to operate a number of channels up to say, six, each dealing with about 40 words per minute.

Experiments are also being made with a view to the simultaneous transmission of signals by alternating currents at different frequencies, these being separated out at the receiving end by means of tuned circuits and filters. The problem of "duplexing" a loaded cable presents a number of difficulties but

research work is being carried out with a view to the production of a satisfactory "artificial line" to copy as nearly as possible the characteristics of the cable. (J. D.-P.; N. C. G. W.)

TELEKI, PAUL, COUNT (1879–), Hungarian politician and geographer, studied jurisprudence and geography in Budapest. After being elected to Parliament in 1905 he spent some years in geographical study abroad, and published *Atlas zur Geschichte der Kartographie der Japanischen Inseln* (Budapest, 1909), which was crowned with the Prix Jomard by the French *Société de Géographie*. During the early part of the World War he served as an automobile officer in the campaign against Serbia and found time to prepare a handbook on *The History of Geographical Thought* (1917). When the revolution broke out he retired from public work and produced a number of ingenious maps showing the national minority problems and economic situation of Hungary. Teleki organised the scientific side of the preparations for the Peace Conference, making an exhaustive and enlightening exposition of the Hungarian case. He was appointed Minister for Foreign Affairs in the first parliamentary cabinet of Admiral Horthy, the Regent (April 1920), and in July of the same year became Prime Minister. He resigned in 1921 after the first attempt of King Charles to regain his throne. Later in the year he was appointed professor of economic geography in the University of Budapset. In 1924 he served in a scientific capacity on the commission appointed by the League of Nations to enquire into the Mosul frontier dispute between Great Britain and Turkey.

Teleki's works include, besides those already mentioned, *The Evolution of Hungary and Its Place in European History* (New York, 1923); Ethnographical Map of Hungary (1920); *Economic Geography of America* (1922, Hungarian).

TELEPATHY: *see* PSYCHICAL RESEARCH.

TELEPHONY (*see* 26.547).—The steady sequence of improvements in exchange cable which began with the installation of the first cable of this type in 1882 has, in the years now under review, included a 900-pair, 22-gauge[1] cable in 1912; a 1,200-pair, 24-gauge in 1914; followed by the 450-pair, 19-gauge cable in 1918, which because of the large size conductors it contains is being extensively used for the building of long toll lines, as will be mentioned in the paragraph *Long-Distance Telephony by Cable*. These increases in the number of conductors—increases of from 200% to 500% over the original value—have all been accomplished without any increase in the outside diameter of the sheath, which still remains, for the largest sizes, at $2\frac{5}{8}$ inches. Along with these increases in number of conductors has gone a notable decrease in the first cost per mile of installed cable conductors. The same developments are also making possible corresponding economies in all smaller sizes of cable which, because of fewer conductors, do not require the maximum size of sheath. A change in cable sheath material has also been effected which makes possible an equally durable sheath at a lower cost. The new sheath consists of lead alloyed with 1% of antimony instead of 3% of tin as formerly.

Telephone Repeaters.—One of the outstanding achievements of the period 1910–26 is the development of long-distance wire telephony to the point that the voice can be carried over practically any terrestrial distance. In this advance the telephone repeater has played a dominant part. The repeater in its present form employs the three-electrode thermionic vacuum tube as the amplifying agent for telephone currents and also includes balancing networks, electric filters and means for controlling amplification, their association calling for great precision of design and manufacture. The first and one of the most notable achievements, employing the thermionic telephone repeater, was the opening for public service, in 1915, of the telephone line between New York and San Francisco, a distance of some 3,400 miles.

In 1921, in order to cope with an increasing demand for transcontinental service, the loading coils were removed from this line and repeaters of an improved type were applied in place of the original six. This change made the circuits suitable for the application of carrier current facilities, and also resulted in a large improvement in the clearness and volume of transmitted speech. The four wires of the original transcontinental line now furnish three telephone circuits and, over certain sections, as many as 20 telegraph circuits. Some picture of the accuracy and amplifying power of the telephone repeater can be gathered from the fact that, in passing from New York to San Francisco, the voice current is amplified over a million-million fold and yet arrives with all the clearness and intelligibility with which it starts.

[1] The wire gauge here referred to is A.W.G.

Long-Distance Telephony by Cable.—As the demand for long-distance telephone service increased, it was foreseen that ultimately the need would arise for an improved type of long-distance circuit offering increased electrical stability and increased immunity from damage and disruption by storm. Moreover, large densities of traffic made desirable a long-distance circuit more compact physically than those in use. Accordingly, research was undertaken along various lines with the object of removing the restriction which had always limited the use of cable circuits to relatively short distances. The success of these researches is attested by the long telephone cable (over 900 m.) which has been completed between New York and Chicago at a cost of $25,000,000. It supplies approximately 250 telephone channels and 500 telegraph channels. Among the developments which have made this cable possible are: improved designs of cable, improved methods for minimising capacity unbalance, means for automatically controlling the amplification of repeaters (as the resistance of the wire circuit to which they are attached varies with temperature), new and very compact types of telephone repeaters and other office equipment and new systems of telegraphy. One system of land cable telegraphy employs a unidirectional line current of about 1/20th the magnitude of the current employed in the standard grounded telegraph circuits; and another, known as "voice frequency" carrier telegraphy, supplies 10 duplex channels in the frequency band required for a single speech channel. New systems of loading designed to reduce "transient" and "echo" effects have also contributed to the success of the cable. In this connection, it may be pointed out that whereas it has become economically desirable, as noted in a preceding paragraph, to remove all loading from certain long, open-wire lines, nevertheless long cables depend upon loading because of their intrinsically higher attenuation.

The Echo-Suppressor.—One of the many novel developments underlying the successful long-distance cable is the "echo suppressor." In talking over very long cable circuits an appreciable interval of time exists between the uttering of the speaker's words and the return of reflected transmission or the "echo" to his ear from the distant end of the cable. This time interval is in the neighbourhood of $\frac{1}{10}$ of a second and early investigations showed that, to the average telephone user, appreciable echoes having such a delay are not only very noticeable but extremely confusing. The voice-operated echo suppressor was, therefore, devised automatically to restrict transmission on the circuit to one direction at a time. The long telephone cable, possessing a high degree of electrical stability and placed either underground or on heavy poles, is a type of long-distance trunk line which will become increasingly important in the future, particularly between large cities.

Carrier Current Telephony and Telegraphy.—From the earliest days of both the telephone and the telegraph there have been many attempts to develop methods for the multiplex transmission of messages employing relatively high frequency currents as "carriers." It was not until the development of the thermionic vacuum tube, however, that carrier systems were brought within the realm of practicability. These tubes are used in carrier systems as repeaters or amplifiers, as generators of the different carrier frequencies and as "modulators" and "demodulators" for respectively combining the messages with and separating them from the carrier currents.

These systems also employ extensively another important device which was given to the electrical art contemporaneously with the vacuum tube repeater. This is the electric wave filter.

This remarkable device can be so designed as to select any predetermined band of frequencies, rejecting all others without absorption. The rôle that the filter plays in carrier systems as a means of separating one message from another is therefore obvious.

Both carrier telephone and carrier telegraph systems have been extensively applied since 1918. When multiplexing a pair of telephone wires, it is customary to add either three or four high frequency channels to the voice frequency channel, thus increasing the message capacity of the wires either four or five fold. In the case of carrier telegraphy, the message capacity of a wire circuit may be made much larger and systems are in use in which as many as 10 to 20 carrier frequency channels are placed upon a single pair of wires. The shortest length of line which it is now economical to multiplex with carrier facilities lies between 150 and 200 m.; but it is expected that as further improvements and simplifications are made, the limiting distance will be brought down to a much lower figure.

Transmission Measurement and Maintenance.—The successful maintenance of vast networks of long-distance telephone circuits, both open wire and cable, has in large measure been made possible by the development of accurate means for making transmission measurements. Great success has been attained in the development of measuring apparatus, which, although of an exact and complicated character, is so simple of manipulation as to be used continuously in extensive daily programmes of routine measurements. In this apparatus, use of vacuum tube amplifiers permits the measuring of minute quantities by instruments that are rugged and, wherever necessary, readily portable.

Radio Telephony.—Since 1911 the entire growth, if not the actual birth, of the radio telephone art has taken place. Like the developments in carrier systems this rapid progress has been largely due to the high standards attained in the design and manufacture of thermionic tubes. An early radio telephone achievement was the transmission of speech across the Atlantic Ocean in 1915. The development of radio telephone apparatus was undertaken during the World War for such purposes as continuous communication between observing aeroplanes and artillery stations behind the lines, and between the units of a destroyer flotilla.

Following the War, public interest in the possibilities of radio telephony was quickly awakened, with a consequent rise of broadcasting (*q.v.*). The development of radio telephony for commercial message uses may appear, in contrast to the rapid strides of broadcasting, to have lain dormant. However, notable progress has been made. Immediately following the War, the development of radio systems for establishing ship-to-shore telephone communication began. In 1920 an experimental system was demonstrated by American telephone engineers which enabled a passenger on a ship several hundred miles at sea to communicate with any telephone subscriber on land through the latter's regular instrument. To accomplish this, the message was carried over the water by radio and at a coastal station was relayed to the land lines, which, in the case of one demonstration, were 4,000 m. long. The system was entirely two-way in its operation, in that it permitted the telephone subscriber and the person at sea to hold a conversation exactly as over the usual telephone circuit. Thus far no very extensive installation of ship-to-shore radio telephony has been made, largely because of the numerous commercial difficulties involved, although a limited service of this sort is, it is understood, offered by some German steamships.

Transatlantic Radio Telephony.—In 1920 a serious study of transatlantic radio telephony was undertaken. The difficult character of the technical problems involved may be inferred from the fact that, due to the extreme variability of atmospheric conditions as they affect the transmission of radio signals, the sending power required to produce a given effectiveness of received signal may increase by several thousand times within the space of a few hours. To ensure even reasonably reliable communication at all times of day and throughout all seasons of the year, therefore, necessitates transmitting stations of large reserve power and special receiving systems to reduce the interfering noise arising from atmospheric disturbances.

Another difficult requirement to be met is that the transoceanic radio link must automatically relay messages to and receive messages from the wire lines in both Europe and America, so that it will be as easy for two telephone subscribers, wherever placed, to converse as though each were located at one of the radio stations. To illustrate the progress made, the demonstration of March 7 1926 might be cited, during which some 20 press representatives in London had two-way conversations with their American confrères.[1] In this test, transmission was effected by wire from New York to the radio transmitter located about 70 m. out on Long Island, where it was automatically relayed to the transatlantic radio link.

Wire Telephony as an Adjunct to Radio Broadcasting.—Early in the development of radio broadcasting, it was apparent that the popularity of the programme would be greatly augmented by bringing to the broadcasting station events of public interest such as large orchestral programmes, sporting events and national ceremonies. This virtual extension of the walls of the studio by the use of telephone lines is now a matter of almost daily occurrence, particularly in England and America. As many as 25 or more broadcasting stations are sometimes joined together by a wire network to disseminate the same programme.

Transmission of Pictures (*see* PHOTO-TELEGRAPHY).—Over a long period of years, many schemes were proposed for the electrical transmission of pictures. Although these early systems were in most cases physically operative, none proved practical. To be of commercial value, a system must be at once simple, rapid and accurate. It has remained for developments of late years to meet adequately all of these requirements. In April 1925 the first commercial picture-transmission service, a development of the Bell Telephone engineers, was introduced. This service, embracing the cities of New York, Chicago and San Francisco, made possible the transmission of pictures in either direction between any of these points. The actual sending time of a 5-in. by 7-in. picture is but seven minutes. At the sending end, the picture is required simply in the form of a positive transparency made by the ordinary photographic process, and after transmission it appears as a negative film from which prints can be produced without delay. As it is possible to transmit while the positive transparency is still wet, the total time of transmission is reduced to a minimum.

Machine Switching Systems.—A retrospective examination of the manually operated switchboard discloses the fact that the tendency of development has been continuously in the direction of increasing the number and extent of the switching operations that are performed electromechanically, thus decreasing the amount of time and effort required of the operator for the handling of a connection. When a point is reached where the operations performed manually at the central office are entirely eliminated, except in the case of certain special classes of calls, the term "automatic" or "machine switching" is applied to the equipment. In this equipment the subscriber's telephone set is furnished with a finger-wheel or dial having 10 finger holes. These holes are designated by the 10 digits, and for the larger cities also by letters. By inserting a finger in one of the 10 holes, rotating the dial to a stop and then letting it return under the control of a spring, the calling subscriber sends to the central office mechanism a series of from one to 10 electric impulses. In this way the number is given by electrical impulses rather than called, the operation of the dial conveying to the central office mechanism the necessary guiding impulses for setting up the connection desired.

Main Types.—There are three principal types of machine switching equipment in extensive use, viz.: the "panel," "step-by-step" and "rotary" types. These names refer to the mechanical design of the devices termed "selectors," which are supplied in the central offices to switch the subscribers' lines into connection with each other. A selector consists of a set of movable terminals which can be connected with any one of a number of sets of fixed terminals and takes the place of the flexible cords, plugs and jacks of the manual switchboard. For

[1] See *Nature*, p. 386 (March 13 1926).

example, in the " panel " type of selector the movable terminals are driven up and down in a straight line over the fixed terminals, which are placed on a flat surface in the form of panels. The step-by-step system was first developed for use in small cities, but redesigned for use in London. The other two systems were developed particularly for use in large cities.

New Magnetic Materials.—Among the new magnetic materials developed for telephone purposes, two deserve special mention. One consists of very finely-divided iron dust cemented together under extremely high pressure to yield a material of substantially the same density as iron, of only $\frac{1}{20,000}$ the electrical conductivity of iron. The product has nearly the same initial permeability as iron, and yet because of its finely divided ingredients, and the consequent microscopic free poles distributed throughout it, the material possesses practically no residual magnetism even after exposure to strong fields. The second new magnetic material, also a development of the Bell system engineers, has been called permalloy. It is so sensitive to magnetising influences that it is completely saturated in the earth's field and is making possible important advances in various branches of the communication art. For example, in co-operation with the Western Union Telegraph Co., a submarine telegraph cable loaded with permalloy has been laid between New York and the Azores, the message capacity being about four times that of the standard type of cable. The permalloy in tape form is wound as a cylindrical covering around the copper conductor, and, because of its very high initial permeability at low magnetising field strengths, causes a more rapid building up of current at the receiving end, which in turn results in increased speed of sending. Permalloy is also being employed in the magnetic circuits of many telephones and telegraph relays, telephone transformers and receivers.

The Use of the Telephone.—Coincidental with these technical advances in the telephone art, there has been a notable increase since 1910 in the use of the telephone throughout the civilised world. The accompanying table shows the number of telephones in the principal countries and continents at Jan. 1 1910 and at Jan. 1 1925, the latest date for which comparative data are available. The number of telephones per 100 people, which is also shown in the table, affords a means of comparing the telephone development of areas differing widely in total population and in total number of telephones. It will be noted that the aggregate number of telephones in service throughout the world increased from about 10,400,000 to over 26,000,000 in the 15 years under consideration. Table I. shows that, at the end of this period, 62% of all the telephones in the world were in the United States, 26% were in Europe and the remaining 12% were scattered among all other countries.

Great Britain and Northern Ireland had, at Jan. 1 1925, somewhat less than 5% of the world's total telephones, Germany had slightly over 9% and France about 2·5% of the total. There was, at that date, one telephone for every 7 people in the United States, one for every 36 people in Great Britain and Northern Ireland, one for every 26 people in Germany and one for every 58 people in France. Sweden had one telephone for every 14 people, Norway one for every 16 people and Denmark one for every 11 people. The Scandinavians also rank high among Europeans in respect to the use of the telephone. During a recent year there were 131 telephone conversations *per capita* in Denmark, 113 in Norway, 106 in Sweden, 23 in Great Britain and Northern Ireland, 30 in Germany and 20 in France. The corresponding annual figure for the United States was 191 telephone conversations *per capita*.

The Telephone and the War.—The increment between 1910 and 1925 in the world's total telephones does not, of course, represent an even growth throughout the period. The normal rate of increase was decidedly retarded in the principal telephone-using countries during the World War. The difficulty and high cost of securing and shipping telephone supplies was felt throughout the world. In the belligerent countries these conditions were intensified by the necessity of giving priority to war requirements and the telephone systems were further handicapped by the depletion of their working forces to supply communication technicians for the military and naval forces.

For example, about 13,000 out of the 20,000 men in the engineering department of the British Post Office joined the army. After the United States entered the War, nearly 25,000 employees of the Bell system joined the war service of the Government. Of this number 233 were women telephone operators who were recruited and sent overseas; and hundreds of others were in training for this service at the time of the Armistice. An enormous amount of telephone construction was also carried out to meet the wartime need for extra telephone service in Washington and at army posts, camps and cantonments, aviation fields and naval and coastguard stations.

Experience with the telephone in the World War practically revolutionised modern military practice in the maintenance of communications (*see* SIGNALLING, ARMY). The Signal Corps of the U.S. Army, for example, constructed during the War 1,990 m. of permanent pole line with 28,000 m. of wire, erected 3,230 m. of wire on French poles, and installed approximately 40,000 m. of combat lines. American military telephone exchanges on permanent lines in France numbered 273, and those in the advance section 123, besides small temporary field installations. About 1,600,000 long-distance telephone calls were handled by the Signal Corps, in addition to local telephone calls estimated at 47,000,000.

Post-War Development.—After the War, the accumulated demand for telephone service in various countries was sufficient to accelerate telephone expansion to the maximum rate permitted by the amount of telephone apparatus which could be made available. In Japan, however, a further setback was experienced as a result of the disastrous earthquake of Sept. 1923, which put out of service upwards of 70,000 telephones, or more than one-eighth of all the telephones in the empire. In the re-establishment of service in the devastated area the opportunity is being taken to introduce " automatic " or " machine-switching " systems in place of the manual equipment formerly used. A like change is gradually being made in many of the large urban telephone systems throughout the world. By the end of 1925 the number of automatic or machine-switching telephones in the United States exceeded 1,650,000.

Administrative Changes.—Some important changes in telephone administration have taken place in Europe since 1910. In Great Britain, on Dec. 31 1911, the British Post Office took over the entire telephone system of the National Telephone Company. All public telephone service in Great Britain and Northern Ireland is now rendered by the Post Office, except at Hull and on the islands of Guernsey and Jersey, where the telephone systems are operated by the local authorities. Upon the establishment of the Irish Free State, the British Post Office transferred to the Free State Govt. its telephone system in Southern Ireland. In 1916 the Netherlands Govt. acquired the 19 exchanges of the Netherlands Bell Telephone Company. Other local systems owned by private companies or by municipalities have been taken over by the Govt. from time to time; but the local telephone service in the larger Dutch cities is still under municipal operation. The interurban lines are owned and operated by the Netherlands Government. The Swedish Govt. in 1918 purchased the telephone system of the Stockholm Telephone Company. On the other hand, a tendency has been manifest in Europe, since the War, toward the extension of private enterprise in preference to government ownership in telephone administration. The Spanish Govt. has transferred its publicly owned telephone system to a private company, which has been granted a concession for the development of a nation-wide telephone network. Local telephone systems formerly operated by the Govt. of Italy have been ceded to private concerns under concessions covering limited territorial zones. The Polish Govt. has transferred its telephone properties in a number of cities to a corporation in which it has only a minority interest. Elsewhere, notably in Germany, official action has been taken looking to the establishment of a form of administration for the national communication services which shall approximate as closely as practicable the corporate organisation commonly employed by private enterprise. At Jan. 1 1925, approximately 71% of the world's telephones were privately owned, and the remaining 29% under public ownership.

International Telephone Communication.—The improvement of international telephone communication has received much attention during the period under consideration. The Bell system in the United States has been connected by submarine cable with the telephone system of Cuba and its long-distance lines afford access to many points in Canada. In Europe, although the distances between the principal cities are less than those covered by circuits in everyday commercial use in the United States, long-distance telephony has encountered obstacles. Differences of language, of equipment and of operating practices

have exerted a restrictive influence on long-distance communication, particularly across international boundaries. European telephone authorities have, however, taken cognisance of this situation. An international conference was held at Paris in March 1923, to organise a "*Comité Technique Préliminaire pour la téléphonie à grande distance en Europe*" in which Belgium, France, Great Britain, Italy, Spain and Switzerland were represented. Various technical proposals were adopted looking to the betterment of long-distance telephony in Europe. A permanent secretariat and a continuing advisory international technical committee were set up. At subsequent technical conferences additional countries have been represented and further progress has been made in the study of the technical problems involved. Greater difficulties are presented, however, by the question as to what, if any, form of international organisation should be entrusted with the administration or supervision of international telephone circuits.

TABLE I. *Telephone Development of the World, Jan. 1 1910 and 1925*
(Some of the figures are necessarily partly estimated)

	Jan. 1 1910		Jan. 1 1925		
	Number of Telephones	Telephones per 100 Population	Number of Telephones	Telephones per 100 Population	Increase in the Number of Telephones from Jan. 1 1910 to Jan. 1 1925
Great Britain	609,274	1·3	[1]1,264,024	2·8	654,750
Denmark	87,436	3·2	397,977	9·0	220,541
France	211,664	0·5	660,127	1·7	448,463
Germany	968,101	1·5	2,385,177	3·9	1,417,076
Italy	63,131	0·2	172,900	0·4	109,769
Norway	57,945	2·4	168,518	6·1	110,573
Sweden	174,055	3·1	418,318	6·9	244,263
Switzerland	73,758	2·0	189,429	4·8	115,671
Other Countries in Europe	506,636	0·2	1,328,895	0·4	822,259
Total Europe	2,752,000	0·6	6,895,365	1·4	4,143,365
Japan	109,780	0·2	[4]544,433	0·9	434,653
Other Countries in Asia	44,220	0·01	257,975	0·03	213,755
Total Asia	154,000	0·02	802,408	0·1	648,408
Union of South Africa	13,650	0·2	[2]71,448	1·0	57,798
Other Countries in Africa	18,000	0·02	82,055	0·1	64,055
Total Africa	31,650	0·02	153,503	0·1	121,853
United States	6,995,692	7·6	16,072,758	14·2	9,077,066
Canada	239,000	3·3	1,072,454	11·6	833,454
Other Countries in North America	38,900	0·1	155,007	0·5	116,107
Total North America	7,273,592	5·5	17,300,219	11·2	10,026,627
Total South America	75,000	0·2	373,157	0·5	298,157
Australia	81,040	1·8	[3]318,279	5·5	237,239
New Zealand	29,680	2·7	[2]120,097	8·7	90,417
Other Countries in Oceania	10,000	0·03	75,480	0·1	65,480
Total Oceania	120,720	0·3	513,856	0·7	393,136
Total World	10,406,962	0·6	26,038,508	1·4	15,631,546

[1] Exclusive of the Irish Free State.
[2] March 31 1925.
[3] June 30 1924.
[4] Exclusive of 23,800 telephones temporarily out of service as a result of the earthquake.

Note: In the case of countries the boundaries of which have undergone change, the figures for each year represent the number of telephones within the boundaries of that year.

England has long been connected with the Continent and with Ireland by submarine telephone cables and the Scandinavian peninsula has enjoyed like facilities for communication with neighbouring European countries (*see* TELEPHONY, SUBMARINE). An event of considerable interest, however, in long-distance telephone extension was the establishment, during 1924, of telephone communication between Spain and Morocco by a cable spanning the Straits of Gibraltar.

TABLE II. *Telephone Wire of the World, as of Jan. 1 1925*
(Some of the figures are necessarily partly estimated)

	Miles of telephone wire	Miles of telephone wire per 100 population
Great Britain and N. Ireland	4,966,746	10·8
Denmark	743,137	21·8
France	1,963,890	4·9
Germany	7,417,263	12·0
Italy	550,000	1·3
Norway	410,628	14·9
Sweden	921,509	15·3
Switzerland	482,091	12·3
Other countries in Europe	3,425,506	1·2
Total Europe	20,880,770	4·2
Japan	1,537,237	2·6
Other countries in Asia	690,441	0·1
Total Asia	2,227,678	0·2
Union of South Africa	246,246	3·3
Other countries in Africa	214,452	0·2
Total Africa	460,698	0·3
United States	46,500,000	41·0
Canada	2,793,596	30·3
Other countries in North America	391,564	1·2
Total North America	49,685,160	32·3
Total South America	986,709	1·4
Australia	1,266,825	21·8
New Zealand	363,361	26·3
Other countries in Oceania	290,626	0·4
Total Oceania	1,920,812	2·8
Total World	76,161,827	4·1

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TELEPHONY, SUBMARINE.—Progress in submarine cable telephony has been due partly to improvements in cable design and partly to the introduction of the telephone repeater which has, in turn, reacted on the design of cables.

Continuous Loading.—In 1887 Oliver Heaviside, in *The Electrician*, vol. 19, showed that the transmission efficiency of a telephone circuit could be improved by artificially increasing the inductance of the circuit. So far as submarine cables are concerned this had been effected by "continuous loading" up to the year 1910. "continuous" or "krarup" loading is effected by winding wire or tape of magnetic material, generally iron, in a close spiral on the conductors of the circuit. Unfortunately in addition to increasing the inductance of the circuit the effective resistance to alternating currents is also increased as well as the

mutual capacity between the conductors. In practice this has hitherto imposed a limit of approximately 20 millihenries per nautical mile as the maximum inductance which can be obtained in a continuously loaded cable. In order to obtain a greater increase in inductance " coil loading " has therefore been resorted to. In 1910 a coil loaded cable was manufactured and laid by Messrs. Siemens Bros. & Co. for the British Post Office between Abbot's Cliff near Dover and Cape Gris Nez in France. Details of the cable are given in the table on page 752. The loading coils are spaced at intervals of one nautical mile (" naut ").

Efficiency of Circuit.—The efficiency of a telephone circuit is measured by the ratio of the current received to the current sent into the circuit. This ratio is expressed by the formula $e^{-\beta l}$ where e is the base of the Napierian system of logarithms, β is the attenuation constant per unit length of circuit and l is the length of the circuit. The naut will be taken as the unit length for the purpose of this article. For the cable referred to above the value of β for the cable unloaded is 0·0524 and for the loaded cable 0·0166. Therefore for the same efficiency the loaded cable could be rather more than three times the length of the unloaded cable. The value of β depends upon the electrical constants of the circuit. For a coil loaded cable the natural inductance is usually small compared with the inductance added by the loading coil and may therefore be ignored. The following approximate formula may then be used $\beta = \frac{R + \left(\frac{R_1}{L_1} + \frac{G}{C}\right)L}{2} \sqrt{\frac{C}{L}}$ where R is the loop resistance of the circuit in ohms, C the mutual capacity between the conductors of the circuit in farads, L the inductance in henries and G the leakance in mhos, all per unit length of circuit. R_1 and L_1 are the effective resistance, and the inductance of the loading coils respectively. All these values are to be taken at the particular alternating current frequency under consideration. In the formula given the two quantities R_1/L_1 and G/C represent properties of the loading coils and of the dielectric respectively. In the Anglo-French cable already mentioned, the value of the former is 60 and of the latter roughly 120 at 1,000 cycles per second. In the next cable laid, the Anglo-Belgian cable, the value for G/C was reduced to 12, at 800 periods per sec., by using balata in place of gutta percha. As regards the quantity R_1/L_1 the value has been reduced to 40.

In addition to the coil loaded cables shown in the table two coil loaded cables have been laid from Dungeness in England to Audresselles in France, two from Dover to Sangatte, and one from St. Margaret's Bay to La Panne, Belgium. In the Abbot's Cliff-Gris Nez cable only the two physical circuits are loaded but in all subsequent cables additional coils have been introduced to enable a third loaded circuit to be provided by superposing. The addition of these coils slightly increases the attenuation constant for the physical circuits, on account of the additional resistance introduced by the superposed circuit coils. In the year following the laying of the Abbot's Cliff-Gris Nez coil loaded cable the French Govt. laid between the same points a continuously loaded cable with gutta percha insulation, details of which appear in the table.

The loading of the physical circuits automatically loads the superposed circuits. A fourth circuit operated as an earthed circuit can be worked over all four wires on which the loop superposed circuit is formed provided that the electrical balance of the conductors is such as to prevent undue crosstalk, and that interference from earth currents is negligible. This system has been worked over the Vancouver-Victoria, B.C., cable manufactured by Messrs. W. T. Henleys Telegraph Works Co.

Telephone Repeater.—The growing demand for circuits for international communication is leading to the adoption of cables with more numerous conductors. This is rendered practicable by the developments which have taken place in the telephone repeater consequent upon the introduction of the three electrode thermionic valve. The use of the telephone repeater, which amplifies the speech currents, enables smaller conductors to be used and an increased number of circuits can thus be provided in a given size of cable. An example of such a cable is the Leba-Tenkitten cable across the Bay of Danzig. This cable contains 12 telephone wires laid up in three groups of four wires (quads) and three telegraph wires all paper insulated. It is provided with two lead sheaths, as a precaution against the penetration of water. In order to assist the lead sheath in supporting the external pressure to which the cable is subjected a spiral of steel wire is placed between the cable core and the lead sheaths. Further, the armouring, instead of the usual cylindrical wires, consists of wires drawn roughly Z shape so as to interlock and form a practically incompressible tube. The ordinary jute serving over all completes the cable. The direct current resistance of the telephone conductors per naut loop is 20·9 ohms for the physical circuits and 10·45 ohms for the phantom circuits. The increase of resistance with frequency due to the loading is indicated below, where $\omega = 2\pi \times$ the frequency. The testing current was 2 ma.

	$\omega = 3{,}000$	$\omega = 5{,}000$	$\omega = 7{,}000$
Physical circuit	0·445 ohms	1·17 ohms	2·17 ohms
Superposed circuit	0·241 "	0·538 "	0·965 "

The rise in resistance as the frequency increases involves an increase in attenuation of the higher speech frequencies. Frequencies up to 2,000 per sec. corresponding to a value of $\omega = 12{,}400$ approximately, must be transmitted without serious loss if good commercial speech is to be obtained. Special attention is therefore paid to the resistance-frequency characteristics of cables with a view to the efficient transmission of the higher frequencies. In 1924 the first continuously loaded paper core cable between England and the Continent was laid between Aldeburgh, Suffolk, and Domburg, Holland, for the Anglo-Dutch service.

This cable contains 16 wires (four quads) providing eight physical telephone circuits and four superposed circuits. Each conductor consists of a center wire 0·076 in. (1·93 mm.) in diameter surrounded by three copper strips each 0·010 in. (0·254 mm.) thick; weight 165 lb. per naut. Each conductor is wound with two layers of 0·008 in. (0·203 mm.) diameter iron wire; weight 87 lb. per naut. The loaded conductor is wrapped with paper to a diameter of 0·188 in. (4·77 mm.). Two lead sheaths are provided, the external diameter of the outer lead sheath being 1·52 in. (37·6 mm.). The armouring consists of 24 cylindrical wires 0·232 in. (5·9 mm.) diameter. The overall diameter of the cable is 2·42 in. (61·5 mm.). No steel spiral is provided between the core and the lead sheath, as the water in which the cable lies is comparatively shallow. The length of the cable is 82·242 nauts. It terminates in a telephone repeater station at Aldeburgh and is extended on the Dutch side by a continuously loaded underground cable to a repeater station at Middelburg. It provides circuits between London and Rotterdam, Amsterdam and The Hague.

In the operation of the two-wire telephone repeater the circuit on each side of the repeater station is balanced by a network having the same impedance as the circuit over a range of frequencies corresponding with the range of speech frequencies to be transmitted. Unless the electrical constants of the circuit are uniformly distributed the curve connecting circuit impedance with frequency will not be smooth and an accurate balance becomes impracticable. The repeater could not then be worked at its highest efficiency. In the Anglo-Dutch cable the impedance frequency curve is so smooth that so far as the cable is concerned the highest amplification which the repeater is capable of giving could be used. Other factors not connected with the submarine cable limit the amplification actually obtained. A second similar cable will shortly be laid between the same points by the Dutch Government. The success of the Anglo-Dutch cable has led to the decision to adopt a similar type of cable for the Anglo-Belgian and Anglo-French cables in each of which 28 conductors will be provided in seven quads giving 14 physical circuits and seven superposed circuits.

The make up of the cables will be as follows:—Conductor, solid wire 0·08 in. (2·03 mm.) diameter; weight 118 lb. per naut. Loading is one wrapping of iron wire 0·008 in. (0·203 mm.)

Examples of Loaded Cables for Submarine Telephony

Coil loaded

Cable	Date Laid	Length in nauts	No. of Conductors	Weight lb. per naut	Conductor Diameter mm.	No. of layers and Diameter of Loading Wire mm.	Dielectric: Weight lb. per naut	Dielectric: External Diameter mm.	Electrical Constants per naut loop: R ohms	L mH	C μF	Characteristic Impedance	Attenuation constant	Reference
Anglo-French Abbot's Cliff-Gris Nez	1910	20	4	·160	2·7	Coil loaded; distance between coils 1 naut	gutta percha 300	9·9	20·9 (750 p.p.s.)	102	0·138	858∠0°54′	0·0166	*Jour. I.E.E.* vol. 46, p. 309
Anglo-Belgian St. Margaret's-La Panne	1911	47·9	4	160	2·7		Balata 150	7·3	25·7 (800 p.p.s.)	102	0·157	800	0·0177	*Jour. P.O.E.E.* 5, 1912, p. 55
							(Superposed circuit)		11·7	51	0·314	400	0·0173	
Anglo-Irish Nevin-Howth	1913	63·4	4	160	2·7		150	7·3	21·0 (800 p.p.s.)	102	0·166	690∠2°40′	0·015	*Jour. P.O.E.E.* 6, 1913
							(Superposed circuit)		10·3	51	0·320	446∠0°52′ (800 p.p.s.)	0·015	
Anglo-Dutch Aldeburgh-Domburg	1922	82	4	160	2·7		150	7·3	D. C. 20·4	102	0·164	800	0·0145	*Jour. P.O.E.E.* 16, 1924
							(Superposed circuit)		10·2	51	0·328	410	0·0137	

Continuously loaded—gutta percha insulated

Anglo-French Abbot's Cliff-Gris Nez	1912	23·42	4	300	3·33	1 x ·305	gutta percha 300	..[1] 10·47	8·54	13·5 (Superposed circuit 0·0204)	0·176	278·5∠2°17′	0·0184	*La Lumière Electrique* vol. 18, 1912
Dalmatia-Istria	1912	32	4	210	2·8	3 x ·2	180	..[2] 8·4	D. C. 11·0	19·8	0·216	302∠2°45′	0·0242	*Electrotecknik und Maschinenbau* July 1913
Vancouver-Victoria, B.C.	1913	28·3	4	300		1 x ·305	300		D. C. 8·0		0·175		0·019	*Electrician* Aug. 22 1913.
Key-West-Havana (3 cables)	1921	104	1	350	3·56	1 x ·2	Special GP 315	..[1] 10·8	4·8	4·1	0·310	118∠6°	0·0216	*Jour. A.I.E.E.* March 1922.
Anglo-Irish Port Mor-Donaghadee	1922	20·12	4	169	2·44	2 x ·305	Balata 195	..[2] 8·5	17·4	24·7	0·183	370∠3°56′	0·0237	
							(Superposed circuit)		8·8	11·9	0·363	182∠3°55′	0·0233	

Continuously loaded—paper insulated

East Prussia Leba-Tenkitten	1920	92	12+		1·45+ 2 tapes 2·7x0·35	2 x ·2	Paper insulated	4·4	22·1	19·6	0·091	468∠6°23′	0·0242	*E.T.Z.* 7th April 1921
			3 Telegraph		3x0·9 stranded				11·0	9·3	0·0253	194∠6°52′	0·0291	
Anglo-Dutch Aldeburgh-Domburg	1924	82·24	16	165	1·93+ 3 tapes ·25= 2·44	2 x ·203	Paper insulated	4·77	16·1	18·7	0·107	414∠6°30′	0·0200	
									7·84	8·95	0·311	170∠6°	0·0238	
Anglo-Belgian Dumpton Gap-La Panne	1926 proposed	50	28	118	2·03	1 x ·203	Paper insulated	3·96	20·8	11·8	0·092	369∠9°36′	0·029	
Anglo-French Sandgate-Audresselles	1926 proposed	23·5					(Superposed circuit)		10·3	5·5	0·27	148∠10°9′	0·036	

[1] Measurements made at 1,000 P.P.S. [2] Measurements made at 800 P.P.S.

diameter; weight 34 lb. per naut. Each conductor will be wrapped with paper to a diameter of 0·156 in. (3·96 mm.). There will be two lead sheaths each 0·085 in. (2·16 mm.) thick; external diameter over the outer lead sheath will be 1·66 in. (42 mm.); armouring 26 wires 0·232 in. (5·9 mm.); weight of complete cable per naut will be 26·5 tons; overall diameter 2·58 in. (65·5 mm.).

The approximate electrical constants are given in the following table:—

	Physical Circuit					Superposed Circuit					
		A.C. at $\omega=2$, f =				A.C. at $\omega=2$, f =					
	D.C.	1,250	3,000	5,000	7,000	12,500	1,250	3,000	5,000	7,000	12,500
Resistance (Standard ohms)	19·9	20·1	20·4	20·8	21·4	23·9	10·0	10·1	10·3	10·5	11·8
Capacity (Microfarads)	·094	·092	·092	·092	·092	·092	0·27	0·27	0·27	0·27	0·27
Inductance (Millihenries)		11·8	11·8	11·8	11·8	11·8	5·5	5·5	5·5	5·5	5·5
Leakance (Microhms)		0·4	1·0	1·8	2·8	5·3	1·4	3·0	5·4	8·1	15·7
Attenuation Constant		·024	·028	·029	·030	·034	·030	·034	·036	·037	·043
Characteristic Impedance		446	385	369	364	361	191	155	148	145	144
		∠26°46′	∠14°52′	∠9°36′	∠7°8′	∠4°29′	∠27°39′	∠15°38′	∠10°9′	∠7°30′	∠4°44′

To preserve uniformity of electrical constants throughout the section of line between Canterbury in England and La Panne in Belgium and between Canterbury and Boulogne in France, at each of which places repeater stations will be provided, a similar type of cable core will be used for the underground cable between the repeater stations and the landing point of the submarine cables. The total length of the Belgian cable will be 68¾ nauts of which 50 nauts is the length of the submarine section. The total length of the French cable will be 47·3 nauts of which the submarine section is 23½ nauts.

These two submarine cables will be extended to London by an underground cable. The Belgian cable will also be extended by underground cable in Belgium. The French cable will be extended by underground cable to Paris with telephone repeaters at Poix and Boulogne.

A different type of cable was laid in 1921 between Key West and Havana. The depth of the sea for part of the route is about 1,000 fathoms (1,830 metres). A special type of cable was designed owing to the great water pressure to which the cable would be subjected. Three single core continuously loaded cables were laid, the insulating material being a special mixture of gutta percha. A cylindrical return conductor was provided surrounding the gutta percha. This was made up as follows:—First a copper tape 1 in. (2·54 cm.) wide and 0·004 in. (0·1 mm.) thick was applied directly upon the core with the turns overlapping; over this were laid two copper tapes each 0·625 in. (1.59 cm.) wide and 0·0222 in. (0·56 mm.) thick laid with edges touching. The armouring varies according to the depth. Each cable provides a telephone channel, a direct current duplex and a carrier current duplex telegraph circuit.

Use of Permalloy.—The future development of the continuously loaded cable depends on finding a magnetic material with a higher permeability for the loading wire (or tape), to increase the inductance, and having also a high electrical resistance to reduce the losses due to eddy currents in the iron, the effect of which is to increase the effective resistance of the circuit. A material called "permalloy," an alloy of nickel and iron, has been used for loading the New York-Azores telegraph cable which represents a step in the direction mentioned (*see The Journal of the A.I.E.E.*, Aug. 1925).

The continuously loaded cable appears very suitable for use in conjunction with telephone repeaters as should repairs, involving an increase in length at the point of repair, become necessary, the uniformity of the cable would be preserved, whereas with a coil loaded cable, in similar circumstances, an irregularity would be introduced which would affect the operation of the repeaters. The accompanying table of cables is intended to give examples of various types of cable and not to offer a complete list of modern telephone cables.

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TELEPHOTOGRAPHY: *see* PHOTOTELEGRAPHY.

TELESCOPE (*see* 26.557).—For the purpose of outlining the treatment adopted in this survey of progress since 1910 astronomical telescopes may be classified as follows:—

I. Reflectors. II. Refractors: (*a*) visual, (*b*) photographic; (1) moderate fields, (2) wide fields.

All of these forms belong properly under the head of telescopes except the last one (II. *b* 2), which belongs more properly to such a subject as the camera or photography.

Comparative Merits.—The respective merits of the several kinds of telescopes for astronomical observations of one kind or another are determined by both theoretical and practical considerations. The theoretical considerations relate to colour performance and field, and are fundamental. The reflector has no chromatic aberration whatever but has only a limited field of critical definition, while a good refractor has a larger field but is never entirely free from secondary spectrum. Other considerations of rather a fundamental nature relate to the superior light efficiency of the reflector at large aperture and the relatively greater latitude allowable in the selection of the glass from which they are made. These important factors will always weigh against each other very considerably as they do now and have done in the past.

Practical considerations relate to such matters as attainable perfection of surface, sensitiveness of the telescope to temperature changes, convenience of handling and a multitude of things whose incidence on telescopic performance will vary as improvements in technical processes bring one or another of them under control. From the maker's point of view a mirror has the important advantage that it has only a single surface to be figured, while a lens has at least four, but this is more or less offset by the necessity of working the one surface to an extremely high degree of accuracy. There seems at present to be substantial ground for the hope that the provision of mirror material of low expansion coefficient and good working quality will contribute materially to the attainment of accurate surface and that the disadvantage just mentioned will be lessened.

The distinction between the two types of refractors, visual and photographic, relates primarily to colour correction, the one being adapted to the region of the spectrum to which the eye is most sensitive, and the other to the blue-violet region. There is, however, a secondary consideration, which is, in effect, equally important, namely, that the eye can utilise only a small telescopic field, while the photographic plate can take full advantage of a large one, so that lenses intended for photography receive careful treatment for field (*see* PHOTOGRAPHY).

I. REFLECTORS

The trend of telescope building since 1910 has been decidedly toward the construction of reflectors. The movement in this direction had set in at the opening of the century, and had resulted by 1910 in the construction of the 5-ft. reflector of the Mount Wilson Observatory. Since then the 100-in. Mount Wilson and the 72-in. Victoria reflectors have been built (see plate), while at least two of 60-in. aperture are reported to be nearing completion.

The Mount Wilson Telescope.—The diameter of the mirror is 100·4 in. (255 cm.), the focal length 42·3 ft. (12·89 metres). The tube of the telescope is swung in a split polar axis, as described under "B" in the résumé of types of equatorial mounting in vol. 26, p. 565, the cross pivots on which the tube rotates serving as the declination axis. The great weight of the telescope (100 tons) is carried by large drums situated at the upper and lower ends of the polar axis, which float in troughs of mercury, while the actual direction of the axis is determined by self-aligning spherical bearings near its two extremities. The telescope can be used either in the Newtonian or Cassegrain form, separate terminal sections of the tube being provided as carriers for the auxiliary mirrors of each. These carriers, or "cages" as they are called, are very massive, and are removed and exchanged with the aid of an electric crane (see the upper left background of plate). When it is necessary to remove the mirror for silvering, which is about twice a year, it is lowered by means of a large hydraulic jack into a laboratory just beneath the floor. The two large tubes lying parallel to the telescope contain weights that can be moved longitudinally to perfect the balance. The hour and declination circles are read through the small telescopes seen on the desk. The instrument is provided with quick and slow motion devices operated electrically, and essentially all movements of it and of the dome are accomplished by motors under independent control by the observer at the eye end and the assistant at the desk. Forty motors and 14 m. of wire are used in the dome. The mirror is supported by a counterpoise system similar to that of the 60-in. telescope (*see* 26.569), and there is provision for making the same optical dispositions as are described in conjunction with that telescope. In order to minimise the effect on the mirror of changes in the temperature of the air, it is surrounded by an insulating sheath of cork-board. Means were originally provided for keeping the mirror cell jacketed with brine, which was automatically held at a constant temperature, but they were eventually discarded and reliance was placed on the cork insulation as well as on the protective covering of the dome.

Access to the Newtonian focus, at the upper end of the tube, is by means of an adjustable platform, which is swung in the dome opening and is reached by means of the ladder in the right foreground (see plate). A ring section of the floor, extending from the dome inward to the circular rail, forming part of the dome and rotating with it serves to stiffen the dome and contributes to the smoothness of its operation. The dome and walls are double sheathed for the purpose of reducing the diurnal range of the interior temperature.

The Victoria Telescope.—The diameter of the mirror is 72·5 in. (184·15 cm.) the focal length 30·1 ft. (9·180 metres). The mounting is of the so-called British form, designated as Type A (26–565). Critical features of this telescope, other than those apparent in the illustration, are the polar axis bearings and the construction of the tube. The polar axis rotates in ball bearings of large size, unrelieved by supporting or flotation devices. This departure from usual practice in the construction of large telescopes has proved very successful. The lattice-work part of the tube is built as a unit, without removable end pieces such as those of the Mount Wilson telescope, provision being made for the direct interchange of the Cassegrain mirror, the Newtonian mirror and the focal plane apparatus without the removal of a terminal section of the tube. The telescope is electrically operated.

Comparisons of Three Large Reflecting Telescopes.—The two telescopes just described and the earlier 60-in. reflector at Mount Wilson possess a high degree of excellence. Incomparable photographs of the Moon, the nebulae and other objects are the product of the Mount Wilson instruments, while the power of the Victoria telescope for spectroscopic observation has fulfilled the most sanguine expectations of its projector. But these instruments suggest a comparative study of different types of telescopes. Each of them differs in size and in pattern from the others and from the proof by trial of the many departures in design is to be derived information essential to the determination of the steps by which further progress is likely to be made.

The split or yoke form of polar axis used in the 100-in. telescope has the advantage that the very heavy tube is swung between pivots and does not overhang the polar axis. This construction makes for stability and centres the telescopes in the dome, advantages purchased at the cost of access to a considerable area of the sky surrounding the North Pole. The range of this telescope is still further reduced by interference of the large float at the upper end of the polar axis. In adopting this form of mounting the designers were no doubt influenced by the circumstance that the Mount Wilson observatory already possessed a powerful reflector capable of covering the entire sky, so that in the region inaccessible to the proposed telescope the loss would be merely that of the marginal efficiency of the larger over the smaller instrument. The excellent mechanical performance of the Victoria telescope suggests that the limit of size for a mounting of its type has not been closely approached, and it seems likely that the design might be used for a very much larger instrument. The use of ball bearings in the polar axis of the Victoria telescope has proved so successful that it is doubtful whether a return will be made to the system of counterweighted rolls, or to the rather cumbersome mercury floats and tanks. Neither of the latter devices provides the ease of motion that is secured in the Victoria telescope, nor does it appear to be superior in stabilising the position of the axis. With respect to the mechanical performance of the telescope, Prof. Plaskett writes: "I can only repeat what I have said before, that it is a joy to operate and use the instrument."

Fortunately, for the purpose of comparative study two of these great instruments are located at the same observatory. The 60 and 100-in. telescopes have now been in operation at Mount Wilson since 1920 under identical atmospheric conditions and in the hands of the same observers. The following comments are excerpted from a personal letter written by Director W. S. Adams of the Mount Wilson Observatory in reply to an enquiry relative to the performance of these two instruments:—

In ease of control the 100-in. telescope is considerably superior to the 60-in., and the dome and shutter are vastly better. We could not improve upon the dome and shutter mechanism if we had them to do over again. One feature of the controls worth noting is the automatic speed change for right ascension and declination slow motions: this has proved almost invaluable in making settings around an instrument where the distances are so great.

If the instrument were to be built at present I certainly think we should do away with mercury flotation. The northern float cuts off an important area of the sky from observation, and the mercury tanks give us considerable trouble with changes of temperature. Large roller and ball bearings have developed greatly since the 100-in. telescope was designed, and I am sure they would now serve this purpose excellently. However, the driving of the 100-in. under normal conditions is very fine. Probably our flotation system could have been made much better if we could have used a greater volume of mercury. It was built during the War, when mercury was almost unprocurable, and we got along with the irreducible minimum.

We have not used the cooling system around the 100-in. mirror since the first few months, and about four years ago we took out the circulating pipes. The insulating cover has proved very efficient, and our automatic temperature records rarely show a range of over 20° C. in the air surrounding the mirror. This insulation is about the most important single feature of the entire telescope, and I think it could be improved upon in future large instruments.

Our experience has shown that the number of nights when we get full benefit of the 100-in. over the 60-in. is surprisingly large. With seeing of 2 or better on a scale of 5 we regularly give exposure times with the spectrograph at the Cassegrain focus one-third as long, and it is only when the seeing is below 2 that the proportion becomes much worse. In very bad seeing, however, the 100-in. is nearly hopeless.

In general, the performance of the 100-in. telescope depends very largely upon the figure of the mirror when the seeing is 2 or better. This is very susceptible to changes of temperature, and a general rise or fall of the mean temperatures of successive nights gives rise to astigmatism which is sometimes very persistent. Our worst figure comes in winter after a cold wave, or a storm after which the temperature begins to rise rapidly. In summer, with settled weather, the figure is usually good with the occasional exception of the first hour or two after dark, when the edges are distorted.

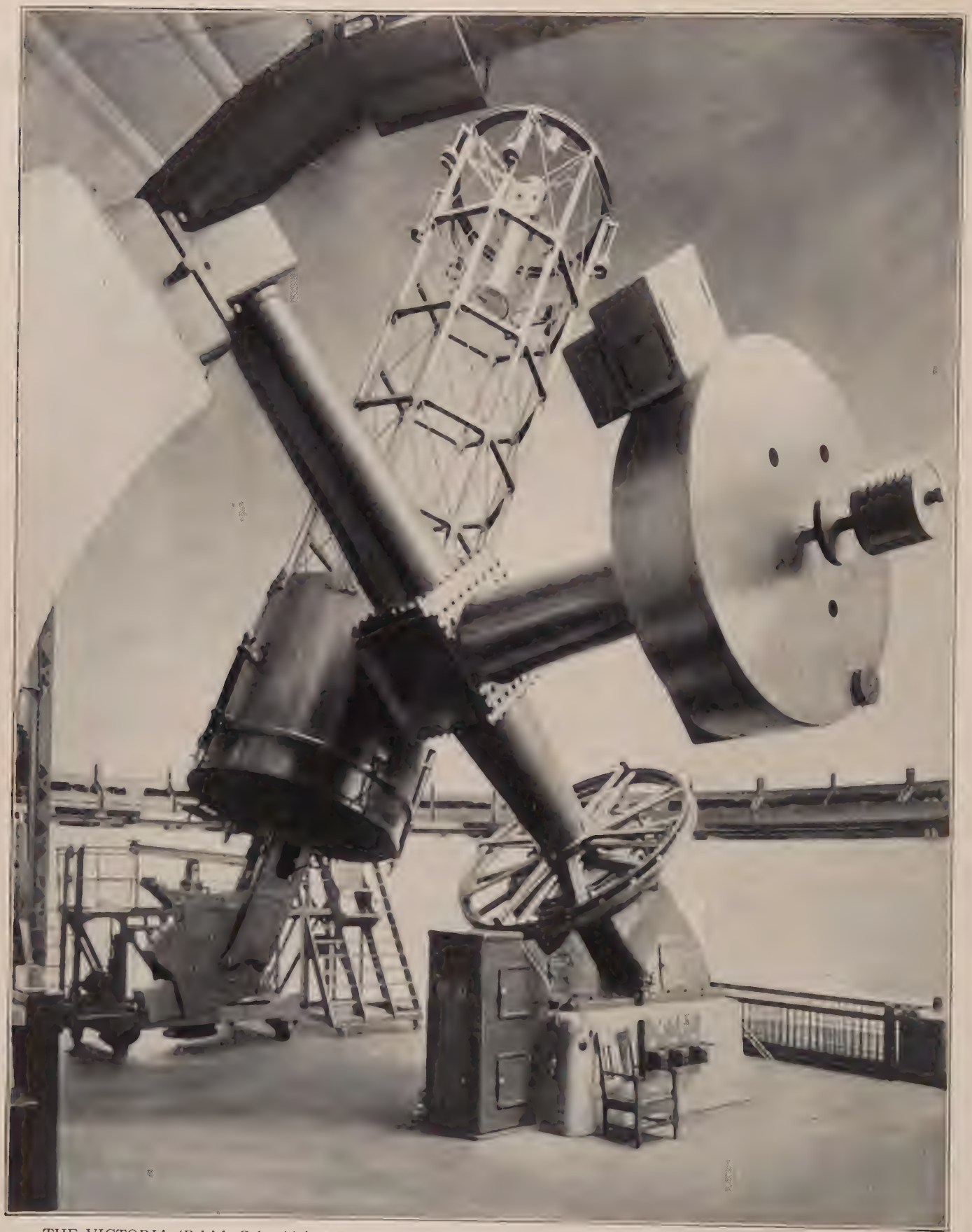
Dr. Hubble has given me the following table of the mean diameters of the faintest stars registered on plates with full aperture and exposures of 30 minutes:—

Seeing 2 to 3 on a scale of 5

Figure of Mirror	Mean Diameters of Smallest Images
Average	1·5 in.
Very good	1·0 in.
2 exceptional plates	0·6 in.

THE MT. WILSON 100-IN. REFLECTING TELESCOPE

TELESCOPE



THE VICTORIA (British Columbia) 72-INCH REFLECTING TELESCOPE. Specially designed to study star spectra.

In addition to speed and resolution the superiority of the 100-in. is very marked for fine details in nebulosity or other surfaces, and especially for narrow linear features, such as are found in planetaries or network nebulae.

Thus the full advantage of size is secured in the light gathering power of the larger telescope; and the two exceptional plates mentioned by Adams indicate most excellent defining power, for while it is true that the theoretical resolving power for a mirror of that size, 0·05 in. is not reached, it is probably more closely approached by this than by any other large mirror in use. Further, the diameters were measured on photographs taken with comparatively long exposures, and the images were consequently subject to the usual unsettling influences of photographic observation. It seems safe to state that no existing refractor, nor any that could be made, could compete with the 100-in. telescope in the matter of light delivery. In respect to definition, the superiority probably does not exist. It is perhaps fair to say that on photographs taken with refractors of 30 or 36-in. aperture images of 0·6 in. are to be expected under "good" conditions of observation, and slightly larger ones under average conditions. Furthermore, the figure of a refractor can always be depended upon. With exceptionally steady atmosphere star disks, as seen with the eye through such an instrument as the 36-in. refractor of the Lick Observatory, are reduced approximately to their theoretical size of 0·13.

Thus in the matter either of ultimate or of average definition the refractor still maintains the lead; but if the figure of the Mount Wilson telescope could be stabilised it would, under average conditions of observation, compare favourably in respect to definition with the best refractors.

Causes of Instability of Figure.—The principal factor contributing to instability of figure is ununiformity of thermal distribution through the material of the mirror, resulting from ordinary changes in temperature of the surrounding air. It has long been realised that this effect might be reduced through the employment of a mirror material of low expansion coefficient and "Pyrex" mirrors of moderate size, which are in use at Mount Wilson, are said to suffer only about $\frac{1}{10}$ the focal disturbance of those of glass.

Importance of Fused Quartz.—Fused quartz, the thermal expansion of which is almost negligible, has been suggested as a material for telescope mirrors, in fact experiments looking toward the production of that material in disks sufficiently large for the purpose were undertaken by Prof. Elihu Thomson in the opening years of the century. At that time the material was rather a curiosity, and was obtainable only in small pieces. In the hands of Thomson the extremely difficult technique of quartz fusing has been sufficiently mastered to permit the production of disks approximately a foot (30 cm.) in diameter. A mirror of this material would be immune from the disturbing effects of temperature and would retain excellence of surface under essentially all conditions of observation. Dr. Thomson, in some very illuminating letters relating to fused quartz, expresses the opinion that with proper mechanical facilities, disks of a quality suitable for mirrors can be produced in whatever size may be desired. With respect to the working qualities of the material he says:—

I find the work of fused quartz for optical surfaces is peculiarly satisfying in that its freedom from expansion makes it unnecessary to look after the temperature of the workroom or take precautions as to its unequal heating. The grinding proceeds with the utmost satisfaction, without danger of scratches, which is always a trouble with glass, and a very fine surface just before polishing is attainable with comparative ease.

Since the property of fused quartz, which insures stability of surface, also facilitates the shaping of the mirror, the use of this material may be expected to result not only in a more quiescent surface but also in mirrors of greater perfection. On the production of fused quartz, or something equivalent to it, more than on anything else, depends the full utilisation of the advantages of the reflecting form of telescope.

Theoretical Considerations.—Two attempts of a theoretical nature have been made to overcome the field limitations of instruments of this class. Where the optical system consists of a single mirror the shape of the surface is uniquely determined as that of a paraboloid of revolution. In the Cassegrain and Gregorian forms there are, however, two reflecting surfaces, and it is possible, within limits, to balance departure from the paraboloidal form of the primary by reciprocal alterations in the surface of the secondary mirror. The problem whether it is possible to do this to the advantage of the field has been attacked by Schwarzschild and by Sampson. The investigation of the former is, in the present state of the art of glass working, hardly more than of theoretical interest. Sampson, besides modifying the reflecting surfaces, brings into the system a number of glass lenses, all of the same material, which without introducing sensible chromatic aberration provide a field comparable with that of a good refractor. The suggestion seems promising for the future, but no instrument of the proposed type seems as yet to have been constructed.

II. REFRACTORS

The production of refractors has not been entirely neglected, and much more would undoubtedly have been accomplished in this direction but for the War, which proved especially disturbing to the optical industry (*see* Optical Glass). The instruments include a few intended for general observational purposes, but a very significant departure has been made in the direction of photographic telescopes. Among the pioneers in large instruments of this class is a 30-in. (76 cm.) Thaw telescope of the Allegheny Observatory, which has proved extremely efficient in the determination of stellar parallax, in the study of star clusters, and in other investigations which require, or derive advantage from, a larger field than is provided by a reflecting telescope. As a result, possibly, of the success of that instrument the construction of a number of others has been undertaken, notably one of 24-in. (61 cm.) aperture for the South African station of the Yale Observatory, and one of 41-in. (104 cm.) aperture and 35 ft. (10·66 metres) focal length (which will be larger than any refractor now in existence) for the Nikolayev Observatory in south Russia. A 24-in. (61 cm.) instrument of 35 ft. (10·66 metres) focus is under construction for the National Observatory near Santiago, Chile. At Johannesburg there has recently been installed a 26-in. (66 cm.) visually corrected telescope, and one of approximately the same aperture is being built for the South African station of the Detroit Observatory.

Lens Design

The most noteworthy advances in design have been made in relation to lenses of wide field. A number of new lenses have appeared since the War, the stimulus for this development being provided perhaps by the necessities of aeroplane photography. A lens calculated by F. E. Ross for work of that nature has, on modification for astronomical requirements, proved very successful, notably in the extremely exacting observations made during a solar eclipse for the measurement of the gravitational displacement of light. Among the excellent wide-angle wide-aperture lenses constructed in recent years are the 16-in. lens of the Arequipa station of the Harvard Observatory, and the 10-in. at Mount Wilson, both of the Cooke type, while a number of lenses of the Petzval type are in successful operation in Europe and America.

Improvements in Material and Methods of Manufacture

Certain glasses having optical characteristics that would lend themselves to the reduction of secondary spectrum are barred from use by their chemical instability, or by the possession of detrimental physical properties. It seems improbable that any marked departure from the existing run of optical properties (refractive index, etc.) will be effected without a serious sacrifice of durability. However, an important English firm of glass makers is reported to have improved the transparency of optical flint glass, and to have produced successfully a large disk of dense barium crown (*see* Optical Glass). The refractive characteristics of glass of the latter type make it especially valuable for the suppression of coma, and its availability holds out hope for marked improvement in the optical performance of refractors. Deterioration of the surface of glass under the action of

air and the weather is occasionally noticed in the most valuable telescopic objectives. Experiments directed toward the prevention of such impairment have been undertaken by the British Scientific Instrument Research Assn., apparently with some prospect of success.

Testing of Lenses.—Among improvements in facilities for testing of lenses may be noted an adaptation to this purpose, by Twyman, of the Michelson interferometer. The instrument is applicable to the testing of small lenses, rather than of large ones, the present limit of aperture being about 5½-in., but within its range tests of extreme accuracy can quickly and conveniently be made. Lenses and mirrors of large size are still tested by long-established methods.

The Telescope-Interferometer.—The outstanding achievement of observational astronomy during the opening quarter of the present century was the measurement of the diameters of giant stars with interference apparatus attached to the 100-in. Mount Wilson telescope.

The writer is greatly indebted for information to Messrs. W. S. Adams and F. G. Pease of Mount Wilson, J. S. Plaskett of Victoria, B.C., Elihu Thomson of Lynn, Mass., and F. Twyman of London.

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TELEVISION.—Although, strictly speaking, the word television might be held to cover any means of seeing distant objects, such as ordinary telescopic vision, the term is in practice restricted to the seeing of distant objects through the intermediary of long electromagnetic waves, passing either through empty space or along wires. Since such waves, in their passage over the surface, can follow the curvature of the earth, obstacles which would cut off the direct passage of light from the object to the observer can be disregarded. Again, the long waves are not appreciably scattered by dust or liquid droplets in the atmosphere, and so do not suffer absorption in the sense that ordinary light does. Further, the attenuation of the energy in passing over long distances is less marked than it is with ordinary light, owing to the fact that the long waves do not spread out with spherical symmetry around the source, but tend, on account of the existence of the upper atmospheric ionised layer, to hug the surface of the earth. In addition, the diminution of the energy is of little moment, since modern wireless technique enables us to amplify the signals to any extent desired. Even in cases, then, where light could pass by a direct path from the distant object to the observer, the utilisation of Hertzian waves as a vehicle for the transmission of vision offers certain advantages.

Mode of Transmission.—For television we must have a transmitting apparatus, by means of which the light from the object is transformed into electric impulses. These electric impulses must then be amplified and made to modulate a carrier wave, as in the case of wireless telephony. At the receiving end the modulated wave must be transformed into current impulses, which can then be used to modify or steer a light source so as to make it imitate in intensity the light falling on the transmitting system.

It is clear that in the transmitter any light-sensitive cell such as is used in the telegraphic transmission of photographs, *i.e.*, a selenium cell (*see* SELENIUM) or a photoelectric cell, can be used to convert a light of fluctuating intensity into a corresponding current impulse. The amplification of the current and the modulation of the carrier wave can be carried out with the help of electronic relay tubes ("valves") by the ordinary method of wireless telephony. The invention of these relays is, of course, one of the things that make television a practical project. At the receiving end the modulated wave produces current impulses which can be made to govern the intensity of a light beam in various ways: for example, the deflection of the string in a galvanometer of Einthoven type might move a very light and small disk so as partly to obscure or release a light beam, or the amplified current might be passed through a glow discharge lamp of the neon type, which responds without appreciable lag. In this way fluctuations of light falling on the light sensitive transmitting cell could be made to reproduce themselves at the receiving end, by the intermediacy of Hertzian waves.

An imaginable way of adapting these devices to send a whole picture in tone would be to imitate the human eye. The eye consists essentially of a large number of light-sensitive cells, each one of which reports to the brain by its own nerve fibre the strength (and colour) of the light falling upon it. An artificial retina would be made up of a large number of photoelectric cells, each one with a corresponding light-governing device at the receiving end. The relative positions of the light-governing devices to one another at the receiving end would, of course, have to correspond to the relative positions of the transmitting cells to one another at the transmitting end. Each cell would then require either its own wire, if wires were used to transmit the impulse, or its own wave-length, if Hertzian waves were used: for this reason, and on account of the extreme minuteness of the cells required, the method is impracticable.

Possible Methods.—The only hopeful methods suggested are based upon the persistence of vision, and demand the use of one cell only, on which falls *in sequence* light gathered from different parts of the picture to be transmitted. At a given instant light from a given small patch of the picture is focused on to the light sensitive cell, and the picture is "explored" or "scanned," *i.e.*, there is some moving element in the focusing system which selects successively and systematically different parts of the picture until the whole has been covered. At any one instant the strength of the governed beam at the receiving end—the recording beam—corresponds to the intensity of light proceeding from a small patch of the picture at the transmitting end. If now the recording beam can be moved in exact synchronism with the scanning beam at the transmitting end, so that not only the intensities but also the positions of the two beams exactly correspond, the picture will be traced out at the receiving end. If the whole picture can be scanned and transmitted in something less than a tenth of a second, and the receiving mechanism can respond sufficiently quickly, then, owing to the persistence of vision (28.130) the impression of the initially recorded part of the picture will not have faded for the observer by the time the last parts are being traced out, and the picture will be seen as a whole. If the object to be seen is moving, and pictures be sent in rapid and uninterrupted succession, the scanning beam returning to its initial position and starting again as soon as it has covered the whole picture, then a moving picture will be seen as in the cinematograph.

Accurate Synchronisation.—It will be clear that this method demands not only the mechanism already contemplated for modulating the carrier waves so as to produce a correspondence in intensity between the scanning beam and the recording beam, but also a mechanism for producing exact synchronism, in the sense not only that the two beams must move at exactly the same speed, but also that they must always be, at a given instant, at corresponding positions of the picture. If, for example, the picture be scanned in horizontal lines—or, rather, narrow horizontal bands touching each other—then obviously the recording beam must begin a line at exactly the same instant that the scanning beam begins a line, and similar considerations hold if the picture be scanned in any other way, for example in a close spiral.

Number of Signals Necessary.—Further, a very large number of separately detectable signals, corresponding each to a small element of the picture, must be sent per second. The ordinary newspaper half-tone reproductions contain some 50 dots to the linear inch, which gives 10,000 dots for a picture two in. square. It must be remembered that, owing to the fact that the image reproduced by a mechanism such as that contemplated above will consist of contiguous patches in tone which may vary in continuous gradation from black to white, whereas the half-tone block consists of isolated dots which are either black or white, the representation will be very much better for a given number of elements in the television picture than in the half-tone block. It is possible that quite good representation would be given with half the number of elements to the linear inch, *i.e.*, only 2,500 to the two in. square. Taking this as a conservative estimate, and 10 pictures per sec. as necessary for the cinematographic representation, also a conservative estimate, it will be seen that 25,000 distinguishable signals per sec. must be obtained.

Feasibility.—The carrier wave imposes a limit upon the number that can be sent, for in the modulation a certain number of oscillations are necessary for the building up and dying down of the signals. Taking a wave length of 150 metres, which is about the least at present used in broadcasting, there are 2,000,000 vibrations per sec., and if 50 waves are necessary for effective modulation of one signal, it follows that a limit of some 40,000 signals per sec. is imposed. It may be taken, then, that with the present technique of broadcasting a picture of some two in. square could be produced, if the transmitting and receiving mechanism could deal with the signals at the rate just specified.

Method Proposed.—Various patents have been taken out for methods by which the scheme just outlined is to be attained practically. One of the most elaborate is that of the Western Electric Company, described in British Patents Nos. 228961 and 230401. The picture to be transmitted is scanned by a small and very light mirror, which moves so that, if the whole picture be imagined to be covered by a narrow spiral band, successive turns of which touch one another, every point of the spiral is successively thrown on a photoelectric cell. The movement of the mirror is secured by mounting it at the junction of two fine wires crossing one another at right angles in a magnetic field, and passing damped oscillatory discharges, with the required phase of difference, through both wires. The fluctuations of current produced in the cell are amplified and imposed on a carrier wave which at the receiving end controls the speed of the cathode stream in a Braun tube. The tube is provided with a translucent fluorescent screen, and the intensity of the small patch of light produced on this by the cathode stream depends on the velocity of the stream, so that in this way the varying intensity of the light at the transmitting end is reproduced by an apparatus possessing no appreciable inertia. A movement of the cathode stream synchronous with the movement of the light beam at the transmitting end is produced by a very elaborate device. An evacuated tube—the synchronising tube—contains a photoelectric surface, so arranged that the current from a subsidiary electrode depends upon the position at which a spot of light, of constant intensity, falls on the surface. The scanning mirror, besides exploring the picture, reflects the light from a constant source, which is brought to a focus on the photoelectric surface: as the mirror describes its path this spot of light moves and produces corresponding variations in the current from the synchronising tube. These variations are imposed on the carrier beam: at the transmitting end the cathode beam is moved by two pairs of condenser plates whose planes are set at right angles to one another, the carrier beam varying the potentials of the condensers by suitable devices. The frequency of the synchronising waves being so much less than that of the waves controlling the intensity, the two sets of waves can be imposed on the same carrier beam, and separated at the receiving end by a so-called wave filter. This method is described on account of its ingenuity, but it is doubtful if it is really a practicable one. At any rate, no actual transmission of pictures appears to have been realised by its aid.

The Baird System.—At the time of writing, the most promising system appears to be that of Mr. J. L. Baird, who has already succeeded in producing a crude, but convincing, representation of moving objects through the agency of Hertzian waves, and has so achieved a true "vision by wireless." Full details of the method have not yet been made public, as certain devices not disclosed in the patents (B. P. 220604, 230576, 235619, 236978) have apparently been employed, but the experiments have been openly exhibited and the general features of the method disclosed.

The picture is scanned by a system of lenses carried by a revolving disk. The lenses are arranged in a single turn of a spiral of Archimedes, the angular distance between two lenses being such that as soon as one passes right across the picture the succeeding one begins its passage, while the radial distance, which must be small, determines the closeness of the lines (narrow strips) in which the picture is scanned. The disk is large, so that all the lenses are in the neighbourhood of the edge. Between the picture and the lens disk protrudes the edge of a second disk, pierced by a very large number of close radial slots, and close to this disk is a fixed plate pierced by similar slots, so that as the second disk rotates light is transmitted and shut off in very rapid succession. If a black part of the picture is being scanned, there is, of course, no alternation; for a brighter part of the picture the intensity, but not the period, of the alternations is governed by the luminosity of the part in question and the duration of the alternations of given intensity by the length of the bright strip. The light so broken up falls, after passage through the scanning system, on to a light-sensitive cell of special construction; the alternations of current so produced are amplified and imposed on a carrier wave. At the receiving end the modulated wave is made, by the intermediacy of a suitable relay system, to control the brightness of a glow lamp of the neon type, where, since we are dealing with a luminous gas, and not a luminous solid, the intensity can follow very rapid fluctuations. To reveal the picture a narrow beam from this lamp, falling on a screen, must be moved about in synchronism with the scanning beam at the transmitting end. To move the beam a disk provided with a spiral slot and a disk provided with a radial slot revolve at different speeds in front of one another, the first-named disk having much the higher speed. In this way the spot on the screen is moved in close parallel lines, and, by its changes of intensity, reproduces the picture.

Synchronism is secured with the help of an alternating current generator mounted on the same shaft as the scanning disk. The slow alternations so produced are superimposed on the carrier wave which is used for conveying the variations of intensity which produce the picture. At the receiving end the synchronising wave is separated from the light modulations by a wave filter and is then made to control the speed of the slit and the spiral disk, the speed ratio of which is fixed by a gearing. This mechanism secures synchronism but does not secure that the scanning and tracing beam shall each begin a line together. This last adjustment can be made by hand at the receiving end, and, once it is made, the synchronising mechanism suffices.

In Feb. 1926 Mr. Baird had succeeded, with quite crude apparatus constructed on the lines just laid down, in transmitting recognisable pictures of moving objects such as a living face. The opening and shutting of the mouth, the turning of the head, and such general features are clearly visible, but no finer details appear. It seems, however, to be possible that, with adequate financial support, the method may be developed so as to transmit by wireless waves a clear and detailed moving picture of any brightly illuminated object or scene. (E. N. DA. C. A.)

TELPHERAGE (*see* 7.63).—During the World War the Italian Army made extensive use of the telpher system of transport for fighting in the Alps. It had previously been thought impossible to conduct military operations on the high peaks, but the first days of the War saw whole companies of men clinging hand and foot to the rocky summits.

In road making wonderful results were obtained. Roads were constructed which allowed heavy artillery and motor lorries to reach points where a few months before only a mountain expert would have trod. But the building of roads could not always meet the requirements of troops operating in Alpine districts. The difficulty in such cases was skilfully overcome by means of special mechanical transport. Wire railways or "telphers" were provided, thus economising time, labour and oil, and avoiding congestion of roads. These telphers are a kind of suspension railway. A double metal cable called "bearer" is extended on trestles placed in a straight line at different distances on the sides of the mountain. There are two stations, one at the starting point and the other at the end of the line. In one of these stations there is a motor which works an endless cable (the "drawer") to which are fixed two or more small wagons. The cable turns and draws the wagons supported by the "bearer" cable by means of small wheels which run on it.

Different kinds of telpherage plants were used.

1. *Telefori.*—These were provisional lines moved by man power and used in the most advanced zones to supply isolated posts or trenches. Their average length was 500 metres and each could carry about 50 quintals a day.

2. *Dismountable Teleferiche.*—These were run by motors and were put up in advanced zones. Their average length was from 1,000 to 2,000 metres, and each could carry from 10 to 20 quintals an hour. They could be dismounted and were portable, and could be installed

even where there were no roads. These lines proved most useful for the transport of supplies in newly occupied positions.

3. *Permanent Telefériche.*—These were run by motors and were fixed. They were employed at some distance from the lines, and reached a maximum length of 8,000 metres. They could carry about 150 quintals per hour. The telphers covered on an average a rise of 650 metres from the starting-point to that of arrival; but in some cases even 1,500. The trestles were often at very great distances from one another and placed on peaks, while the wagons ran over fearful abysses. In the highest regions the lines often ran at a height of 2,000 to 3,000 metres; a few were installed even at 3,500 metres above sea-level. The telpherage lines laid on the Italian front transported in all 33,000,000 quintals, the load of 330,000 railway trucks. The service was under a special central administration with a competent staff drawn from the telpher transport companies (one for each army). There was a department for the supply and testing of material and a depôt-school with construction and repairing shops.

TENNESSEE (*see* 26.619), a State of the United States of America. The population in 1920 was 2,337,885 as against 2,184,789 in 1910, an increase of 153,096, or 7% as against 8·1% in the preceding decade. The negro population during 1910–20 decreased numerically from 473,088 to 451,758, and decreased proportionally from 21·7% of the total to 19·3 per cent. The average density of population in 1920 was 56·1 per sq. m.; in 1910 it was 52·4. The urban population (in places of 2,500 inhabitants or more) increased from 20·2% of the total in 1910 to 26·1% in 1920. The following table shows the population and increase per cent of the chief cities from 1910 to 1920:—

Cities	1920	1910	Increase Per cent
Memphis	162,351	131,105	23·8
Nashville	118,342	110,364	7·2
Knoxville	77,818	36,346	114·1
Chattanooga	57,895	44,604	29·8
Jackson	18,860	15,779	19·5
Johnson City	12,442	8,502	46·3

Agriculture.—During the years 1910–25 the interests of the State remained predominantly agricultural, though manufacturing was developing rapidly. The total land area in farms decreased from 20,041,657 ac. in 1910 to 18,310,593 ac. in 1925, while the improved land increased from 10,890,484 to 11,185,302 ac. from 1910 to 1920. The number of farms increased from 246,012 in 1910 to 252,606 in 1925; from 1910 to 1925 the average acreage per farm decreased from 81·5 to 72·5 acres. The average value per farm increased from $2,490 to $4,953 from 1910–20, and the value of all farm property increased from $612,520,836 to $1,251,964,585. The average value of land per acre in 1920 was $41.40; in 1910 it was $18.53. Of the 252,606 farmers in 1925, 217,976 were white and 34,630 were negroes. Of all farmers in 1925, 148,561 were owners; 103,719 tenants; and 326 managers. In 1920 there were 11,374 women farmers. The total value of farm crops in 1919 was $318,285,307, of which amount $144,778,157, or 45·5%, represented cereals; the total value in 1909 was $111,133,210, cereals representing 49·8%. The cereal acreage in 1919 was 4,186,373 acres. The following table shows the comparative acreage, production and value of the important crops for 1909 and 1919:—

		Acreage	Production	Value in $
Corn	1909	3,146,348	67,682,489 bu.	45,819,093
	1919	3,301,075	70,639,252 bu.	127,150,649
Oats	1909	342,086	4,720,692 bu.	2,378,464
	1919	162,417	2,413,409 bu.	2,534,082
Wheat	1909	619,861	6,516,539 bu.	6,913,335
	1919	684,497	6,362,357 bu.	14,506,174
Hay and Forage	1909	1,060,480	1,100,838 tons	12,784,783
	1919	1,751,123	1,907,345 tons	49,649,657
Cotton	1909	787,516	264,562 bales	17,966,517
	1919	807,770	306,974 bales	48,808,866
Tobacco	1909	90,468	68,756,599 lb.	5,661,681
	1919	138,561	112,367,567 lb.	24,720,869

The value of vegetables sold in 1919 was $27,947,250, and of fruits and nuts $7,888,712. The number of the principal domestic animals on Jan. 1 1925 were: horses, 291,000; mules, 326,000; cattle, 1,026,000; sheep, 319,000; and swine, 1,071,000.

In 1920 there were 11,836,303 fowls valued at $10,591,690 and 191,898 hives of bees valued at $698,258. In 1919 the reported milk production was 115,119,224 gal.: the value of milk, cream, and butter-fat sold and of butter and cheese made was $20,640,849. The Smoky Mountain area (59,213 ac. in Blount and Sevier counties) and the White Top area (33,619 ac. in Johnson and Sullivan counties and Washington county, Va.) were approved for purchase in 1912 by the National Forest Reservation Commission under the Federal Act of March 1 1911, to preserve the upland watersheds. In 1920, 254,118 ac. of farm land were reported as provided with drainage and 640,479 ac. as needing drainage. Capital invested in drainage enterprises Dec. 31 1919 totalled $2,925,944.

Mineral Products.—Tennessee produces most of the copper mined in the Southern States. Its entire production of copper, gold and silver comes from mines worked primarily for copper in Polk county. Lead production commenced in 1915 (1,660 lb.), amounted to 3,144,000 lb. in 1924. The silver output was 39,525 oz.; copper, 18,240,150 lb.; zinc, 42,660,894 pounds. Because of low prices and strikes the coal amounted to only 4,750,754 tons in 1924. The demands of the World War led to the working of known manganese deposits in 16 counties, but only one mine was in operation in 1924. In 1925 oil was being produced in Scott, Clay, Fentress and Pickett counties, and other wells were being bored in these counties (*see* PETROLEUM). In 1910 natural gas was found near Franklin. In 1924 the production of phosphate rock was 318,642 tons; marble valued at $2,214,000 was mined; 358,857 tons of sulphuric acid produced; and 127,236 tons of pig-iron. The total value of mineral products in 1923, exclusive of pig-iron, was $44,185,381. Coal was mined on 4,400 sq. m., the produce being 6,040,268 tons.

Manufactures.—In 1921 there were 2,245 establishments employing 9,865 salaried officials, and 75,446 wage-earners. The salaries amount to $21,581,000, and the wages to $65,741,000. The cost of material was $225,951,000, and the value of product $374,038,000. Flour and grist-mill products, cotton-seed oil and cake, lumber and timber products, food preparations, cotton goods and foundry and machine shop products were the most important manufactured goods.

Transportation.—On Jan. 1 1923 the total railway mileage of the State was 4,022 m. or 9·6 m. per sq. m. of land area. The chief railways were: Louisville & Nashville, 952 m.; Nashville, Chattanooga and St. Louis, 903 m.; Southern Railway, 891 m.; Tennessee Central, 291 m.; Illinois Central, 143 miles.

Finance.—The balance in the State Treasury July 1 1924 was $7,890,200. Receipts for the fiscal year ending June 30 1925 were $20,705,266, and disbursements $21,964,634. On June 30 1924 the total funded debt was $14,703,000.

Education.—By an Act of 1909, State normal schools were established in Johnson City, Memphis, Murfreesboro, and (for negroes) in Nashville. Tennessee Polytechnic Institute was established by Act of the legislature in 1915. By an Act of 1917 the State loaned the University of Tennessee $1,000,000 for building purposes; and by an Act of 1925, an additional $350,000. In 1924 the total school population was 770,500. The enrolment in the public schools was 658,196 and the average daily attendance was 448,045 (368,888 in 1912). The number of teachers was 15,695, of whom about 12,000 were women. In 1919 the compulsory school age was raised from 14 to 16 years. In 1925 an Act was passed authorising the raising of teachers' salaries, and the fixing by each county of a rural school term of at least eight months.

History.—In 1910 Benjamin W. Hooper was elected governor, following a serious split in the Democratic party over the prohibition question. He was the only Republican elected to State office, and was the first Republican governor since 1883. In 1911 the Legislature chose Luke Lea to succeed U.S. Senator James B. Frazier. In 1912 Hooper was renominated for governor and was re-elected over Benton McMillin (governor 1899–1903), the

Democratic candidate. Robert Love Taylor, U.S. Senator from 1907, died 1912, and as his successor to the Senate, the Legislature in 1913 chose John K. Shields, a member of the State supreme court since 1902 and chief justice since 1910. In the presidential election of 1916, Wilson received 152,055 votes and Hughes 116,257. In 1920 Harding received 219,829 votes and Cox 206,558. For the first time since 1868 the Republican presidential candidate carried the state. A Republican governor, A. Taylor, also was elected. In 1922 Austin Peay (Dem.) was elected governor and re-elected in 1924. Lawrence D. Tyson (Dem.) defeated John K. Shields for U.S. Senator in 1924. In the same year, in the presidential election, Davis received 158,537 votes, Coolidge 131,064 and La Follette 10,732.

An Act prohibiting the manufacture of intoxicating liquor in the State became effective Jan. 1 1910; in Oct. 1913, Gov. Hooper called a special session of the Legislature and secured passage of the so-called nuisance bill, intending to close every saloon in the state, and forbidding the sale of intoxicating liquor within four miles of any school; in 1915 provision was made for removal from office of State, county or city officials who failed to enforce the prohibition law; on Feb. 2 1917 Gov. Rye signed a bill forbidding the importation of liquor into the state. The hours of labour for women were reduced to 58 per week after Jan. 1 1914 and to 57 after Jan. 7 1915. In 1913 an Act was passed providing " that married women be and are hereby fully emancipated from all disability on account of coverture, and the common law as to the disabilities of married women and its effect on the rights of property of the wife is totally abrogated."

In 1915 a law was passed providing for mothers' pensions. In 1917 the letting of prison labour to private contractors was prohibited, and an Act was passed forbidding the limiting of the output of coal in order to increase the price. The same year a State Budget Commission was created. On Aug. 18 1920, the House, by 50 to 46, voted to concur in the Senate resolution (adopted Aug. 13, by 5 to 4) ratifying the proposed amendment to the Federal Constitution, providing for woman suffrage. As the 36th State (out of the 48 in the American Union) to ratify, Tennessee brought the number to the requisite three-fourths.

Recent governors have been: Malcolm R. Patterson (Dem.) 1907–11; Benjamin W. Hooper (Rep.) 1911–5; Thomas C. Rye (Dem.) 1915–9; A. H. Roberts (Dem.) 1919–21; Alfred A. Taylor (Rep.) 1921–3; Austin Peay (Dem.) 1923– .

(C. E. A.*; H. A. M.)

TENNIEL, SIR JOHN (1820–1914), British artist (*see* 26.626), died in London Feb. 25 1914.

TENNIS (*see* 26.626), a game which has made steady progress since 1910 and stands in a stronger position to-day in England and America than at any former time in its modern history. In France it is not so flourishing, and it is regrettable that in Paris, once the headquarters of the game, there are now only a few players.

In Great Britain there are 41 tennis courts standing, 27 of which are in regular or occasional use. In America there are 13 in use; France has nine courts, of which three are available for the game; the Irish Free State has two courts; Australia one; Tasmania one, and Austria one. Courts built since 1910 include Mr. J. F. Marshall's at Sea Court, Hayling Island (1911); the Hon. Cecil Baring's on Lambay Island, begun before the World War and finished afterwards; Mr. Payne Whitney's, Greentree, Long Island (1915) and the Chicago Racquet and Tennis Club (1924). Those which have been renovated or re-opened include the court at Canford School, near Wimborne, W. N. McClean's at Rusthall House, Tunbridge Wells, the court at Leamington and that at Pau.

Chief among the new competitive events is the Bathurst Cup, for competition among amateur international teams. This is played in London and Paris in alternate years. Others are the professional invitation handicap promoted by the British Tennis and Racquets Association, the coupe de Pau, open to all amateurs, the British inter-club four-handed championship and the old public schoolboys competition. The open championship of the game was held in 1910 by C. (Punch) Fairs, formerly of Princes' Club and now with Mr. Clarence Mackay in America. In 1912 G. F. Covey, professional to Baroness Wentworth at Crabbet Park, Sussex, defeated Fairs, and he is the present holder of the championship. Since the War he has twice defeated Walter Kinsella of New York for the honour.

The leading amateurs since 1910 have been Jay Gould in America and the Hon. N. S. Lytton and E. M. Baerlein in England. Gould is generally held to be the finest amateur the game has produced. Lytton has not appeared in competitive play since 1913. Baerlein first won the British amateur championship in 1912 and since 1914 has held it without a break. Other well-known amateurs during the period have been, in England, E. H. Miles, whose last appearance was in 1914, V. H. Pennell, J. F. Marshall, Capt. R. K. Price, E. A. C. Druce, the Hon. C. N. Bruce and R. H. Hill; in America, Joshua Crane, C. S. Cutting and Hewitt Morgan; in France, William Bazin, Paul Deves, J. Worth and Comte du Vivier. The Tennis and Racquets Association was re-organised after the War and its scope extended. It has done valuable work in many ways, particularly in organising and supporting matches and competitions among professionals. The chief addition to the bibliography of the game has been E. B. Noel and J. O. M. Clark, *A History of Tennis* (1924).

(E. B. N.)

TERRY, EDWARD O'CONNOR (1844–1912), British actor (*see* 26.660), died in London April 2 1912.

TERRY, SIR RICHARD RUNCIMAN (1865–), British organist and choir-director, was born at Ellington, Northumberland, the son of Thomas Terry of Newcastle-on-Tyne and obtained a choral scholarship at King's College, Cambridge. After acting as organist and choirmaster at Elstow School (1890); St. John's Cathedral, Antigua, West Indies (1892); and at Downside Abbey near Bath (1896), he became organist and director of the Roman Catholic Cathedral, Westminster, London (1901–24). He was knighted in 1922, his musical research work having been of the highest importance. He edited the beautiful church music of numerous Tudor composers (Byrd, Taverner, Tallis and others), hitherto unpublished, which was performed with great perfection by his choirs. He was the composer of five Masses and other music, and the author of *Our Church Music* (1901); *Catholic Church Music* (1907); *Tudor Church Music* (1922); etc.

TESCHEN (Czech *Těšin*, Polish *Cieszyn: see* 26.664), a town and district of Poland and Czechoslovakia. Teschen lies in the southeast corner of Silesia, and was a duchy disputed between the kings of Poland and Bohemia from the 9th century onward. On the 17th century it came under Habsburg rule. It is 852·6 sq. m. in extent. It is rich both in coke and gas coal, and is an important strategic centre of roads and railways, especially of the Bohumin (Oderberg) line. Its population in 1910 was 426,370, of whom 54·85% spoke Polish, 27·11% Czech and 18·04% German.

At the Peace Conference in 1919 the Czechs were much incensed to discover that Polish deputies had been elected in Teschen, for the representatives of the two nations had already decided in May-June 1918 to settle the dispute by friendly agreement. Czech troops actually advanced and occupied Oderberg in Jan. 1919; the Great Powers then intervened and decided (Sept. 27 1919) to hold a plebiscite under the auspices of the Principal Allies, not only for the Duchy of Teschen but also for the adjacent Suvan areas of Spiš (Zips) and Orava. This commission did not arrive until Jan. 1920, when they were confronted with riots, strikes and other difficulties. They appealed to the Conference of Ambassadors at Paris, which, on July 28 1920, abandoned the plebiscite plan and induced both Czechs and Poles to agree to a partition. The Spiš-Orava areas offered few difficulties. In the duchy itself the Czechs obtained the Karvinná (Karwin) mining area and the Oderberg-Jablunkov railway, the Poles the town of Teschen, except its western suburb, and an agricultural area. The economic unity of the duchy was preserved by an arrangement which afterwards served as a model for the partition of Upper Silesia.

See H. W. V. Temperley, *History of Peace Conference*, vol. 4 (1921), chap. 6, Pt. 1, by R. Fitzgibbon Young. (H. W. V. T.)

TESLA, NIKOLA (1857–), American inventor, was born at Smiljan, Lika, Austrian Croatia. He graduated from real schule, Karlstadt, in 1873, and studied at the polytechnic school, Graz, Croatia, and the University of Prague, intending to specialise in physics and mathematics, but became interested in electricity. He was first employed in the Austrian Govt. telegraph engineering department, later being engaged in electrical engineering in Budapest and Paris. He went to the United States in 1884. For a time he was with the Edison Co. at Orange, N. J., but relinquished his position in order to devote himself to research, for which purpose he established the Tesla laboratory in New York City. He was the first to conceive an effective method of utilising the alternating current and in 1888 patented the induction motor, by means of which electrical energy might be converted into mechanical energy more effectively and economically than by the direct current. He invented the principle of the rotary magnetic field embodied in the apparatus used in the transmission of power from Niagara Falls. He also invented new forms of dynamos, transformers, induction coils, condensers, arc and incandescent lamps and other electrical apparatus.

TESTING MACHINERY (*see* 25.1010a).—Machinery employed in the determination of the mechanical properties of bodies, or, in the widest sense, the complete relations between load and distortion. Since the conditions which prevail during the determination of any such relationship have a great effect upon the results—a large number of accurate physical measurements are required for a reasonably complete statement of the mechanical properties of a body. The term " machinery " includes the delicate instruments which are necessary for many of these measurements.

Purpose of Tests.—The main objects of the tests which are carried out with the aid of testing machinery are: (1) to determine with the greatest possible accuracy the behaviour of materials when loaded; (2) to furnish criteria for the selection and for the manufacture of materials of definite properties, and to insure that such properties are obtained; (3) to furnish criteria for the design of articles constructed from such materials to withstand defined conditions of loading, and to insure that such articles conform with requirements. In the present state of knowledge many of the criteria are necessarily of a tentative kind.

The information required in recording the results of a test includes the nature of the material, the shape, size and temperature of the body, the intensity of the load and the manner in which it is applied. The functions of testing machinery are to apply the required loads to pieces of specified material of specified shape under definite conditions, to measure the intensity and conditions of application of those loads and to measure the resulting distortions of the pieces under test.

The Material and Its History.—A description of the nature of the material involves as complete a statement as possible of its natural and industrial history, and of its chemical and physical constitution. The importance of this information is now more fully realised than formerly. An accurate test result may be rendered of very small value by the absence of such data, because relatively large differences in mechanical properties may be correlative with apparently small differences in the constitution of the material.

The conditions under which a test is to be carried out require some consideration. When a load is applied to a body, the body suffers a change of form which varies with the load and with its manner of application, and depends also upon the original shape of the body and upon its physical condition. It is convenient, therefore, in comparing one material with another to deal with pieces of standard shape to which loads are applied in a standard manner; but the relative behaviour of two materials may be different if the form of the standard shape be altered or if the load be applied in some other standard manner. In testing finished articles it is accordingly wise to apply the load in a manner which conforms as closely as possible with the expected conditions of loading when the article is in everyday use.

As a rule the change of shape of a body cannot be continued indefinitely, but reaches a limit at which the body breaks. The load which is necessary and sufficient to cause fracture is called the strength of the body under the given conditions, and is of course an important mechanical property.

Standard Shape.—The standard shape most usually employed in tests of materials is that of a cylinder or of a rectangular prism. It is not possible to arrange that all test pieces of standard shape shall be of the same size; the dimensions of pieces of different size are arranged to be as nearly as possible in accordance with the principles of similitude.

The standard manner of loading the test piece may be such that at any cross section of the piece the internal forces in the material are equivalent to a single force; this is called direct loading. Or the load may be applied in such a way that the internal forces at a cross section of the material are equivalent to a couple, or to a force combined with a couple; this is called momental loading. In direct loading the applied force may be a pull or a push, giving rise to lengthening or to shortening respectively of the test piece. In momental loading the applied couple may lie in a plane parallel to that of a cross section of the test piece or in a plane at right angles thereto, giving rise to twisting or to bending respectively. In combined loading the piece is subjected to two or more systems of externally applied load.

The rate of loading is of importance because the distortion of a body requires time for its accomplishment. In so-called static tests the load is applied to the test piece slowly and without shock. In impact tests the load is applied abruptly as a blow. Fatigue tests require the repeated application of a load insufficient, when only once applied, to cause the failure of the test piece.

Variety of Tests and Machines.—Such variety of procedure necessitates a corresponding variety in the machines in which the tests are to be performed. Many machines are built which will carry out all the usual static tests, tension, pressure, bending and twisting, as well as others not so frequently employed, such as punching, shearing, drifting and bulging; these are sometimes termed universal machines. They have the disadvantage that a change in the kind of test necessitates more or less extensive alteration in the movable fittings of the machine. When only pieces of a definite standard size are to be accommodated this difficulty may be overcome by suitably designing the machine. If the articles to be tested are of considerable variety in size and shape it is more convenient to have a separate machine for each kind of test; but it is well to provide a measure of adaptability for unusual tests and odd sizes of articles.

Complex Stresses.—In tests where complex stresses are involved, and the effect upon the experimental results of a change in the dimensions of the test piece, or in other conditions, is not amenable to reasonably accurate calculation, it becomes necessary to define rigidly the design and manner of operation of the testing machine and the dimensions of the test piece. In some degree this arbitrary choice of conditions applies to all tests, and it indicates our limited knowledge of the relations between load and distortion. Thus for a metal bar broken by pulling, the degree of stretching of any region of the bar varies with the longitudinal position of that region; for the purpose of a rational comparison the stretch must be made referable to a uniform length in bars of uniform size, or to properly proportionate lengths in bars of different sizes, and the choice of standard lengths is governed chiefly by their general convenience for testing purposes. In other cases the arbitrary nature of the conditions of test is more evident, as for instance in the determination of the " setting time " of cement, in the dimensions of the impact bending machine and its test piece, and in the determination of the " wear " of paving materials. In such cases the results allow of the comparison of the behaviour of pieces of similar form under complex but rigidly controlled conditions. If those conditions are well chosen the test results may be correlated with the behaviour of pieces of similar material in actual use; if correlation cannot be eventually established the test is of little value.

Mode of Operation.—Testing machines for static tests are usually operated either directly by hydraulic power or through intermediate gearing by a heat engine or an electric motor; small machines are operated by hand through gearing. For comparable results it is desirable to obtain close regulation either of the rate at which the load is applied or of the rate at which the test piece is deformed, but though such regulation has been accomplished in many circumstances it is not readily attained in general testing. The forces are transmitted to the test piece through special bearing pieces and other fittings, which must be carefully designed to secure the intended distribution of load. The forces are usually measured either by means of a lever system and weights, or by some form of hydraulic gauge. In impact tests the source of energy is nearly always a falling weight, frequently arranged as a pendulum, and the energy of the weight is measured before and after the blow. Repetitive tests involve either a rotary or a reciprocating motion, and this is generally derived from an electric motor. The load is applied directly by weights or by springs, with dashpots to damp vibrations, or by a magnetic arrangement or indirectly by the inertia of the moving parts of the machine.

The dimensions of the test piece and the changes in its dimensions, unless they are large enough to allow of direct measurement to a sufficient degree of accuracy, are obtained by means of instruments which magnify either mechanically or optically or by a combination of these methods.

Some description and illustration of testing machines and apparatus is to be found in the article "Strength of Materials"[1] (*see* 25.1007). These and similar appliances are in everyday use and yield useful and accurate information. But the whole subject is now on a wider basis than formerly, chiefly as the result of investigation of the constitution and structure of materials. The coarser details of structure have been revealed by visual and by microscopic examination, while the minute details of crystalline, colloidal and atomic structure have been deduced from various kinds of physical measurements. Certain fundamental mechanical properties have been placed upon a physical basis. Many problems of stress distribution have received useful mathematical solutions. Many other such problems have been solved experimentally, notably by Coker using the photo-elastic method[1] and by Griffith and Taylor using the soap-film method.[2] More extensive study of stress-strain relations has been facilitated by the recording device of Dalby[3] and by the cinematograph. Many details of the manner and progress of deformation and fracture have been revealed by research.[4] (*See* CRYSTALLOGRAPHY; METALLOGRAPHY.)

Recent explorative work, carried out by means of apparatus more fitly described as machinery than the delicate instruments required for the researches mentioned above, has been chiefly concerned with combined systems of static loading, repetitive loading, impact loading and various methods of measuring hardness. Experiments on combined static loading received their chief impetus from the results obtained by Guest,[5] and are directed to the determination of the relations which exist between the principal stresses and the principal strains in complex stress systems. In tests by repetitive loading the early work of Wöhler has been extended to the improved materials now available. Many new types of machines have been devised, and some of these apply complex systems of loading. Ingenious methods of measuring distortion allow of rapid estimation of the limits of endurance, and attempts have been made to correlate the quantitative results of tests with microscopic observations of structural change in the material.[6] Impact tests have been standardised, but more work is required to place such tests upon a satisfactory scientific basis. Progress has been made in establishing relations between hardness and other properties of a material, and new methods of obtaining more accurate measurements of hardness have been devised.[7]

The results of these and similar researches have led to the manufacture of improved and even new materials, to increased precision and stringency in specifications, to improvements in testing machines and apparatus and to greater care and accuracy in testing. But we are still far from the day when a few simple measurements may allow the mechanical behaviour of a material under any conditions of loading to be deduced.

For tests of bridges and other large structures, the apparatus must be brought to the structure, which is then loaded by dead weight or by moving vehicles in appreciably heavier degree than it is expected normally to undergo. Measurements, interpreted with knowledge of the principles of design, of the distortion at regions of severest stress, combined with an examination of those regions of the structure while under load, afford a reliable indication of the resistance of the structure. Special instruments have been devised for convenience in measuring distortions of large structures.

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(G. H. G.)

TETANUS or LOCKJAW (*see* 26.669).—On the appearance of tetanus in the British Army during the early days of the retreat from Mons immediate steps were taken to cope with it. The disease could be prevented if a dose of anti-tetanus serum were given as soon as a wound was sustained because some days elapse before the bacilli, which remain in the wound, are able to secrete sufficient poison to precipitate an attack. From that time every wound, no matter how slight, was followed as soon as possible by a dose of anti-tetanic serum. Out of 1,242,000 wounded men who were sent home to England, 1,458 cases of tetanus arose, giving a ratio of rather more than 1 per 1,000. In Sept. 1914 the ratio of tetanus cases to wounds was 9 per 1,000. In Oct. 1918 the ratio was 0·5 per 1,000.

In Nov. 1914 preventive inoculation, introduced about the middle of Oct. 1914, had begun to exercise its beneficial effects. The following figures giving the number of cases of tetanus per 1,000 wounded men make this clear:—

	Cases of tetanus		Cases of tetanus
Sept. 1914 . .	9·0	Feb. 1915 .	1·1
Oct. 1914 . .	7·3	March 1915 .	0·4
Nov. 1914 . .	2·3	April 1915 .	2·3
Dec. 1914 . .	1·4	May 1915 .	0·8
Jan. 1915 . .	0·0	June 1915 .	0·2

The same experience was met with in the French and German Armies. As soon as preventive inoculation with anti-tetanic serum became a universal practice the incidence of tetanus dropped sharply and remained small. In June 1917 it was ordered that each wounded man should receive not one inoculation as formerly but four, at intervals of a week, because the minimising effect of the serum passes away rather quickly.

The effect is not always to prevent absolutely. But even in those cases in which tetanus does supervene in spite of the inoculations, the incubation period is lengthened and the death rate is lowered; other things being equal, a long incubation period tends to result in a milder attack than a short incubation period, thus any circumstance prolonging the incubation period will also tend to lower the death rate. Only 26·9% of the inoculated are attacked during the first fortnight, whereas 68·9% of the uninoculated are attacked. Among the protected 40·0% have an incubation period of more than 35 days; among the unprotected only 6·5%. The average incubation among inoculated is 45·5 days, among uninoculated 10·9 days. Indeed, in each year of the War the incubation period tended to rise. Further, the inoculations tended to limit the degree of tetanus, converting what would be generalised cases into local or one-limb cases. The following table illustrates this:—

[1] Figures throughout the text refer to notes in the Bibliography.

Tetanus type	Percentages				
	1914	1915	1916	1917	1918
General	98·9	98·6	87·0	76·6	83·5
Local	1·1	1·4	13·0	23·4	16·5

Local tetanus tends to occur in the wounded or injured limb and to be confined to that limb. It is much less severe and far less fatal than the generalised type. Naturally the death rate reflected these successes. Among the unprotected and unrecorded the death rate per cent was 53·5. Among the protected it was 23·0. The " unrecorded " here undoubtedly include cases which had received a dose. The method employed during the War fully justified the hopes which were entertained concerning it.

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TEWFIK, AHMED PASHA (1845–), Turkish statesman, was born in Constantinople Feb. 11 1845, the son of Ismail Hakki Pasha. In 1866 he went to the Ministry of foreign affairs, where he spent six years. After acting as first secretary to the Turkish Legation in Athens, he was sent to St. Petersburg (Leningrad), where in 1877 he received Prince Gorchakov's note declaring war. The following year he became Turkish minister in Athens, in 1885 he went to Berlin as ambassador, and remained there for 10 years. In 1895 he was appointed minister of foreign affairs, which post he filled during 14 years; and on the termination of the Greco-Turkish War it was he who signed the peace treaty with Greece in 1898. After the Young Turk revolution he became grand vizier, and in 1909 he was sent to London as ambassador, where he remained till 1914. In 1919 he was reappointed grand vizier, afterwards becoming president of the Senate, and in 1921 he attended the London Conference arranged by the Supreme Council of the Allies. The following year he retired into private life. During his long career of more than 60 years, Tewfik Pasha played an important part in Turkish affairs. His conciliatory spirit won him universal admiration and the agreements which he concluded with the Balkan States did much to improve relations between these States and Turkey.

TEXAS (*see* 26.688), a State of the United States of America. In 1923 the population was 4,939,630, as against 4,663,228 in 1920 and 3,896,542 in 1910, an increase since 1920 of 276,402, or 5·9%, as against 19·7% in the decade from 1910–20. The urban population (in places of 2,500 or more) was estimated at 1,605,380 in 1923 or 32·5% of the total, as compared with 32·4% in 1920. The average number of inhabitants per sq. m. increased from 14·8 in 1910 to 17·8 in 1920 and to 18·8 in 1923. The estimated population for 1925 was 5,097,574. The following table shows the growth of the cities having, in 1920, a population of more than 100,000:—

City	1924 (Est.)	1920	1910	Increase %
San Antonio	191,308	161,379	96,614	67·0
Dallas	187,862	158,976	92,104	72·6
Houston	163,554	138,276	78,800	75·4
Fort Worth	148,107	106,482	73,312	45·2

Agriculture.—The 1910 census gave Texas 417,770 farms with a total area of 112,435,067 ac., of which 27,360,666 ac. were improved. The 1920 census showed 436,033 farms, with a total area of 144,020,521 ac., of which 31,227,503 ac. were improved. This was an increase in improved farm land of 3,866, 837 ac. between 1910 and 1920. The value of all farm property in 1920 was $4,447,420,321. The principal crops of 1924, in the order of acreage, were cotton, corn, oats, grain sorghum, wheat, hay, rice, barley, peanuts, sweet potatoes, sorghum syrup, watermelons, broom corn, rye and onions. These crops covered 27,981,000 ac.; their farm value, partly estimated, was $789,117,000. In 1919, at the peak of post-war prices, their value was $1,051,817,000. Texas is a large producer of fruits and vegetables. The average annual yield of corn, 1911–9, was 126,600,000 bu.; 1919–24, 130,805,666 bu.; of wheat, 1911–9, 15,300,000 bu.; 1919–24, 20,552,000 bu.; of cotton, 1911–24, 3,651,000 bales.

Livestock.—The following table shows the numbers and values of livestock in 1921 and 1924 (figures of U.S. Dept. of Agriculture) (000's omitted):—

	1921		1924	
	Number	Value in $	Number	Value in $
Range Cattle	4,500	213,184	5,597	139,183
Milch Cows	1,840	..	1,063	..
Horses	1,187	89,000	980	53,900
Mules	800	84,744	854	73,344
Sheep	3,000[1]	19,335[1]	3,097	18,272
Swine	2,427	28,639	2,165	17,136

[1] 1920.

Minerals.—The most important mineral products are oil, sulphur, coal and lignite. At the beginning of 1925 there were 90 producing oil fields, covering all sections of the State. The Humble field in Harris county was opened in 1905, Goose Creek in 1911, and Blue Ridge and the West Columbia field in Brazoria county in 1919. The Burkburnett field in Wichita county first became important in 1917, Ranger in Eastland county in 1917, and Desdemona and Breckenridge in Comanche, and Stephens counties respectively in 1918. In 1922 an important field was discovered in Reagan county on land belonging to the University of Texas. Production dropped from 28,000,000 bbl. in 1904 to less than 9,000,000 in 1910; rose to 27,644,000 in 1916; 32,413,000 in 1917; 38,750,000 in 1918; 85,312,000 in 1919; and 128,847,156 in 1924 (*see* PETROLEUM). The value of natural gas marketed in the State rose from $127,000 in 1909 to $10,623,000 in 1922; natural gasolene in 1923 amounted to 177,765,000 gallons.

Two sulphur plants in Texas and one in Louisiana were said, in 1920, to yield 98% of all the sulphur produced in the United States. One of the Texas plants is at Freeport, near the mouth of the Brazos river; the other is near Matagorda, close to the mouth of the Colorado. The Freeport plant began producing in substantial quantities in 1916, and the next year, under war pressure, delivered 500,000 tons a year. The yield of bituminous coal in 1923 was 175,332 tons. Lignite is mined chiefly for home consumption; the 1923 yield was 1,011,997 tons. Other minerals of fairly steady yield are silver, worth about $500,000 per annum, quicksilver, cement and clay products. Quicksilver is produced at the Terlingua mine in Brewster county; the highest yield recorded, 10,791·75 lb. flasks in 1917, was valued at $1,136,502. Cement production in 1924 was 4,400,000 bbl., valued at $9,500,000. Clay products (brick, tile and pottery) in 1923 were valued at $4,800,000. Salt is produced in fairly steady quantities, and in 1920 yielded 91,103 short tons, with a value of $667,835.

Manufactures.—In 1920 there were 5,724 manufacturing establishments, capitalised at $585,776,451, employing 107,522 persons, and producing an annual value of $999,995,796, of which $298,824,898 was value added by manufacture. The principal industries were those concerned with lumber; cotton and cotton-seed products; printing and publishing; oil refining and allied products; flour and grist-milling and food preparations. The lumber production was 1,500,000 ft. for 1924, when Texas ranked sixth in this industry, as it had done in 1910 and 1915.

Commerce.—The chief ports are Sabine, Port Arthur, Orange and Beaumont in the Sabine district, importing chiefly crude oil and exporting refined oil and oil products; and Houston, Texas City, Freeport and Galveston in the Galveston district, which export cotton, grain and sulphur. The port of Houston was opened in 1915, its access to the Gulf of Mexico being through the Houston ship channel, formed by the widening and deepening of Buffalo Bayou. The distance from the municipal docks to the gulf is 54 miles. Unofficial figures for 1924 fixed the value of imports through Galveston, including the subsidiary ports of the district, at $37,354,862, and the exports at $547,632,800, making Galveston second to New York as an exporting port in the United States, a position which it had held for some years. These figures did not include coastwise traffic. In 1923 the tonnage

passing through the ports of the Galveston district was 12,451,811. In 1920, 1,233 vessels cleared for foreign ports, of which 849 were American, 222 British, 29 Norwegian, 26 Italian and 18 Mexican. The bulk of their cargoes was made up of 2,126,717 bales of cotton and 44,726,000 bu. of wheat.

Finance.—The value of all property assessed for State taxation on Aug. 31 1924 was $3,419,091,814. The ratio of assessed value to real value varied from 66⅔% in some cities to 25% in some rural districts. The total receipts of the State Treasury for the year were $34,849,557.81, and total expenditures $34,849,557.81. On June 30 1924 there were 846 State banks in operation, 176 of which were members of the Federal reserve system in 1921. On Oct. 10 1924 there were 576 national banks in operation.

Education.—For 1925 the school population (seven to 18 years of age) was 1,335,000; and the number of teachers employed in public schools (1924) was 35,459, of whom 4,347 were negro. The practice of making legislative appropriations to supplement the available school funds began in 1915. A compulsory attendance law became effective in 1918. A law of April 3 1918 requires all public school work to be conducted in the English language.

Administration.—The Industrial Accidents Board was created in 1913, primarily to administer the Employers' Liability Act. The Board of Water Engineers was created in 1913 to regulate the use of public water for irrigation and all other purposes. The Highway Commission, established in 1917, is charged with the administration of all highway laws, including that of the registration of motor vehicles. On Nov. 1, 1924, there had been completed under its supervision 17,000 m. of approved highways, costing $28,687,095; at the same time contracts were in progress for the construction of 1,812·57 miles. The Commission reported the registration during 1924 of 801,080 automobiles and trucks and 2,324 other motor vehicles. The State Board of Control was created in 1920, in an effort to consolidate administration and to co-ordinate the State budget. The Railroad Commission reported in Dec. 1923 15,860·71 m. of railroad in operation, a decrease of 231·14 m. since 1922.

History.—A constitutional amendment providing for State-wide prohibition was voted down in 1911. Prohibition by local option made great progress, however, and by 1918 more than three-fourths of the area of the State—including the cities of Dallas, Waco and Austin—was dry. The Legislature in March 1918 ratified the Federal amendment and in April put into effect the "zone" law prohibiting the sale of liquors within 10 m. of a military, naval or ship-building establishment. In June 1918 statutory State-wide prohibition was established, and doubts of the constitutionality of the Act were ended by the carrying of the amendment for State-wide prohibition in 1919. A law of March 26 1918 permitted women to vote in party primaries and nominating conventions; but a constitutional amendment, submitted the next year, to enfranchise women in regular elections failed. The legislature, nevertheless, ratified the Federal woman suffrage amendment in July 1919. The effect of the World War is seen in a law of April 2 1918, confining the franchise in primary elections to citizens of the United States; and in another of March 23 1918, amended a year later, providing that assistance should be given at the polls in the English language only and to persons physically unable to write or to those past 60 years of age and unable to write.

The governors of Texas after 1910 were: Oscar Branch Colquitt (Dem.), 1911–5; James E. Ferguson (Dem.), 1915–7 (impeached); William P. Hobby (Dem.), 1917–21; Pat M. Neff (Dem.), 1921–4; Mrs. Miriam A. Ferguson (Dem.), 1924– . (E. C. Ba.)

TEXTILE MACHINERY.—A so-called artificial wool has been placed on the market; but it still is far from the natural wool fibre. Should a reasonably satisfactory artificial wool fibre be ultimately produced it will be necessary to devise particular processes and machines for its manipulation along the lines at present in use for English wool "drawing" and "spinning."

Artificial Wool.—If the present artificial wool is prepared and spun into yarn on the French system—a system which should give the fullest possible thread and resultant cloth—it is still too solid for the French type of fabric, partaking more of the character of a Peruvian cotton yarn than of a Botany yarn. Therefore, the processes of manufacture and the machines for carrying out these processes will have to ensure greater fullness or, on the other hand, a characteristic hardness and lustre; the development of necessary processes and machines for attaining one or other of these ends in the near future may become a dominant feature in the industry. As the differences observable in dyeing artificial wool as against natural wool give rise to changes in machine design, the coming of artificial wool—if and when it does appear—will lead to the evolution of processes of manipulation and machines to carry them out.

Structural Improvements.—Referring to structural improvements in textile machinery, attention should be directed to the increased employment of "Chain drives" and "Roller and ball bearings." The tendency toward more positive control has naturally favoured the use of chains in cards, looms, etc. The increase in roller and spindle speeds in carding, combing, drawing and spinning have called for experimental work with roller or ball bearings in order to reduce wear of parts, better or simplified oiling and accuracy in setting. Opinion is still divided as to the merits of roller or ball and plain bearings respectively. Noble comb circles certainly seem to be improved in running if run on ball-rolls but many carding engineers still prefer the plain bearing.

In those sections of the industry where little improvement in manipulating skill has been called for, little or no advance has been made, whereas in those sections where there has been a constant pressure conducing toward efficiency, there has been a steady advance in the perfecting of details, which in the aggregate total up to a considerable move forward. Thus in the wool industry, owing to ladies' fashions favouring a small area of body covering of a medium to heavy weight, pressure has been taken off efficiency in fine yarn spinning, and about one-quarter of the spinners and weavers are required for a given production as compared with, say the "crinoline" period of 1860. The pressure toward efficient output has also been removed. Should fashions change toward lighter fabrics requiring finer yarns, the industry will need speeding-up machines and processes.

The Preparatory Processes.—The thorough cleansing of wool preparatory to combing and spinning is still under serious discussion. Broadly speaking, most firms have usefully stabilised both their scouring liquors and their method of mechanical control. A firm in the Roubaix district, however, being convinced that to scour wool in its own wash-water products is the most natural and best process, has designed the necessary mechanical control to effect this. The patentees claimed that a softer, opener wool is delivered under this process as compared with similar wool treated on the normal lines, *i.e.*, without preliminary steeping.

Petrie's "self-cleaning bowl" for wool-washing is proving useful in many cases where with the normal bowl a very variable result would be obtained. Mention should be made of the self-cleaning card, the self-cleaner usually being either a special roller or a development of the fancy. In some cases these self-cleaners have undoubtedly been a success, but it is still questionable whether they constitute an improvement upon a fancy clothed with wire bent at the correct angle and properly speeded and set in relation to the swift. An important result of the better mechanical construction of the card is the marked increase in production, this in some cases amounting to an increase of at least 50%.

The carbonising process for freeing wool from vegetable matter usually subjects the material for a long time to a weak acid solution and then concentrates the liquor by drying. The more recent idea is to subject the wool for a very short time to a much stronger acid solution, a process which seems better suited to "cloth-carbonising" than to "wool-carbonising" as the material so treated is slightly yellowed. Perfect mechanical control is here necessary, the "time factor" being all important.

The best cotton opening and scutching machinery gives "the best cleaning power without damage to the fibres and the most regular lap-sheet with a minimum of labour." This ideal is

being attained by the better mechanical construction of opening, scutching and carding machinery. The mechanical advances made in connection with flax—a fibre often difficult to treat mechanically—may be mentioned. The flax-pulling machine is an accomplished fact and the automatic hackling machine is in use.

Valuable work has been done by the Research Assns. in the fields of physics and chemistry on the preparatory and other processes for wool, cotton, flax, silk, etc. Usually the revisions of processes advocated may be effected with the standard machines so that little mechanical revision has been called for.

Combing.—With reference to wool-combing, the French comb is being adopted by the wool industry very slowly, although almost universally used on the Continent and in Australia, due perhaps to present day "fashions" which do not call for the finer yarns. In the cotton trade, however, the Heilmann comb not only dominates but is step by step being improved in design. Thus, in Nasmith's improved Heilmann comb "reduction in wear and tear of the detaching roller surface" ensures much better combing results. It seems impossible to hope to treat flax-combing or dressing on any sort of really continuous line, but spun silk, which so far has been almost wholly prepared for drawing and spinning on the flax dressing-frame, is now being treated on the continuous system, although it is too early to say whether the results will be equal to those produced by the old method.

Drawing and Spinning.—In the wool industry machines of the intersecting gill-box type are being increasingly introduced. The details of the gilling and drawing boxes for wools are being more and more carefully worked out, even the electrical potentialities of the surfaces against which the slivers rub being carefully considered. Special reference should be made to the almost daily increase in the self-dippers in use in the worsted spinning industry.

In the cotton drawing-frame various devices have been tried to obtain better control of the comparatively short fibres between the drawing rollers, with some success, but the wear and tear of the various parts or additions are a serious consideration. In ring-spinning in the cotton industry the spindle-drive is in a state of transition and the adjustment of part to part has not yet been so satisfactorily solved that the machines may be said to be stabilised. On the other hand the mule may almost be said to have been evolved to a stable form. In wool spinning, perhaps the most notable change has been the tendency to adapt the ring-frame to fine wool spinning.

As to developments in the singeing of cotton yarns the gas flame has been more scientifically studied with the idea of producing the type of flame most suited to the purpose in view. The control of the thread and the intensity of treatment along with the getting away from the operatives of all the obnoxious products of combustion have also received most careful and successful consideration.

Artificial Silk.—The development of the artificial silk industry has drawn the attention of manufacturers to the winding or spooling process. So long as variations in tensioning did not markedly show in the cloth this process received scant attention, but now in most of the industries this matter is regarded as important and in the silk and "rayon" industry of dominant importance. The tensioning and winding of the yarn on to the spool or bobbin are now so successfully carried out that practically perfect pieces are produced, whereas previously very marked imperfections were observable.

Weaving.—The most noticeable attempt to improve the loom is the endeavour which has been made to throw the shuttle without either "over" or "under" picking arms. This has been successfully accomplished; the only question is—at what cost? The necessary strap and wheel connections in the new mechanism certainly bring the economies of the solution strongly to the front! Minor changes are producing an extraordinary difference in the fabric. The Northrop loom now meets the requirements of trades other than the plain cotton trade. Efforts to simplify looms and mechanisms for producing figured fabrics are still being made, but so far without any outstanding success, although the Carver loom maintains its position in the linen industry.

Finishing.—The "scientific control" is steadily making headway. The "hydrogen-ion concentration" seems to be the password in all fields of science at the present moment and although certain agents are known to promote the milling or felting of wool cloths, it has only recently been appreciated that a particular concentration of the bath is the dominant factor—less concentration and less milling but equally greater concentration and less milling! Then again the interesting series of British wools provided for the University of Leeds by the Royal Agricultural Society revealed in their milling properties variations of structure in the distinctive British wools which are leading to most remarkable deductions with reference to the fundamental structure of the wool fibre. This research bids fair to revolutionise some of the finishing processes which are daily becoming more scientific.

Knitting and Knitting Machinery.—Fascinating improvements in the possibilities of design and colour have been made, and flat-warp machines developed in which a texture is produced which bids fair to make a position for itself in men's wear markets.

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THAMES, England (*see* 26.723).—A comprehensive scheme for the disposal of flood water was prepared in 1914, but proved too expensive. In 1921, however, a programme, involving an expenditure by the conservators of £290,000 over a period of seven years, was approved by Parliament. In the first two years £130,000 was spent on the improvement of weirs, locks, etc. The periodical Thames floods are not as formidable as they were, owing to the work of the Thames conservancy in dredging and enlarging weirs, but difficulties have arisen owing to the interference with natural drainage caused by the development of land in the Thames valley, the building of narrow bridges over tributary streams, the filling up of ditches, etc. The floods, such as those of 1925, are also rendered far more noticeable by the number of small houses erected on land subject to inundation. A large sum has been spent on dredging and new locks between Lechlade and Oxford, but there has been little increase in the traffic. A large double lock and transporters were opened at Boulters' Lock, Maidenhead, in 1912, and later the course was widened at Henley. A new lock has been built at Mapledurham. Locks, weirs and other improvements have been made at Iffley, and a lock (the largest on the river) and a boat conveyer at Teddington.

The Thames Bridges.—Much attention has also been given to the problem of the London bridges, and a committee of the London County Council was formed to inquire into the subject in 1924. The proposal to build a bridge at St. Paul's, authorised by Parliament, met with much opposition from the authorities of the cathedral. Proposals for the reconstruction of Lambeth bridge (closed to vehicles in 1910 in the interests of public safety), and for widening the Albert Embankment and Lambeth Road were in an advanced stage in 1924. Owing to subsidence, Waterloo bridge was closed in 1925 and a temporary bridge was erected alongside. The London County Council decided, despite opposition, to remove the old bridge and to build a new one of five spans and carrying six lines of traffic; a proposal to invite designs in competition was announced in March 1926. The bridge near Datchet has been demolished, and a new concrete bridge was in course of erection in 1925. A new bridge at Reading was opened in 1923, and the old one was being rebuilt in 1926. The question of a tunnel under the Thames to give further facilities for traffic between the east of England and the southeastern counties has also received attention. Estimates for its construction between Tilbury and Gravesend were prepared in 1924, and an engineering survey was undertaken in 1925. Precedence was given, however, to other road improvements nearer the centre of London. A scheme promoted by Sir Samuel Instone in 1924 for a fleet of motor boats on the river between Hammersmith and

Greenwich and Woolwich did not materialise, as the London County Council was not prepared to provide the necessary piers. In 1924 a company initiated a scheme for the construction of a wharf, a mile long, at West Thurrock, about 18 m. from London Bridge, to accommodate the largest vessels, with industrial development on modern lines of an area of 3,000 acres.

(O. J. R. H.)

THAYER, ABBOTT HANDERSON (1849–1921), American painter and naturalist (*see* 26.728), died at Dublin, N.H., May 29 1921. During the World War he worked in England on the development of camouflage.

THAYER, WILLIAM ROSCOE (1859–1923), American writer, was born in Boston, Mass., Jan. 16 1859. He studied at St. Mark's Academy, Concord, N. H., travelled with a private tutor in Europe, and graduated from Harvard in 1881. He was assistant editor of the Philadelphia *Evening Bulletin*, 1882–5 and then returned to Harvard, receiving the degree of A.M. in 1886. He was editor of the *Harvard Graduates' Magazine* 1892–1915. In 1903, at the International Historical Congress at Rome, he represented both Harvard University and the American Historical Assn., as also in 1906 at the Italian Historical Congress in Milan. He was a member of the Harvard board of overseers from 1913 to 1919. In 1918 he was elected president of the American Historical Association. He died at Cambridge, Mass., Sept. 7 1923.

Thayer was best known for his works on Italian history, especially *The Dawn of Italian Independence, 1814 to 1840*, 2 vol. (1893); *A Short History of Venice* (1905), and *The Life and Times of Cavour*, 2 vol. (1911). His other works include *Italica* (1908); *The Life and Letters of John Hay*, 2 vol. (1915); *Letters of John Holmes* (1917); *Theodore Roosevelt—An Intimate Biography* (1918); *Democracy: Discipline: Peace* (1919, lectures at Brown University); *Volleys from a Non-Combatant* (1919); *The Art of Biography* (1920, lectures at the University of Virginia); and *George Washington* (1922).

THEATRE (*see* 26.729).—The War period and the almost universal depression in trade that occurred shortly after had its effect upon theatre economics as upon nearly all other forms of business. The building of modern theatres virtually ceased in most parts of the world from 1914 to 1920, owing either to prohibition of what in England was termed luxury building or to commercially prohibitive cost resulting from the economic upheaval of the War. This cost has at least, if not more than, doubled; the expenditure on producing plays, *i.e.*, salaries of performers, wages of staff, prices of timber, canvas, materials and costumes, have risen similarly. Then taxation, both ordinary and upon entertainment receipts, has been an adverse factor. Increased rates upon property—an item that may run from £2,000 to £4,000 per annum or more upon an individual theatre—the outlay upon advertisements, travelling expenses of touring companies and other sundry expenses have all added to running costs, and, except perhaps in the United States of America, the result has been to limit development and experiment. The revenue obtainable has not generally been commensurate with increased costs. The public has paid from 75% to 200% more than before the War for many classes of commodities, but entertainment managers in England have found it impossible without endangering public patronage to raise admission prices to an extent comparable with the rise in expenditure.

On the continent of Europe—Germany, Austria and the Central States—the War produced even more serious economic results than in England or the United States. The worst effects have been experienced in Vienna, once a city of great theatrical and operatic activity. An impoverished and diminished nation could not support its luxury entertainments or those of a more educational character to the same extent as in pre-War days. Higher costs in every department necessitated higher prices of admission, to which was added special state and municipal taxation, with the result that except for a limited number of those who lived on capital or War time profits the great majority patronised what had formerly been the cheaper sections of theatre accommodation. The sum total of these factors resulted, more particularly in Central Europe, in the impoverishment of managers and the reduction of many artists to a state where it was almost impossible to earn sufficient to provide themselves with the bare necessities of life.

Cost of Construction

The cost in 1914 of building and equipping a theatre in England capable of accommodating something between 800 to 1,200 persons was between £40,000 and £75,000, according to the locality and the degree of elaboration desired in architectural design, furnishing, decoration and equipment. A carefully prepared estimate of the cost of erecting a new theatre in the West End of London in 1925, consisting of ground floor and two tiers, to seat in all some 670 persons, showed this to be approximately £100,000, made up as to £30,000 for a freehold site and £70,000 for construction, furnishing, equipment and outgoings during construction. Upon this basis such a theatre when erected would involve an annual charge for interest on capital, local rates, depreciation of building, furnishing and equipment, cost of nucleus staff, heating, etc., approximating £12,500, or about £250 per week. In common with all other property, the rental values of existing theatres have tended to increase, although it is doubtful if generally the increase has been sufficient to compensate for the depreciation in the value of money.

Apart from the rise in prices of materials and wages since 1914, many other matters account for increases in constructional cost. Improvements in seating and in other details necessary to secure greater comfort have become essential and the municipal authorities responsible for the safety and health of the public have made demands necessitating substantial capital outlay. Exits are now required to have a better relation to the number of persons, whether performers or public. Improved arrangements of seating and gangways have been designed to diminish risk of injury or loss of life in fire or panic. Practical experience and investigation have resulted in regulations requiring better fire-resisting qualities of structural materials, scenery and hangings. Also it is only within comparatively recent years that scientific systems of heating and ventilation have been made compulsory by the licensing authorities and found desirable by owners of theatres. The most elaborate installations for these purposes cost from £2,000 upwards according to the size of the theatre.

Another factor in increased costs has been the invention and installation of elaborate systems of stage lighting and the use of high powered modern lamps undreamt-of in the early years of the century. From one stage switchboard all lights can be operated and different parts of the stage lit or put in shadow at will: the illuminative power can be easily diminished and changes of colour can be effected by the manipulation of a single switch. From a large switchboard hundreds of lights can be controlled by a single individual using the very simple mechanism.

Improvements in Design

In modern design the most important change, apart from simplification of decoration, has been the elimination of the boxes and all but one tier above the ground floor. In Great Britain the one tier principle is common in cinema theatres, but the most notable example up to the present time (1926) of a dramatic or variety theatre is the new Liverpool Empire, reopened in the autumn of 1925, which was designed and reconstructed at a cost of something over £160,000. This theatre is used for operatic, dramatic and variety entertainments of every kind. It has a sloped ground floor accommodating some 1,380 persons and one tier above accommodating about 1,100. There are no boxes and the rows of seats are so stepped in gradation as to give a good view of the stage from every point. Foyers, lounges, entrances and other conveniences are on a spacious scale. The stage is 100 ft. wide and 40 ft. deep, with a proscenium opening of 48 feet. Elaborate appliances for ventilation and heating as well as a hydraulic lift for moving scenery and properties from the street level to that of the stage above have been installed. As in many theatres nowadays, the stage and dressing room sections are fitted with sprinklers, from which floods of water can be released in case of fire. The system of stage lighting enables

elaborate changes and combinations of light and colour to be used by means of the footlights, the battens above the stage and the vertical lighting, the operation being easily and rapidly effected from the switchboard. In addition several powerful arc lights can be operated from above the tier to throw long beams of light of all colours to the stage.

Another important theatre reconstructed in 1922 is the Theatre Royal, Drury Lane, London. The old theatre had four tiers above the ground floor level and a large number of boxes. The new premises have only three tiers above the ground level and eight boxes on each side. The reconstruction of the interior cost approximately £150,000, and some idea of what is involved in modern theatre construction and equipment may be gained from the following facts. Every seat is of the tip-up armchair type, the theatre having a total seating accommodation for 2,300 persons. In the matter of heating and ventilation, the Plenum system has been adopted, *i.e.*, the air is drawn from the outside, washed and warmed to any desired temperature and then forced by a centrifugal fan through underground ducts to all parts of the auditorium. Suction sweeping plants electrically operated are used for cleaning the carpets, seating, etc. The auditorium has 400 separate light fittings, giving a total candle-power of over 60,000. The electric light, power, signal bells and telephone installations required some 15 m. of cable and 60,000 ft. of tube. On the stage an aggregate candle-power illumination of 40,000 can be obtained.

In Paris two new theatres have been constructed, both showing a great advance in regard to public comfort, heating and ventilation over the older type of Parisian theatre. One is the Théâtre de la Madeleine and the other the Théâtre de la Michodière. Both of these are theatres of the smaller type, appropriate for the intimate dramatic piece rather than for the large spectacular productions seen in theatres of greater dimensions.

Employees.—Persons employed in a theatre are represented as in other industries by trade unions or other associations. These organisations have secured increases in rates of pay for their members that are from 75% to 100% above the pre-War levels. The musicians by the Musicians' Union negotiate rates of pay for ordinary and overtime hours, rehearsals and other matters on behalf of their members. The stage and electrical workers and all those who are employed in the "front" of the house are represented in England by the National Association of Theatrical Employees.

In Great Britain the Stage Guild, a composite and important organisation of actors, managers and authors, has for its main objects the promotion, improvement and advancement of the interests and status of the theatrical profession in all its branches. The constitution of the guild contains a definite proviso against the imposing of any regulations or the adoption of any object which would make the guild a trade union. A trade union organisation, the Variety Artistes' Federation, concerns itself with the conditions of contracts and other important matters affecting the welfare of variety artists, but many of these perform in what are technically stage plays, *e.g.*, the revues, in which members of the "legitimate" stage as well as of the variety are employed in London and the provinces.

In the United States the Actors' Equity Association is a powerful organisation which, after prolonged struggles, secured important conditions in the contracts of employment and other benefits for the advantage and protection of its members. Its authority is considerable.

Organisations representative of the employers now exist in most countries. These concern themselves with negotiations with the employees' organisations on questions affecting forms of contract, hours and conditions of labour, the fixing of a minimum wage and other matters of common interest, as well as with legislation affecting either the capital or labour employed in the entertainment industry.

Producing and Running Costs

In Great Britain the cost of producing a non-musical play for a medium sized theatre—that is to say, the scenery, costumes, properties, rehearsals, salaries and wages—may be put at between £1,000 and £2,000. The corresponding cost for musical comedies and revues may run from £5,000 to £15,000. The expenditure per week for running a non-musical play would be from £800 to £1,200. This expenditure would cover salaries of actors, stage staff (including carpenters, electricians and others) management, accountancy, box-office, check-takers and other persons employed in the "front" of the house; advertising and printing; lighting, heating and sundry expenses and authors' royalties (generally a percentage of the receipts).

The surplus of receipts over weekly running expenses must first be devoted to paying off the production expenses. If the run of the play continues long enough for this to be done then profits may be made; if the run is short, as often happens, the production cost may wholly or partly be lost. If to the running costs mentioned above be added the weekly fixed charges for rent, rates, repairs, depreciation and "front" of house staff, it will be seen that the cost of running a theatre with an average non-musical play may be from £950 to £1,500 or more per week. The revenue capacity would be about £200 to £250 per performance or £1,400 to £2,000 (according to the size of theatre) per week, inclusive, of supplemental income from bars, etc. In the larger theatres and for musical comedies or revues, expenditure may run from £2,000 to £2,500 or more per week; the receipts from an outstanding success may in such cases be from £2,500 to £5,000 or more weekly, according to the holding capacity of the theatre and the number of performances given.

Theatrical enterprises are very susceptible to temporary adverse causes, *e.g.*, inclement weather in winter time; great heat in summer; industrial upheavals and crises, sickness of the leading actors engaged, and any of these factors may—unless, which is unusual, large capital resources are available to tide over a bad period—determine the fate of a play irrespective of its merit. Experience has shown, too, that a large proportion of failures are unavoidable and substantial profits are required to secure over a period of years a reasonable degree of stability and of financial success.

The entire financial liability of maintaining and running a theatre is rarely undertaken in England by a single individual or company. The theatre owner or lessee may let his theatre for a fixed weekly or annual sum, and beyond sometimes an approval of the plays to be produced has no concern with the presentation of the plays. More commonly, however, the theatre-owner enters into a sharing arrangement—in effect, a kind of partnership with the producer of the plays. In turn the producer often forms his own company or syndicate for the financing of his participation in the arrangement. Receipts are shared upon an agreed basis, the producer paying out of his share for everything seen and heard upon the stage, and sometimes a proportion of other agreed outgoings such as advertising. The lessee or owner pays all fixed expenses such as rent, rates, taxes, as well as for the staff and organisation of the "front of the house." Such an arrangement is usually determinable at the end of a fixed period, or when the receipts fall below a certain sum for an agreed minimum number of weeks.

From the foregoing it will be seen that the successful theatre owner, manager or lessee must be a capable man of business. He should also possess imagination, and something more than a casual knowledge of the technical and artistic side of the theatre. He must be familiar with theatre design and equipment, structure and maintenance; he should similarly be capable of forming a judgment of plays, of actors and the taste of the public. In the opinion of some people a division of the business from the artistic side is considered desirable to secure the best results, but as a rule a clear division is not to be found. Generally, close co-operation, sympathy and understanding of all the factors by all those engaged in a theatre organisation are essential. Vital as is the literary side of the theatre, important as are the scenic and costume design and the art of the actor and of the producer or stage director, the development of the theatre as an institution and its success commercially as well as in public estimation must in the long run depend, not upon isolated triumphs of great artis-

tic effort financially unsuccessful, but upon a wholesome respect for the well laid and hard foundation stones of economic facts and law. (W. P.)

THEOLOGY (*see* 26.772).—It will be convenient to preface this review of theological development with a reference to the Modernist movement in the Roman Catholic Church which was active during the opening years of the present century, for this movement throws into relief tendencies of thought which have remained operative down to the present.

Roman Catholic Modernism 1902–7.—It was the aim of Roman Catholic Modernism to bring the theology of the Church into relation with the thought of the modern world by means of a new theological method which would enable Roman Catholic scholars to move freely in the modern study of nature and of history, especially Biblical and ecclesiastical history, while remaining loyal to the dogmatic affirmations of the Church. It was urged, *e.g.*, by M. Le Roy, a distinguished representative of the school of Bergson and Boutroux—that the *impasse*, in which Catholic apologetic now found itself, was due to the assumption on the part of friends and foes alike that the primary meaning of dogma was intellectual and that its practical and moral meaning was derived from its intellectual meaning. This assumption rendered the entire conception of authoritative dogma impossible to the modern mind. The true policy in religious apologetic was to revise the conception of dogma and to recognise that from an intellectual point of view the function of dogma was negative only: the positive function of dogma was only relevant to the world of conduct and behaviour.

A similar philosophy underlies Loisy's famous criticism of Harnack. Harnack's attempt to treat faith in the Fatherhood of God as the immutable essence of the Gospel is a piece of unconscious scholasticism. The teaching of Jesus was itself conditioned by the eschatological expectation, and from the very beginning the Church has adapted the Gospel to the ever changing conditions of human life. The intellectual or logical development recognised by Catholic theology does not cover the facts. "It is the notion of 'development' itself that we now need to develop."

By the Papal Encyclical *Pascendi dominici gregis* of Sept. 1907 the Vatican disallowed the new apologetic, and the Roman Catholic clergy is required to accept the main positions of the scholastic theology: the existence of God provable by the natural light of reason, revelation attested by miracles and prophecies, the Church founded by Jesus Christ upon Peter and his successors forever, the apostolic doctrine transmitted unchanged through the orthodox Fathers to ourselves, faith the true assent of the intellect to truth revealed from without.

The Modernist movement in the Roman Church coincided with fresh developments in non-Roman theology. Two forces, both ultimately deriving from the Romantic movement of a hundred years ago may be first distinguished (1) the historical and comparative study of religion, (2) the psychological study of religion.

The Historical and Comparative Study of Religion

Comparative Study of Religion and Systematic Theology.—The school of Ritschl, which on the whole had remained the most important theological influence in Germany until towards the close of the 19th century, had confidently appealed to the prophetical religion of the Bible, had assumed the immediate relevance of the teaching of Jesus upon the kingdom of God, and had decidedly depreciated non-Biblical religions, and non-Biblical elements in Christianity. The *Religionsgeschichtliche Methode* has led to a change in emphasis: (*a*) Wider acquaintance with the background both of the Old Testament and of the New Testament has brought into prominence the relation of the Biblical documents to the external conditions which helped to determine their form and content. (*b*) There is a general disposition to recognise a genuine eschatological element in the preaching of the historical Jesus, which had been slurred over by many "Liberal" theologians. (*c*) Further study of the religious history of mankind has revealed the inadequacy of Ritschl's unsympathetic attitude towards non-Biblical religions. We may here note that some of the earlier New Testament studies of the *religionsgeschichtliche Schule* tended to regard primitive Christianity as essentially syncretic; but, while the new criticism has left a permanent mark upon the study of Christian origins, later work shows a fresh grasp of the distinctive position of Christianity in history.

Troeltsch's Work.—Valuable suggestions towards a new dogmatic have been made by Troeltsch. Troeltsch follows Schleiermacher in his fundamental idea of dogmatic. Dogmatic presupposes and depends upon scientific studies, but it is not itself a science. Its proper aim is the instruction and edification of the religious community. A Christian dogmatic orientated in view of the historical study of religion must first form an estimate of Christianity in relation to other world faiths. Secondly it must form a conception of the "essence" (*das Wesen*) of Christianity. Thirdly dogmatic consists specifically of the presentation of this "essence" of the Christian Faith. Uncertainties consequent upon historical criticism make it unsatisfactory to propose historic personalities as *direct* objects of faith: present experience with its metaphysical implications must give us our direct approach to God. But historical personalities—especially Jesus—are essential as "sources of power" and "points of concentration," without which a religious community cannot exist. Thus dogmatic will fall into two parts:—(*a*) A valuation and interpretation of the historical personalities for the individual and for the community. (*b*) A presentation of the metaphysico-religious conceptions of Christian thought about God, the world, the soul, redemption, the religious fellowship, the last things.

The Psychological Study of Religion

The Romantic Movement, represented for Theology by Schleiermacher, conceived of religion as a state of feeling rather than as a system of beliefs. The psychological interest in religion thus aroused has persisted and has led to important works on religious psychology during the period under review. Much recent apologetic, encouraged by psychologists such as William James, tends to base itself upon the authority of "religious experience." Writers upon the psychology of religion recognise in general that the science of psychology as such is not concerned with the validity or invalidity of religious beliefs. Leuba however has not only criticised James' wish "to believe in a mystical revelation," but has claimed "to have shown that the truth-kernel of religious ecstasy is no other than the truth-kernel of narcotic intoxication, and of ecstatic trance in general." Other psychologists, influenced by psycho-pathological theories of projection have argued that religion is to be explained in terms of hallucinatory images formed by the mind, to which objective reality is wrongly ascribed.

Otto's Theory.—Otto's theory of "the holy" more directly concerns dogmatic theology. Otto follows Schleiermacher in regarding religion as fundamentally a "feeling of dependence" but he criticises Schleiermacher for not recognising the unique quality of the feeling of dependence in religion, which may be expressed through the term "creature-feeling"; and secondly, he criticises Schleiermacher for making belief in God an *inference* from the feeling of dependence whereas, according to Otto, the creature-feeling carries an immediate reference to an object outside the self. The object is "the holy," or, as Otto prefers to call it, "the numinous." "The holy" is an ultimate category of thought, presupposed in all religious experience, and is to be distinguished alike from the "rational" and the "moral."

Philosophical Theology

We conclude with a reference to developments in philosophical theology. There has been a reaction from the Ritschlian attempt to sever metaphysics and religion. Troeltsch, as we have already seen, aimed at a correlation of theology and philosophy. Ritschl has never dominated British theology. During the latter part of the 19th century the British Hegelians kept interest in philosophical speculation alive in Britain after the idealist movement had died down in Germany, and they exercised wide

influence on theological thought. They have left both disciples and dissenters who have made important contributions to philosophical theology. Of especial importance to theologians are Rashdall's and Sorley's arguments for Theism on the basis of the moral consciousness. Mention should also be made of Professor James Ward's development of a theistic position from a pluralistic starting point.

Finally we may allude to the rise of a new school of theology in Germany led by Karl Barth. This school starts from Paulinism and the conception of faith, and aims at emancipating theology from the psychological subjectivism and historical relativity which have hampered it since the rise of the Romantic movement, and at restoring the sense of objective spiritual reality.

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THERAPEUTICS (*see* 26.793).—Since 1910 very considerable changes have taken place in our knowledge, and our general conception of the problems involved has been correspondingly broadened.

Prevention.—Prevention, the ideal aim of medicine, has greatly advanced in its practical application (in this country this has been fostered by the establishment of a Ministry of Health in 1919 which has greatly expanded the scope of work carried on by the Local Government Board, and also by the activities of the Medical Research Council founded in 1913 as part of the National Insurance Scheme). Preventive medicine includes, in addition to improvement of environmental conditions, prophylactic treatment in the very early stages of disease, such as can be provided in antenatal, school, dental and venereal clinics and so comes within the number of advances to be chronicled under the heading of therapeutics.

A notable example of prophylactic treatment is the prevention of goitre (*see* GOITRE) or, as in this country it is often called, Derbyshire neck; this is an endemic or local disease, probably depending, as Lieut.-Colonel R. McCarrison in India showed, on contamination of the water supply with micro-organisms; it is extremely prevalent in Switzerland and in North America both in men and lower animals in the neighbourhood of the Great Lakes, and has been found to be associated with a diminished content of iodine, which has a well-marked antiseptic action, in the thyroid gland. By the periodical administration of iodine to children in districts where the condition is prevalent it has been most successfully prevented.

Deficiency Diseases.—Another aspect of the same question is presented by the group of "the deficiency diseases" or the avitaminoses, which depend on the absence from the food of the vitamins or "accessory food factors." As constituents of food these vitamins (*q.v.*), of which there are several, are remarkable for the contrast between the extremely minute amounts present and the striking changes resulting from their absence. Their chemical constitution is unknown, but they are mainly formed in vegetables and plants, including yeast, and pass into herbivorous animals and so are available for those whose diet is confined to meat. Their absence from the diet stops growth and causes certain diseases, such as beri-beri (*see* BERI-BERI) a disease of the nerves due to a diet of polished rice from which the husk containing the water-soluble B vitamin has been removed; if a man or animal suffering from beri-beri is given the rice polishings of the husks the disease disappears.

Scurvy (*see* TROPICAL MEDICINE), formerly a serious disease in the navy in long voyages, was banished just before the close of the 18th century by the empirical use of fresh vegetables and fruit juices, but recurred in the armies in certain areas during the World War, due to the absence of a vitamin named water-soluble C. Infantile scurvy is sometimes seen in civil life in babies fed most carefully but too exclusively on boiled milk.

Rickets is due to deficiency of a fat-soluble vitamin (D); this antirachitic factor can be produced by the action of sunlight and ultra-violet rays on a large number of foodstuffs, especially fats, and from cholesterol. Another probable deficiency disease is pellagra, due to eating maize and a diet defective in protein (*e.g.*, meat).

Tropical Diseases.—The prevention of tropical disease originated in Great Britain under Sir Ronald Ross's direction with the destruction of the mosquito, the carrier of the malarial parasite (*see* TROPICAL MEDICINE), has been much expanded by the Rockefeller Foundation, which has instituted many campaigns against diseases, such as malaria, yellow fever and especially a world-wide attack on ankylostomiasis, a disease due to a worm in the intestines (*see* HOOKWORM; MALARIA; YELLOW FEVER). Yellow fever, which formerly took such a terrible toll of life, has now been almost entirely eradicated from South America by destruction of mosquitoes, the carriers of the infection.

Inoculation.—The World War proved the enormous value of prophylactic or protective inoculations against certain diseases on the same lines as Edward Jenner's vaccination against smallpox (*q.v*). Just before the South African campaign Sir Almroth Wright started the method of protection against typhoid fever (*see* IMMUNITY) by injection with a vaccine composed of killed cultures of the *Bacillus typhosus;* this inoculation sets up changes in the body which render the individual immune for a time, probably about four years, to this form of infection, in the same way as an attack of the disease. After the South African campaign cases were observed resembling typhoid fever but due to different though allied bacilli, and two additional forms, paratyphoid A. and paratyphoid B., of fever became recognised, the three diseases being collectively described as enteric fever (*see* INFECTIOUS FEVERS). In order to protect against infection of these three forms of fever, it is necessary to inoculate the individual with the three vaccines, and soon after the outbreak of the World War paratyphoid fever attacked the troops in Flanders and did not spare those inoculated against typhoid fever only; the three vaccines, known collectively as T.A.B., were then given, and the wonderful freedom of the army from enteric fever, which in past wars has killed as many as bullets, is a triumph for preventive medicine. In a like manner men who were wounded and so likely to be infected with *Bacillus tetani* (*see* TETANUS), which appeared to be common in the much cultivated Belgian soil, were at once injected with the antitetanic serum and so protected from tetanus or lockjaw.

Dysentery (*see* DYSENTERY) is another war disease, and there were many cases among the troops at Gallipoli and elsewhere in the East. There is more than one kind of dysentery. One of them, amoebic dysentery, is prone to be followed by liver abscess, the amoeba passing to the liver. Before the War it was found that emetine, an alkaloid of ipecacuanha long known as an empirical remedy for dysentery, was extremely efficient in curing this form of dysentery and also the hepatitis or inflammation of the liver which precedes the formation of an abscess. Our soldiers suffering from dysentery were injected almost as a routine with emetine and the number of cases going on to liver abscesses was surprisingly few. The other common form of dysentery due to a bacillus was treated with an antidysenteric serum, but not with such success.

As a result of the large numbers of officers and men who suffered from war strain and its effects, often called shell-shock, during and after the War, the psychotherapy (*see* PSYCHOTHERAPY) of these nervous disorders has greatly developed.

Endocrine Therapy.—When any of the endocrine glands, the thyroid, adrenals, pituitary, which pour an internal secretion into the blood and keep the body in health, are diseased or fail to do their work properly, signs of disorder or disease result. The secretion may be suppressed or diminished, excessive or altered in character (*see* ENDOCRINOLOGY). When the secretion is diminished an attempt to provide it can be made, and in the case of thyroid, which when inadequate produces myxoedema, or in early life cretinism, brilliant results have long been obtained by this substitution therapy or giving the thyroid gland or an extract of it by the mouth. In 1914 E. C. Kendall of the Mayo Clinic, Rochester, Minnesota, obtained in a pure form the active principle—thyroxin—which is extremely effective. The parathyroid glands, small bodies close to the thyroid gland in the neck, manufacture an internal secretion which passes into the blood and exerts an action apparently opposed to that of the thyroid. Whereas the thyroid is concerned with the control of iodine in the body, the parathyroids deal in a similar manner with calcium salts. Deficiency in the action of the parathyroids appears to lead to a diminished quantity of calcium salts in the body and to an irritable state of the nervous system, and is thought to be responsible in children for the contracture of the hands and feet known as tetany, though on this question there is considerable discussion. Recently the extract of the parathyroid glands has been given in a number of diseases of a chronic infective nature, especially in sprue (*see* SPRUE), a tropical disease characterised by diarrhoea, want of digestion of food so that the patient wastes as if from starvation. It has also been recommended for ulcers slow to heal and other obstinate conditions.

Organotherapy.—An outstanding advance on organotherapy is the insulin treatment of diabetes mellitus (*see* DIABETES). In this disease the patient, who is unable to utilise sugar and starches, passes sugar in the urine, wastes and may eventually die in coma. The pancreas, or sweetbread, is a gland concerned with the digestion of food, including starches, in the alimentary canal, and at the same time that it provides this external secretion pours an internal secretion into the blood which enables the body to make use of sugar. This internal secretion is manufactured by structures in the pancreas known as the islands of Langerhans, and the extract from them is called insulin. After many trials the technical difficulties in obtaining a satisfactory insulin (*see* INSULIN) were surmounted in 1922 by F. C. Banting and C. H. Best of Toronto, and a remedy was thus made available, which though it does not cure diabetes, any more than thyroid extract cures myxoedema, yet for some hours makes the previous diabetic practically a normal person as regards the utilisation of starch and sugar. The hypodermic administration of insulin must be repeated at least once daily, but this treatment keeps the disease in abeyance and has thus prolonged and saved innumerable lives. In diabetes insipidus, a comparatively rare disease, in which large quantities of urine free from sugar are passed, relief for some hours is similarly obtained by hypodermic injection of extract of the posterior lobe of the pituitary gland. The success of thyroid and insulin treatment has stimulated research and trial in the case of other glands and numerous commercial preparations have been placed on the market; but the claims sometimes made for various forms of organotherapy have yet to be confirmed.

Chemiotherapy.—Chemiotherapy, or the use of a drug which has a selective affinity for a germ and leads to its destruction without damaging the tissues of the body, was the conception of Paul Ehrlich of Frankfort-on-Main who in 1910 discovered the specific remedy "606" or salvarsan which rapidly leads to the destruction of the *Spirochaeta pallida* (*see* VENEREAL DISEASES), the protozoan responsible for syphilis. It now appears that the action is not independent of the activities of the patients' bodies and that the germ is not poisoned and killed off solely by the drug, which indeed may damage the tissues of the patient very severely and even cause death, so that the ideal of chemiotherapy has not been realised. Remedies of this class are, like quinine in malaria, specific, lead to a complete cure, and are therefore of the greatest importance in opening a new vista in medicine. Since its introduction salvarsan and its modification neo-salvarsan "914" and allied organic preparations of arsenic have been increasingly used in the numerous results of syphilis with great success; but this treatment has its limitations, for when the parasite of syphilis gets inside the central nervous system and causes locomotor ataxia and general paralysis of the insane the drug cannot follow the spirochaete and the disease is little if at all influenced. Recently it has been found that inoculation with the malarial organism and an attack of the disease benefits patients with general paralysis, but how far this is a permanent cure remains to be proved (*see* MALARIA). Trypanosomes, animal (or protozoan) parasites closely akin to spirochaetes are responsible for diseases, such as trypanosomiasis and African sleeping sickness (to be distinguished from quite a different disease epidemic to encephalitis [*see* ENCEPHALITIS LETHARGICA] popularly called sleepy sickness) which are also curable by the organic arsenical compounds atoxyl and arsacetin. Tartar emetic, a salt of antimony, acts like arsenic on trypanosomes and in addition effects a cure in bilharziasis (*see* BILHARZIASIS) (a disease due to flukes), filarial disease and kala-azar, three tropical infections (*see* KALA-AZAR; PHARMACOLOGY).

Serum Therapy.—Just as in enteric fever, so in cerebro-spinal ("spotted") fever and pneumonia (*see* CEREBRO-SPINAL FEVER) bacteriology (*q.v.*) has shown the existence of several strains or types of the causal micro-organism; these though morphologically indistinguishable are so biologically different that each is most efficiently treated by an antitoxic serum, obtained from an animal injected with, and so immunised to, that particular type. Before the recognition of these types antitoxic serums were employed, but they might or might not correspond to the exact strain of the micro-organism present in an individual case. In 1913 Douchez and Gillespie, working at the Rockefeller Institute, New York, isolated four types of pneumococci, the micro-organism causing acute pneumonia; but it is only the antitoxic serum corresponding to pneumococcus type I that is curative.

During the War, especially in 1915, epidemic cerebro-spinal meningitis or cerebro-spinal ("spotted") fever became prevalent among the fighting forces, especially in young recruits. It is due to the *Meningococcus intracellularis* (*see* SERUM THERAPY), and in order effectively to neutralise its effects Simon Flexner of the Rockefeller Institute prepared an antitoxic serum from animals immunised from 40 different strains (multivalent). This serum is injected by lumbar puncture into the (subdural) space around the spinal cord, so that it can come into direct contact with the meningococci which chiefly select the central nervous system. The prevalence of the disease stimulated research and strains of meningococci were isolated; Mervyn Gordon, working for the Medical Research Committee (now Council) which devoted all its energies with great effect to the conditions of diseases in the troops, isolated four types of meningococci and prapared four corresponding mono-type sera; when a case was bacteriologically proved to be due to infection with one of these strains, the corresponding serum was given; while waiting for the bacteriological decision as to the responsible type, a mixture of

type I and type II serum was given, as 80 to 85% of the cases were due to these strains.

Tuberculosis.—The search for a specific remedy for tuberculosis, such as a new form of tuberculin, an antitoxic serum or a metallic preparation analogous to salvarsan or tartrate of antimony in protozoan diseases, has continued, but no finality has been reached (*see* TUBERCULOSIS). Spahlinger's treatment by vaccines and serums has received intermittent attention, mainly in the lay press; Dreyer in 1923, by removing the fatty material from tubercle bacilli, obtained a vaccine, called diaphyte, which has been tried on human beings, and from experiments on animals was at first thought to have an increased effect, as compared with other vaccines; later reports have not been favourable, but both experimentally and clinically it may still be premature to decide about its ultimate value. Quite recently sanocrysine (a gold compound) has been introduced by Möllgaard of Copenhagen and is at present on trial; it is a powerful remedy which kills the tubercle bacilli and, by liberating their poisons, may produce severe constitutional reactions; Knud Faber, from his clinical experience, points out that in order to avoid these dangerous results, the doses should be small.

In pulmonary tuberculosis a great factor in obtaining arrest and cure of the disease is rest, and in order to immobilise the lung the production of artificial pneumothorax (*q.v.*) is now widely practised. Air is introduced into the pleura—the space between the lung and the chest wall—on the other side of the affected lung which then collapses and comes to rest, all the work of respiration being carried on by the other lung. This procedure has given very good results in selected cases. Treatment in sanatoria is of great value in arresting the progress of pulmonary disease and in teaching the patient the laws of health that he must follow, but it is now becoming recognised that there is urgent need for a more prolonged protection from the strain of ordinary life in the environment of cities, and that tuberculous colonies in the country are required for this purpose, such as Papworth near Cambridge and Preston Hall near Maidstone.

The treatment of leprosy (*see* LEPROSY) by intravenous and intramuscular injections of soluble products of chaulmoogra, hydnocarpus, soya bean and cod-liver oils, as advocated by Sir Leonard Rogers, has been shown by reports from leper asylums in various parts of the world to have had beneficial effects and to have reduced the death-rate in a remarkable manner. Although there are very few lepers in this country, there are 300,000 in the Empire, and at a conservative estimate 1,700,000 in the world, so that any efficient remedy is obviously important.

Protein Therapy.—By a turn of the wheel the strictly scientific employment of vaccines composed of the micro-organisms thought to be responsible for the morbid condition has led by an empirical process to non-specific protein therapy. It was found, sometimes accidently, not only that the administration of a vaccine specific for one form of infection benefits a morbid condition due to another infection, but that intravenous injection of foreign protein, such as peptone and milk, may when they set up a reaction, namely fever, shivering and illness, (" protein shock therapy "), produce a beneficial effect, just as one disease sometimes cures another. This protein shock therapy has been employed particularly in asthma and in chronic rheumatoid arthritis.

After an attack of many infective diseases there develops an immunity so that a second attack is rare; the reverse of immunity is an exaggerated susceptibility or hypersensitiveness; this is what is meant by idiosyncrasies and the proverb " What is one man's meat is another man's poison." This is seen in various diseases, such as recurrent colds and asthma. A method of cure is to desensitise the subject of one of these toxic idiopathies by the administration, usually by hypodermic injection, of the substance, a bacterial or other protein, to which the individual is hypersensitive. Thus a patient subject to hay fever is injected with the pollen of the plant which excites an attack; or a patient with bronchitis and asthmatic seizures is injected with an emulsion of dead bacilli (vaccine) obtained from the expectoration.

In many cases of disease and ill-health the cause is a " septic focus " or a local collection of micro-organisms, for example, in the teeth (*see* DENTISTRY), tonsils, appendix, gall bladder and intestines, which poison the body and may produce chronic painful conditions, such as chronic arthritis, sciatica, lumbago, fibrositis. The removal of such foci is therefore the important and indeed the first step in treatment; after that vaccines made from the predominant micro-organism present in the focus, and spa treatment may complete the cure.

Anaemia.—The fatal form of anaemia (*q.v.*) called pernicious or Addisonian after its describer Thomas Addison of Guy's Hospital (*see* ANAEMIA) is the result of chronic infection of the stomach and alimentary canal, which in its turn may be due to a septic focus, but it now appears from the observations of Arthur F. Hurst, also of Guy's Hospital, that an important factor is absence of the hydrochloric acid in the gastric juice which enables the micro-organisms causing pernicious anaemia to take root and live instead of being, as in normal people, destroyed. It has, therefore, been treated by supplying the absent hydrochloric acid by its medicinal administration by the mouth, with a success which is due to investigation of the chemistry of the stomach.

In this, as in anaemia due to haemorrhage, the operative procedure of transfusion of blood (*see* BLOOD TRANSFUSION) has been carried out, after the blood of the donor has been compared with that of the patient to see that they are compatible and after measures have been taken to avoid transmitting diseases, such as influenza, malaria and syphilis from the donor. Transfusion of blood is a very old method of treatment and was performed as long ago as 1667, but it is only recently that the tests for the compatibility of the blood based on the existence of four blood groups in man have rendered the procedure less dangerous. Transfusion of blood with these precautions was employed on a large scale in the War for haemorrhages and severe shock, as from gunshot and shell wounds, and has also been used in conditions popularly called blood poisoning. A recent development of blood transfusion is to immunise by means of vaccines, made from the micro-organism infecting the patient, the blood of the donor, and then to transfuse his blood into the patient.

Radiotherapy.—X-rays, though mainly employed for diagnosis, have from their power of destroying the tissue cells, many therapeutic uses. Thus enlarged glands and the spleen in various diseases of the blood, and especially in lymphadenoma, are much reduced by X-ray exposure. The recent Erlanger treatment of internal cancer by intensive X-rays has the grave disadvantage of making some patients extremely ill (*see* RADIOTHERAPY). Radium bromide, the rays of which are much the same, has been much used in the treatment of inoperable carcinoma and in quite superficial growths of the skin, especially rodent ulcer on the face, which, though classed as malignant, is much less virulent. In cancer of the uterus radium has proved of unquestionable value; from a combination of operation and radium good results have been obtained in cancer of the breast; but in malignant growths of the tongue, mouth and throat its use has generally been disappointing. Gye and Barnard's discovery of the long sought parasite of cancer brings nearer the possibility of obtaining a cure, by a vaccine or a serum. (*See* CANCER and MICROSCOPY.)

The important advance in the diagnosis of disorders of the heart and the mechanism of its beat have been followed by a more accurate knowledge of how to give digitalis and by the employment of quinidine in the disorders known as auricular fibrillation and paroxysmal tachycardia. Numerous researches have been undertaken with the view of devising reliable tests for the functional activity of the liver, and it is clear that sugar is the food which most readily protects and repairs the damaged liver cells.

Heliotherapy.—Recent years have shown an increasing tendency to utilise to the full the *vis medicatrix naturae* in open air treatment, improved ventilation, heliotherapy which has indeed been imitated by the use of ultra-violet rays (*see* HELIOTHERAPY), baths and waters, and exercises. The prophylactic measures based on experience and empirical use have been elaborated by the teaching of scientific research and as a result physiotherapy

or physical therapeutics, which includes massage and the various forms of electrical treatment, has considerably advanced in knowledge and application. Medical hydrology has been studied and taught on these rather than on purely empirical lines, and it may be noted that spas did excellent work during and after the War for invalided soldiers. Hand in hand with open air treatment and heliotherapy has come less surgical activity in the way of operating in tuberculous disease of bones and joints.

(H. Ro.)

THERMIT (*see* 28.501).—Thermit is a mixture of aluminium powder and iron oxide. On ignition the reaction, $8Al+3Fe_3O_4=9Fe+4Al_2O_3$, gives a temperature estimated to be between 2,300° and 2,700° Centigrade. The reaction, stated in weights, means that 217 parts of aluminium plus 732 parts magnetite (iron oxide) equals 540 parts steel plus 409 parts slag, or approximately, three parts of aluminium plus 10 parts of magnetite will produce, on combustion, seven parts of steel. This steel represents about one-half of the original thermit by weight and one-third by volume.

Discovery.—Thermit was discovered by Dr. Hans Goldschmidt, of Essen, Germany, in 1895, while trying to reduce chromium and manganese. Dr. Goldschmidt's principal discovery related to a simple and safe method of ignition, as the action of aluminium when mixed with various oxides, sulphides and chlorides was well known. Fine aluminium will not burn below the temperature of molten cast iron, and previous experimenters had resorted to heating their mixtures in a crucible. This made the initial temperature so high at the moment of ignition that there was an explosion. Dr. Goldschmidt obtained ignition of a cold mixture by means of a barium-peroxide fuse, which was set off by a storm match. Later, magnesium powder or ribbon was used, being set off in the same way. A red-hot iron rod may also be used to set off the magnesium, which in turn ignites the thermit. Dr. Goldschmidt's original American patent No. 615700 was granted March 16 1897 and related principally to the use of aluminium as a reducing agent for the production of carbon-free metals such as cobalt, chromium, magnesium, tungsten, etc., by what is now known as the aluminothermic process. Thermit is now used considerably in the foundry for purifying iron and steel in the ladle. For this purpose the thermit is placed in a can on the end of a rod and plunged to the bottom of the molten metal. The intense heat generated tends to liberate many impurities which are carried away in the slag. The principal and better-known use, however, is in welding.

Thermit Welding.—Two methods are employed, known as the plastic and the fusion. The first is used for welding pipe and the latter for solid or large sections. In the plastic method, in which the thermit is used merely for heating purposes, the ends of two pieces of pipe are machined square and clamped in a cast-iron mould with the ends butted together. This mould is in two parts, so arranged that the pipe ends may be forced together when heated. The thermit is placed in an open-top crucible lined with magnesia-tar, and ignited. After the reaction takes place, the slag rises to the top of the molten metal, and is first poured into the mould as shown at the left in figure 1. This slag forms a protective coating on the pipe and on the inside of the mould, and keeps the thermit from melting or burning through. At the right the thermit is shown flowing into the mould and forcing out the bulk of the slag, but leaving a coating as mentioned. When the pipe ends become plastic they are forced together, completing the weld. After cooling, the mould is easily knocked off, since the slag coating prevents adhesion. To weld a pipe takes from ¾ to 1½ minutes.

In fusion welding on solid sections, in which the thermit mixture forms a casting holding the parts together, a special V-shaped magnesia-tar-lined crucible, open at the bottom, is used. The hole in the bottom is closed by a headed plug, covered with refractory sand, which may be pushed upward. This crucible is placed over the mould, the proper amount of thermit put in and ignited. After the reaction, which takes about 35 sec., the plug in the bottom is pushed up and the molten thermit allowed to run into the mould. In this method great care is taken to keep the slag from contact with the surfaces to be welded, and consequently enough thermit must be used to fill the mould before the slag on the top of the melted metal can enter.

A typical mould for heavy sections is shown in (figure 2). In preparing to weld, the surfaces to be joined should be cut or set so as to be ½ in. or more apart. Yellow wax is then built up around the joint in the same shape as the weld is to be. Next the mould box is placed and sand rammed up round the wax, wooden patterns being placed for the pouring gate, riser and preheating gate. The mould is vented, the patterns withdrawn and a gas or oil flame used to melt out the wax. The heating is continued until the sections to be welded are red-hot. This prevents chilling of the thermit, which is poured in after the preheating gate has been plugged. The steps in making a typical thermit weld on a locomotive frame are graphically shown in (figure 3). Thermit welding is largely used in repairing broken rudder frames, propeller shafts, locomotive frames, steel rolling-mill pinions and other heavy sections, but it cannot be economically used for welding thin sheet metal sections. Welds have been made where from 3,000 to 4,000 lb. of thermit were used. For commercial purposes there are now produced three varieties of thermit, known as plain thermit, railroad thermit and cast-iron thermit. The plain thermit is simply a mixture of aluminium and iron oxide, as already given. Railroad thermit is plain thermit with the addition of ⅝% nickel, 1% manganese and 15% mild steel punchings. Cast-iron thermit is plain thermit with the addition of 3% ferrosilicon and 20% mild steel punchings. The names of these mixtures indicate their principal uses.

(E. VI.)

THERMODYNAMICS: *see* HEAT.

THERMO-ELECTRIC PYROMETER.—The thermo-electric pyrometer is most generally used for measurements of high temperatures in industry, such as the temperatures of furnaces of all kinds as, for example, for annealing, hardening, tempering, carbonising or case-hardening; blast furnaces; the temperatures of molten metals; the temperatures in galvanising, tinning, lead and salt baths; the temperatures in various processes in brick, tile, pottery and glass works, and the many temperatures throughout an efficiently operated boiler-plant. The pyrometer is also used to determine the recalescence points of steel, the freezing points of alloys and in connection with general research work in the laboratory.

General Principles.—If two wires of dissimilar metals are joined at their ends to form an electric couple, and one junction is heated, an electromotive force is set up which gives rise to an electric current in the circuit. The magnitude of the electromotive force depends upon the difference in the temperatures of the hot and cold junctions. If a millivoltmeter, by means of which the electromotive force generated can be measured, is introduced into the circuit, it is consequently possible to determine the temperature of the hot junction, provided that the cold junction temperature and the relation between temperature and electromotive force for the two metals used are known. The circuit can thus be used for the measurement of temperature, and a thermo-electric pyrometer consists essentially of a thermo-electric circuit in which the hot junction is exposed to the temperature to be measured, and the resulting electromotive force is measured by an indicating or recording millivoltmeter, which for convenience is usually graduated to read directly in degrees of temperature.

In a simple thermo-electric pyrometer the cold junction is placed in a constant temperature vessel, such as a vacuum flask. The two dissimilar wires, suitably insulated and protected, form the thermo-couple which is exposed to the temperature to be measured, the ends of the thermo-couple wires being connected to a millivoltmeter. The introduction of the millivoltmeter and connecting leads makes no difference to the electromotive force generated. Suitable metals must be chosen for the thermo-couple wires, the essential points being that the electromotive force developed by the junction should be sufficiently large and should increase as regularly as possible as the hot junction temperature rises, and that this electromotive force should not be altered by prolonged heating of the thermo-couple. Since the electromotive

force generated by the thermo-couple is affected by changes in the cold junction temperature, various methods have been devised for maintaining a steady cold junction temperature, such as, for example, the use of compensating leads which have the effect of transferring the cold junction from the thermo-couple head to some position less subject to temperature variations, or the immersion of the cold junction in a vacuum flask, or in an electric thermostat.

Simple Thermo-Electric Circuit.—In practice, a simple thermo-electric circuit is composed of the following parts:—(*a*) a thermo-couple, or hot junction, which receives the temperature; (*b*) a length of connecting leads, with or without a junction box, to make electrical connection between the thermo-couple and the millivoltmeter; (*c*) a millivoltmeter, which may be either an indicator or a recorder. Frequently it is desirable to have both these instruments, in which case a switch is usually required at the indicator.

Multi-Point Thermo-Electric Circuit.—A multi-point thermo-electric system is similarly built up of items which may be sub-divided as follows:—(*a*) a thermo-couple or hot junction at each point where the temperature is to be measured; (*b*) a system of leads and junction boxes; (*c*) a millivoltmeter, which may be an indicator or a recorder. In combined outfits one indicator can be used in conjunction with one or more recorders. In addition a selector switch is required at the indicator, and sometimes a selector switch is required at the recorder. In addition to the above parts, and particularly for accurate work at moderate temperatures, as, for example, in outfits for determining the temperatures of stator windings, a cold junction is provided which forms a separate unit. (F. J. D.)

THERMOMETER: *see* KATA THERMOMETER.

THEUNIS, GEORGES (1873–), Belgian politician, was born at Montegnée, near Liége, Feb. 28 1873. In Jan. 1916 he attended the Inter-Allied Relief Commission in London and in 1919 represented Belgium on the Reparations Commission. In 1920 he became finance minister in M. Carton de Wiart's Coalition Ministry, the aims of which Government were first to settle the reparations question, with due regard to Belgium's prior claim and secondly to maintain the entente between the Allies. M. Theunis represented Belgium at the Inter-Allied Conferences of San Remo 1920, London 1924 and Paris 1925, which resulted in the adoption of the Dawes Plan and a corresponding inter-Allied settlement. His home policy was to place Belgian finance on a sound basis and to reconstruct the devastated regions. His Cabinet resigned in April 1925, after the elections in which the Democratic parties triumphed. In Aug. 1925 M. Theunis was sent by his Government to Washington to discuss the question of the Belgian debt to U.S.A. This mission resulted in an agreement which was submitted to the Parliaments of the two countries.

THIRD (COMMUNIST) INTERNATIONAL, THE.—The Communist International (abb. Komintern) is the international organisation of the Communist party of all nations, founded in 1919. It is also called the Third International. In structure and programme it differs from the first and Second. Communism sympathises unreservedly with the first International, founded under the leadership of Marx and Engels, whose policy was essentially one of active revolution. As, however, its organisation lacked a definite central point and had not its roots in party associations, its practical manifestation, the Paris Commune, was bound to fail. Lenin evolved his theory of revolutionary movement from the lessons of the failure of the Commune, and arrived at the conclusion that a successful revolution might begin as a spontaneous popular upheaval, but could only achieve and retain victory in the form of an organised and systematically controlled movement. The first International lost its practical importance after the collapse of the Commune.

Birth of the Third International.—In 1889, when the Socialist Labour movement had recovered its force, the Second International (*q.v.*) was founded. Up to 1914 this represented the international organisation of the Socialist Labour movement as a whole. The constructive importance of the Second International, from the point of view of the Communist parties, lay in the fact that it organised and grouped labour in trade unions, co-operatives, educational associations and political parties. The Second International already contained a Bolshevik opposition which refused to assimilate with the larger body. It was led by Lenin, who was a member of the International Bureau (B.S.I.) of the Second International in 1914. In 1914 the Second International collapsed. The Communists date the epoch of the Communist International from this moment. This epoch emerged out of a transitional period comprising the first three years of the War, during which Lenin struggled to "transform the imperialist war into a civil war." The foundations of the Third International were laid at the conferences of Zimmerwald and Kienthal in Switzerland. It only achieved real authority, however, when the leaders of the German Army conceived the idea of making the Russian February revolution more extreme. The German supreme command brought Lenin and Trotsky to Russia in the fond hope that the fire of the Russian revolution which they were kindling in Russia would stop at the frontiers of Germany.

The Third International was not formally founded till March 1919. Up to that date the Communist parties believed that they would be able to break up the Socialist parties from within and transform the Second International bodily into a Communist organisation in the tempest of the world revolution. Especially during the episodes of the Soviet Republics in Bavaria and Hungary, and even after their collapse, during the labour troubles in Britain, Germany, Italy, etc., Moscow continually believed the outbreak of world revolution imminent every hour, and expected that the Socialist parties could be simply absorbed in the Communist parties. As it grew ever plainer that this hope (which at first was shared by Lenin) was Utopian, the Communists devoted even greater energy to their own International.

Fundamental Principles.—The following are their basic principles:—

1. The Communist International is the organisation of the Communist parties of each nation; it is therefore revolutionary. Its chief purpose is to accelerate the development of events towards world revolution. It rejects any compromise or co-operation with bourgeois parties. Similarly it rejects parliamentarism as a normal method of political development. In certain circumstances it advocates a unity of front with Socialist parties, including the Second International. This is, however, never more than a temporary and tactical co-operation. The Communist International is honest enough to state openly that it is only ready to support the Socialist parties so far as "the hangman's rope supports the convict." The aim of the Communist International is the creation of really revolutionary proletarian parties which shall be the advance-guard of the revolution, and the combination of them in a great homogeneous international Communist party. Their headquarters are only "for the moment," as Lenin said, and probably not for long, in Moscow; later they will move to countries where the economic system and the proletariat alike are more advanced, so soon as one such country achieves a Soviet constitution.

2. The Communist International is no loose organisation like the Second International, but an association bound together by a common programme and principles, and receiving its orders from a central organ, the Bureau of the Third International. This central organ does not merely issue general rules of conduct, which may be carried out or not by the individual national parties according to their own convictions and views of the general situation; it lays down policy to the smallest details. The men at the head of Communist parties have been repeatedly changed under orders from the International, and tactics (*e.g.*, the question of co-operation with the Socialist parties, or the attitude to be adopted towards Parliament) have often been defined in detail by resolutions of the International Bureau. This central organ of the Communist International is indubitably in close personal and political touch with the Russian Govt., the Soviet of People's Commissaries.

3. The individual Communist parties are by no means all organised on the Russian system. The Communist parties of Western Europe are "open parties" which anyone may join. In some countries the Communist parties are proscribed by law. Presumably there is everywhere an inner kernel or party ring which forms the political centre. The ideas of the periphery are inspired by this inner ring. Wherever it is possible, a sort of military organisation probably also exists, exactly as in the nationalist and fascist parties.

4. In matters of internal policy the individual parties are, as already stated, strongly influenced by the Communist International,

but there are great differences between the nations. In countries where democracy is firmly based and parliamentary tradition of long standing, the tactics of the Communist parties are correspondingly modified. Communists take part in Parliament, bring forward legislative motions, etc.; at times they even co-operate with the Socialist parties. This is, however, only a temporary tactical move, the ultimate aim being always world revolution. The formation of the so-called "unified front" is a means to an end and a tactical move. The organised workmen in the trade unions are to be captured in such a way that the trade unions gradually come under the influence of the Communist parties.[1]

Developments Outside the Industrial Proletariat.—Since the aim of the Communist International is world revolution, and since the state of the Continent of Europe has grown much less disturbed since 1921, the chief aim of the Communist International proved unattainable. The revolution had taken the offensive at isolated points, but failed to develop into a world-wide movement. The International therefore put forward officially the doctrine that sudden enthusiasm alone will not bring about world revolution; this must be achieved by a strict organisation which must first be created. Such an organisation, however, presupposes a compact communist international unified front. The Communist International began by continuing the traditional policy of the Second International. It desired to be an organisation of manual labour. But in Russia the actualities of the situation soon forced the party to admit the peasants as members (at first only the poor peasant, later the medium peasant). A Peasants' International was founded in 1923, but made slow progress. Nevertheless, it then became possible to embrace the extremist agrarian movement—a matter of the greatest importance in countries where large estates are common. The rather unexpected pronouncement was therefore made that "the peasants have become the natural allies of the workmen." Thus a link was forged with what had been the oldest revolutionary movement in Europe. To-day, indeed, with the emergence of the peasants from serfdom, their status and feelings, especially in Central Europe, have changed radically. It is most unlikely that revolutionary feelings will ever become widespread among them.

Oriental and Colonial Propaganda.—Far more important is the connection between the Communist International and parties and currents of thought which may be described as the heart of the movement for national and economic independence among the colonial and semi-colonial territories of Asia and Africa. Countries such as India, China and the wholly independent Japan are already represented in the Communist International by considerable parties; although these parties differ very markedly from those of Western Europe. The psychological bases for intensive Communist propaganda in Asia are, firstly, the appalling conditions in the newly developed enterprises (women's and children's labour, long hours of labour, barrack conditions for workmen); and secondly—perhaps more important—the breakdown of the social structures of these countries. Throughout Asia the family is the basis of society. Industry destroys this, and nothing comes to replace it. But man, in the Far East, cannot live except as member of a community. He cannot grasp the idea of an abstract existence, secured simply by a contract of labour. Existence is uprooted, and all his instincts revolt against an economic system which attempts to make him into an individual. This revolt finds its plainest expression in the Communist movement, the essence of which is thus the resistance of the social instincts to the destructive influences of industrial life.

Furthermore, the closing of the United States and Australia against foreign immigrants, the restrictions placed on Indian emigration to Africa, the unfortunate results which attended Chinese labour conditions in South Africa, combined with the insistence laid by the white races on the preservation of racial distinctions, have created a real and practical feeling of unity among all coloured races and nations throughout the world—a feeling which extends throughout all Africa and Asia, and as far as the negroes of America. In the face of this racial antagonism, Soviet Russia is the only power today which stands on principle for racial equality and full equality of rights for all races on their own territory.

Thus Communist propaganda directed against the influence of European capitalists and the partisans of racial superiority in Asia has an easy task. Even Japan has been led by similar motives to a political *rapprochement* with Soviet Russia. Communist propaganda in Asia and Africa is therefore adapted to local conditions. Social and national considerations take the first place; less insistence is laid on the purely economic factor.

The resentment against capitalist exploitation, combined with the struggle against the Imperialist European Powers and against the United States, inevitably draws the leaders of those movements towards Russia, and thus towards the Communist International. This connection has been developed by special congresses to the oriental peoples (as that of Baku in 1920), and has certainly been exploited by the Russian Govt. to further Russia's traditional foreign policy in Asia. In all these countries the small tenant farmers are particularly susceptible to the allurements of the Communist programme.

Results up to 1925.—The Communist International forms a bond between the States organised on the Communist system and the Communist parties in the capitalist bourgeois states. In this way one may look on its work as the "formation of the front line of a world-revolution." In fact, a country which contains a strong and active Communist party finds it impossible to participate in an European counter-revolutionary movement. In terms of practical politics, this means that the States of Europe would find it hard to undertake war against Russia, in face of the opposition of their own Communists and Socialists. This is probably the greatest success of the Communist International. The Communist International is therefore both an association of national parties with a definite internal political programme, and at the same time an international political organisation of really international importance on a world-wide scale.

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THOMA, HANS (1839–1924), German painter (*see* 26.862), died at Karlsruhe Nov. 7 1924. He has published the following books since 1910: *Das Hans Thoma Buch* (1919); *Die suchende Seele* (1919, etc.); *Im Winter des Lebens* (1919). See C. Anton, *Hans Thoma der Maler* (1919).

THOMAS, ALBERT (1878–) French politician, was born June 16 1878 at Champigny-sur-Marne, near Paris. His father was a baker who by great sacrifices enabled his son to receive a college and university education. Albert Thomas proved himself a very brilliant scholar and in 1898 he passed with distinction into the Ecole Normale Supérieure. Meanwhile he had won a scholarship entitling him to travel in Russia, which he did in the same year and published his first booklet on *Russia a Colonising Nation*. After a year of military service he re-entered the Ecole Normale and, in 1902, obtained the highest French university

[1] The conditions of affiliation to the Communist International prescribe that every party which desires affiliation to the C. I. must develop a systematic and persistent communist activity within the trade unions, works committees, co-operative societies, and other mass organisations of workmen. Within these organisations it is necessary to organise cells, which by persistent and continuous work must win the unions, etc., to the cause of communism. The communist cells must be completely subordinated to the party as a whole.

degree, the *agregation*, in history and geography. Afterwards he obtained another scholarship which enabled him to travel through Germany and to study the German Trade Union movement. A sequel to this was his book *Le syndicalisme allemand* (1903) in which his socialist faith was propounded for the first time.

When, in 1904, Jaurès, the great French socialist, launched *l'Humanité* he appointed Thomas sub-editor, having a high opinion of his knowledge of labour questions. Meanwhile Thomas had been elected in the same year as municipal councillor for Champigny—his first public appointment. In those days most of his activity was devoted to the Trade Union movement, for he had become one of the intellectual leaders of the "reformist" section of French syndicalism, the section opposed to the "revolutionary syndicalist" wing, which was then leading the "Confederation of Labour." He also edited a most useful and constructive magazine, *La Revue syndicaliste*. In 1908 he published in Jaurès' great *Histoire socialiste* (*1900–1908*) a remarkable volume on *Le second empire* which is perhaps his best book. During this time he acted as private tutor to the great-grandson of Victor Hugo, whose grandmother, Mme. Menard-Dorian, remained a great friend and supporter of the brilliant young professor and politician.

Thomas entered politics in 1909 when he stood for Parliament as candidate for his native city and was narrowly defeated by a moderate Radical. He was successful, however, in the same constituency at the general elections of May 1910 and soon made his mark in the Chamber, being elected a member of the budget committee. In the same year he supported the railway workers' general strike and strongly criticised the mobilisation of the strikers by the Prime Minister, M. Briand. In 1912 he became reporter of the bill on the miners' old age pension, having in the meanwhile been elected mayor of Champigny. He played an important part in the battle waged by Jaurès and the Socialists against the Three Years Compulsory Military Service Bill of 1913.

In May 1914 he was re-elected. He joined his regiment on the outbreak of the World War two months later. After he had seen a few weeks of War service, the "National Defence Government," newly constituted under the presidency of M. Viviani, summoned Thomas and two other Socialists, Jules Guesde and Marcel Sembat, to organise the production of munitions. In May 1915 he entered the Cabinet as Under-Secretary for Armaments and also joined the Briand ministry which followed at the end of the year. Towards the end of 1916 he became Minister of Munitions, retaining this post in the Ribot ministry which followed. In April 1917 he was sent to Russia where he remained for several months and succeeded in persuading Kerensky to undertake the ineffectual "great offensive" against the Central Powers which hastened the Bolshevik revolution.

Meanwhile in France the struggle was becoming very bitter between the majority (pro-War) and the minority (internationalist) sections of the French Socialist party, culminating in the Stockholm Conference. Leader, with Renaudel and Sembat, of the majority party, Thomas was also a strong advocate of the independence of Czechoslovakia and Poland and the creation of a "Great Serbia" and a "Great Rumania." Since this "majority wing" policy was opposed by many Socialists, particularly in the Paris district, Thomas decided not to stand again in the Paris suburbs and resigned the mayoralty of Champigny. At the elections of Nov. 16 1919 he was returned as a Socialist in the Tarn, Jaurès' former constituency. At the International Labour Conference, held in Washington at the end of the year, Thomas was elected Director of the International Labour Bureau, and as such he did much valuable work for Labour both in France and abroad. A year later he resigned from Parliament owing to the claims of his work at Geneva, but remained a member of the "right" section of the French Socialist party. For this *Encyclopædia* M. Thomas has written on Corporation and the International Labour Organisation. (J. Lo.)

THOMAS, AUGUSTUS (1857–), American playwright, was born in St. Louis, Mo., Jan. 8 1857. He was educated in the public schools, for several years worked in railway freight offices, and, after serving as special correspondent for various newspapers, became in 1886 editor and proprietor of the Kansas City (Mo.) *Mirror*. He wrote a play, *Editha's Burglar*, based on Mrs. Burnett's story of the same name, which was first produced at St. Louis in 1883 and subsequently presented with great success at the Madison Square theatre in New York in 1889. His play *Alabama* (1891), depicting the old-time South, contributed to the removal of sectional prejudice resulting from the Civil War. He was elected to the American Academy of Arts and Letters in 1912.

His numerous dramas include *In Mizzoura* (1893); *The Hoosier Doctor* (1898); *Oliver Goldsmith* (1900); *Arizona* (1900); *Soldiers of Fortune* (1902); *The Earl of Pawtucket* (1903, highly successful in England); *Mrs. Leffingwell's Boots* (1905); *Jim De Lancey* (1905); *The Witching Hour* (1907–8); *As a Man Thinks* (1911); and *The Copperhead* (1917). In 1922 he published his reminiscences, *The Print of My Remembrance*.

THOMAS, EDWARD (1878–1917), British author and poet, was born on March 3 1878 and educated at St. Paul's School and at Lincoln College, Oxford. His first book was a volume of nature studies, *The Woodland Life* (1897), but the first notable collection of his reflective essays was *Horae Solitariae* (1902), the predecessor of several similar, such as *Rest and Unrest* (1910) or *Cloud Castle* (1922). Among a good many miscellaneous works should be noted his critical studies of *George Borrow* (1912); *Swinburne* (1912); and *Walter Pater* (1913), and a volume of stories, *Four-and-Twenty Blackbirds* (1915). But the fullest revelation of his sensitive, beauty-loving nature came when he began, under the influence of his friend Robert Frost, the American poet, to write poetry. His verse appeared in 1917 in reviews signed "Edward Eastaway," a volume of *Poems* under his own name following in that year. Serving with the Royal Garrison Artillery, he was killed in France in April 1917. His *Last Poems* appeared in 1918, and *Collected Poems* in 1920.

THOMAS, JAMES HENRY (1878–), British politician, was born at Newport, Mon., on Oct. 3 1878. Entering the service of the Great Western Railway as an engine cleaner, he rose rapidly and soon became a power in Swindon (the G.W.R. headquarters) both as a trade unionist and in local government. By 1910 he had become president of the Amalgamated Society of Railway Servants and played a leading part in its reorganisation as the National Union of Railwaymen of which he was appointed general secretary after the great railway strike of 1911. Under him the N.U.R. became the leader in the policy of "industrial" or "all grades" as against "craft" trade unionism. His sagacity and influence made the N.U.R. a dominant factor both in industry and the political world.

Mr Thomas early saw that larger labour aspiration can be realised only through political action, and was an intrepid opponent both of syndicalism and of communism. He was elected member for Derby in 1910 and his services to industrial peace were recognised by his appointment to the privy council in 1917. He opposed conscription, refused to enter the Coalition Govt. and fought the 1918 election on "No more war." In the railway strike of 1919 he won important concessions for the railwaymen who, before the War, had been miserably underpaid. His book, *When Labour Rules*, published in 1920, expounded a policy of nationalisation for railways and other essential instruments of production. As Secretary for the Colonies in 1924, he showed statesmanship in his handling of the Irish and other specific issues and in his outlook on imperial problems. From the first Mr. Thomas was closely associated with the management of the British Empire Exhibition at Wembley and on this subject he has written for this *Encyclopædia*.

THOMSEN, VILHELM LUDVIG PETER (1842–), Danish philologist, was born Jan. 25 1842 at Copenhagen. He took his doctor's degree in 1869 and in 1871 became a lecturer at the University of Copenhagen, where from 1887–1916 he was professor of comparative philology. In 1876 he visited England and lectured at Oxford University. Thomsen came to be known as one of the most prominent linguists of modern times and possessed an extensive and thorough knowledge of the various

classes of languages. In different linguistic fields he wrote works of very considerable importance. Of his writings dealing with Northern and East European languages may be mentioned *Den gotiske Sprogklasses Indflydelse paa den finske* (1869); *Beroringer mellem de finske og de baltiske Sprog* (1890); and *The Relations between Ancient Russia and Scandinavia and the Origin of the Russian State* (1877). In Romance philology he solved the problem of softened consonants (1876); he was the first to ascertain the palatal law in the phonic system of the Indo-European languages. In 1894 he deciphered the Orkhon inscriptions from Mongolia (*Inscriptions de l'Orkhon déchiffrées*, 1894) etc., and made in 1899 important interpretations of Etruscan and Lycian texts, and in *Turcica* (1916) he treated Ancient Turkic. Thomsen's complete articles appeared in 1919 in three volumes. He became the president of the Royal Danish Scientific Society in 1909.

THOMSON, CHRISTOPHER BIRDWOOD, 1ST BARON (1875–), British soldier and politician, was born April 13 1875. Educated at Cheltenham and the Royal Military Academy, Woolwich, he served in the Mashonaland campaign and in the South African War. From 1902–5 he was instructor at the military engineering school at Chatham. In 1909 he passed on to the Staff College and in 1911 to the War Office. During the World War he served as military attaché and chief of the British military mission in Rumania (1915–6), and in Palestine (1917) and was on the Supreme War Council in 1918. Having attained the rank of brigadier-general, he resigned from the service in 1920 as a protest against Allied intervention in Russia. He joined the Labour party, and accompanied, as military expert, the commissions of enquiry dispatched by that body to Ireland and to the Ruhr; later, he visited Russia. In 1922, and again in 1923, he stood for Parliament in the Labour interest, but was unsuccessful. In 1924, he was appointed Air Minister in the first Labour Govt., with a seat in the Cabinet, and raised to the peerage. A graceful and effective speaker, Lord Thomson also possessed marked literary gifts; he wrote *Old Europe's Suicide* (1922); *Victors and Vanquished* (1924); and *Esmarana* (1926).

THOMSON, JOHN ARTHUR (1861–), British naturalist, was born at East Lothian on July 8 1861, and was educated at the universities of Edinburgh, Jena and Berlin. He was, for a time, lecturer on zoology and biology at the school of medicine in Edinburgh, and in 1899 he became regius professor of natural history at Aberdeen University. Apart from his purely zoological work, chiefly on alcyonarians, Professor Thomson did much, both by his lectures and his numerous attractive books and writings, to popularise biological science, and he was indefatigable in his efforts to correlate science and religion. He made an extensive lecture tour in America in 1924.

His publications include: *Outlines of Zoology*, 7th ed. (1920); *Introduction to Science* (1911); *The Wonder of Life* (1914); *Secrets of Animal Life* (1919); *The System of Animate Nature*, Gifford Lectures (1920); *Science, Old and New* (1924); *The New Natural History* (1925); *Science and Religion* (1925) and many other books and papers on allied subjects.

THOMSON, SIR JOSEPH JOHN (1856–), British physicist, was born Dec. 18 1856 near Manchester and educated at Owen's College, Manchester, and at Trinity College, Cambridge, where he was elected a fellow in 1880 and became lecturer in physics in 1883. In 1884 he was appointed Cavendish professor in the University of Cambridge and in 1919 research professor, holding in addition from 1905–18, the professorship of physics at the Royal Institution, London, and subsequently an honorary appointment. He became master of Trinity College in 1918. He developed at Cambridge a great research laboratory, which attracted numerous workers from many countries, and carried out there epoch-making investigations on the conduction of electricity through gases, the determination of the charge and mass of the electron, and analysis by means of positive rays. He became F. R. S. in 1884, and was president in 1915. He was knighted in 1908, and was the recipient of many British and foreign awards and honours, including the Royal and Hughes Medals of the Royal Society in 1894 and 1902 respectively, the Hodgkins Medal of the Smithsonian Institute of Washington in 1902, the Nobel Prize for physics 1906, the O. M. in 1912 and the Franklin Gold Medal, 1923. During the World War he assisted various Government departments in an advisory capacity. (*See* GASES.)

In addition to a large number of publications in the *Proceedings of the Royal Society* and *The Philosophical Magazine*, he published *A Treatise on the Motion of Vortex Rings* (1883); *The Application of Dynamics to Physics and Chemistry* (1888); *Recent Researches in Electricity and Magnetism* (1893); *Elements of the Mathematical Theory of Electricity and Magnetism* (1895, 5th ed. 1921); *The Discharge of Electricity Through Gases* (1898); *The Conduction of Electricity Through Gases* (1903); *Rays of Positive Electricity and Their Application to Chemical Analysis* (1913 2nd ed., 1922); *The Electron in Chemistry*, Five Lectures delivered at the Franklin Institute, Philadelphia (1923); and, with Professor Poynting, a number of general text-books on physics.

THORNDIKE, EDWARD LEE (1874–), American psychologist, was born at Williamsburg, Mass., Aug. 31 1874. He graduated at Wesleyan University (A.B., 1895), proceeding later to Harvard University (A.B., 1896) and Columbia University (Ph.D., 1898). He taught for a year in Western Reserve University and in 1899 became instructor in psychology at Columbia University, where in 1904 he was appointed professor. His application of statistical methods to intelligence tests constituted a notable advance in the field of psychology.

He wrote *Educational Psychology* (1903); *Mental and Social Measurements* (1904); *Animal Intelligence* (1911); *The Original Nature of Man* (1913); *The Psychology of Learning* (1914); *Psychology of Arithmetic* (1922); *Psychology of Algebra* (1923); and, in part, *The Measurement of Intelligence* (1926).

THORNDIKE, SYBIL (1885–), British actress, was born at Gainsborough, Lincolnshire, and educated at the high school, Rochester, when her father, Rev. A. J. W. Thorndike, was a canon of the cathedral. From 1903–7 she toured America in Shakespearean repertory with Ben Greet. Returning to England she became a member of Miss Horniman's company at the Gaiety Theatre, Manchester, 1908–9. Her training in repertory stood her in good stead when, in 1914, she became attached to the "Old Vic" company in London. She remained there until 1918, and is said to have acted in every Shakespearean play. Her reputation as an actress was steadily growing, but it was not until 1919, when she appeared in a series of matinées at the Holborn Empire, in which she played the parts of Hecuba in *The Trojan Women* and of Candida, in Mr. Bernard Shaw's play of that name, that she attracted wide attention. Henceforward her success was assured. Among her principal parts were that of Jane Clegg in Mr. St. John Ervine's play, and Joan of Arc in Mr. Bernard Shaw's *Saint Joan*. From 1920–2 she sustained a number of leading parts in Grand Guignol at the Little Theatre, London. In 1908 Miss Thorndike married Mr. Lewis Thomas Casson, with whom she had often appeared upon the stage, and who frequently acted as her producer.

THORNYCROFT, SIR WILLIAM HAMO (1850–1925), British sculptor (*see* 26·881), died at Oxford Dec. 18 1925.

THRACE (*see* 26.885), a former Turkish province, now divided between Greece (Western Thrace) and Turkey (Eastern Thrace). Thrace was one of the three theatres of the first Balkan war of 1912, when the Bulgarians entered it and defeated the Turks in the great battle of Lule Burgas, subsequently marching up to the ramparts of Chatalja, where the armistice with the Turks was signed. With the assistance of Serbian troops the Bulgarians took Adrianople, and the Treaty of London of May 30 1913 put back the frontier of European Turkey to a line drawn from Enos on the Aegean to Midia on the Black Sea. Nearly all Thrace had thus fallen to the share of Bulgaria, but her quarrel with her allies over the spoils in Macedonia led to the second Balkan war of 1913, and the Turks took the opportunity to recapture Adrianople, to reoccupy Western Thrace and create the "independent government of Gümüljina," a mainly Moslem district.

The treaty of Constantinople of Sept. 29 1913 set back the Turco-Bulgarian frontier in Thrace to the mouth of the river Rezvaya on the Black Sea, considerably to the north of Midia, and, while making the right branch of the Maritsa the frontier on the Aegean, so drew the line between those points as to include Kirk Kilisse and

Adrianople within Turkish Thrace. But Gümüljina was restored to Bulgaria, with the result that 14 Moslem deputies of Western Thrace held the balance of power in Bulgaria and, under the influence of their compatriot Talaat, helped to bring Bulgaria over to the Central Empires. Meanwhile the third Treaty of Bucharest fixed the Greco-Bulgarian frontier at the mouth of the Mesta; thus the Thracian coast from the Mesta to the Maritsa gave Bulgaria her coveted outlet on the Aegean. But the frontier cut the latter river and the Mustafa-Pasha (Svilen) Adrianople-Dedeagach railway so that Bulgarian trains had to traverse Turkish territory before reaching their Bulgarian port. The Maritsa was consequently declared free to the transit of both states till they had made fresh lines on their own territories. The cession of this awkward bend in the railway to Bulgaria in 1915 was a further inducement to enter the War on the Turkish side. Thrace was not long left in peace, for the operations at the Dardanelles brought her again within the war zone. The Treaty of Neuilly of 1919 again changed her boundaries. Bulgaria was moved back from the Thracian sea coast in favour of Greece, which by Article 27 of the Treaty of Sèvres of 1920 obtained the lion's share of Thrace as far as "a point near the mouth of the Biyuk Deré" on the Black Sea, and "a point on the sea of Marmara about one kilometre southwest of Kalikratia"—in other words, up to the Chatalja lines. Thus the valuable tobacco plantations of Xanthe, and the port of Dedeagach (rechristened Alexandroupolis) became Greek.

But the Allies undertook to make the Maritsa an international river and "to ensure the economic outlet of Bulgaria to the Aegean" by Article 48 of the Treaty of Neuilly. This they effected—in theory—by "the Thracian Treaty," signed on the same day as that of Sèvres, which decreed, as a condition of the recognition of Greek sovereignty over the former Bulgarian territories in Thrace, that Bulgaria should have "freedom of transit over the territories and in the ports assigned to Greece in the present Treaty," that "in the port of Dedeagach Bulgaria will be accorded a lease in perpetuity, subject to determination by the League of Nations, of a zone," and that Dedeagach be "declared a port of international concern," free to all members of the League. In practice, Bulgaria has not availed herself of this provision, rejecting M. Veniselos' offer in 1922 of a lease of the port and preferring a corridor and actual possession. The Greek tenure of Eastern Thrace was brief. After the disaster in Asia Minor, Article 2 of the second Treaty of Lausanne of July 24 1923 restored Eastern Thrace up to the Maritsa to Turkey, leaving Western Thrace to Greece. By conventions 3 and 6, on either side of these Greco-Turkish and Bulgaro-Turkish frontiers in Thrace demilitarised zones of about 30 km. were established and existing fortifications ordered to be dismantled, and the Moslem inhabitants of Western Thrace were exempted from the obligatory exchange of populations. Thus Thrace is at present divided between Turkey, Greece and Bulgaria. A boundary question between Greece and Turkey arose later over an island at the estuary of the Maritsa.

Economic Conditions.—Southwestern Thrace, the most fertile portion of the country, has scarcely recovered from the damage inflicted upon it during the Balkan wars of 1912–3. The Maritsa is navigable up to Adrianople by flat-bottomed boats, but the Thracian ports are poor. Railway communications are complicated by the unscientific frontier near Adrianople, whereby the line from Western Europe to Constantinople traverses a tiny strip of Turkish territory, re-enters Greece and then recrosses into Turkey. Like all territories which have been under Turkish rule, Thrace is in a primitive condition, but the economic loss of the eastern half has been specially felt, because that would have been a field of labour for the Greek refugees. Turkish Thrace is now ethnologically overwhelmingly Turkish, while the Greeks find the remaining Moslems of the western half useful for the tobacco culture. The demilitarisation of the Gallipoli peninsula by the Lausanne Treaty should spare Thrace the spectacle of hostile armies. But the present situation (1926) may be regarded as provisional and artificial.

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THROAT: *see* EAR, NOSE AND THROAT, DISEASES OF.

THUNDER: *see* ATMOSPHERIC ELECTRICITY.

THURINGIA (*see* 26.901), a territory and free state (*Einheitsstaat Thüringen*) of the German Reich. Its area is 4,541 sq. m. and the population (1926) 1,624,675.

Political History.—On April 30 1920 the union of the territories Saxe-Weimar-Eisenach, Saxe-Meiningen, Saxe-Altenburg, Saxe-Gótha, Reuss, Schwarzburg-Rudolstadt and Schwarzburg-Sondershausen was recognised by a law of the German Reich on the basis of article 18, section 2, of the Constitution of the Reich. This was a natural consequence of the disappearance of the small particularist dynasties which had been removed in these States, as elsewhere, by revolutionary methods in Nov. 1918. An exception was Schwarzburg-Rudolstadt, where the Republic was established by a law enacted conjointly by the Prince and the Diet. The two principalities of Reuss had already united in one democratic state of Reuss. On the other hand, the personal union between Coburg and Gotha was dissolved, Saxe-Coburg declaring for union with Bavaria Nov. 30 1919 (ratified by the Reich April 30 1920). After the revolution all Thuringian states (except Gotha, where a Soviet régime held sway for some months) instituted elections for constituent assemblies to vote new constitutions. Meanwhile, however, the movement for union grew. All the States except Saxe-Meiningen and Saxe-Coburg concluded a preliminary "treaty of community" forming a kind of federated State with a single organ of legislation (*Volksrat*) and of administration (*Staatsrat*). Saxe-Meiningen subsequently joined this union, and on Jan. 28 1920 the Volksrat passed a law assuming the right to include within its competence the enactment of a constitution for the state of Thuringia. On May 12 1920 the provisional constitution voted by the Volksrat was promulgated and ratified with certain amendments on March 11 1921 by the newly elected Landtag.

Constitution.—Thuringia is a republic with parliamentary government. The diet consists of a single chamber elected on a system of proportional representation. It can be dissolved by a popular vote (*Volksentscheid*). The peculiarity of the Thuringian constitution is that the committees of the diet may call in experts to supplement their membership. The executive power is in the hands of the Ministry, which is formed on the principle of equal colleagues (*Kollegialprinzip*), and consists partly of members who hold office and partly of members who hold no office and who are designated state councillors (*Staatsräte*). The members of the ministry are appointed by the diet. The president of the ministry is chosen by the Ministry and is merely its chairman. The Thuringian constitution does not provide for any president of the state.

The legislative prerogatives of the diet are limited by the right of the people themselves to initiate legislation (*Volksbegehren*) or vote by referendum on measures already passed. After the revolution the Communists were in the majority and formed the Government, but the elections of 1924 brought a reversal; the new Government was formed by the bloc of non-socialist parties (*Ordnungsblock*).

(W. v. B.)

TIBET (*see* 26.916), a country of Central Asia. Estimated area 800,000 sq. miles. Population estimated at 4,000,000. In Feb. 1910 Chinese troops entered Lhasa. The Dalai Lama and his ministers fled to India, taking their seals of office with them. The Govt. of China issued a proclamation deposing the Dalai Lama, but the Tibetans refused to recognise this. In exile at Darjeeling the Tibetan Govt. denied the Chinese claim to suzerainty over Tibet and appealed for British intervention. The British Govt., however, declined to dispute the authority of the *de facto* Govt. in Tibet. At the same time they reminded the Chinese Govt. of the necessity of respecting British treaty rights, and announced their intention of protecting Nepal, Bhutan and Sikkim, should the necessity arise for doing so.

China and Tibet.—Until the outbreak of the Chinese revolution in 1911 the Chinese worked steadily to consolidate their position in Tibet. But in Nov. 1911, when the news of the revolution reached Tibet, some of the Chinese garrisons mutinied, and commenced looting the Tibetan villages. Fighting followed, with the result that the Tibetans overpowered the Chinese troops in central Tibet and deported them across the Indian frontier. In June 1912, the Dalai Lama returned to his country. Throughout eastern Tibet the Chinese were able to maintain most of their ground. In July 1912, a Chinese force was again dispatched to Tibet but failed to make much headway, and was withdrawn after representations had been made by Great Britain at Peking to the effect that such action contravened the convention of 1906.

At the end of 1912 Russia concluded a convention with Mongolia. This was signed at Urga, the Mongolian capital. Russia agreed to assist Mongolia in preserving her autonomy against China, and received in return extensive economical and political

privileges in that country. This convention was followed by what purported to be a treaty between Mongolia and Tibet, but the validity of this latter document is questionable. Towards the end of 1913 a Russo-Chinese treaty confirmed the Russo-Mongol convention.

A Futile Conference.—During 1913 the Chinese resumed hostilities and endeavoured also to negotiate with the Tibetan Government. The latter declined to meet any representatives from China unless a British representative were also present at the conference. Accordingly, in Oct. 1913, plenipotentiaries from the three countries assembled at Simla to discuss and to define the political status of Tibet. China was represented by Mr. Ivan Chen, Tibet by Lönchen (a title denoting chief minister) Shatra and Great Britain by Lt. Col. Sir A. H. McMahon. After six months' discussion the three plenipotentiaries initialed a convention by which:—

(*a*) Chinese suzerainty over Tibet was recognised.
(*b*) Tibet was divided into "Inner Tibet," the part nearer China, and "Outer Tibet," the part nearer India. The latter was to be autonomous, the former under a considerable measure of Chinese control.
(*c*) The Chinese Amban was to be re-established at Lhasa with a suitable military escort.
(*d*) A fresh trade treaty was negotiated between India and Outer Tibet.
(*e*) The frontier between Tibet and northeastern India was settled.

The Chinese Govt. refused to ratify the convention, explaining that its sole objection was to the frontier between China and Tibet as established by the convention.

After the break-up of the conference the Chinese and Tibetan Govts. agreed to suspend hostilities against each other pending a renewal of the negotiations. In 1917, however, fighting was resumed, the Chinese general on the frontier being apparently responsible. In the campaign that followed the Tibetans were victorious. Driving the Chinese out of the districts of Mangkam, Traya and Chamdo, they recaptured their territory as far east as the Yangtze Kiang. In July 1918 a truce was arranged by the British vice-consul, the Tibetans retaining the lands which they had reconquered but advancing no further.

The War and After.—During the World War the Govt. of Tibet offered 1,000 Tibetan soldiers to fight on the British side and further ordered that special services for the success of the British arms should be held from time to time in the leading monasteries throughout Tibet. An event of some significance occurred about this time in the dispatch of four Tibetan boys of the upper middle class to England, where they received, so far as the time at their disposal allowed, an English education. In 1919 the Chinese Govt. at Peking proposed a renewal of the negotiations abandoned in 1914, but subsequently withdrew their proposals, as they met with strong opposition from their own countrymen. Early in 1920 a Chinese mission visited Lhasa and remained there four or five months, but left without coming to any settlement with the Govt. of Tibet.

Towards the close of 1920 Mr. (afterwards Sir) Charles Bell, the British representative in Tibet, was dispatched to Lhasa at the request of the Tibetan Govt., the first mission from any country outside China to be invited to the Tibetan capital. As a result of the mission, which remained a year in Lhasa, it was decided to afford the Tibetan Govt. such reasonable assistance in the settlement and development of their country as might be expected from a friendly neighbour more advanced than themselves. The desire of Tibet for closer co-operation with India was further shown by her request for the linking up of Lhasa with the Indian telegraph system. This was effected during the summer of 1922. The Tibetan Govt. are thus enabled to communicate with India and receive an answer the same day instead of waiting seven days for the reply.

In 1926 the position of the Sino-Tibetan dispute was that Tibet desired a settlement. But there is a strong body af public opinion in China opposed to recognition of the standing which Tibet claims, and, even if a settlement were reached with the Chinese Govt., the latter is not strong enough to impose it on Kansu, Szechwan and Yunnan, the three provinces that are chiefly concerned with Tibet. Since 1912 the Tibetan Govt. has maintained complete independence of China. Her military strength appears to be slowly increasing, but is hampered by shortage of funds, for the country is poor, and a large share of the revenue is alienated to the priests and the nobility.

Trade, etc.—The trade between Tibet and India is expanding slowly. Minerals have not yet been discovered on such a scale as to warrant their being exploited commercially. During recent years a mint has been opened at Lhasa. Gold, silver and copper coins are minted. A limited number of currency notes have been put into circulation, the value of these ranging up to 50 tankas (=about 16 shillings). One of the four Tibetan lads who came to England for education is understood to be starting a small hydroelectric scheme in Lhasa.

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TIDAL POWER.—The idea of utilising the rise and fall of the tides for power purposes has long attracted the attention of inventors, and many ingenious schemes have been suggested. So far, however, the only practicable method is based on the use of one or more tidal basins, separated from the sea by dams or barrages, and of hydraulic turbines through which the water is passed on its way between basin and sea or between one basin and another.

Any simple tidal power scheme suffers from the disadvantages that the working head is both low and variable, not only from day to day but also over any one tide; and that the turbines cease to operate for a more or less extended period on each tide. Moreover since this idle period depends on the time of high and low tide it gradually works around the clock, and will, at regular intervals, be included in the normal working day. While schemes of operation are feasible in which the idle period may be eliminated this involves a large reduction of output per square mile of tidal basin area. Even in such schemes, unless the working head and the output be limited to that available at the lowest neap tides there is still a large variation of output between springs and neaps. On the other hand, with such a limitation the power developed is only a small fraction of the total energy available, and the cost of the necessary engineering works per horse-power-year will be prohibitive except under exceptionally favourable circumstances.

In order to obtain a continuous output or energy, or an output suitable for any ordinary industrial load, some storage system is necessary, unless the scheme is connected with some steam or inland water power station capable of equalising the supply at the idle periods and during the neap tides.

Storage Systems.—Various storage systems have been suggested, such as electrical accumulators, electrically heated steam boilers, and those using compressed air. At present the most promising consists of an elevated storage reservoir supplied from pumps driven from the turbines at times of excess supply, and feeding a battery of secondary turbines. The method is, however, only possible where there is a suitable elevated site within reasonable distance of the tidal basin.

Types of Schemes.—Briefly outlined the more promising of the schemes of tidal power development are as follows:—

(*a*) A single tidal basin is used, divided from the sea by a dam in which are placed the turbines. The basin is filled through sluices during the rising tide. At high tide these are closed. When the tide has fallen through about one-half its range, the turbine gates are opened and the turbines operate on a more or less constant head until low tide or slightly after. If A be the surface area of the basin in square feet; if H ft. be the tidal range; if a constant working head of h ft. be adopted; and if the turbines operate until low tide, the volume of water used during the falling tide will be A (H-h) cu. ft., and the energy available in the water will be

$$64\ A(H-h)\ \text{ft. lb. per tide.}$$

This expression is a maximum when h = H—2, that is when the working head is one-half the tidal range, and then equals 16 A H² ft. pound.

If A is in square miles, and if the efficiency of the turbines is 75% the output in horsepower-hours per tide is given by

$$\frac{0{\cdot}75\times64(5280)^2AH^2}{4\times33000\times60}=169AH^2$$

The cycle of operations is shown in fig. 1 where A B denotes the working period and C D the period of replenishment of the basin. The sine curve represents the level of the sea outside the basin. Owing to the great variation in the rate of efflux of the water in this constant-head method of operation, the power output varies very largely during the falling tide. This variation may be reduced con-

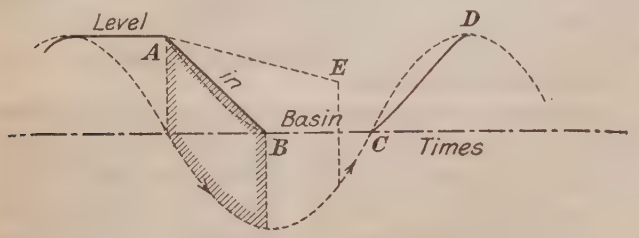

Fig. 1.

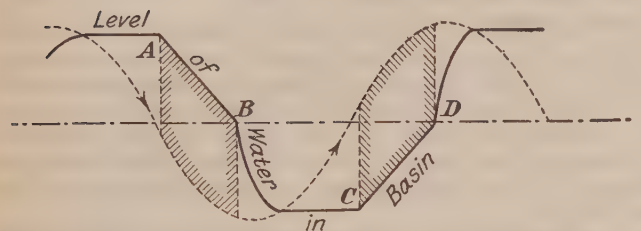

Fig. 2.

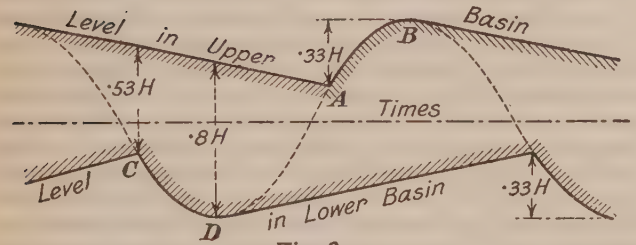

Fig. 3.

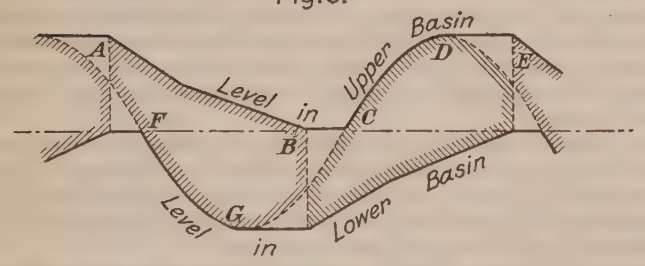

Fig. 4.

SCHEMES OF TIDAL POWER DEVELOPMENT

FIG. 1.—Single tidal basin, divided from sea by a dam in which are placed the turbines. FIG. 2.—Single tidal basin, with turbines operating on rising and falling tides. FIG. 3.—Two tidal basins, with turbines in dividing wall. FIG. 4.—Two tidal basins, with turbines installed in walls dividing the sea from each basin.

siderably by allowing the turbines to operate on a more or less constant fall of level in the basin as shown by the straight full line A B. By this method of operation the necessary turbine capacity for a given output may be greatly reduced. By extending the working period beyond low tide, as indicated by the dotted line A E, a greater amount of energy may be developed per tide and the idle period is diminished, but at the expense of an appreciably greater variation in head. The most efficient combination of working period and of working heads can only be determined by detailed examination of the particular site, and with a knowledge of the exact form of the tidal curve.

(*b*) A single tidal basin is used, with the turbines operating on both rising and falling tides. The cycle of operations is indicated in fig. 2. The working period per complete tide now extends from A to B and from C to D. Slightly before low water, at B, the basin is emptied through sluice gates, and at D, a little before high water, the basin is filled through the sluice gates. With a working head equal to one-half the tidal range, the period of operation is approximately 60% greater than in system (*a*) with operation down to low tide, and the work done per complete tide is some 60% greater.

(*c*) Two basins of approximately equal areas are used, with turbines in the dividing wall. Each basin communicates with the sea through suitable sluice gates. In one of these basins, called the upper, the water level is never allowed to fall below one-third of the tidal range, while in the lower basin the level is not allowed to rise above one-third of the tidal range. The working head then varies from 0·53 H to 0·80 H, with a mean of approximately 0·66 H, and operation is continuous as indicated in fig. 3, which shows the cycle of operations. Between A and B, the upper basin is filled from the sea through appropriate sluice gates, and the lower basin discharges into the sea from C to D. For a given total basin area and a given tidal range, the output is only about one-half that obtained in system (*a*) and one-third that obtained in system (*b*), so that except where the physical configuration of the site is particularly favourable the cost per horsepower is likely to prove very high.

(*d*) Two tidal basins of approximately equal areas are used. Turbines are installed in the walls dividing the sea from each basin. Fig. 4 shows the cycle of operations. From A to B the upper basin discharges through its turbines into the sea. From B to E the sea enters the lower basin through its turbines. The upper basin is filled from the sea through its sluice gates between C and D, and the lower basin is emptied through its sluice gates from F to G. The head varies from 0·25 H to 0·62 H, and the output is some 25% greater than in system (*c*), but the number of turbines required is much greater.

It is possible to arrange in each of these systems that the head shall be maintained constant during any one working period, but since this means that the working head is then limited to the minimum obtaining during that period, a loss of energy is involved, with a great additional cost of construction and complication in manipulation and with little compensating advantage.

For any scheme of development involving the use of a tidal estuary of such type as is found in the Severn or Dee, the cost of any of the multiple basin systems would appear to put them definitely out of court.

A scheme involving operation only on a falling tide has the disadvantage that the output is only about 60% of the output theoretically possible with double-way operation. On the other hand the output per unit of turbine capacity is sensibly the same, while it enables a much more efficient type of turbine setting to be used, and enables the number of sluice gates to be halved. It has the further advantage, where applied to a navigable river, that the depth of water in the basin never falls below mean tide level or thereabouts, so that navigation above the barrage is improved. The scheme is essentially more simple than any one involving double-way operation.

The Severn Scheme.—Up to the present (1926) no tidal scheme of any magnitude has been constructed. The possibilities of such an installation on the estuary of the Severn are, however, now under consideration by a committee appointed by the British Government. This would consist of a single tidal basin of about 25 sq. m. in area formed by a barrage probably in the neighbourhood of Sudbury, along with a storage reservoir some 500 ft. above sea level and about five miles away above the Wye Valley. Single-way operation of the turbines is proposed. It is estimated that the scheme would be capable of developing some 500,000 H.P. over a 10 hour working day throughout the year.

Fundy Bay Scheme.—Designs have also been prepared for a two-basin scheme for utilising the tides at Passamaquoddy Bay, an inlet of the Bay of Fundy in Nova Scotia, from which it is estimated that between 500,000 and 700,000 horsepower can be generated.

Aber-Vrach Scheme.—A scheme to which the French Government is giving financial assistance is projected at Aber-Vrach on the coast of Brittany, and appears likely to be undertaken almost immediately. For the tidal operated station a barrage 490 ft. long is to be constructed in the estuary. Four turbines connected to synchronous generators are to be installed, each capable of developing 1,200 H.P., under the maximum head available at spring tides. The turbines are to operate both on the ebb and flow tides. This station will work in conjunction with an auxiliary water-power station some 4 m. away on the river Diouris. The

river is to be dammed at this point, forming a fresh water reservoir from which turbines having a maximum capacity of 2,700 H.P. are to be supplied. Electrically driven centrifugal pumps of a capacity of 3,200 H.P. will also be installed.

During the idle periods of the tidal station, and during neap tides, the river plant will be used. As the tidal turbines come into operation the river plant will be shut down and finally when the tidal power becomes in excess of the demand the alternators at the river plant will be run as motors to operate the pumps, which lift water from the lower to the upper side of the river dam. It is anticipated that the combined plant will make it possible to maintain a continuous output having a maximum of 3,200 H.P. and a minimum of 1,600 horsepower.

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TIDES (*see* 26.938).—During the present century there has been a marked increase in the interest taken in tides.

Observation.—The observation of coastal tides by means of automatic gauges has been continued in most countries, but comparatively little has yet been done in the measurement of off-shore elevations. A number of attempts have been made to construct a self-registering gauge which, when placed on the bottom of the sea, will give a continuous pressure-time record. From such a record it is of course easy to pass to an elevation-time relation. The gauge which appears to have met with most success is that of L. Favé, of the French Hydrographic Department. The continuous measurement of currents has been continued, though not to the extent which the importance of the work warrants. Owing chiefly to the trouble of keeping a meter fixed relatively to the sea-bottom the accurate measurement of currents is attended with considerable difficulty. For the valuable series of observations taken in the North Sea much credit is due to the International Council for the Exploration of the Sea, which has its bureau at Copenhagen.

Harmonic Analysis.—In 1920 J. Proudman wrote for the British Association a report on work in the British Empire of Harmonic Analysis, and pointed out that much remained to be done on the subject. The harmonic constants did not represent completely the records analysed; for certain British stations the discrepancy reached a semidiurnal range of one foot and a quarter diurnal range of one foot. Also, the numbers obtained for the same constant from different records showed considerable variation. Since then much attention has been given to the subject, notably by A. T. Doodson, of the Liverpool Tidal Institute, which was established in 1919. He has made a new development of the generating potential, working to a much higher order of approximation than G. H. Darwin, and making it truly harmonic instead of grouping together a number of terms to form a slowly varying constituent. He found that there is a very large number of other terms which, while certainly smaller than those of Darwin, are not very much smaller and in their aggregate may be important. In other words, the convergence of the series of constituents is not so rapid as had been assumed. A corresponding state of affairs exists with regard to *over tides* and *compound tides*. For certain British stations Doodson has found it possible to obtain a practically complete representation of the quarter diurnal tides, but it involves many more harmonic constituents than had previously been sought for by the customary methods. He has also been able to account for part of the variation in the numbers obtained for harmonic constants. P. Schureman, of the United States Coast and Geodetic Survey, has published a list of harmonic constants for 840 stations. *Tide Tables* can still not be regarded as completely satisfactory even for such practical purposes as docking large vessels and navigating over shoals. The main deficiency appears to be one of analysis of records.

Geographical Distribution.—Observation has now provided us with a good knowledge of the principal tidal constituents along all the coasts of the world, but very little is yet known for certain as to their distribution over the oceans. General theory indicates that somewhere in the oceans there will be "amphidromic points," *i.e.*, points at which there is no rise and fall of the water and from which the cotidal lines radiate. A knowledge of the position of these points would summarise a large amount of information, and consequently much attention is paid to them. In 1920 R. Sterneck prepared world-charts for the chief semidiurnal and diurnal constituents, based on all available data, but they must be regarded as largely hypothetical. The charts differ in many important respects from those of R. A. Harris, though there is much similarity for the North Atlantic. Where tidal currents have been well observed, fundamental mechanical principles lead to much information regarding the tidal elevations. An example of this is afforded by the North Sea, the principal constituent of the tides of which may now be regarded as well known over the whole area. The investigation has been carried out since 1920, and so far is almost entirely restricted to the North Sea.

Dynamical Theory.—The tides of any body of water are dynamically determinate when either the elevations or the normal currents are known along the sections which are taken as dividing the body from other waters. In explaining the tides of any particular sea or ocean, it is therefore necessary to assume either from observation or from other theory the tidal conditions in the water immediately neighbouring. The detailed explanation, on dynamical principles, of observed tides has so far been restricted to the elongated basins of narrow seas, channels and gulfs. The work is due chiefly to A. Defant and R. Sterneck and has all been carried out since 1910. It rests on the principle that for such basins the tidal currents are non-rotating and parallel to the general direction of the basin. In these circumstances the motion of the water may be regarded as a longitudinal oscillation with an oscillating transverse surface-gradient sustained by the currents in virtue of the earth's rotation. The differential equations are constructed after the manner introduced by G. Chrystal for the seiches of elongated lakes, and are then solved by numerical step-by-step methods. Applications have been made to the tides of the Red Sea, the Persian Gulf, the English Channel, the Irish Sea and the Adriatic Sea. When the transverse currents cannot be neglected the theory presents much greater difficulty. Even for the North Sea a complete detailed dynamical explanation has not yet been given, though it is possible to give a qualitative one. In 1911 R. Witting proposed an explanation of the Baltic tides, and later R. Sterneck proposed explanations of those of the Mediterranean and Black Seas. Their methods are largely those which apply to narrow seas, except that they are used transversely as well as longitudinally. No generally accepted detailed explanation of the tides of the great oceans has yet been given, though A. Defant has recently made an attempt for the Atlantic and Arctic basins.

As regards the tidal dynamics of geometrically simple bodies of water it is convenient to consider separately closed and open basins. Of the former the only cases which had yielded to mathematical treatment up to 1914 were those of a flat circular sea whose depth is a function only of the distance from the centre, and an ocean covering the whole globe, with the depth a function only of the latitude. The details for polar and zonal basins of uniform depth were worked out by G. R. Goldsbrough in 1914, while the solution for a flat rectangular sea of uniform depth was given by G. I. Taylor in 1920. For open basins the most important contribution is G. I. Taylor's solution (1920) for the tides in a rectangular gulf of uniform depth. When modified to allow for friction the results provide a first approximation to an explanation of the tides of the North Sea. At a later date J. Proudman investigated the tides of a channel whose section is uniform along the length but of varying depth from side to side, obtaining results which indicate the degree of error in the assumption of no transverse current in narrow seas. Other parts of the dynamical theory which have undergone development relate to the effects of capes, bays and islands on local tides, to slowly rotating seas and oceans and to limiting forms of long period tides. In the last connection it should be mentioned that there is an erroneous statement in 26·958; viz., that continental barriers have the same effect as that attributed by Laplace to friction. That this is not necessarily the case has been emphasised by E. Fichot.

Two attempts have been made to bring some of the latest methods of pure mathematics to bear on the general problem. In 1910 H. Poincaré transformed the dynamical equations from the differential to the integral form. The theory of integral equations has grown up almost entirely since 1900; its results are perfectly general, and are stated explicitly in terms of direct operations. But in the case of tidal problems the arithmetical labour necessary to carry out these operations is so prodigious as to prove quite prohibitive even for the reproduction of known solutions. Nevertheless, the theory is valuable for the establishment of existences, and in 1923 was further developed by G. Bertrand. In 1917 J. Proudman specified the tidal state of an ocean by means of an infinite number of co-ordinates of the Lagrangian type, and then transformed the differential equations into an infinite set of linear algebraic equations.

Friction.—If tidal motion were everywhere non-turbulent the amount of friction in the tides would be quite insufficient to account for the outstanding discrepancy between theory and observation in the motion of the moon. But tidal currents in shallow seas are undoubtedly turbulent, and though this has long been recognised it was left for G. I. Taylor in 1920 to make a numerical estimate of the associated dissipation of energy.

H. Jeffreys concludes that the total amount of friction is just sufficient to account for the discrepancy mentioned. He takes the chief contributing areas to be Behring Sea, the Yellow Sea, Malacca Strait and the N.W. Passage. Assuming the magnitude of the ocean tides to be of the order given by the equilibrium theory, Jeffreys calculates that the total energy at any time present in the oceans is only equal to that dissipated by friction in about two days.

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(J. P.*)

TIENTSIN, China (*see* 26.963), with a population estimated variously at from one to two millions (including 683 British in 1925), is now the leading port of northern China and the principal outlet for the produce of four provinces. The trade of the port has grown rapidly, particularly with the United States and increased 100% between 1917 and 1923. Commerce in eggs, carpets and marmot skins has developed. Till 1920 the harbour was closed each winter by ice, but in that year three powerful ice-breakers were installed. Tientsin handles a third as much trade as Shanghai.

In 1925 the authorities of the seven concessions were reclaiming land within their limits to cope with the need for houses and offices. The municipal services are very efficient, and the streets of the concessions are in good condition. A large electric light company started work in 1912. Tientsin is an important railway centre, with a line to Pukow and a station on the Pekin-Mukden line. A distributing, not an industrial, centre, it has a number of cotton mills, and distilling and salt-evaporation are large local industries. The concessions have been rapidly developed. The former German and Austrian concessions were taken over by the Chinese authorities in 1917 and the two British concessions were amalgamated in 1918. The disastrous floods of 1917, when the Grand Canal burst its banks, carried away the main railway line to Pukow and flooded the concessions, led to the formation of a commission to consider the problem of the Chih-li river. An outer dike at Tientsin, a cutting which shortens the course of the Hai-ho and does away with some difficult bends, and an outlet for the Machang channel have been made. Other plans were considered in 1924, when further severe floods occurred. In 1925 the banks of the Grand Canal were strengthened.

TILAK, BAL GANGADHAR (1856–1920), Indian nationalist leader, a Chitpavan Brahmin, was born at Ratnagiri July 23 1856. At an early age he took the lead in providing education in Poona under Indian direction. In 1890 he was proprietor and editor of two weekly papers, *Mahratta*, printed in English, and *Kesari* (*Lion*), printed in Mahratti, which organs he used for anti-Government propaganda. His violent condemnation in 1897 of the plague prevention regulations resulted in his being convicted for sedition and sentenced to 18 months' imprisonment. For the same offence he was sentenced in 1908 to six years' transportation, subsequently commuted to simple imprisonment in Mandalay. After his release he took an active part in the home-rule campaign, and secured for his party the control of the National Congress. He died in Bombay on Aug. 1 1920. His paper on the *The Orion, or Researches into the Antiquities of the Vedas*, read at the International Congress of Orientalists in London 1892 (published at Poona 1893), expounded a theory of extremely remote Aryan origins, which has not been accepted by other scholars. His formative part in the cult of Indian unrest is shown in the report of the Rowlatt sedition committee (1918). His speeches are collected in *Lokamanaya B. G. Tilak* (2nd ed. Madras, 1920)

TIMBER: *see* FORESTRY; NATURAL RESOURCES, CONSERVATION OF.

TIME: *see* SPACE–TIME.

TIME SALES.—The second of the factors which played a great part in expanding the market for motor cars was the practice of selling under the time-payment plan. For a long time the automobile business was conducted on a cash basis. The purchaser made a deposit of from 20 to 30% at the time of placing his order, and paid the balance upon delivery. No difficulty was experienced in enforcing these terms, because the demand for cars ran ahead of the capacity of the factories to produce. Gradually, however, production caught up with the demand, and it then became necessary to create a market among those classes of the population which generally are not well supplied with ready money. Under the time payment plan, introduced to this end, the purchaser makes an initial payment of perhaps 33⅓% when receiving his car, and the remainder is paid in monthly or weekly installments. *See* INSTALLMENT SELLING.

TIN (*see* 26.995).—Although deposits of tin are widely distributed, the two areas of chief importance are the Asiatic deposits, comprising Malaya, Siam and China, and those of Bolivia. These two areas provide about 85% of the world's total output. Until 1916 the British Empire production exceeded that of foreign countries; but since that date, owing to the enlarged output from Bolivia and the Dutch East Indies, the production of foreign countries has been the larger. In 1925 the world's most important producer of tin was still the Federated Malay States where the alluvial deposits of the Kinta valley form the richest tinfield. The methods of working are ground sluicing and hydraulic mining; open cast-workings; underground workings and dredging. In Burma the most important occurrences of tinstone are in the Bawlake State of Karenni, at the Mawchi Mines, in the Amherst district (*a*) at Belugyum, (*b*) east and west of the Seludang range; and in the Thaton, Tovoy and Mergui Districts.

The Burmese mineralised belt continues southwards through the F.M.S. to the Islands of Singkef, Banka and Billiton in the Dutch East Indies, thus forming the world's richest tin-producing area. In 1924 it supplied over 60% of the world's total output; and the Dutch East Indies alone contributed no less than 23·2% of the world's production. It was, however, stated in 1925 that within 12 years the bulk of the rich secondary deposits of Dutch East Indies, of Malaya, of Siam and of Lower Burma will have been exhausted. Other Asiatic occurrences of tin are those of French Indo-China in the Province of Tongking; in China, in the provinces of Yunnan, Kwangsi, Hanan, Kwangtung and Fukien;

and in Japan in (*a*) the Akenob district, Tajima province, (*b*) the Taniyama mine, Satsuma province, (*c*) the Kiura mine, Bungo province, (*d*) mines near Takayama and Hirukawa, Mine province.

In North and Central America cassiterite is known to occur in very small quantities, also in Canada, United States, Mexico and British Honduras. The most important producer in South America is Bolivia, whose tinfields supplied 21·4% of the world's total output in 1924. The chief mines occur in La Paz, Cochabamba, Oruro and Potosi. The most important point about the Bolivian deposits is that they are primary, and lode-mining is much more likely to yield larger outputs over a longer period of future years than is the case with the Asiatic deposits. Tin is widely distributed in Australasia—all the States of the Commonwealth of Australia and also New Zealand produce the mineral—but in 1923 the whole area yielded only $2\frac{1}{2}$% of the world's total production.

In the continent of Africa the most important tin producer is Nigeria (Bauchi plateau), followed by the Union of South Africa and Swaziland. Other contributing countries are the Gold Coast, Nyassaland, Belgian Congo, Portugese East Africa, South West Africa and Rhodesia. In 1924 the continent of Africa produced 5·47% of the world's production of tin for that year, of which 4·47% was contributed by Nigeria.

In Europe the chief producing countries are Great Britain, Czechoslovakia, Germany, Portugal and Spain. With regard to the mines in Cornwall and Devon, during the 50 years ending 1800 the output varied between 2,000 and 3,500 tons a year. The maximum output during the War was 6,537 in 1914. By 1922, when so few mines were working, the production was only 370 tons. By 1924, owing to the greatly improved conditions, the figure had risen to 1,725. In 1925 about 95% of the production occurred in the Camborne-Redruth area.

The following table gives the world's production, in long tons, of tin ore for 1913, 1918 and 1923.

	1913	1918	1923
United Kingdom	5,288	3,954	1,021
Nigeria	3,872	5,904	5,860
Swaziland	270	358	107
Union of S. Africa	2,251	1,422	918
India (Burma)	303	647	1,400
Straits Settlements	7	22	6
Federation of Malay States	50,125	37,369	37,643
Unfederated Malay States	1,241	2,720	1,727
Australia	7,780	4,747	3,283
Approx. total	71,100	57,100	52,000
Bolivia	26,327	29,104	29,767
Dutch East Indies	20,541	19,200	31,019
Siam	6,747	8,835	6,334
China	8,408	8,730	8,727
Other countries	200	226	1,740
Approx. total	62,000	66,100	78,600
World's total (approx.)	133,200	123,200	130,600

The 1924 total was approximately 137,860 long tons.

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(N. M. PE.)

TIRES (*see* 26.1006).—Structurally tires are divided into two main classes: solid rubber and pneumatic. The cushioning properties of solid (American) or band (British) tires come from the elasticity of the rubber and the depth of the tread. There is a sub-class of solid tires, designated by the name of cushion tires. In pneumatic tires compressed air serves both as the cushioning and load-supporting medium. The rubberised fabric structure of the casing in this case serves as a flexible, yielding container for the compressed air.

History.—In 1910 the motor-vehicle industry used the "clincher" or "beaded edge" pneumatic tire constructed with square woven fabric. These tires in 1910 averaged only 3,000 to 4,000 m. of service. The clincher design of the rim and bead combination (fig. 1) as a method of attachment of tire to the rim had its limitations, particularly in the larger sizes, so that progress in improving the service of tires of this type was discouraging. The principle of the bead of the Dunlop-Welch wired-on bicycle tire was then developed and introduced under the name of the "straight-side" bead. This idea first became practical for motor-vehicle use in 1907, when an American manufacturer (the Goodyear Tire and Rubber Co.) offered to the American public its "detachable" straight-side rim and tire (fig. 2). Its progress was slow because of competitive hindrances, but by 1910 the merits of the detachable rim obliged the clincher tire manufacturers to furnish some sort of a detachable tire. The result was the "quick-detachable" (Q.D. clincher), a tire fitting a detachable clincher rim and having its beads shaped like the regular soft bead clincher, but with an inextensible wire bead core like the straight-side tire. During this period of development, the Q.D. clincher served as a transition type.

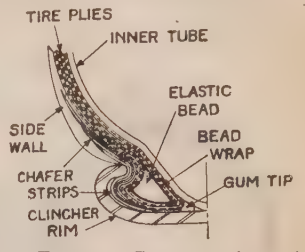

FIG. 1.—Cross section of clincher bead on rim.

The merits of the straight-side construction, however, gradually made it more popular than the Q.D. clincher, with the result that the last Q.D. clincher rims were made in 1916. In the meantime the European demand continued to be for the clincher type exclusively, while they were discontinued in American production except for the use of clinchers in the Ford sizes.

Progress in details of design, materials and methods of manufacture was very gradual, the general idea being always to build a "balanced" tire, that is, one in which all parts were equally durable. The straight-side tires of square woven fabric of 1920 averaged 5,000 to 6,000 m. of service and required air pressure ranging from 55 to 75 pounds. About 1912 electric automobiles in America created a demand for "power saver" tires, to which

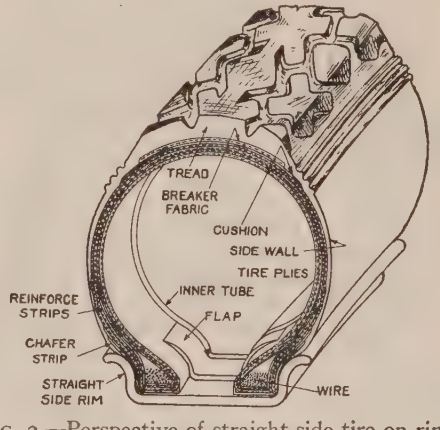

FIG. 2.—Perspective of straight-side tire on rim.

the tire makers responded by offering special casings of "cord" fabric structure for which exceptional resiliency and lack of internal friction were claimed. This tire was not at all durable at first, but as it was gradually perfected, the leaders of the industry became convinced that it (what is now called the "high-pressure" cord tire) was to be the quality tire of the future (fig. 3).

The Cord Tires.—Ply separation and fabric breaks in cord tires are effectively prevented because the cords, being completely insulated from each other, provide a flexibility of the "carcass" without chafing, that greatly reduces injury from under-inflation and overloading. The two-ply "cable" cord

construction was the initial form, and the "multi-ply" construction (The Goodyear Co.'s contribution) soon followed. In 1920 the merits of the multi-ply construction had prevailed to such an extent that the cable cord was no longer made. After the World War European tire manufacturers began to duplicate

FIG. 3.—Cross section of high-pressure straight-side tire.

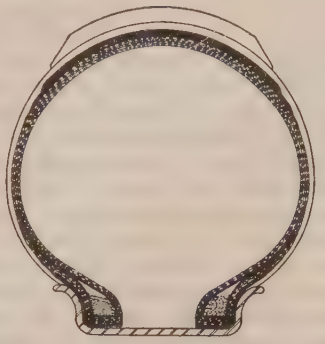

FIG. 4.—Cross section of balloon tire.

American multi-ply cord construction in their millimetre beaded-edge sizes. The cord tires of 1920 averaged 7,000 to 8,000 m. of service and required air pressure of 45 to 65 pounds.

The Balloon Tire.—The next major development in automobile tires came with the introduction of the balloon tire. This type was first developed, perfected and put on the market by the Firestone Tire and Rubber Co., the fundamentals underlying this development being, first, to make it possible to owners to use air pressure ranging from 25 to 35 lb.; second, to use a much larger cross section of tire in combination with a smaller diameter of rim so that the overall height of the tire would remain the same; and third, to use only four plies of cord in the carcass construction in order to give the extreme flexibility which would be necessary for use with low pressures, and at the same time to secure the durability which the public demanded (fig. 4). By way of example in showing the relationship between high-pressure cord tires and the balloon type, the following table is included to give typical examples:

High-Pressure Tires				Balloon Tires		
Sedan Models	Size	No. Plies	Proper Pressure	Size	No. Plies	Proper Pressure
Ford	30x3½ Fab. Cl.	4	55 lb.	4·40–21	4	30 lb.
Buick	31x4	5	60 lb.	5·25–21	4	34 lb.
Dodge	32x4	6	60 lb.	5·77–20	4	35 lb.
Willys-Knight	32x4½	6	60 lb.	6·20–20	4	30 lb.
Paige	33x4½	6	65 lb.	6·75–21	4	34 lb.
Packard	33x5	8	65 lb.	7·30–20	4	30 lb.

The improved riding comfort secured from the use of balloon tires brought them into general use very rapidly; the first being sold for change-overs and put on cars by manufacturers as original equipment in the early autumn of 1923. By the autumn of 1924 they were used as original equipment on nearly all cars except Fords, and the Ford Co. adopted them to replace the clincher fabric tires early in 1925. In 1925 the high-pressure cord and balloon tires reached such perfection that the cord tires averaged from 12,000 to 14,000 m. and the balloon tires between 16,000 and 18,000 miles.

To summarise the progress of pneumatic tire development over the period of 1910 to 1925 from a dollar-and-cents standpoint, we find that the tire cost per mile on a medium size car diminished as follows:

Period	1910–2	1913–5	1916–8	1919–21	1922–5
Tire Mile Cost	$0.0112	$0.0055	$0.0041	$0.0030	$0.0016

The balloon tire development in America was entirely on straight-side rims with the standard flat base design. The Dunlop Rubber Co. in England simultaneously developed balloon tires similar to those used in America, with rims worked out in the straight-side type with the drop centre design, as on the old Dunlop-Welch wired-on bicycle tire.

Tires for Motor Trucks.—In 1915 the Goodyear Co. started actively to develop large, heavy construction pneumatic tires for use on motor-trucks. Beginning with 1916 all activities in this line were confined to the cord construction which gradually developed in 6, 7, 8, 9 and 10 in. sections, ranging from 10 to 16 plies, and employing from 90 to 130 lb. of air. To carry the load, in some cases, it was necessary to use the tires in dual or twin application on the rear wheels. The use of these tires was very limited, however, until the period of motor-bus expansion which began in 1921, so that truck or bus tires, as they were called, came into large production by 1925 in both single and dual application. The average mileage of these tires on buses varied over a wide range due to the different classes of service; in some localities as low as 12,000 m. while in other places as high as 25,000 miles. In 1925 the balloon-tire principle was introduced into bus application by the Firestone Co., by bringing out what was known as "balloon bus tires," designed to run with from 45 to 50 lb. of air.

Solid Tires.—The typical solid tire of 1910 was the British "pressed-on" band tire (fig. 5), then in use in Europe and soon to be duplicated in America. These tires were fitted to the wheels by simply forcing or pressing on with a special press, but in the absence of conveniently located tire presses, some American manufacturers adapted the metal-base idea to a "bolted-on" design (called "Demountable"), having bevels on the inside edges of the steel band so arranged that hoop-shaped "wedges" could be fitted to mount the tire, the whole assembly being bolted in place with "side flanges." Early metal base tires in America failed prematurely from fracture of the exposed hard rubber at the edge of the base band due to rough streets. To remedy this the band was made in "channel" form and the hard rubber protected by the side of the channel (fig. 6). In 1913, as an experiment, a "channel base" tire was tried, made to press directly on the S.A.E. (Society of Automotive Engineers) standard wheel without traction plate or staples, previously considered necessary. The experiment was successful, and this new type, being much simpler and less expensive, rapidly superseded all other types in America. In 1915 wide single solid

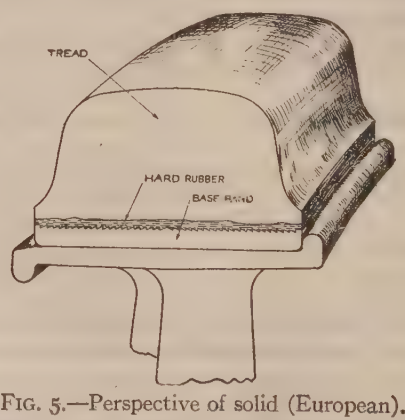

FIG. 5.—Perspective of solid (European).

tires (fig. 6) were introduced in America (8 in., 10 in., 12 and 14 in. wide) on the rear of heavy trucks in place of dual or twin tires. In 1920 wide singles and duals were almost equal in popularity. The principal development in the period from 1920 to 1925 was the much wider demand for non-skid treads (fig. 6) on solid tires and the development of the cushion tires of the hollow type; that is, having a circumferential cavity extending around the tire inside.

The growth of pneumatic tire production in the United States is shown by the following figures, those for 1913, 1915 and 1925 being estimates:—

1913	6,588,000	1922	40,930,000
1915	12,840,000	1923	45,245,000
1920	32,400,000	1924	51,633,000
1921	27,297,000	1925	53,900,000

Structure, Materials and Manufacture.—In designing pneumatic tires, five major forms of tire troubles must be kept in mind by the manufacturer: (*a*) possibility of premature tread wear; (*b*) breaks in fabric structure; (*c*) bead troubles; (*d*) loosening of the tread from the carcass; (*e*) separation between the plies of cord fabric. The proper resistance to tread wear is provided by using a very high quality of stock as a tread material, combined with suitable thickness and tread pattern. Fabric breaks are guarded against by using a high grade cotton in the cord structure and in suitable quantity so that the factor of safety is at least seven against bursting due to air pressure in the tire. The other three items are functions of the flexing, and to develop further the principles underlying tires, the balloon tire will be taken as an example. Low-pressure air in any tire means a relatively large area of contact. A large area of contact means a greater flattening out (or greater vertical deflection). Flattening out means flexing and working of the carcass, particularly the

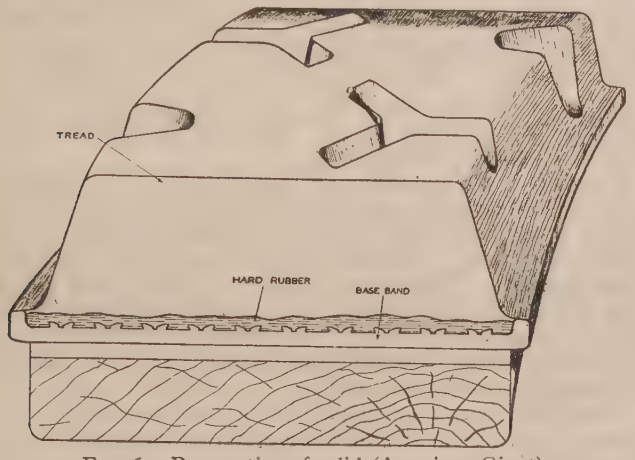

FIG. 6.—Perspective of solid (American Giant).

sidewall, a condition which, carried to an extreme, may easily lead to premature failure in circumferential flexing breaks in the sidewall or tread separation or ply separation.

The importance of flexing problems may be seen from the following considerations: For every single revolution of the wheel, the tire carcass from bead to bead and completely around the circumference has to flex, so that if the tire is run soft, the degree of flexing is much more exaggerated than if run properly inflated. A tire which renders 15,000 m. revolves 10,000,000 times. To give this mileage, every part of the carcass must flex 10,000,000 times and not fail. Manifestly, if a great many million flexes must be provided against without failure, the major problem is to prevent excessive flexing and introduce qualities into the tire to make it still more proof against flexing failures.

The component parts of the straight-side pneumatic tire are shown in figs. 7 and 8. The bead portion has embedded in it a circular inextensible wire core, usually of many strands in the form of braid, cables or coils (to give a certain amount of flexibility). This wire anchors the tire to the rim, prevents it from blowing off, and gives enough rigidity to prevent the tire from creeping on the rim when inflated. The body or "carcass" of the pneumatic tire consists of bias "plies" of cotton fabric impregnated with adhesive rubber "friction," insulated from each other by a thin "skim coat" of the rubber, and having the edges of the plies folded or "tied in" alternately over and round the wire bead core (see fig. 7 showing detail of a typical bead "tie-in"). Since the function of the carcass is to serve as a strong yet flexible container for the inner tube with its charge of compressed air, the specifications covering the fabric call for great strength, uniformity of weight, freedom from grit and the best grades of long staple cotton. "Cord" ply-fabric is primarily a warp composed of parallel cores of combed Arizona high-quality cotton resembling fish line and weighing 11 to 15 oz. per sq. yard. Each cord (23s–5–3), cabled yarn, has a tensile strength of 16 to 20 pounds. In cord tires the cords of each ply must cross those adjacent, consequently the direction of the bias is reversed in the successive plies. The bead "tie-in" around the rubberised wire bead "core" also includes narrow reinforcing strips of frictioned fabric (see figs. 7 and 8). The outermost of these is named the "chafing" strip. The outside of the carcass is entirely covered with rubber; the sides with a

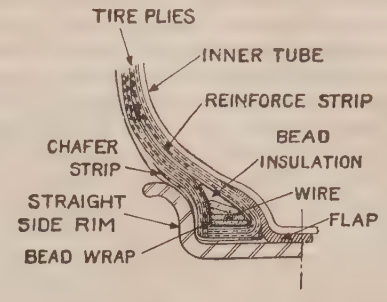

FIG. 7.—Cross section of straight-side bead on rim.

"sidewall" layer, 1–16 in. thick, and at the tread portion with "cushion stock," "breaker fabric," "undertread" and "tread."

The tread is the thick, tough, firm, wear-resisting face of the tire which is in contact with the road surface. The forces and stresses of vehicle operation are so severe in their tendency to tear the tread from the carcass that the tire makers have found it impracticable to attach the tread directly to the carcass, and have interposed the soft, elastic, adhesive "cushion" and open mesh "breaker fabric" to taper off the severity of the shearing stresses that would loosen the tread. Another very important function of the cushion and breaker is to prevent fabric rupture of the carcass by softening and spreading the intensity of impact of rough roads. The design and quality of the tread rubber must be worked out to wear at least as long as any other part of a balanced tire. The physical properties most desired are toughness, to resist cutting and chipping, and attrition resistance to provide against abrasion from road surface friction.

Inner Tubes.—There are no particular differences of design for the inner tubes; nearly all makes resemble each other very closely. Highest quality rubber, with little or no compounding except sulphur, is used for grey tubes (*see* RUBBER). The best red tubes are compounded with antimony sulphide. To be

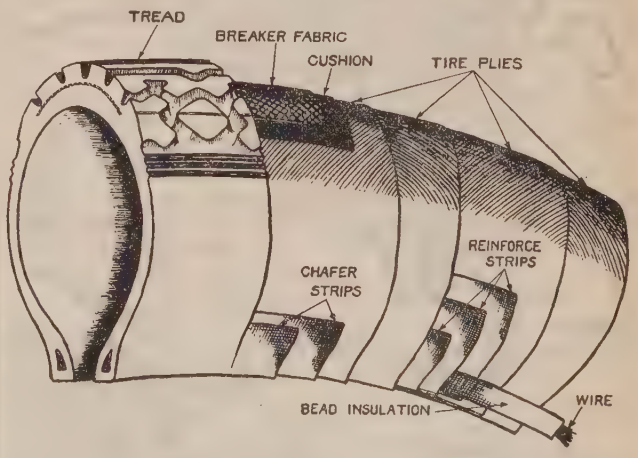

FIG. 8.—Perspective of step down section of balloon tire.

satisfactory the tube must hold air; not crack or check in storage; not stretch out of shape; not stick to the casing; not split or tear easily; not be affected by heating; and must be repaired easily. "Flaps," made of inexpensive rubberised fabric, are used in straight-side tires to prevent the tube from being pinched or nipped under the edge of the bead, and to keep water and rim rust away from the tube.

Manufacturing Processes.—Only general ideas of manufacturing can be mentioned. First, there is "stock preparation;" the rubber and "compounds" are mixed, the fabrics "frictioned" and "skimcoated" with rubber, gauged to a very exact thickness, the frictioned fabric cut to proper widths on a

machine called the "bias cutter," the cushion, undertread, and sidewall stocks sheeted out and cut to width on the calender, the tread rubber prepared either in the calender or the "tubing" machine, and the bead wires padded with rubber and frictioned fabric and cold pressed into shape (*see* RUBBER). "Building" the tire is the next step. A "core," in shape and size like the inside of a finished tire used as a building form, is mounted on a stand which permits the core to revolve. The tire plies are drawn taut around the core and rolled down smooth one after another, and at the proper time the bead is put into position. After the last ply is in place, the tie-in at the bead is made; the building is finished by adding the sidewall, cushion, breaker strip and tread. The final step is the vulcanising or "curing." Fundamentally this is simply the process of subjecting the "uncured" tire to pressure in a strong iron "mould" with an inflated "air bag" inside the tire. The heat effects chemical changes in the rubber compounds just as in cooking. Quality in a tire is very dependent on the curing. (*See* also MOTOR VEHICLES.)

(J. E. H.*)

TIROL (*see* 26.1010).—The question that arose in 1926 in this area is more properly that of the South Tirol—*i.e.*, Trentino and Alto Adige. The area of Trentino is 2,454 sq. m.; that of Alto Adige (including Ampezzo) 2,953 square miles. By the census figures of 1910 there were in Trentino 13,450 Germans and 360,847 Italians and Ladins. In Alto Adige there were 215,796 Germans and 22,500 Italians and Ladins. There can be no question that the arrangement made in 1866 was intended to give Austria a strategic advantage against Italy. The Trentino projects into Italy, and threatened the plains of Lombardy and Venetia.

Treaty of London and the Peace Settlement.—The first Italian demand was made, when Italy was still neutral, in Jan. 1915. Italy formulated her demands on April 8 1915. The line which she desired ran from Monte Cevedale to the northeast, including Bozen (Bolzano), and then followed an irregular line to Cortina

d'Ampezzo. The Austrians replied by offering the Trentino but excluding Bozen and the Alto Adige. These terms were declined by Italy, which signed the secret Treaty of London with the Entente on April 26 1915, and broke with Austria openly on May 3. By the Treaty of London Italy was promised much more than she had previously claimed. She demanded, and France, Great Britain and Russia consented, that she should receive an area of an average depth of 30 km. to the north up to the Brenner Pass. It included many areas and districts inhabited by a purely German race, and 229,261 Germans in all. Italy claimed this region on purely strategic grounds. At the Peace Conference Austria stood out strictly for the ethnical line, which would have given Italy all the Trentino and a part of the Alto Adige. The principal allied Powers replied that they saw no reason for altering the proposed frontier, adding:—

It results from the very clear declaration made by the president of the council of the Italian Ministers (Signor Tittoni) to the Parliament at Rome that the Italian Govt. proposes to adopt a broadly liberal policy towards its new subjects of German race in what concerns their language, culture and economic interests.

This was on Sept. 2 1919. France and Great Britain were bound by the Treaty of London, but President Wilson was not. He seems to have been unaware of the ethnical facts at the time, and is known to have greatly regretted his decision subsequently. So early as Nov. 12 1919 he took an opportunity of pointing out to Italy that he had, out of his "sincere sympathy for Italy," permitted her to annex in the Tirol "a considerable region populated by alien inhabitants."

Minorities.—The question of the protection of the racial culture of Germans in what is now Italian territory is difficult. During 1919 Tittoni gave repeated pledges in public on the subject, and Italy's Allies had publicly affirmed their belief in her sincerity. There was therefore a strong moral pledge given by Italy, and an equally strong moral obligation on her Allies to exhort her to keep it. But it cannot be contended that any question of legal obligation was involved. Had that been so, Italy would have been compelled to sign a minority treaty.

Italian rule began by being liberal, but soon became oppressive. A small but singularly illuminating incident is that of the confiscation without compensation of the entire property of the Austrian Alpine clubs in the new Italian territory. The protests of the Tiroleans were vehement, and not always discreet, but the severity of Italian rule increased as Mussolini developed his power. A violent interchange of speeches took place between the Austrian Govt., Herr Stresemann speaking for Germany, and Mussolini in Feb. 1926. It is not clear that Stresemann's intervention was in order, as Austria is forbidden to unite with Germany by Art. 80 in the Treaty of Versailles (*cf.* Article 88 of Treaty of St. Germain). Mussolini replied with warmth, and perhaps without adequate respect for the pledges of Tittoni. It would have been open to Great Britain or France to bring the matter up in the Assembly or the Council of the League, under Article 11 of the Covenant.

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TIRPITZ, ALFRED VON[1] (1849–), German admiral, was born on March 19 1849 at Küstrin, the son of a high Prussian magistrate, and the descendant of a noble family impoverished by the Thirty Years War. His great grandmother came of a French refugée family named de Sainson. As a boy he was quick, daring and enterprising. He was very capable, but did badly at school. In later years he filled the gaps in his education by industrious private study in languages, history and economics, and by keen observation during his foreign travels. He was an admirer of Treitschke. In 1865 he entered the Prussian navy, the training for which followed the British model. In 1869 he became an officer, in 1888 postcaptain; in 1895 rear-admiral; in 1899 vice-admiral; in 1903 admiral; in 1911 Admiral of the Fleet. In 1897 he became secretary of state for naval affairs, and then, to his regret, had no further chance of practical service at sea. On March 15 1916, for political reasons, he resigned all his offices.

This article like Admiral Scheer's (Vol II. p. 218) is published as written by Admiral Hollweg in accordance with the principle laid down in the footnote thereto.

Whilst still a young officer his talents were recognised and suitably employed by the leaders of the German Fleet, General von Stosch and General von Caprivi, and he received exceptional promotion. From his 29th year he was employed only in important positions of organisation or leadership. General von Stosch taught him the need of increasing over-populated Germany's economic and industrial activity, the importance of trade and colonies, the necessity of protecting these interests and making the shipbuilding industry quite independent of foreign help. General von Caprivi initiated him into the system of the duties of the general staff. His creative talents were first utilised when torpedoes developed into an arm suitable for war, in building torpedo boats and in working out a tactical system for their mass employment. His work during this period proved of great value to him later when constructing a fleet of great battleships. Here, and in constructing the fleet, he accomplished model work with a minimum of expense. After practical service at sea as captain, he became chief of staff of the Supreme Naval Command in 1892, and began the preliminary work for his plan of fleet construction by profound studies in the history and practice of naval warfare.

The idea of the offensive use of arms was the guiding note of all Tirpitz's work. His memoranda, designed to educate the naval officers in modern ideas of their profession, fell into British hands and in this way influenced British tactical ideas also. He combined practical operations with model squadrons of useless ships with the elaboration of his tactical ideas. Simultaneously with this went on the transformation of the modern ship of war, with its technical complications, into an apparatus which worked with mechanical perfection. He encouraged the education of crews to independent action in all emergencies. His tactical memorandum, No. 9 (printed in *Nauticus, Jahrbuch für Deutschlands Seeinteressen*, 1926), which sums up everything of basic value in the art of naval warfare, afterwards served him to convince the reluctant Reichstag of the necessity of forming a German fleet according to quite definite laws. Tirpitz himself considered his tactical abilities to be his greatest gift and often regretted that he afterwards no longer exercised decisive influence on the further development of sea tactics. As a statesman, Tirpitz pursued the political aim of securing the growing marine interests of the German people, which had become a great exporting and importing industrial state. For this reason he felt the building of a fleet to be a necessity and no luxury, since it made Germany a more acceptable ally and helped to create a sort of balance of power at sea.

The overwhelming power of Great Britain, the dependence on her and other superior naval powers into which Germany had fallen and which no longer corresponded with her greatness and her vital necessities, the aversion of the Germans from the sea, made a deep impression on him even as a youth, and particularly on his last foreign journey as Admiral of the cruiser squadron, 1895–7. As early as 1871, he spoke of the necessity of a German fleet in a letter to his father. He considered that it was an economic and also a social necessity that the working German people should gain greater independence from all political eventualities. He further saw in Germany the power of the future on which the smaller European powers might lean at sea. In view of the formation of great self-sufficient economic units in the world, he probably considered his ideas to be a consistent continuation of Bismarck's train of thought, and perhaps thought of a kind of economic Pan-Europa under a wise German leadership.

Tirpitz vigorously opposed the suggestion that Germany might annex Holland, one reason being that he was always anxious to spare the small Nordic states. He would also have been prepared to make the Danes concessions in Schleswig in order to win their friendship, and was anxious for Italy to have a considerable fleet. Tirpitz never asked for war and always believed that a war could only interrupt Germany's rise; but was in favour of a German rapprochement with Russia as Bismarck wished it, and of a German-Russian-Japanese understanding. He disapproved also of the German Baghdad policy because it infringed simultaneously on the Russian and British spheres of influence. He was against irritating America in any way and disapproved both of the German intervention in Manila and of the British German blockade of Venezuela. Moreover he saw clearly that in forming Germany into a sea power he would have to reckon with the opposition of Great Britain. He believed firmly, however, that it must be possible, if Germany proceeded with caution, to pass through the danger zone of the time of fleet construction without war, and that, finally, an honest understanding between Germany and Great Britain could only be advanced if Germany was a real power on sea as on land. Summing up British psychology and British love for everything straight and strong, he reckoned that Germanic England, whose statesmanship and power at sea he rated very highly, would in the end prefer a rapprochement with a strong Germany to any other political combination. It was only unwillingly and with hesitation that he adopted " the idea of risk " aimed at Great Britain in his naval estimate of 1900.

Even after the World War, and even when he had learnt the details of the British policy of encirclement, Tirpitz did not change his opinion that, taking all in all, the rapprochement between Germany and Britain was advanced rather than hindered by the construction of the fleet, and that only the outbreak of the War, which was most unwelcome to him, had prevented the last maturing of his political aims. His naval programme always aimed at leaving Britain a sufficient superiority. He considered that the formula of the respective strengths of three to two suggested by Lloyd George, which Churchill later, although with reservations, altered to 16 to 10 or eight squadrons to five, gave Britain sufficient protection against any aggressive intentions on the part of Germany.

When organising the construction of the German fleet, Tirpitz went through the work very carefully and systematically, as his nature was. Each step was thought out to its last consequences. He refused flatly to construct the greater cruiser fleet which the Emperor was anxious to have when he was appointed Secretary of State, in view of the experience of the past with cruiser warfare and the lack of all foreign bases for Germany. His aim was and remained the formation of a battle fleet. In view of early experience with naval construction programmes in the Reichstag, his naval estimates carefully avoided votes for new constructions of ships which depended on the momentary humour of the deputies. He aimed at securing legal authority for the number of ships of the fleet to be built, for their regular replacement and maintenance. Inevitably a certain stiffness thus came into the naval programme, which was at times a little inconvenient during the critical years.

Tirpitz was always haunted by the fear that his successor would abandon important principles of his programme. He was convinced that the diplomats did not understand the real idea of his programme in the least. The squadron of eight ships as a tactical unit was the base of his naval programme. The first law of 1898 approved a double squadron of ships of the line with the necessary cruisers. The law of 1900 doubled the battle fleet. Supplementary laws of 1904, 1906 and 1908 reduced the maximum age of ships and thereby altered the plan of new construction. The foreign cruiser fleet and the torpedo-boat forces were increased, and account was taken of the British dreadnought programme. The Kiel Canal was widened to take battleships. The supplementary bill which Tirpitz introduced after Agadir in 1912 only increased the number of ships to be constructed by a little, but increased the strength of the active fleet. The supplementary law of 1912 was to be the last bill of the naval programme. The fleet of 1920 was to consist of one flag ship of the fleet, five squadrons of battleships of eight ships each, 12 cruisers for home service, eight large cruisers for foreign service and 40 small cruisers, including 10 for foreign service. Three squadrons of ships of the line with the necessary cruisers were to be always ready as a battle fleet. His construction programme was reduced after the negotiations with Haldane in 1912, and only provided for three new ships to be distributed over several years. Taking 61 great battleships and a life of 20 years, three large ships would be launched regularly every year on this plan.

If Britain had really recognised German sea power, Tirpitz would probably have agreed to some arrangement on the lines of the later Washington agreement of 1922, dealing with the proportionate strength of the two Powers. Tirpitz only became deeply interested in the construction of submarines after the Diesel engines were perfected for service in 1908. The ultimate strength of submarines was then fixed at 72. There was never any idea of mercantile submarine warfare. Tirpitz considered the battle fleet to be the best protection for the extensive German coast line, and spent little money on its fortification. He only modernised Heligoland, and expanded it into a fortified harbour. Parallel with the construction of the fleet, the State wharves were systematically expanded and grew to be industrial implements of the first order.

Tirpitz's relations with the Emperor were peculiar. The Emperor could not do without him to organise the expansion of the fleet, although not really liking his rather stiff but always consistent and never obsequious manner. Tirpitz complied with the particular wishes of the Emperor whenever possible but energetically opposed fantastic plans of naval construction. He often was hampered by William II.'s political ways, and whenever possible put on the brake. But so long as he controlled the construction of the fleet he held firmly to his real aim, in spite of varying political currents. Tirpitz was a convinced Monarchist and remained so after the War. Tsingtao, whose acquisition he had proposed, and whose expansion he wished to control himself, was developed by him into a model colony on the most modern lines. He always considered this lease in China as a bond between German and Chinese culture, never as a base to exploit the Chinese economically.

Up to the outbreak of the World War, Tirpitz enjoyed a steadily increasing popularity in Parliament and with the people. The feelings of German nationality and unity and manly pride in German strength and deeds were encouraged by him. The circle of his real co-workers and colleagues was, however, always small. The number of those who were united to him in personal friendship was even smaller. He was a good judge of men and exploited the special talents of his subordinates ruthlessly. He himself always retained his wide general view and never lost himself in details. In the Corps of Naval Officers his aims were not always fully understood. He probably never revealed his ultimate aims to any of his friends, and, like all great men, was often compelled to stand alone. He was careful to keep up relations with members of Parliament and cultured men, and did much for the journalistic profession. He recognised very early that a good idea needs publicity to be politically effectual. Before the War he exercised but little influence on the activities of the Admiralty staff. Yet he always kept under his own control, in spite of all opposition, the construction of the ships which proved their worth so well in the War. The orders to the fleet and army at the outbreak of War were not known to him. Before the War he purposely paid little attention to the mobilisation plans of the fleet, because he was against war on principle.

In politics Tirpitz seldom played an active part. He knew nothing of the British offer of an alliance at the close of the 19th century. Other details of foreign policy were also concealed from him; and although he offered his advice to the Chancellor von Bethmann Hollweg he was not consulted when important political measures were taken; for example, when the cruiser was sent to Agadir in 1911. At the end of 1911, he could have become Chancellor of the Reich, but he never desired this office. During the critical time of Lord Haldane's visit in 1912, Tirpitz stated that he would have given up his supplementary naval estimate completely for a real neutrality agreement with Britain. He did not entirely approve of the measures taken by the German Govt. after the murder in Sarajevo (1914) and was for avoiding the threatened war at all costs. Tirpitz did not share the opinion that Britain would stand out of the war, and foresaw that the sympathies of America would be on the side of Britain. He was in favour of a short war, and for putting the German Fleet to a decisive battle. He believed that the intervention of America would in any case prevent a complete victory, but thought that if Germany exercised all her forces, the German Reich could remain a really great power, and at the worst acknowledge defeat whilst her forces were still unexhausted. He was also against any form of annexation but was only anxious lest the Belgian coast should pass into the possession of Britain. In general, he saw the War as the last struggle of freedom against the world capitalism of the Anglo-Saxons.

The part assigned to Tirpitz in the War was unworthy of his abilities. At the beginning he offered to take over the entire control of the navy, including the military control, but this was refused. His position at general headquarters was unsatisfactory; his advice was hardly listened to by the politicians and hardly ever taken. The naval battle for which he wished was not fought. He early recognised the importance of the new U-boats for the issue of the War, but was against employing U-boats too early in the commercial war, and named the spring of 1916 as the right moment. He disapproved of the attitude of the German Govt. during the exchange of Notes with America on the occasion of the sinking of the "Lusitania" and the "Sussex," regarding it as weak. Tirpitz was not implicated in the declaration of U-boat warfare in 1917, and later stated that had he guessed Russia's coming collapse and known of President Wilson's efforts for peace, he would probably have used his influence against U-boat warfare in 1917.

After leaving his post in 1916, Tirpitz entered politics and helped to found the *Vaterlandspartei*, which propagated the will to endure; and after the War had ruined his life's work, he entered the Reichstag in 1921 as German National Deputy. He generally remained in the background in plenary sittings, but owing to his great experience he played an influential part behind the scenes. He spoke in favour of the Dawes Plan and against the Pact of Locarno. In small circles, at official sittings or in the budget commission of the Reichstag, he spoke in a masterly and convincing fashion. In the plenary sittings, he sometimes kept too closely to his preconceived ideas, but created a deep effect by the substance of his speeches.

Tirpitz was not a courtier and found recreation in Saint Blasien in the Black Forest, where he possessed a country house. Four children, two sons and two daughters, were the fruit of his very happy and harmonious marriage with Marie Lipke, who was also his confidante and assistant in his work. His eldest son, a naval officer on the Cruiser "Mainz" was taken prisoner by the British on Aug. 28 1914.

After the War, Tirpitz wrote his recollections, *Erinnerungen* (1918), and was thus one of the first to bring out his memoirs. Both the form and contents of this book make it a very important contribution to contemporary history, although naturally its account is given from the point of view of the author. In order to prevent erroneous conclusions from being drawn from the official German publications and documents which were edited by Tirpitz's political opponents, he issued a second book in the autumn of 1924 *Politische Dokumente; Der Aufbau der Deutschen Weltmacht.* The book is also a contribution from the German point of view to the question of responsibility for the War. It intentionally gives the political opponents of the German naval policy space to state their case at length. The book, in which the author clings stoutly to the correctness of his political ideas, ends with the conclusion that the German people has not shown itself suitable or ripe to rise to be a world power.

See article in Nov. 1925 issue of *Sud-deutsche Monatshefte* on attempts at a naval agreement with Great Britain, and Ulrich von Hassel *Admiral von Tirpitz.*

(C. Ho.)

TISSUE CULTURE.—The object of tissue culture is the study of the physiology of higher organisms. Within the body of a living animal the relations between tissues and humours cannot be investigated easily because they are too complex. But when tissue cells living in media of known composition are kept under observation like bacteria in pure culture, their fundamental characteristics become apparent. The reciprocal influence of the tissues and of the pericellular fluid can be studied and often expressed quantitatively. In this manner, a new cytological science is being progressively built up.

The method is founded on the possibility of maintaining tissue cells in a condition of active and permanent life outside of the organism. When cells are cultivated, in the proper sense of the word, they multiply, as do bacteria, and synthetise new protoplasm from the constituents of their medium. This condition differs widely from that of survival, where the cells may live and multiply for some time without using the substances contained in the medium. The development of the method has consisted chiefly in the invention of procedures by which pure strains of cells could be isolated and kept in a state of true cultivation indefinitely.

Early Work.—The method of cultivating tissues outside of the organism may be considered as the logical development of the investigations of many scientists, such as Cohnheim, Jolly, Leo Loeb and others who have studied with various techniques cells surviving within or without the organism. But it was directly inspired by the beautiful experiments of Harrison, who in 1907 observed the growth of nerve fibres of the frog embryo in a drop of lymph. In 1910 and 1911, other experimenters replaced the lymph with blood plasma, and fragments of adult and embryonic tissues and of tumours of birds and mammals were observed to survive *in vitro* for a few days. At this time it was thought that the cells multiplying in plasma were in a true condition of cultivation. But Lewis found that embryonic cells proliferate as well in saline solution as in plasma. Even in plasma, the mass of the tissues does not increase. By this early technique the tissues were kept in a condition of survival but not of cultivation. It became obvious that no problem of cell physiology could be studied on fresh tissues surviving for a few days in a drop of plasma and subjected to complex influences, such as those of living and dead cells of their own and other types, and of a medium that deteriorated spontaneously within a short time. In 1912, Carrel developed a technique for maintaining a pure strain of fibroblasts in a true state of cultivation. The cells not only survived but synthetised new protoplasm from the constituents of the medium, and the mass of the tissues increased in an unlimited manner. Later, strains of macrophages (1922), of cartilage (1922), of pavement epithelium (1922) and of thyroid (1924) were isolated and kept in pure cultures.

Techniques.—The techniques by which a strain of cells can be maintained in a state of true cultivation are far more delicate and difficult than the early procedures, and a thorough apprenticeship is necessary to apply them successfully. The tissues are generally embedded in a coagulum of plasma diluted with tyrode solution and embryonic tissue juice. Proliferation of embryonic tissues takes place as readily in saline solution as in blood serum or plasma. But epithelium and connective tissue do not manufacture new protoplasm when they are cultivated in plasma alone, and, although the cells multiply, the mass of the colonies does not increase. The dividing cells appear to use the substances set free by other cells. When embryonic juice is added to the medium, the building up of protoplasm from the constituents of the nutrient fluid begins immediately. As long as the cells are supplied with embryonic juice, under proper conditions, they synthetise protoplasm. Monocytes behave differently. Cultivated in embryonic tissue juices, they die in a short time. On the contrary, if the medium is composed of diluted serum, they remain alive and spread over large areas. They build up protoplasm from some constituents of serum, while neither fibroblasts nor epithelial cells possess this property. Serum not only fails to supply fibroblasts and epithelial cells with the substances necessary for multiplication, but it inhibits their proliferation and shortens their life *in vitro*. As a rule, the restraining action of serum becomes more pronounced after it has been shaken or heated. The agents that inactivate serum also render it more inhibiting for homologous fibroblasts.

It appears that serum contains certain growth-promoting substances, which are destroyed by shaking and heating, and oppose the inhibiting effect on fibroblasts of other substances that resist heat and shaking. There are in serum two antagonistic groups of substances, the growth-promoting ones always being weaker in their action than the growth-inhibiting. The growth-inhibition of serum is partly due to the presence of certain lipoids. The nature of the nitrogenous compounds present in embryonic juice and used by epithelial and connective tissue cells in the building up of protoplasm is still unknown. But some of their properties have been studied. Embryonic tissue juice loses its growth-promoting effect after it has been shaken for several hours, or heated at a temperature of 65° C. for a few minutes. The substances that promote cell multiplication are very sensitive to heat. They are partly destroyed at 56° C. in 30 min., and when left in an incubator at 38° C. for 48 hr. their action is greatly weakened. They are also sensitive to the action of radium and X-rays. These substances, used as food material by other cells, are called trephones, from *τρέφω, I feed*. They are present in abundance in embryonic tissue, in certain glands of the adult animal and in leucocytes.

Use of Plasma.—The plasma is obtained easily from the blood of adult animals such as rabbits, dogs, guinea pigs and chickens, and can be maintained in a fluid condition for a sufficient length of time. After it has been placed in the culture flasks together with the tissues, coagulation is brought about by adding some embryonic juice. The principal constituents of the culture media most generally used are plasma, serum, tyrode solution and embryonic tissue juice, at an hydrogen concentration varying from pH 7·4 to 7·8.

In a fluid containing all the substances necessary for cell multiplication, no growth occurs if the cells do not find the proper support on which to creep. A plasma coagulum, or the surface of a slide covered by a drop of lymph, serum or saline solution, may supply cells with the conditions required for their migration. The finest details of cells spreading on a cover-glass in a saline solution may be observed without difficulty, and this technique is excellent for certain cytological studies. But tissues grow incomparably better and more regularly in a plasma coagulum than in any other medium. Besides, the transfer of the tissues from medium to medium is possible without disturbing the cells embedded in and protected by the fibrin. The cultures are prepared in such a manner that a continuous growth of the tissues becomes possible. The waste products must not be allowed to accumulate in the medium, and the nutrient substances that are unstable and easily destroyed at body temperature must be regularly supplied to the cultures. Two procedures are generally used in order to keep the tissues indefinitely in a condition of constant activity.

The first technique consists in removing the tissue fragment frequently from its medium, washing it in Tyrode solution and transferring it to a fresh medium. The transfer of the tissue takes place every two days. As the nutrient substances contained in the medium do not undergo complete disintegration in 48 hr., and as the accumulation of waste products has but a very slight action on the growth of the tissues during that period of time, the cultures, when transferred from medium to medium, live under practically unchanged conditions.

A second technique has been developed by which the culture medium may be renewed frequently without mechanical disturbance of the tissues or danger of bacterial contamination. Special containers have been made consisting of flat, round flasks with oblique necks. They belong to different types, some being used for measuring the rate of growth of tissues, and the others when cytological examinations are required. The size of the flasks varies from five to eight cm. in diameter, which makes possible the use of large amounts of tissues and medium. By means of special instruments the tissues may be handled conveniently inside the flasks. The principle of the method is to use a medium composed of two parts, one solid and the other fluid, the latter being renewed as often as necessary. The solid medium is composed of coagulated plasma in which the tissues are embedded and which covers the bottom of the flask in a thin layer. The fluid medium, which bathes the solid medium continuously or not as desired, is composed of tyrode solution in which are dissolved the substances to be investigated as to their action on the tissues. The fluid medium diffuses its nutrient principles in the coagulum and also receives the catabolic products of the

tissues. As it may be changed frequently, the tissues grow on the bottom of the flask without being disturbed, in a medium that varies but little in composition. With this technique, epithelial cells, fibroblasts, leucocytes and tumour cells may be observed in a condition of uninterrupted growth for long periods of time.

Rate of Growth.—The measurement of the rate of growth is made in the following manner. The slides are placed in a projectoscope, and the outlines of the tissues are drawn immediately after the preparation of the cultures, and after 48 hours' incubation. The areas of the original fragment and of the new growth are measured with a planimeter, and the ratio of the area of the new growth to that of the original fragment is calculated. This relative increase of pure cultures of fibroblasts or epithelium in 48 hr. expresses the rate of growth. The rate of growth, the increase in mass of the tissues in a number of passages and the duration of life of the cultures indicate whether the medium is nutrient, non-nutrient or growth-stimulating without being nutrient. When the tissues are cultivated in large flasks, the increase is measured in the same way and, as the growth is uninterrupted, it may be expressed graphically in a simple manner. The curve expressing the rate of growth of fibroblasts and epithelial cells in a nutrient medium is a parabola. If the medium is non-nutrient, the curve is S-shaped. Modifications in the form of this curve indicate whether the medium contains substances that activate or depress the rate of cell multiplication.

The inherent growth energy of a tissue at a given instant is a function of several independent variables: its growth energy at the preceding instant, and the concentration in the pericellular fluid of the substances that increase or decrease cell activity. It could be ascertained by the activity displayed during an instant by the cells in a medium containing neither activating nor retarding substances, if such a measurement were possible. But the residual energy, which was found to vary at the same time as the inherent energy, may be used as a measurement of the latter. The residual energy is expressed by the duration of life and the proliferative activity of the cells in tyrode solution.

When a sufficient amount of tissue is placed in a flask, it becomes possible to detect the presence of the secretions in the fluid medium. The growth-promoting effect of substances set free by the leucocytes was found in this manner.

The morphology of the tissue cells growing *in vitro* is studied while they are still living. Fragments of the coagulum containing cells are removed from the flasks and placed on ordinary slides. The living unstained cells may be photographed or cinematographed. The use of neutral red, trypan blue, and janus green allows the study of the cytoplasm while the cells are active. The tissues may also be fixed and stained by the ordinary methods.

Isolation of Pure Strains.—The isolation and maintenance of pure strains of various types of tissues was an indispensable step in the adaptation of the method of tissue culture to physiological research. The first pure culture of fibroblasts originated over 14 years ago from a fragment of the heart of a chick embryo, and was cultivated in embryonic tissue juice, which was discovered at about the same time to have the property of giving to fibroblasts an unlimited proliferating capacity. Pure strains of fibroblasts can be obtained readily from practically every tissue of fowls, dogs, etc., as connective tissue cells multiply more rapidly than the other cells, which spontaneously disappear within a few weeks. The fibroblasts grow as a dense tissue, which doubles its volume in about 48 hours. The cells are polygonal or spindle-shaped, with long, sharp processes, and with an oval nucleus containing generally two nucleoli. The pure strains of fibroblasts are used especially as a physiological reagent for detecting in serum and other fluids the presence of substances promoting or inhibiting cell multiplication.

Strains of large mononuclears are obtained from cultures of white blood corpuscles. The polymorphonuclear leucocytes, endowed with greater activity, occupy the peripheral area of the culture. The inner zone is covered chiefly with lymphocytes and monocytes. After a few days, the polymorphonuclear leucocytes progressively disappear. They are generally taken up by the lymphocytes and digested. Finally, the mononuclear cells alone remain, multiply in the medium, and wander through it isolated or in columns, but never aggregate in a tissue. When they accumulate in large numbers, or are packed together by contraction of the medium, they generally die or become transformed into fibroblasts.

Strains of epithelium may be isolated from the iris, the thyroid, the skin and probably from several other tissues. When multiplying on the surface of a plasma clot in a thin layer of embryonic juice, the pavement epithelium derived from the iris assumes the appearance of a continuous membrane. Its rate of growth is slower than that of fibroblasts, and the cultures double in size in about three days. The cells do not dedifferentiate. They grow as a thin mosaic at the surface of the medium and manufacture a large amount of black pigment, similar to that of the cells of the iris. They multiply for many months outside of the organism. Strains of epithelial cells are easily obtained from the thyroid glands of a chick embryo. The cells from a four- or five-month-old strain grow equally well at the surface of the medium or in its depth. They readily digest the fibrin of the coagulum, but multiply at a more rapid rate and are more resistant than pavement epithelium. Sometimes they form acini (grape like clusters) with colloidal material in the centre.

Generally they are more or less irregularly spread in the coagulum, and drops of colloid substances with their characteristic appearance may be seen within the cells or near them in the medium. When pure cultures of fibroblasts are added to thyroid tissue, the fibroblasts soon surround the thyroid epithelium, which organises in a small gland showing acini filled with colloid substance. The inclusion of a fragment of thyroid strain in a pure culture of fibroblasts accelerates the proliferation of the fibroblasts during a number of passages. Pure cultures of fibroblasts and of malignant macrophages are easily isolated from Rous sarcoma. Cartilage cells may be obtained from the pars cartilago sclerae of the eye of chick embryos and cultivated for a long time. The hyaline substance disappears and the small lymphocyte-like cells become transformed into large spindle-shaped cells, which form thin membranes. The rate of growth is slower than that of fibroblasts and epithelium. It is probable that the cells of many other tissues will be obtained in pure cultures.

The method of tissue culture is still in its infancy. But its rapid development and the results already obtained show that it will have an important bearing upon our knowledge of fundamental problems in physiology and pathology.

See A. Fischer, *Tissue Culture* (Copenhagen, 1925); R. Erdmann, *Pratikum der Gewebepflege oder Explantation besonders der Gewebezuchtung* (Berlin, 1922). (A. Ca.*)

TISZA, STEPHEN, Count (1860–1918), Hungarian statesman (*see* 26.1017).—Tisza only returned to politics after Count Khuen-Hédervary became Prime Minister (Jan. 1910). In the Hungarian Parliament the coalition was still predominant, but it was splitting up and had no hold in the country. Tisza now reorganised the old Liberal party under the name of the National Party of Work with a programme of a return to the strict principles of the compromise of 1867 elaborated by Deak. In the elections of June 1910 this party secured an overwhelming majority, due not so much to traditional governmental oppression and corruption as to Tisza's personal suggestion and unceasing activity. But as the obstruction of the extreme Left against the army legislation could not be stopped by the standing orders of the House, Tisza, considering that the threat of complications in the Balkans made it essential not to weaken the Austro-Hungarian army, took an energetic step. He had himself elected President of the Lower House in 1912, introduced new standing orders, and forced the Army Bill through, ejecting the opposition from the House. A member fired three times at Tisza, who remained calm in his chair. This scene made him very popular. He had to fight some duels with his adversaries, including one with Count Michael Karolyi, which left the two adversaries bitter enemies.

On June 15 1913 Tisza was for the second time nominated Prime Minister. This office gave him the right to control, together with the Austrian Premier, the activity of the common Minister

of Foreign Affairs. In his first memorandum, written after the second Balkan War, he deplores the growth of Serbia and the collapse of Bulgaria, Turkey and later Greece. He further states that Rumania, where public opinion was growing hostile to the dual monarchy, should be assured its territorial integrity, but if it abandoned its alliance, Bulgaria should be brought to bear against it. War should be avoided. In home politics, Tisza was willing to favour such of the non-Hungarian nationalities as would support the State. He attempted to reach an understanding with the leaders of the Transylvanian Rumanians, but without success.

After the murder of the heir to the throne at Sarajevo (June 28 1914) Berchtold proposed a sudden attack on Serbia. Tisza opposed this project in a letter to Francis Joseph (July 1). A week later he again urged his view that diplomatic steps were necessary and a severe ultimatum should be sent, but its conditions should not be impossible to comply with. To avoid the intervention of the Entente, Tisza carried in the Council of Ministers (July 19) that the integrity of Serbia's territory should be respected even if war was to be declared. Though the war against Serbia was declared, he exerted himself for peace by accepting Sir Edward Grey's last proposition (July 31). The Russian general mobilisation marred his endeavours. From that moment he devoted all his energy to the service of his country. He was anxious to miss no opportunity of concluding peace. He was opposed to all German aspirations of territorial aggrandisement and to the introduction of unlimited submarine warfare. When Italy was about to enter the War he offered the chiefs of the opposition seats in the Cabinet to establish a Government of concentration, but met with a refusal.

Apart from foreign politics he had difficulty with the Supreme Command over the extension of its powers to civil affairs; he exerted his influence against military excesses, committed against Hungarian Serbs, and was in frequent conflict with the Austrian Government. He was a true partisan of German Alliance, but he admitted no interference with Hungary's sovereign rights and was strongly opposed to the German idea of an economic "Mittel Europa."

Of truly historic interest was the controversy between him and Conrad von Hötzendorf. In 1915 the armies of the Central Powers were in a very favourable situation. The offensives of their enemies in Italy, Russia and round Arras had been checked; their armies occupied all Poland and Serbia. Conrad declared that Austria's war aims must be the annexation of Poland as far as the Bug, Serbia, Albania and part of Italy. Tisza protested (Dec. 30) against any annexation, on the grounds that the monarchy already possessed too many centrifugal tendencies; he also stated that Belgium should be restored and Serbia be granted lenient peace terms. The monarch adhered to Tisza's opinion. The background of this conflict is still more interesting. Conrad and the greater part of his staff were partisans of Archduke Francis Ferdinand's Magyarophobe policy. They wanted to replace the dualist system, under which Hungary was one of two equal partners in the monarchy, by a federal system dividing the monarchy into five parts under a central Government in Vienna. It was the last struggle between old Austrian tradition, inherited from the Holy Roman Empire and the national kingdom of Hungary.

As long as Francis Joseph lived Tisza's prestige remained unbroken. King Charles, however, was under the influence of Tisza's Austrian and Hungarian enemies. Their rancour was fostered by the participation of Tisza, a Calvinist, with the Primate of Hungary in the act of coronation. The pretext for Tisza's dismissal in June 1917 was his refusal to grant the suffrage to soldiers at the front and his opposition to the demand of the Socialists.

The new Cabinet had but a minority in Parliament. Tisza, now chief of the opposition and in the majority, framed a resolution in which he affirmed the necessity of the German Alliance and pointed out the ambiguous behaviour of the Czechs in the Reichsrath. Finding his position difficult, he went to the front. In the Bukovina and in Italy he commanded a regiment with distinction. Though suffering from dyspepsia, he contented himself with the privates' food; though one-eyed, he was always on the watch. During this time his only political action was his mission to Croatia and Bosnia (Sept. 1918). Returning to Budapest, he declared (Oct. 17) "We have lost the War," and thus gave the signal for the collapse. He wanted a peace with honour, not a treacherous one. His last two weeks he spent in attempting to unite the different parties; he was even ready to accept Karolyi's leadership in order to save the country and to procure a good peace. Too proud and too conscientious to allow the publication of his pacific endeavours, he was set as a mark for the defeatist soldiers and the mob. Though warned of his grave danger, he remained in Budapest, working until his last moment to unite the historical parties. He was killed by soldiers on Oct. 31 1918, the first day of Count Karolyi's revolution, probably by order of the soldiers' council. His last words were, "It had to be."

Tisza evolved slowly. A party man in his first administration and in his struggle against obstruction, only the immense work and the responsibility put on him by the World War made him a statesman. He had much in common with Bismarck, unlike whom, however, he was a true Liberal, but he did not realise the rapid increase of social democracy due to war industry. Even in politics his tragedy was to be more of a knight than of a diplomatist. Full of animal spirits, he could not always master his temperament. But he was, and, as his memory lives, he is, the finest representative of the old Magyar spirit. See Istvan Tisza, *Ossres Munke*, 2 vol., 1925 (Personal Recollections, letters June to end of Dec. 1914, pub. by the Hungarian Academy). (H. Ma.)

TITANIC, LOSS OF THE.—At 2:20 A.M. on April 15 1912, the White Star liner "Titanic," at that time the largest ship afloat, on her maiden voyage, went to the bottom of the Atlantic in lat. 41° 46′ N., long. 50° 14′ W., about 2¾ h. after striking at full speed on an iceberg, with a loss of 1,513 souls out of 2,224 on board.[1] The full record of the disaster is contained in the reports of the inquiries held at once in America by a committee of Congress under Senator Smith, and later in London by a special commission presided over by Lord Mersey (report issued July 30). Painful and difficult though it was to distribute blame in such a case, there could be little doubt that the loss of life—817 passengers out of 1,316, and 696 out of a crew of 908—was much greater than ought to have been possible. Capt. E. J. Smith (b. 1853), a highly experienced seaman, who had been for 38 years in the service of the White Star Co. and who now went down with his ship, seems to have been averse from taking steps at first which might cause a panic on board. A natural expectation of security had been engendered, alike among the owners, officers and passengers of these magnificently appointed liners, which, until a crisis actually came, had made it almost unthinkable that it could come with such suddenness; but the fact remains that responsibility for the lives of passengers rests with those who control the ship.

In this case, it was not the inadequacy of the physical means of escape that accounted for the large proportion of the lost who remained on board; it was the inadequate organisation for purposes of using them and inadequate information as to the necessity. Apart from that, both Great Britain and America could mingle sorrow and pride over many fine incidents of the tragedy. The figures of the 711 saved by the "Carpathia" (including about 60 who were picked up in the boats after the ship went down) speak for themselves: Women: first class, 140 out of 144; second class, 80 out of 93; third class, 76 out of 165; crew, 20 out of 23. Children: first class, 6 out of 6; second class, 24 out of 24; third class, 27 out of 79. Men: first class, 57 out of 175; second class, 14 out of 168; third class, 75 out of 462; crew 192 out of 885. Altogether the percentage of women saved was 74·35, of children 52·29, of men 20·27. The comparatively small proportion of third-class passengers saved was shown to be purely accidental and not due to any preference being deliberately given to others; they were handicapped, however, by their quarters being remote from the boat deck, and by so many of them being unable to speak or understand English.

See British Parliamentary Papers: No. 2253, *Shipping Casualties (Titanic), 1912* (cd. 6352).

[1] The exact figures remained doubtful, but those given are from Lord Mersey's report.

TITTONI, TOMMASO (1855–), Italian politician, was born in Rome and educated at Naples, Oxford and Liége. In 1886 he was elected deputy for Civitavecchia and in 1902 was raised to the Senate. He was Foreign Minister for the second Giolitti Cabinet (1903), and in this capacity he aimed at improving relations with Austria. On the resignation of Giolitti in March 1905, Tittoni became interim premier for a few days and remained in the Fortis Cabinet as Foreign Minister. His proposed reduction of the duty on Spanish wines in connection with an Italo-Spanish commercial treaty aroused much indignation and caused the fall of the Cabinet on Dec. 24 1905. In March 1906 he was appointed ambassador in London, but on the return of Giolitti to power in May, he returned to the *Consulta*, and there continued the policy of improving relations with Austria. In April 1910 he was appointed ambassador in Paris. When the World War broke out, in spite of his Triplicist policy, he openly expressed himself in favour of Italian neutrality. In Nov. 1916 he resigned from the Paris Embassy. In June 1919 Nitti chose Tittoni as Foreign Minister and first delegate at the Peace Conference, but he was forced to resign owing to ill-health in November. He was chosen president of the Senate in Dec. and was later appointed Italian delegate on the Council and Assembly of the League of Nations, but ill-health again forced him to relinquish the latter appointment. On the advent to power of Fascism he supported the new Government, without joining the Fascist party.

TOBACCO (*see* 26.1035).—During the period 1910–25 the world production of tobacco greatly increased. The production for the year 1923 was about 3,977 million lb. as against an annual average of about 3,000 million lb. for the years 1909–13. The following table shows the area under tobacco and the production of the chief producing countries in 1909–13 (annual average), 1914–8 (annual average) and 1924, according to the *International Year Book of Agricultural Statistics:*—

Country	Area (hectares)			Production (quintals)		
	Average 1909–13	Average 1914–8	1924	Average 1909–13	Average 1914–8	1924
Germany	15,709	11,365	[1]6,252	301,805	257,625	[1]142,525
Bulgaria	8,094	24,489	46,955	62,856	167,623	436,975
France	14,873	10,458	12,791	205,354	154,713	244,301
Yugoslavia	2,411	[3]	35,230	16,960	[3]	356,851
Greece	15,466	33,756	60,049	127,103	224,107	494,151
Italy	8,072	6,611	33,800	100,699	86,200	413,250
Hungary	49,047	45,579	15,482	665,091	507,724	172,573
Russia in Europe	55,836	54,432	[3]	930,851	903,433	[3]
United States	495,017	580,487	696,067	4,518,553	5,387,326	5,636,414
British India	423,815	434,896	539,070	[3]	[3]	[3]
Japan	29,301	29,142	37,686	425,095	463,256	562,500
Philippines	62,167	62,673	72,000	294,857	473,315	433,230
Russia in Asia	14,804	20,261	[3]	140,338	174,387	[3]
Algeria	10,170	11,710	20,572	106,237	129,385	300,000
Dutch East Indies	162,135	166,543	167,488	635,666	530,758	[2]448,400
Cuba	[3]	[3]	[3]	334,148	285,807	[1]181,000
Brazil	[3]	[3]	78,774	[3]	450,000	[1]595,504

[1] 1923. [2] From cultivation by Europeans only. [3] Not given.

The Americas.—The United States retained its position during 1910–25 as the chief tobacco producing country in the world. The tobacco industry made considerable progress, and, although the output of cigars varied but little, the output of cigarettes increased tenfold to over 75 billion in 1925. Exports of leaf tobacco increased from 388,284,000 lb. for the annual average of 1910–4 to 546,257,000 lb. in 1924. Tobacco is the second crop in Cuba and its cultivation is rapidly extending. The extra import duties imposed on cigars by the United Kingdom had an adverse effect upon Cuba's export trade to that country and resulted in the United States replacing the United Kingdom as the chief market for Cuban cigars; the total value of tobacco consumed in and exported from Cuba in 1924 was $82,289,686. The cigars of Mexico are second only to those of Cuba, and Mexican tobacco culture is making rapid progress. In Argentina during the post-War period, experiments were made with the cultivation of many varieties of tobacco, and favourable results were obtained. In Santo-Domingo, Porto Rico and the Central American republics the tobacco crop is of considerable importance. Brazil is an important source of world supply, exporting over 70,000,000 lb. annually from 1921 to 1925.

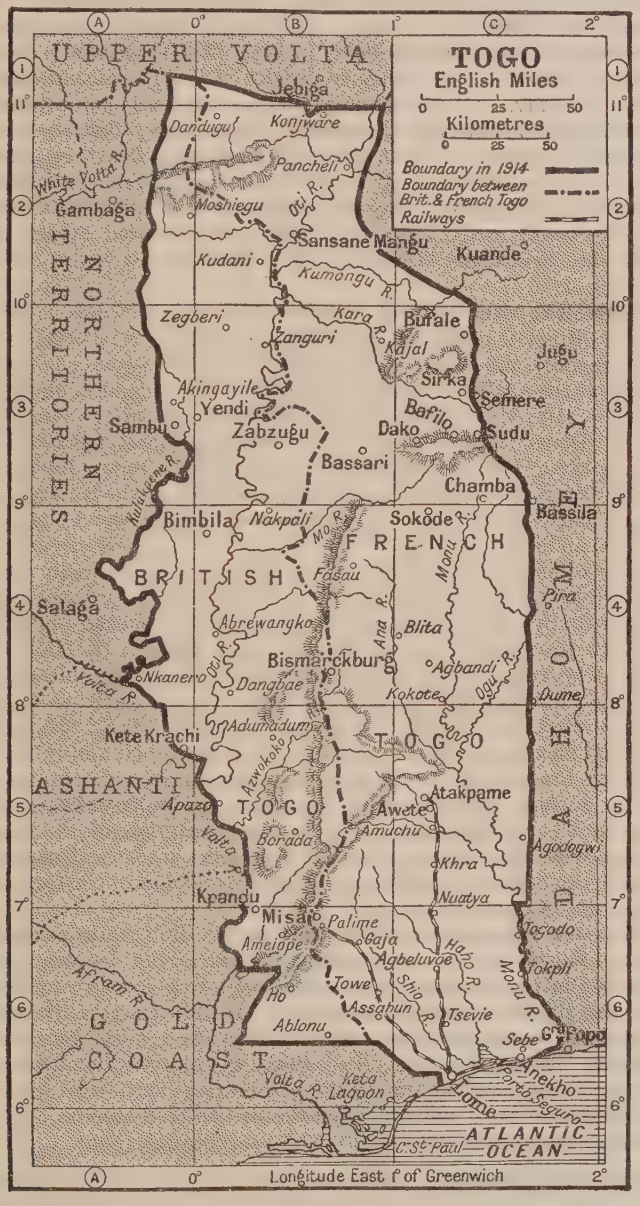
British Empire.—Special attention is being devoted in Canada to the extension of tobacco cultivation. The area under tobacco greatly increased during the post-War period, exports of leaf tobacco, mostly to the United Kingdom, increasing from 200,153 lb. in 1921 to over 3,500,000 lb. in 1925. The West Indies, Nyasaland Protectorate, Rhodesia, Kenya, Uganda, Tanganyika, the Union of South Africa, North Borneo, British India and Palestine are paying particular attention to the development of their export trade, which is greatly helped by its preferential import duties granted to Empire from tobacco by the United Kingdom, which is one of the chief world markets for tobacco. Exports from Nyasaland increased from 14,000 lb. in 1902 to over 7,000,000 lb. in 1924. In Southern Rhodesia, tobacco production is a well-established industry, the average annual crop from 1920 was approximately 3,000,000 lb. Northern Rhodesia produced 813,033 lb. of Virginia and 8,152 lb. of Turkish tobacco in 1922–3. South Africa exports of tobacco increased from an annual average of 175,896 lb. for the period 1910–4 to 2,312,284 lb. in 1923. In India the area under tobacco increased by some 25% between 1910 and 1925. Exports, principally to the United Kingdom, Belgium, Germany and Holland, increased greatly during the post-War period, rising from under 4,500,000 lb. in 1922–3 to over 14,500,000 lb. in 1924–5. Export of cigars from Jamaica in 1924 totalled 88,245 lb. Production in British East Africa and Palestine is of growing importance.

Europe.—Climatic conditions in the south of the Balkans are very favourable to the cultivation of tobacco. Bulgaria became prominent as a tobacco producing country after 1913, when, by the Treaty of Bucharest, she obtained possession of tobacco-producing areas of Xanthe, Kirdjali, etc. Her output rapidly increased and good markets were found during the World War in Central Europe. After the end of the War, in spite of the cession of the Xanthe area to Greece, progress was maintained and production steadily increased. Greek production, stimulated by the great influx of refugees from Asia Minor after 1921, rapidly increased. Hungary was very prominent as a European source of tobacco before and during the War, but the surrender of large areas after the War resulted in a great decrease in her output, and a corresponding increase in the output of Yugoslavia and Rumania, who obtained possession of the surrendered districts.

Considerable progress was made during and after the War in tobacco cultivation in Italy, and her output more than doubled between 1921 and 1924. After 1918 Czechoslovakia joined the list of tobacco-producing countries: considerable assistance was given to the industry by the Ministry of Agriculture and experimental stations were established. The output of both Germany and France fell during the War: in the case of Germany the fall continued after 1918, owing to the loss of Alsace; but France, with the addition of the Alsatian output, soon exceeded her pre-War production. French needs during the War resulted in the increase of cultivation in Algeria, whose output increased threefold between 1910 and 1924. Russian production in 1923 was only some 40% of the pre-War figure.

Other Areas.—The loss of her European territory caused a serious decrease in the Turkish output, but during the post-War period the Anatolian crop increased from an annual average of some 50,000,000 lb. for 1919–22 to over 150,000,000 lb. in 1925: this great increase was partly due to the influx of Turkish refugees from Macedonia, but mainly to more stable political conditions. China, Japan, the Philippines and the Dutch East Indies retained their importance as tobacco producing areas: the Japanese output showed a considerable increase between 1910 and 1924.

TOGO (*see* 26.1046).—This German colony in West Africa was conquered in the first month of the World War (Aug. 1914) by a British force, from the Gold Coast under Capt. (temp. Lieut.-Col.) F. C. Poryant, aided by detachments sent by the French from Dahomey. Before surrendering, the Germans blew up the powerful wireless station at Atakpame, which had been completed a little earlier in the year. Thereafter the western part, including Lome, the chief port, was administered by the British and the eastern part by the French. In May 1919 the Supreme Council gave the mandate for Togo to Great Britain and France. The first division, made in an Anglo-French agreement of July 10 1919, gave dissatisfaction to French colonial circles, as it left Lome to Great Britain, and by a convention of Sept. 30 1920, in exchange for an enlarged British area in the interior, Lome and the whole



seaboard except 32 m. went to France. Both spheres are governed under mandates approved by the Council of the League of Nations on July 20 1922, and, in each, citizens of the United States have obtained the right to equal treatment with nationals of the members of the League.

British Sphere.—The British sphere, which adjoins the Gold Coast, has an area of 13,040 sq. m. and a pop. (1921 census) of 187,959, of these, 9,652 were Christians and 5,678 Moslems; in 1924 the European residents numbered 27. The sphere is divided into two sections, the northern being administered as if it formed part of the Northern Territories of the Gold Coast, the southern as if it formed part of the Gold Coast Colony. Cocoa, cotton, kola nuts and maize are cultivated, and there are large herds of cattle in the north, but the chief exports are palm oil and palm kernels. The division of Togo left the whole railway system in the French sphere and, although a motor ferry over the Volta at Senchi connects the southern British section with the road system of the Gold Coast, the railway from Palime to Lome, which runs close to the border of the British sphere, takes a large part of the trade. For the year ending March 31 1924 exports were valued at £115,000 (cocoa £99,510) and imports at £22,800. For the same period revenue was £20,000 and expenditure £49,000. Deficits are made good by the Gold Coast.

French Sphere.—The French sphere—area 21,893 sq. m.; pop. (1923) 698,340, of whom 210 were whites—adjoins Dahomey, but is administered as a separate entity, the chief official being styled commissioner. He is aided by a council on which non-officials, including one native, have seats. Lome, the capital (pop. 9,400) is the centre for trade. The chief products and exports are the same as in the British sphere. The area under cocoa and cotton is increasing. In 1922 the exports were valued at 17,197,000 francs, the imports at 10,107,000 francs; the budget for 1923 balanced at 8,123,000 francs. Up to 1926 there had been no addition to the railway system left by the Germans in 1914.

See Reports of the French Govt. on Togoland (annual); *Official Reports on the British Sphere in Togoland* (annual, London); *Togoland Handbook* (H. M. Stationery Office, London 1920). *Draft Mandate for Togoland* (cmd. 1350 of 1921). (F. R. C.)

TOKUGAWA, YOSHINOBU, Prince (1837–1913), Japanese statesman, was born Sept. 29 1837 at Tōkyō. He was the last of the Tokugawa Govt. (*see* 26.1047), succeeding Shogun the 14th Shogun, Iemochi, in 1866. Realising after a year's time that the proper government of the country was impossible on the lines of feudalism, which was a bar to all progress and a source of continual internal strife, the Shogun handed his resignation to the emperor on Oct. 14 1867. This act of sacrifice was the prelude to the enlightened Meiji era, which dates from the beginning of 1868. Tokugawa, having renounced his shogunate rights, went into a strict retirement from which he never emerged. He even renounced the succession to his title for his direct heir in favour of a collateral branch of the family, the first to inherit the title being Prince Iyesato Tokugawa, for many years president of the House of Peers. The Emperor Meiji accepted the renunciation, but he conferred on him another title of prince to be bequeathed to his son. He died Nov. 21 1913 at Tōkyō.

TOKUTOMI, IICHIRO (1863–), Japanese journalist and author, was born at Kumamoto in Jan. 1863 and educated at the Doshisha, Kyoto. In 1887 he issued a monthly magazine, *The Friend of the Nation*, and in 1890 started in Tōkyō, the daily *Kokumin Shumbun* (Nation), of which he was proprietor and editor. He also began to issue in the same year *The Far East*, an English monthly. Tokutomi, who was appointed a crown member of the House of Peers in 1911, published many important political and historical works including *The Future Japan* (1886) and *History of Modern Japan*, not yet complete. In 1924 the Imperial Japanese Academy awarded him the Emperor's Medal in recognition of the merit of his works on Japanese history.

TŌKYŌ, Japan (*see* 26.1047), had in 1923 a population of 2,478,233, but in Sept. of that year a disastrous earthquake and a fire which followed reduced the population by death and migration to 1,529,616. From being the fifth largest city in the world, Tōkyō fell to the 10th place. The damage was enormous, though the destruction was not as complete as at Yokohama; the railway station and the Imperial Hotel escaped. An area of nearly 25 sq. m. was burnt, and between 60,000 and 70,000 people killed, many of them in a big clothing factory. The water pipes were broken, which made it impossible to check the conflagration which followed the shock; and 80% of the numerous bridges were destroyed. Reconstruction was begun at once, and very large sums were given to relief funds. Tents were first put up for the survivors and the unburnt portions of buildings rendered habitable, and later large barracks were erected, which housed great numbers, living on charity and Government

relief, for many months. The streets were soon lined with temporary shops and huts.

Before the earthquake Tōkyō had many narrow alleys and slum areas, and after the disaster an elaborate plan was prepared, embodying wider roads, many open spaces, new thoroughfares and the consolidation of the city under a central authority. The work of clearing the ruins, of re-establishing communications, and of reconstruction proceeded with wonderful rapidity, and by June 1924 about 80% of the houses in the city before the earthquake were replaced by temporary erections. The town plan, however, was largely ignored, since it involved the displacement of many thousands of these temporary homes, and the voluntary cession by a number of the inhabitants of a portion of their land for purposes of road widening. The approach to the Imperial Museum, however, has been nearly doubled in width, and the schools have been rebuilt with large playgrounds, which will serve as refuges in case of fire. The new buildings are either large concrete or small wooden erections. Two big department stores have been built on the Ginza. The Shimbashi bridge was reopened in 1925 and the Russian cathedral is being rebuilt. The new Parliament buildings were destroyed by fire in Sept. 1925, and a temporary building was erected for the winter session. The electric railway has been reconstructed as a circular line; the line to Yokohama was electrified and double-tracked in 1915. No sewage system has been undertaken, and the large programme of port improvements, planned in 1920, had not been begun in 1924. In 1925 Rockefeller gave £400,000 to the Imperial University library, and many books have also been sent from Great Britain. An art gallery, planned before the earthquake, was begun in 1924.

TŌKYŌ, UNIVERSITY OF (*see* 15.221).—Imperial Ordinances, 388 (Dec. 5 1918), 12, 13 and 14 (Feb. 6 1919), 50 (March 31 1919), 409 and 411 (Aug. 20 1919), 408 (Sept. 16 1920), 310 (July 9 1921), regulate the constitution of the university, its officers and chairs. Other ordinances deal with the institution of chairs of which there were 255 in 1923, distributed as follows: faculty of law, 32; faculty of medicine, 33; faculty of engineering, 57; faculty of letters, 39; faculty of science, 39; faculty of agriculture, 39 and faculty of economics, 16. The university is closely associated with the committee for the compilation of a national history and geographical records. The Tōkyō Astronomical Observatory is attached directly to the university. The Government appropriation for the university was stated at yen 2,984,805 by Law No. 8 on March 27 1922.

TOLEDO, Ohio, U.S.A. (*see* 26.1051), enlarged its area to 35·55 sq. m. by 1925. The population increased 44·3% in the decade after 1910, reaching 243,164 in 1920, of whom 38,296 were foreign-born and 5,691 were negroes (an increase of 203·2%); and in 1925 (census bureau estimate) 287,380. The output of the diversified industries within the city limits was valued at $61,230,000 in 1909; $293,521,000 in 1919; $360,375,095 in 1923. Receipts and shipments by water, including both foreign and domestic commerce, amounted in 1923 to 2,547,000 and 9,441,000 net tons respectively, the tonnage of shipments ranking second only to that of Duluth-Superior among the Lake Ports. In 1925 the coal loaded on vessels amounted to 14,010,000 tons, and the freight-car movement totalled 5,747,900 cars. Building permits in the five years 1920–4 represented a value of $55,844,000. The assessed valuation of property in 1925 was $560,000,000. In addition to 18 steam railways and nine inter-urban electric lines, by 1925 there were nine inter-urban bus lines entering the city. The local transit system, owned by the Community Traction Co., was operated under a service-at-cost franchise, with clauses reserving to the city the right to acquire ownership.

A new city charter was adopted in 1914, providing for the election by popular vote on a non-partisan ballot of a mayor (with extensive appointing powers), a vice-mayor, 20 councilmen, and the five members of the Board of Education. The City Plan Commission, created by this charter, was organised in 1916, and as soon as funds were available proceeded to prepare (1922–4) a comprehensive plan, with many and important improvements. By 1925 the public-school system included 55 elementary and 4 high schools; the University of Toledo (supported by the city) had about 1,600 matriculated students; the total park area had been increased to 1,401 acres. Toledo has a low general death-rate; a low infant mortality; a relatively small amount of illiteracy and of child labour; and a high proportion (49·4%) of home ownership.

TOLLER, ERNST (1893–), German poet, was born at Samotschin, on Dec. 1 1893. On the outbreak of the World War he joined the army as a volunteer, but became ill and thereupon devoted himself to study. He was a socialist, and a friend of Eisner, and in 1918 became President of the Munich section of the German Independent Socialist party. He commanded the Red Guard in Dachau during the Soviet régime in Munich (April 1919). In July 1919 he was tried for high treason and sentenced to five years imprisonment in a fortress. Toller is the dramatist of the Revolution. His works, which are strongly coloured by his political ideas, include *Die Wandlung* (1920); *Masse Mensch* (1921, Eng. tr. 1923); *Die Maschinenstürmer* (1922, Eng. tr. 1923); *Hinkemann* (1924); also two choral works, *Der Tag des Proletariats, Requiem den erschossenen Brüdern;* two volumes of poetry, *Gedichte der Gefangenen*, and *Das Schwalbenbuch* (1924, also Eng. tr.) A grotesque comedy *Der entfesselte Wotan*, and the puppet play *Die Rache des verhöhnten Liebhabers* (1925) stand apart from this politically coloured sphere of thought. See Stefan Grossmann, *Der Hochverräter Ernst Toller* (1919).

TOMSKY, pseudonym of Michael Pavlovich Efremov (1880–), Russian politician, born Oct. 19 1880 in St. Petersburg (Leningrad), was the son of a workman, and became a factory hand at the age of 12, specialising later as a skilled chromolithographer. In 1904 he joined the Bolshevik section of the Russian Social Democratic party and was a member of the Reval Council of Workers' Deputies during the revolution of 1905. Between 1906 and 1917 Tomsky was an active member of the St. Petersburg and Moscow secret committees of the Bolshevik party, edited an illegal party paper *The Worker's Flag*, suffered various terms of imprisonment and deportation and was finally sentenced to five years' hard labour in the Moscow Butyrka prison, followed by deportation for life to Siberia. Released by the March revolution of 1917, Tomsky took part in the Bolshevik July rising in St. Petersburg and the Nov. revolution in Moscow. Afterwards he devoted himself particularly to trade union work, and edited *The Metal Workers' Review.* He was elected member of the Moscow trade union council and in 1918 became President of the All-Russian central trade union council, with a short interval when he acted as representative of the Soviets in Turkestan. On the reorganisation of the Russian Soviet Federation of Socialist Republics into the Union of the Soviet Socialist Republic he became a member of the Central Executive Committee of the U.S.S.R.

Tomsky also took an active part in the diplomatic work of Soviet Russia and was vice-president of the Soviet delegation to London in 1924 and one of the signatories to the treaty ratified by the British Labour Government. In March 1926 he was appointed one of the delegates to Paris in the negotiations with France. He acted as general secretary of the provisional international council of the trade unions from its formation on Aug. 1 1920 to May 1921, and addressed the British trade unions at the conferences at Hull (Sept. 1924) and Scarborough (Sept. 1925).

His most important writings and addresses are included in the following volumes: *Die Neuen Aufgaben der russischen Gewerkschaften* (1922); *Der gegenwärtige Stand der Gewerkschaftsbewegung in Russland* (1923); *Getting Together: Speeches Delivered in Russia and England: 1924–25* (1925).

TÖNISSON, JAAN (1868–), Estonian nationalist leader, was the son of a farmer in the Viljandi district of Livonia. After graduating in law at the University of Dorpat (Tartu) he was for some years in the judicial service of the Russian Imperial Govt., but quitted it in 1896 to become editor of *Postimees* (*The Postilion*), the oldest Estonian daily newspaper in Dorpat. Thenceforward he took an active part in the Estonian national movement. This, dating from the middle of the 19th

century when the first collections of Estonian folklore were made, had been greatly intensified during the agrarian struggle against the German-Baltic nobility. At first the national movement enjoyed the countenance of the Russian authorities who saw in it a useful counterpoise to the Germanism of the ruling classes of the Baltic provinces. Later, however, a compromise was arrived at with the Baltic barons by which the Estonians were saved from being Germanised only to be submitted to a process of Russification. At this crisis in the national movement Tönisson took a line independent of both German and Russian political influences and endeavoured to concentrate the activities of the Estonian people upon work in the economic and cultural spheres. In the revolution of 1905 he was at the head of the Estonian moderate constitutional movement, which he likewise represented in the Russian Duma, where he attached himself to the Russian Cadet Party, and to the non-Russian element. With the other signatories to the Wiborg Appeal, he was sentenced to three years' imprisonment and loss of political rights.

From 1917 onwards Tönisson, as leader of the Estonian People's Party, was a member of all the representative bodies of the Estonian people. In the winter of the same year, after he had been expelled by the Bolsheviks, he was associated in Stockholm with the representatives of the Allied Powers in connection with the independence of Estonia, and with them carried through the preliminaries of a *de facto* recognition. From 1919–20 he was Prime Minister, and during his period of office peace was concluded with Russia. In the second Riigikogo (Parliament) he brought about an alliance between his own party and the Christian People's Party and the National Liberals, so as to form a democratic " bloc," which was strong enough to secure his election as president of the Chamber.

TÖNNIES, FERDINAND (1855–), German economist and sociologist, born July 26 1855 in Oldensworth, Schleswig, began to teach at Kiel in 1881, and from 1908–16 was professor there. In 1902 he was made chairman of the German Sociological Society.

His principal works are:—*Gemeinschaft und Gesellschaft* (1887, 5th ed. 1922), *Thomas Hobbes, der Mann und der Denker* (Leipzig, 1922); *Der Nietzsche Kultus* (Leipzig, 1897); *Schiller als Zeitbürger und Politiker* (1905); *Entwicklung der sozialen Frage* (1907); *Die Sitte* (1909); *Englische Weltpolitik in englischer Beleuchtung* (1915); *Der englische Staat und der deutsche Staat* (1917); *Die Niederländische Uebersee-Trust-Gesellschaft* (Jena, 1916); *Weltkrieg und Völkerrecht* (1917); *Menschheit und Volk* (1918); *Marx's Leben und Lehre* (Jena, 1921); *Kritik der öffentlichen Meinung* (1922).

TONSILS: *see* EAR, NOSE AND THROAT, DISEASES OF.

TORONTO (*see* 27.52), the chief city of Ontario, Canada, and the second city in the Dominion, had a population, predominantly British, of 521,893 in 1921, and an area of 32¼ square miles. The death rate was only 10·5 per 1,000 in 1922. Buildings erected since 1911 include Government House, overlooking the Don valley; the fine Anglican church of St. Paul's; the Timothy Eaton memorial church (Methodist); the Prince Edward Viaduct, from Sherbourne street to Danforth avenue; and big office buildings for the Royal Bank of Canada and the Canadian Pacific railway. A similar building, in course of construction for the Canadian National railways in 1925, was said to be the highest in the British Empire. A new joint railway station for the Canadian National and Canadian Pacific systems has been built near the harbour, to replace the old inconvenient joint station, but the transference was somewhat delayed by difficulty in adjusting the railway tracks to a level well above that of the harbour front.

An art museum and college have been opened in the Grange, an interesting old house, formerly the home of Goldwin Smith, and Trinity College has been sold to the city. A scheme has been brought out for the construction of a 33-m. boulevard, which would encircle the city, and 30 m. of internal driveways. Over 12,000 buildings were erected yearly in 1923–5; there are 336 churches and 1,472 ac. of parks and playgrounds. There are two radial electric railways, and in 1921 the municipality took over the tramway system. It was extended, and in 1923 had 222 m. of track. The city's War memorial, in front of the city hall, was unveiled in 1925, and there is also one to men of the 48th Highlanders in Queen's Park.

Improved Shipping Facilities.—The deepening of the Welland canal is expected to bring the larger vessels plying on the Great Lakes to Toronto. A large scheme of harbour improvements has been in progress since 1917 under the Toronto harbour commissioners, and will provide accommodation for over 100 vessels of 5,000 to 10,000 tons when completed. The whole harbour is to be deepened to 30 ft.; a ship canal, retaining walls, and piers and slips across the whole front of the inner harbour, are being built. Reclamations of land are being made between these and the old shore line, on the lake front to the east and west of Toronto, and on Toronto Island. The Eastern Harbour Terminals (formerly Ashbridge Bay), 1½ m. from the centre of the city, and connected with the inner harbour by a ship canal, is being developed as an industrial centre on an area of reclaimed land. In 1924, 477 ac. had been reclaimed, 2½ m. of paved streets made, and 15 m. of railway built. At the Central Harbour Terminals, intended for lighter manufactures and warehousing, 139 ac. of marsh had been reclaimed behind the 2½ m. of wharfage in 1924, and Fleet street had been extended. Toronto has a larger number of industrial establishments than any other Canadian city, and the bank clearances exceeded those of Montreal for the first time in 1923. The annual exhibition, which is held in grounds of 264 ac. is the largest in North America. The hydroelectric system, deriving power from the falls of Niagara, is one of the largest municipal supply undertakings on the American continent. The tendency to centralise the wholesale business of the province in Toronto has been accentuated by the development of mining and lumbering in Northern Ontario. Toronto is the chief livestock market of Canada, and a winter fair, for cattle, etc., was established in 1922. Helium gas was discovered 40 m. from the city in 1925.

TORONTO, UNIVERSITY OF (*see* 27.52).—While in some respects the University of Toronto follows what is called the Oxford type, it has developed independently and with vigour, and as a teaching university occupies a very high position. The four colleges of the university, the Federated and Affiliated Colleges, form a very strong group of educational institutions. In 1923–4 $1,148,901.20 was received on behalf of the faculty of medicine from the Rockefeller Foundation. For a school of hygiene and for the development of the department, the International Health Board of the Rockefeller Foundation gave $650,000 and the E. C. Whitney Bequest amounted to $400,000. There were 4,859 students registered and the enrolment for the university extension classes was 2,560.

The university has benefited largely by gifts, and in recent years a University Press and an electrical engineering building have been erected, and a faculty of music, a school of engineering research, and a department of social service inaugurated. An insulin division of the Connaught laboratories was organised in a building on the campus, previously occupied by the Y.M.C.A., in 1922. A school of public health is to be opened and a building for the study of forestry erected. Hart House, a magnificent building presented for the social and athletic use of the men students, was finished in 1919; the beautiful tower is a War memorial, and contains records, pictures, etc. of the work of the University during the War. Queen's Park house was given as a social centre and hostel for women students in 1925.

TORPEDO (*see* 27.53).—In the World War of 1914–8 the torpedo played a most important part, especially as employed by the German submarines during the submarine campaign. Apart from the use of the torpedo by capital ships, light cruisers, torpedo boat destroyers, submarines and coastal motor boats, torpedoes are also carried by flying machines specially constructed for the purpose. The torpedoes are carried slung under the fuselage, and released at the will of the observer.

During the War a number of specially adapted vessels were fitted to carry torpedo planes, their construction enabling the machines to " take off " and " alight " on the flying deck (*see* AIRCRAFT CARRIERS; SEAPLANE). Coastal motor boats, small-vessels of great speed were also used for the discharge of torpedoes.

Construction.—In the British Navy 21 in. and 18 in. torpedoes are carried, the former by capital ships, light cruisers and destroyers, and the latter by submarines, coastal motor boats and aircraft. The torpedo is divided into six compartments viz., head, air vessel, balance chamber, engine room, buoyancy chamber and tail. These may be described as follows:—

There are two types, the war head containing the explosive, and the collision head used for practice. The former carries a charge of high explosive which is detonated on contact by a device known as the pistol. The collision head used for practice is a steel shell partially filled with cork to ensure buoyancy—it is brought up to approximately war head weight by filling it with water. On impact with target the forepart collapses, thereby lessening the blow on the target and shock to the torpedo itself. To facilitate recovery an indicating light is fitted in a pocket in the head, consisting of phosphide of calcium which on contact with water spontaneously bursts into flame, indicating position of torpedo at the end of the run.

The air vessel consists of a special nickel steel forging containing highly compressed air which provides the motive power of the torpedo.

The balance chamber is a watertight compartment, which contains the depth-keeping mechanism and the heater apparatus and the supply of fuel (petroleum in a special flask). The depth-keeping mechanism consists of a pendulum weight so interlinked with a hydrostatic valve that the weight corrects departure from the horizontal, whilst the valve maintains the set depth, their joint action operating the horizontal rudders through the medium of a small air engine termed the servomotor.

The engine room is the next compartment abaft the balance chamber; it is watertight and together with the buoyancy chamber to which it is attached, forms what is known as the afterbody. This portion of the torpedo is secured to the balance chamber by a number of screwed bolts which allow of the torpedo being parted for examination of mechanism in the engine room. It consists of (*a*) the engines of the four cylinder single acting Brotherhood type; (*b*) the steering engine or servomotor; (*c*) the starting valve and counter gear; (*d*) the reducing valve which maintains an approximately constant working pressure at the engine irrespective of air vessel pressure; (*e*) oil bottles for lubricating working parts.

The starting valve is operated by an air lever which projects through the shell of the torpedo and is thrown aft on discharge by a downward projecting bolt in the torpedo tube. In addition to opening the starting valve, it releases the gyroscope. (*f*) The counter-gear, a piece of mechanism driven off the engines for stopping the torpedo at a definite range, or permitting it to run away. Off the counter is driven the ignition gear, whose function is to fire the cordite ignitres in the "heater" at a pre-determined moment and start the combustion of air and fuel. This gear can be set to float for practice or sunk for action; in the latter case a small valve is lifted at the end of the run admitting water to the buoyancy chamber, thus sinking the torpedo which might otherwise remain a floating mine.

The buoyancy chamber provides a large portion of the buoyancy of the torpedo. It consists of thin sheet steel, strengthened up internally to enable it to withstand external pressure, (*a*) impulse pressure on discharge, (*b*) immersion at great depth. The engines are secured to the foremost bulkhead of this compartment, and two watertight tubes run through it, one carrying the propeller shaft and the other carrying a rod connecting the servomotor and horizontal rudders. The sinking valve is on the bulkhead. The gyroscope is fixed to suitable brackets in this compartment, and connected to the vertical rudders. This piece of mechanism is a comparatively heavy bronze wheel mounted horizontally and vertically in gimbals. The gyroscope is released when the air lever is thrown aft, the wheel being initially spun to a high rate of revolution, due to the release of a strong spiral spring in torsion.

On discharge the whole system is freed from external constraint, and following the dynamical laws of rotating bodies the spinning axis tends to maintain its direction in space. It will be seen the axis of the spinning wheel provides a datum line, the direction of the gyro wheel on release. Subsequent deviations of the torpedo are corrected by the relative movements of the spinning axis and the fore and aft line of the torpedo. These relative movements control the air supply to a small steering engine which operates vertical rudders, so bringing the torpedo back to its original direction.

The tail carries the horizontal and vertical rudders which are mounted on corresponding fins; it also contains gearing to enable two four-bladed propellers to be driven in opposite directions off the engine and this ensures that the torpedo keeps its upright condition without heel, the turning effect of one propeller being balanced by the other. (*See* SUBMARINE WARFARE.) (W. M. M. R.)

TOSTI, SIR FRANCESCO PAOLO (1846–1916), Italian composer and teacher of singing, was born at Ortona, Abruzzi, April 9 1846. At the age of 14 he began his musical studies at Naples, where he studied under Mercadante and Carlo Conti. In the course of time he was appointed teacher of music to Queen Margherita, then a princess of Savoy and later became keeper of the musical archives of the Italian Court. In 1876 he paid his first visit to England; five years later he was appointed teacher of singing to the Royal family and settled in England. He published many songs, which from the first had a wide success, the most famous being "Goodbye," "Ask Me No More" and "For Ever." He was knighted in 1908 and died in Rome Dec. 2 1916.

TOTEMISM: *see* ANTHROPOLOGY.

TOURNEUX, JEAN MAURICE (1849–1916), French man of letters (*see* 27.107), died in Paris Jan. 13 1916.

TOWN PLANNING: *see* CITY PLANNING.

TOWNSEND, MEREDITH WHITE (1831–1911), British journalist was born at Bures, Suffolk, April 1 1831, and educated at Ipswich grammar school. In 1848 he went out to India, and four years later became editor of *The Friend of India*, acting also for some years as *The Times* London, correspondent. In 1860 he returned to England and in the following year purchased the weekly *Spectator* (*see* 19.562). With R. H. Hutton he was joint-editor until 1879, and he was largely instrumental in making it an established success, writing most of the political articles and the opening paragraphs every week. His two chief publications were *The Great Governing Families of England* (1865), written in conjunction with J. L. Sanford and *Asia and Europe* 4th ed. (1911). He died at Little Bookham, Surrey, Oct. 21 1911.

TOY, CRAWFORD HOWELL (1836–1919), American Hebrew scholar (*see* 27.114), died at Cambridge, Mass., May 12 1919. In 1913 he published *Introduction to the History of Religions.*

TOZZI, FEDERIGO (1883–1920), Italian novelist, was born at Siena Jan. 1 1883, the son of an innkeeper. His childhood and early youth are described in *Congli ochi chiusi* (1919). His father died in 1908, and Tozzi married the same year, and *Il Podere* (1921) is a record of his experiences at this time. He learnt Latin and studied old Tuscan, his first book being an *Antologia d'antichi scrittori senesi* (1913). But *Tre Croci* (1920) translated into English as *Three Crosses* (1921), the only one of his books which is not autobiographical, is considered his finest work. He died in Rome on March 21 1920, before he was able to reap the fame which the success of his latest work brought him. Tozzi, although all his work centres round his native place, Siena, does not speak with a provincial accent; his spirit is a universal spirit. He uses with success the curious power of presenting objectively a subtly psychological drama, and the nearest parallel to his methods is to be found in Chekhov.

TRACKLAYING: *see* RAILWAYS.

TRACTORS.—The petrol tractor for agricultural and kindred purposes is a development of the steam traction engine, widely used for operating grain threshers and to a small extent for ploughing. Steam ploughs were used toward the end of the 19th century on the large ranches of the northwestern section of the United States, in Canada and in Egypt. Their usefulness was limited, however, owing to their great weight, which resulted in the packing of the soil and in rather inefficient operation. When the weight of the petrol engine was greatly reduced by motor-car engineers, about 1900, the idea of substituting that type for the heavy steam plant naturally suggested itself.

I. PRODUCTION AND MECHANISM

The first petrol tractors seem to have been those built by the Huber Mfg. Co., of Marion, Ohio, in 1898. These were not successful and only 30 were completed. In 1901 the Hart-Parr Mfg. Co., of Charles City, Iowa, engaged in the manufacture of petrol tractors, and, although it met with many difficulties, this company was successful. There are two general types of agricultural tractor, the wheeled and the crawler or caterpillar, types. The crawler type, in which the weight is spread over a large supporting surface on the ground, can pass over marshy land where the wheeled tractor would be mired, and when used for pulling harrows, seeders and other implements over ploughed ground, does not pack the soil as a wheeled tractor would. Early technical development was chiefly toward large tractors, designed to operate from 6 to 12 plough bottoms, because the only farmers who then took an interest in tractors owned large ranches in western America.

The largest producers of petrol tractors in the United States between 1905 and 1913 were manufacturers whose main line was general agricultural machinery and steam traction engines, such as the

International Harvester Co., the J. I. Case T. M. Co. and Emerson-Brantingham Company. The large petrol tractors of that period were crude in design and very heavy; their frames were built up of heavy rolled channels, and they had driving wheels of enormous diameter. Their great weight naturally rendered them inefficient, for a large proportion of the engine power was consumed in moving the tractor itself. The tractor shown in fig. 1 is characteristic of tractors of an earlier period.

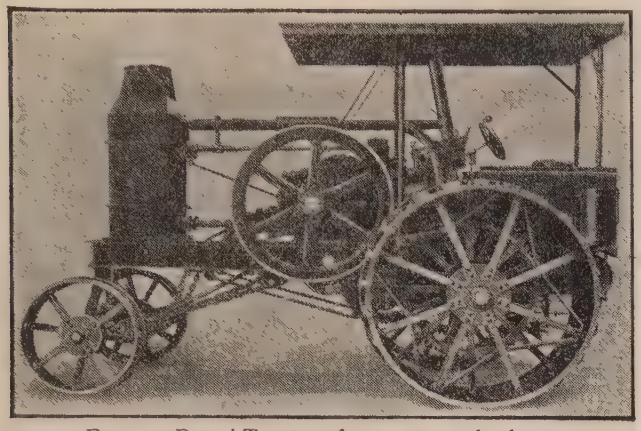


FIG. 1.—Petrol Tractor of a type now obsolete.

Agricultural Tractors.—Tractors are usually rated in terms of the number of 14-in. plough bottoms they will pull. In 1925, of 104 models on the American market pulling two or more bottoms, 12 were two-plough tractors; 42 three-plough; 28 four-plough, and the rest were capable of pulling five or more ploughs up to a dozen. However, the tractors in the two-plough class were produced on the largest scale by far. Of a total of 134,590 tractors produced in the United States in 1923, 102,126 had a belt horse-power rating of 15–19, which corresponds to the two-plough class. Table I. shows the production of tractors in the United States from 1910 to 1923.

TABLE I. *Tractor Production in the United States*

1910	4,500	1919	136,162
1912	11,400	1920	203,300
1914	10,400	1921	73,198
1916	29,670	1922	99,692
1918	132,697	1923	134,590

According to statements of the Minister of Transport, between Jan. 1 and March 31 1921, there were registered in Great Britain 10,161 motor-ploughs and similar machines, for each of which an annual tax of 5s. was paid. For the same period in 1925 the figure was 14,079. According to the Ministry of Agriculture, from Jan. to Nov. 1921, there were registered in this class 18,100 machines, and from Jan. to Nov. 1924, 16,040. These figures, however, do not give an accurate idea of the number of agricultural tractors in service in Great Britain because the 5s. tax class includes other types of machines and, besides, as some of the tractors never use the public roads, their owners do not bother to register them. Of the tractors manufactured in the United States 14,854 (23·7%) were exported in 1917; 29,143 (14·3%) in 1920 and 16,643 (12·4%) in 1923. In 1912 the business in the large tractors of 6 to 12 plough capacities reached its zenith, and thereafter it declined rapidly.

The first popular small tractor, the Bull, was brought out the following year, and in 1914, no fewer than 3,000 tractors of this make were sold. Although smaller, it was still of the same crude design as the larger machines, with exposed gears, plain bearings and similar features. About 1916 a number of engineers with motor-car experience entered the tractor field, and as a result of their efforts tractor design was greatly improved. Many farm tractors were designed to use paraffin as fuel, because paraffin was considerably cheaper than petrol, and the conditions of engine operation on a tractor (constant speed and steady, heavy load) made it comparatively easy to burn paraffin with a moderate degree of success. Petrol, however, proved much more satisfactory in the average engine, and when in 1919 the price of paraffin advanced sharply, tractor users generally turned to petrol. The consumption of petrol in gallons per acre is less, there is less difficulty in cold weather, and the oil in the crankcase does not lose its lubricating value so quickly.

Typical Design.—For the sake of economical manufacture many of the earlier small tractors were made with only three wheels, but the buying public did not approve of this feature of construction, and the typical 1925 wheeled tractor has four wheels, two in front for steering and two in the rear for driving. The Twin City 12–20 H.P. tractor shown in fig. 2 is a good example of the lighter tractors based on motor-car practice. The tractor industry was hard hit by the heavy slump in the prices of agricultural products which set in late in 1920. Prices of tractors and other agricultural machinery did not drop nearly

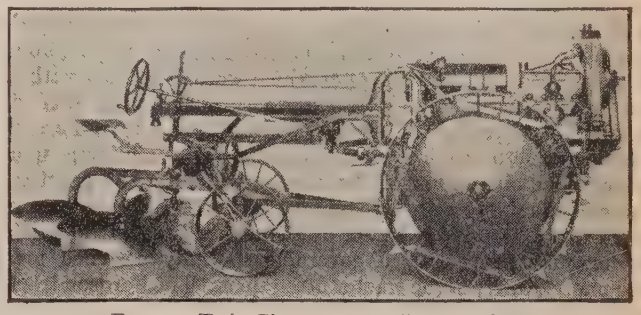


FIG. 2.—Twin City tractor, a light machine.

as rapidly nor as much as those of farm products, and the result was a "buyers' strike," the effect of which is clearly reflected in the production figures for 1921. When business came practically to a standstill, one manufacturer cut the price of his machine exactly in half (from $790 to $395). While losing money at the new price he hoped that the reduction would greatly increase the demand, and with increased demand and increased production the cost of manufacture would come down and profits return. A very keen price competition set in, and many tractor manufacturers went out of business during the next two years. The low level of prices reached in 1921 was not maintained (the price of the tractor referred to above was raised again to $495 about two years later), and in 1924, when the financial situation of the farming community improved, there was also a noticeable improvement in the tractor industry.

The Fordson Tractor.—A tractor which was manufactured in very large numbers and distributed all over the world was the Fordson, manufactured by the Ford Motor Co., Detroit, Michigan. A central longitudinal section of this machine is shown in (fig. 3). It was of the frameless or backbone type, the crankcase

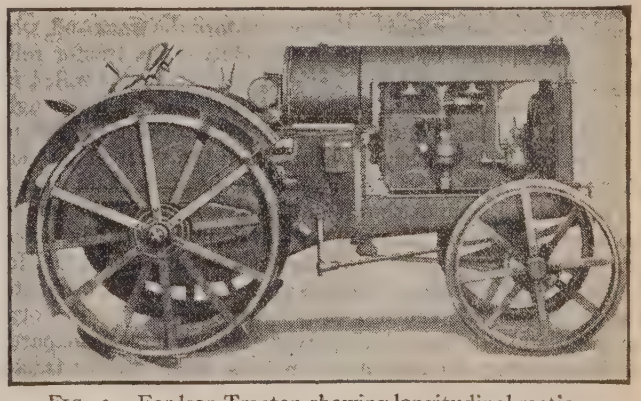


FIG. 3.—Fordson Tractor, showing longitudinal section.

of the engine and the cases of the change-speed gear and rear axle forming the supporting structure. The engine had four vertical cylinders of 4-in. bore and 5-in. stroke, which were cast in a single piece with the upper half of the crankcase, the lower half of this case being a separate casting. To the rear of the crankcase was bolted a housing which enclosed the flywheel, the friction clutch and the change gearing, and also formed the rear axle housing. There was no direct "through" drive, the power

being always transmitted from the upper to the lower of two parallel shafts in the gearset, and an extension of the lower shaft carried the worm which meshed with the worm wheel on the rear axle differential gear.

Changing of gear was effected not by meshing the gears, which remained in mesh continuously, but by securing one or another of the gears to the shaft by positive clutches. The rear wheels were 42 in. in diameter and the tractor was geared to give a ploughing speed of 2¾ M.P.H. with an engine speed of 1,000 R.P.M. In addition to the ploughing speed there were provided a low forward speed and a reverse motion. Over the engine was mounted a double compartment fuel tank holding 1 gal. of petrol and 16 gal. of paraffin. Air was taken in through an air washer and the carburettor was of the Holley make in which the paraffin, after having been sprayed into a stream of air to form a very rich mixture, was vaporised by being passed between two stampings of sheet steel, the outer faces of which were in contact with the hot exhaust gases. Additional air was mixed with this rich mixture close to the inlet valves. Ignition was by a Ford flywheel magneto, engine lubrication by the circulating splash system, and circulation of the cooling water by the gravity or thermo-siphon system. Unlike most others, this tractor was not fitted with an engine governor by the maker, but several speciality manufacturers offered governors specially designed for it and many owners of the tractor fitted them. The Fordson tractor had a wheelbase of 63 in. and weighed 2,562 lb. complete. The front axle was swivelled at its centre on a saddle casting bolted to the front of the engine and was braced near its ends by radius rods with flexible joints extending to lugs cast on the bottom of the engine crankcase. A belt pulley for power work was provided and ran at engine speed.

General Features.—Belt pulleys formed a part of the equipment of practically all tractors, being used for operating threshing machines, wood saws, silo fillers, etc. It was customary to apply a double horsepower rating; for instance, a three-plough tractor was often rated as a 12–25 H.P. machine. This signified that the tractor could develop 25 H.P. on the belt and 12 H.P. on the drawbar, the difference of 13 H.P. being required for moving the tractor itself over the field. Four belt speeds were standardised, namely, 1,500, 2,600, 3,000 and 3,500 feet per minute.

The crawler tractor had one or two continuous-chain tracks on which it ran and which it carried with it. That portion of the chain track in contact with the ground had transverse projecting bars or depressions which caused it to grip the ground firmly, while the upper side of the lower portion of the chain formed a smooth track on which rolled idler wheels carried on the frame of the tractor. The power from the engine was transmitted through a suitable reduction gear to a pair of toothed wheels which engaged with teeth or rollers on the inner side of the track and, when power was applied by letting in the clutch, the tractor rolled ahead on the track and the track at the same time rolled forward. The power was applied to the two chain wheels through a differential gear, and in order to steer a tractor of this kind, one track was held stationary by a brake on the shaft of its chain wheel, while all the power was applied to the other chain wheel.

The Cletrack tractor shown (in fig. 4) was one of the smallest tractors of this type. Much of the development work in connection with crawler tractors was done in California, where the Holt, the Best and the Yuba, all tractors made in large sizes, originated. The Holt, which is called a caterpillar, became the prototype for the "tanks" (*q.v*) which played such an important part in the World War. In 1925 many of these large crawler tractors were used for other than agricultural purposes—for example, in oil-fields, in lumbering and in road-building. The city of New York in 1920 purchased a large number for use in clearing the streets of snow. The lumbering or logging work done was mainly in swampy districts where horses cannot work except in winter when the ground is frozen, whereas the crawler tractors make logging in such districts possible the year round. The weight on the track of a crawler tractor of the 1925 type was as low as 5 lb. per sq. in., and such a tractor could go into boggy places where no wheeled vehicles could follow.

Nebraska Legislation.—In 1919 the Legislature of the State of Nebraska passed a law providing that thereafter no tractor should be sold in that state until the manufacturer had first

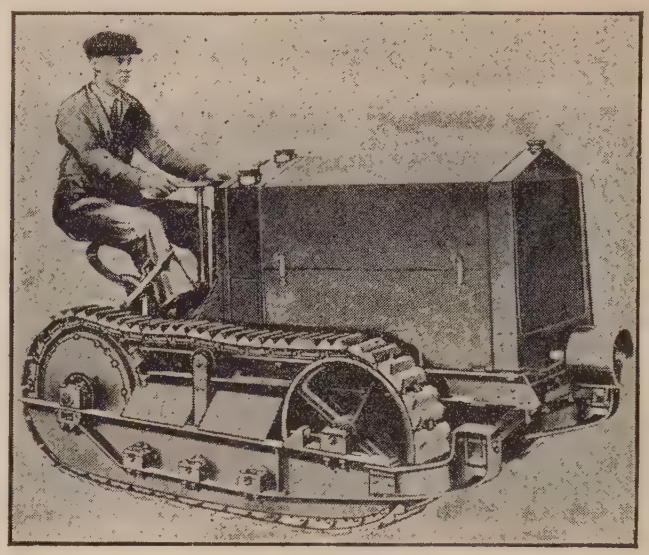


FIG. 4. Cletrack tractor, a small machine.

submitted a sample tractor for trial to the agricultural Engineering Dept. of the University of Nebraska and the tractor had satisfactorily met the test required. The manufacturer must also satisfy the state authorities that he is maintaining an adequate supply of repair parts within the state. This legislation was the result of complaints of farmers that manufacturers were overrating their tractors. The result was that, during a period when 66 tractors were tested, the makers of 8 were compelled to increase their rated engine speed, 13 lowered their horsepower rating, 14 changed some part and 4 withdrew. Up to 1925 no other states had passed similar laws, but the Nebraska test results were widely published and served for the whole country.

II. COST AND USES

The three chief items of cost in tractor ploughing are fuel, depreciation and labour. At the tractor trials held at Lincoln, England, in the autumn of 1919, the fuel consumption per ac. averaged almost exactly 4 imp. gal. for ploughing in heavy clay soil, and 3 gal. for ploughing on cliff lands. In the corn belt of the United States, where the soil is comparatively light, it has been customary to reckon on a fuel consumption (either petrol or paraffin) of 2·5 U.S. gal. (2 imp. gal.) per acre. On the other hand, in a *Bulletin* of the U.S. Dept. of Agriculture on "The Gas Tractor in Eastern Farming," a fuel consumption of 3½ U.S. gal. per ac. is made the basis of cost calculations of the eastern section, and in the tractor trials held at Harrisburg, Pa., in 1919, the average fuel consumption of all tractors using paraffin worked out at 3·28 U.S. gal. (2·62 imp. gal.) per acre. The fuel consumption in tractor ploughing varies both with the character and condition of the soil and with the depth of ploughing. The average depth of ploughing at Lincoln was 5¾ inches. The resistance of the soil (drawbar pull) averaged 11·5 lb. per sq. in. for the heavy clay soil and 9 lb. per sq. in. for the cliff land. In the corn belt of the United States the soil resistance generally varies between 5·5 and 7 lb. per sq. in., and this explains the low fuel consumption in ploughing there. The estimate here given of the cost of ploughing one acre is based on the results of an inquiry by the U.S. Dept. of Agriculture among 400 tractor farmers in the Dakotas concerning their experiences in 1917 and 1918. Only one change is made from the estimate of the department, namely, the assumption of a tractor life of seven instead of nine years. The answers to the questionnaire yielded the averages shown in Table II.

TABLE II. *Average Cost and Performance of Tractor Ploughing in the Dakotas.*

	Two-plough Tractors	Three-plough Tractors	Four-plough Tractors
First cost . . .	$1,050	$1,460	$2,000
Full working days per year . . .	45	52	64
Acres ploughed per 10-hr. day . .	6·3	8·5	10·9

FIG. 1. Silo being filled by power from tractor. FIG. 2. Two-ton caterpillar tractor pulling 3″ tandem disc and harrow. FIG. 3. Fordson tractor as used for pushing copper bars. FIG. 4. 10-inch flexible creeper (Kegresse system of propulsion) on 2-ton Delahaye truck. This type of creeper-band has been successfully used in crossing the great Sahara desert by motor. (Photo Meurisse). FIG. 5. Mack semi-tractor, capacity 26,000 lb., pulling a tank-car semi-trailer.

Other factors on which the estimate is based are the following: cost of petrol, $.276 per U.S. gal.; paraffin, $.152 per gal.; lubricating oil, $.50 per gal.; grease $.10 per lb.; repairs, 4% of the first cost per year; depreciation on a 7-year basis; man labour at $4.00 per day; interest at 6% on the average investment (one-half of total investment). Such items as housing, insurance and taxes are neglected.

TABLE III. *Cost of Tractor Ploughing in the Dakotas 1917–8*
(Dollars per acre)

Size of Tractor	Total Cost of Ploughing		Fuel		Oil
	Petrol Tractor	Paraffin Tractor	Petrol	Paraffin	
Two-plough	2.21	1.915	0.69	0.395	0.075
Three-plough	1.975	1.68	0.69	0.395	0.075
Four-plough	1.757	1.462	0.69	0.395	0.075

Other Items

	Grease	Repairs	Depreciation	Man Labour	Interest
Two-plough	0.02	0.15	0.53	0.635	0.11
Three-plough	0.02	0.13	0.49	0.47	0.10
Four-plough	0.02	0.11	0.409	0.368	0.085

With these data a close estimate can be made of the cost of tractor ploughing under different conditions, as all the basic costs are given. The average soil resistance in the Dakotas may be assumed to be 8 lb. per sq. inch. In heavier soils the area ploughed per day will be less in substantially the inverse ratio of the soil resistance (provided the latter is not excessive). This is borne out by estimates of the ploughing capacities of the tractors which competed in the Lincoln trials of 1919, made by the judges of the event. Averaging the estimates for heavy clay soil (soil resistance 11·5 lb. per sq. in.), and reckoning on the basis of a 10-hr. instead of an 8-hr. day, the following results are obtained: Two-plough tractor, 4½ ac., three-plough tractor, 5⅝ ac., four-plough tractor, 6¾ acres.

As the application of tractors increased in the United States the average number of full days use per year decreased, which is partly accounted for by the fact that the large farms had the tractor first, and the smaller ones, which put it in service in later years, had not so much work for it. An inquiry made by the U.S. Dept. of Agriculture in 1922 showed that in the Corn Belt in the Middle West the average full days use of the tractor was 31.

Power Take-off.—One of the developments in tractor work that came shortly before 1925 was the provision of a power take-off by means of which power can be transmitted from the tractor to the implement drawn by it, for operating the mechanism of the implement, as, for instance, the sickle and binding mechanism of a grain binder, for which a small separate engine was sometimes used previously. According to an American agricultural standard, power take-offs are designed to turn at 536 (plus or minus 20) R.P.M. and in a clockwise direction when viewed in the direction in which the tractor travels.

Advantages.—To the American and Canadian farmer the advantage of the tractor is not so much that it reduces the cost of ploughing as compared with horses, as that it enables one man to work a much greater acreage. Approximately one-third of several hundred tractor farmers in Illinois circularised by the U.S. Dept. of Agriculture had increased their acreage by purchasing tractors. Another great advantage is that the tractor permits work to be done quickly when the weather is favourable. Power farming has proved particularly advantageous in the wheat belt of Kansas. For the best yield the land must be ploughed in August, when the temperature is often above 100° F. in the shade and very little work can be accomplished with horses. The tractor works as efficiently at this temperature as in winter. Moreover, the tractor can be used also for threshing, and the old practice of contract threshing has been largely superseded by the plan of four or five farmers owning a small threshing machine co-operatively and helping each other thresh their grain, each using his own tractor as the motive power. A three-plough tractor is generally recommended for a 20×36 in. grain separator. Sometimes it is necessary to get a crop into the ground very quickly, and, with a double shift of operators, tractors can then be operated continuously day and night.

Development in Europe.—Interest in farm tractors increased greatly in Europe during and following the World War. In 1919 and 1920 tractor trials were held at Lincoln, England, the first under the auspices of the Society of Motor Manufacturers and Traders and the second under that of the Royal Agricultural Society. The French Govt. in 1920 paid a bonus of 25% on the purchase price of tractors of domestic manufacture and 10% on tractors of foreign manufacture. French engineers paid particular attention to tractors for use in vineyards, which must be very narrow. Tractor development and application in Europe also received a severe setback about the time of the world-wide business depression of 1921, chiefly owing to the high cost of the fuel. The tractor trials of the Royal Agricultural Society were not repeated after that date, and in France the high cost of petroleum fuel was said to make tractor ploughing impracticable economically. Attempts were made to solve the fuel problem by the development of portable suction gas plants, but in 1925 tractors so equipped were not yet in regular production.

Use in Orchards, etc.—Tractors for use in orchards, on which a number of American makers specialise, must be of lower build than those for general use. A distinct type is the garden tractor, for the cultivation of row crops and general work in market gardening. The Beeman, the first tractor of this type, was put on the market in 1915, and in 1923 the total number of such tractors produced in the United States (by nine manufacturers) was 2,682 (*see* MOTOR VEHICLES).

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(P. M. H.)

TRACY, BENJAMIN FRANKLIN (1830–1915), American soldier (*see* 27.127), died in New York City Aug. 6 1915.

TRADE (*see* 3.235).—Trade is the business of buying and selling commodities. By a natural transition of thought and usage the term is applied also to the goods themselves. The expression "international trade" is likewise employed to refer both to the business or occupation of buying goods in a foreign country and of selling them abroad and to the goods themselves. In practice, however, the term country or "nation" in this connection is used to mean not necessarily a separate political entity, but a territory with an independent customs frontier, when such frontier exists. Thus, since the customs convention of May 1 1922, between Belgium and Luxembourg, it is no longer possible to speak of international trade between these two political entities.

THE COMPARABILITY OF FOREIGN TRADE STATISTICS

In most countries careful records are kept of the quantity and value of goods crossing the customs frontier and great importance is attached to the expansion or contraction of the quantum of trade, although there is no necessary connection between the growth of a country's trade and its general economic prosperity. But neither the quantum nor the value of that trade can be measured with any nice degree of accuracy. The difficulties which present themselves are due in part to the different systems of measurement adopted in different countries, in part to the recent alterations which have been introduced in those systems, in part to changes in the composition of world trade, and in part to changes in value.

Two Main Divisions.—Although the trade statistics of no two lands are compiled on exactly similar principles, it is customary and on the whole the custom is justified, to divide the world into two broad divisions of countries consisting of those which enforce the "continental" and those which enforce the "Anglo-Saxon" system. The former show what is called general and special trade, "general trade" meaning all imports into warehouse and exports therefrom, and "special trade" all "imports for domestic consumption" and all exports of "national and nationalised produce." The latter publish

"imports" and "exports," which are roughly equivalent to the general trade of the first division of countries, transhipment, transit and temporary trade and re-exports of foreign produce normally being excluded.

Were the definition of nationalisation of foreign goods uniform in all countries the existence of these two different systems would be of no great importance, because the imports, less the re-exports, of the "Anglo-Saxon" countries would be roughly equivalent to the special imports of the "continental" group, and the exports of the one and the special exports of the other would likewise be approximately comparable. But in the great majority of countries adopting the continental system all goods which have entered the free domestic market are considered as being for domestic consumption and all goods exported from the free domestic market as being national or nationalised. When an import duty is imposed on goods entering the domestic markets this supposition is generally justified; but in the case of raw materials, which are usually free of duty, it may frequently be quite unfounded. As a result the special imports and exports of countries adopting the continental system tend to include a certain amount of commerce which would be excluded from the statistics (imports minus re-exports and exports) of countries employing the Anglo-Saxon system.

The second great difference of method lies in the systems of valuation. In certain countries the goods are valued at average prices fixed by a government commission. These prices may or may not be differentiated by countries or be applied equally to imports and exports. Normally they are revised once a year, with the result that the trade of any given year is valued at prices ruling during the previous twelve months. In others and now in the majority of countries, the values recorded in the trade statistics are based on the declarations of the importers and exporters, which are checked against the documents accompanying the goods. Were the official valuations accurate and the merchants' declarations always honest, the coexistence of these two systems would be of little importance. But in post-war years the violent fluctuations of prices rendered the official valuations useless and the great majority of countries abandoned them in favour of merchants' declarations. This change, while increasing the comparability of trade statistics in the last year or two has rendered the annual national statistics of certain countries incomparable at various dates since 1917. Moreover, the "declared value" system demands a degree of commercial honesty and administrative competence to which all communities cannot lay claim.

A further difficulty arises on account of the fact that certain imports and exports are not included in all statistics—the commonest exclusions being gold and bullion, goods sent by parcel post, government stores, ships and ships' stores. The importance of such exclusions may vary enormously from one year to another. Thus, the British trade statistics during the War up to July 1917 were rendered quite misleading by the exclusion of all articles, other than food, imported on British Govt. account.

Difficulties of Measuring Values.—These three difficulties all relate to the manner in which national trade statistics are compiled. But even were all countries to adopt a common system, it would still be impossible to measure accurately the volume or value of world trade during the years immediately succeeding the War; still less during the war period. In order to measure changes in volume either the goods must be so similar in kind that they can be measured in some common unit of weight or they must be reduced to some other common denominator. But the only available common denominator—price—has undergone such violent changes in recent years as to render the trade statistics of many countries almost meaningless. At the same time, and largely as a result of relative price changes, the composition of international trade has been greatly modified. In each country an unequivocal trade price index may be compiled by taking fixed commodity weights equivalent to the importance of each class of goods on a given date. Such a procedure postulates that the relative importance of each commodity has remained unchanged.

The quantitative importance of the various commodities of which the trade of any country is composed has, however, in most cases changed very considerably since 1914 and even in 1924 when world economic conditions had become more normal the catena of commodities arranged in the order of their "full value" importance was by no means identical with that of 1913. As a result indices so compiled, though unequivocal in the sense that their oscillations are dependent on changes in values only, are based on a hypothesis which we know to be untrue. In addition to this difficulty the indices are liable to be misleading because the apparent changes in values may be due, not simply to an alteration of price, but to a modification of the quality of the article the price of which is measured. In other words the second necessary hypothesis, that the character of the goods measured remains unaltered, may likewise prove untrue. Such indices have, however, been compiled in a number of countries based, as a rule, on a pre-war "weighting" and attempts have been made to show the variations in the quantum of trade by dividing the values of imports and exports by them. The results, for the reasons just given, cannot be accepted as giving more than a rough indication of the general character and trend of the changes which have taken place.

The international problem presents similar, though even greater, difficulties than the national. First it is necessary to convert the national currencies into some common unit of measure, a conversion which during periods of very rapid inflation involves great risk of error. Secondly it is necessary to compile a price index of all goods entering into international trade from the various national trade value indices. This composite index must be weighted according to the relative importance of the trade of each country in some given year, preferably the base year of the national indices. But just as it is not true that the relative importance of different goods entering into the trade of any single country has remained unchanged, so also is it not true that the relative importance to world trade of the imports or exports of each country is the same now as it was in 1913. Different results will be obtained if the standard year adopted be, for instance, 1913 or 1924. An analysis of the data for these two years, however, will show that the differences are not very great.

In a publication of the League of Nations entitled *Memorandum on Balance of Payments and Foreign Trade Balances* (1925) an attempt is made to obtain a rough measure of the changes which have taken place since 1913 in the general level of the prices of the goods composing world trade in 1924 by means of these trade value indices. The conclusion reached is "that it is not unreasonable to presume that the average gold value of the goods entering into international trade in 1923 was somewhere between 40% and 50% higher than in 1913 and that in 1924 it was nearer the latter than the former figure." During the years immediately preceding 1924 the difficulties of international comparison were so grave, and the reliability of national statistics so questionable, that no attempt to estimate the volume of world trade could be justified. By 1924, however, prices throughout the world had become so far stabilised, and the movements of the exchanges so far reduced as to render reasonable the belief that the published estimates of world trade present at any rate data from which certain very general conclusions may be drawn.

Changes in the Volume of World Trade

If the calculations made by the League of Nations be accepted as a rough guide, and the results obtained are in accordance with the general evidence available from other sources, then it would seem probable that the total quantum of world trade in 1913 and in 1924 did not differ greatly. Possibly in the later year it was still slightly less than in the earlier.

In the accompanying table the imports and exports and total trade in terms of dollars of the very great majority (136 in 1924) of the independent trade statistical areas are given for the years 1913 and 1924.

The table is not quite complete, as statistics for a few countries, none of any great importance, are not available. It is further not absolutely accurate. In certain cases the figures for 1924 have not been published and those for 1923, occasionally even 1922, have had

Trade of 1913 and 1924 Reduced to Dollars (000,000's Omitted), Merchandise Only
(Figures in brackets are for the latest available previous year)

Country	Imports				Exports				Total			
	In million $		As % of total		In million $		As % of total		In million $		As % of total	
	1913	1924	1913	1924	1913	1924	1913	1924	1913	1924	1913	1924
[1] United Kingdom	3,214	5,047	16·49	17·89	2,557	3,520	13·97	12·96	5,771	8,567	15·27	15·47
United States of America	1,775	3,581	9·11	12·69	2,448	4,498	13·38	16·57	4,223	8,079	11·18	14·59
[1] France	1,625	2,099	8·34	7·44	1,328	2,168	7·26	7·98	2,953	4,267	7·81	7·71
[1] Germany	2,563	2,174	13·15	7·71	2,403	1,555	13·13	5·73	4,966	3,729	13·14	6·73
India	587	752	3·01	2·67	772	1,182	4·22	4·35	1,359	1,934	3·60	3·49
Canada	619	789	3·18	2·80	432	1,070	2·36	3·94	1,051	1,859	2·78	3·36
Japan	363	995	1·86	3·53	315	728	1·72	2·68	678	1,723	1·79	3·11
[1] Italy	704	845	3·61	3·00	485	624	2·65	2·30	1,189	1,469	3·15	2·65
[1] Belgium	895	815	4·59	2·89	702	644	3·84	2·37	1,597	1,459	4·23	2·63
China	416	825	2·14	2·92	294	625	1·61	2·30	710	1,450	1·88	2·62
Argentina	479	650	2·46	2·30	501	793	2·74	2·92	980	1,443	2·59	2·61
[2] Australia	380	642	1·95	2·28	375	629	2·05	2·32	755	1,271	2·00	2·30
Spain	252	716	1·29	2·54	204	374	1·11	1·38	456	1,090	1·21	1·97
Czechoslovakia	..	469	..	1·66	..	502	..	1·85	..	971	..	1·75
Dutch East Indies	187	261	0·96	0·93	272	585	1·49	2·15	459	846	1·22	1·53
Straits Settlements	258	437	1·32	1·55	212	395	1·16	1·45	470	832	1·24	1·50
Switzerland	359	452	1·84	1·60	265	364	1·45	1·34	624	816	1·65	1·47
Austria	..	486	..	1·72	..	278	..	1·02	..	764	..	1·38
Brazil	326	305	1·67	1·08	317	421	1·73	1·55	643	726	1·70	1·31
Cuba	140	291	0·72	1·03	164	434	0·90	1·60	304	725	0·80	1·31
Sweden	227	378	1·17	1·34	219	335	1·20	1·23	446	713	1·18	1·29
Denmark	208	365	1·07	1·29	171	331	0·93	1·22	379	696	1·00	1·26
[2] Union of South Africa	200	290	1·03	1·03	317	372	1·73	1·37	517	662	1·37	1·20
Poland	..	285	..	1·01	..	244	..	0·90	..	529	..	0·96
Irish Free State	..	301	..	1·07	..	221	..	0·81	..	522	..	0·94
Egypt	133	217	0·68	0·77	158	296	0·86	1·09	291	513	0·77	0·93
[2] Mexico	96	151	0·49	0·54	154	354	0·84	1·30	250	505	0·66	0·91
New Zealand	102	214	0·52	0·76	102	227	0·56	0·84	204	441	0·54	0·80
[1] Russia	700	166	3·59	0·59	775	233	4·23	0·86	1,475	399	3·90	0·72
[2 3] Turkey	191	226	0·98	0·80	105	151	0·57	0·56	296	377	0·78	0·68
Norway	145	213	0·74	0·75	102	145	0·56	0·53	247	358	0·65	0·65
Chile	121	(113)	0·62	(0·40)	149	(194)	0·81	(0·71)	270	(307)	0·71	(0·55)
[1 2] Rumania	114	131	0·59	0·46	130	139	0·71	0·51	244	270	0·65	0·49
Hungary	..	143	..	0·51	..	117	..	0·43	..	260	..	0·47
Korea	36	(129)	0·19	(0·46)	15	(127)	0·08	(0·47)	51	(256)	0·14	(0·46)
Algeria	129	146	0·66	0·52	97	104	0·53	0·38	226	250	0·60	0·45
Finland	96	119	0·49	0·42	78	125	0·43	0·46	174	244	0·46	0·44
Philippines	53	108	0·27	0·38	47	135	0·26	0·50	100	243	0·27	0·44
[1 2] S. H. S.	(20)	106	(0·10)	0·38	(16)	122	(0·09)	0·45	(36)	228	..	0·41
Ceylon	60	98	0·31	0·35	76	121	0·41	0·45	136	219	0·36	0·40
[1 2] Greece	34	142	0·17	0·50	23	62	0·13	0·23	57	204	0·15	0·37
Peru	29	74	0·15	0·26	44	102	0·24	0·38	73	176	0·19	0·32
Federated Malay States	44	50	0·23	0·18	76	110	0·41	0·41	120	160	0·32	0·29
Formosa	31	(54)	0·16	(0·19)	26	(96)	0·14	(0·35)	57	(150)	0·15	(0·27)
[2] Persia	59	66	0·30	0·23	42	75	0·23	0·28	101	141	0·27	0·25
Uruguay	52	52	0·27	0·18	70	89	0·38	0·33	122	141	0·32	0·25
[2] Colombia	29	52	0·15	0·18	34	86	0·19	0·32	63	138	0·17	0·25
Portugal	96	96	0·49	0·34	37	31	0·20	0·11	133	127	0·35	0·23
Siam	33	58	0·17	0·21	43	64	0·23	0·24	76	122	0·20	0·22
Nigeria	31	47	0·16	0·17	35	64	0·19	0·24	66	111	0·18	0·20
Morocco	45	52	0·23	0·18	9	34	0·05	0·13	54	86	0·14	0·16
Latvia	..	49	..	0·17	.	33	..	0·12	..	82	..	0·15
Tunis	28	49	0·14	0·17	34	30	0·19	0·11	62	79	0·16	0·14
[2] Bulgaria	36	40	0·19	0·14	18	36	0·10	0·13	54	76	0·14	0·14
Gold Coast	17	37	0·09	0·13	17	39	0·09	0·14	34	76	0·09	0·14
Austria-Hungary	712	..	3·65	..	607	..	3·32	..	1,319	..	3·49	..
Other Countries	441	764	2·26	2·71	428	720	2·34	2·65	869	1,484	2·30	2·68
	19,490	28,212	100	100	18,300	27,153	100	100	37,790	55,365	100	100

[1] Changes in territory.
[2] Includes bullion and, in some cases, small amounts of specie.
[3] The figures for 'Iraq, Syria and Palestine are included under Turkey.

to be interpolated; in others it proved impossible to exclude specie and gold bullion; in others general trade had to be given instead of special. In addition the statistics are subject to all the reservations and qualifications to which reference has already been made. All countries the total trade of which in 1924 was less then $75,000,000 have been grouped together. The Netherlands have been omitted altogether, because the system employed in the compilations of their trade statistics was so radically changed in 1917 as to render the returns before and after that year quite incomparable. The Russian statistics for 1924 have been increased by 50%, *i.e.*, by what would appear to be the approximate average rise in the value of goods constituting world trade, as the published figures are based on the average prices ruling in 1913. Certain other minor adjustments of the published data have also been made.

The total imports in 1924 of all the countries shown in the table are 145% of the imports in 1913 and the total exports 148% of the pre-war 1913 figure. These percentages are remarkably close to the probable change in value of goods and in so far as the figures constitute reliable evidence concerning the actual facts, would point to the conclusion mentioned above, that any difference which there may have been in the total quantum of world trade in the two years considered cannot have been very great. In this connection attention must again be drawn to the fact that the countries of which the world is composed are no longer the same as before the War. What has been the effect on the trade of France of the accession of Alsace or on the trade of Belgium of the Zollverein with Luxembourg it is impossible to estimate. Some of the international trade of the Austro-Hungarian Succession States to-day was domestic trade

before the War: some pre-War foreign trade, as for instance that between Transylvania and the old Kingdom of Rumania, has now become domestic. The Balfour Committee on Industry and Trade estimates that the existence of the Irish Free State resulted in an apparent inflation of the quantum of British exports in 1924 by 6%, and it is probable that on balance the result of the new territorial divisions has been to raise the foreign trade statistics by the inclusion of a net amount of exports and imports which in 1913 would have been domestic trade.

The Distribution of International Trade

Although the total quantum of world trade in 1924 was probably not much less than before the War, the share which the various countries of the world could claim therein was widely different. The first place in the list of exporting countries had been surrendered by the United Kingdom to the United States. The exports of Canada, Japan, China, Cuba, the Dutch East Indies, Mexico, New Zealand, Hawaii, Colombia, all more than doubled during the period. The German percentage fell from 13·1 to 5·7; that of Belgium from 3·8 to 2·4; that of Russia, after raising the Russian values which are expressed in terms of pre-War prices by the approximate average rise in gold prices, namely 50%, from about 4·2% to about 0·9%. The share of the United Kingdom was likewise slightly reduced from 13·97 to 12·96%, or if the necessary adjustments be made on account of trade with the Irish Free State probably to about 12·2%. On the other hand, India and the British dominions, with the exception of South Africa, gained ground. The percentages of the more important trading divisions of the British Empire may with advantage be grouped together.

Percentages of World Totals

	Imports		Exports		Total Trade	
	1913	1924	1913	1924	1913	1924
United Kingdom	16·49	17·89	13·97	12·96	15·27	15·47
India	3·01	2·67	4·22	4·35	3·60	3·49
Canada	3·18	2·80	2·36	3·94	2·78	3·36
Australia	1·95	2·28	2·05	2·32	2·00	2·30
Straits Settlements	1·32	1·55	1·16	1·45	1·24	1·50
Union of South Africa	1·03	1·03	1·73	1·37	1·37	1·20
New Zealand	0·52	0·76	0·56	0·84	0·54	0·80
Ceylon	0·31	0·35	0·41	0·45	0·36	0·40
Federated Malay States	0·23	0·18	0·41	0·41	0·32	0·29
Total	28·03	29·51	26·87	28·09	27·48	28·81

Thus the total share of the British Empire, exclusive of the smaller Crown colonies, etc., slightly increased. The British percentages are based on the published official figures without adjustments on account of Irish trade. Their contraction and the considerable augmentation of Canadian and New Zealand trade is typical of world movements and the shift of the centre of gravity towards America and the economically younger countries of the world.

The change in the contribution of different quarters of the globe to the totality of world trade may be conveniently summarised by showing the percentage distribution of world trade by continental groups.

Percentage Distribution of World Trade

	Imports		Exports		Total	
	1913	1924	1913	1924	1913	1924
1. Central and Eastern Europe (included in [2])	21·28	14·52	21·57	12·16	21·43	13·35
2. Europe	61·69	55·73	55·39	45·17	58·64	50·55
3. North America	12·20	15·31	15·56	20·31	13·81	17·76
4. Caribbean	2·06	2·58	2·68	3·91	2·36	3·23
5. South America	5·64	4·68	6·67	6·57	6·14	5·62
6. Africa	3·94	3·78	4·05	4·26	4·18	4·02
7. Asia	11·96	14·84	12·63	16·58	12·29	15·68
8. Oceania	2·51	3·08	2·66	3·20	2·58	3·14
Total 2–8	100	100	100	100	100	100

The division of the states or trade statistical areas into the groups given is necessarily more or less arbitrary and opinion may well differ concerning the group into which this or that island should be placed. The first division is supplementary to the others and consists of Austria, Bulgaria, Czechoslovakia, Estonia, Germany, Hungary, Latvia, Lithuania, Poland, Rumania, Russia and the Kingdom of the Serbs, Croats and Slovenes in 1924 and of Austria-Hungary, Bulgaria, Germany, Rumania, Russia and Serbia in 1913. Its share in world trade in 1924 had shrunk to about 62% of what it was before the War, despite the increase in the number of trading units.

The European contraction is largely due to the great diminution in the international exchange of goods in the eastern and central countries; but the rest of Europe had not quite recovered its position in this year. There has been a definite shift from the Atlantic Ocean to the Pacific and that group of countries, the United States of America, Canada, Japan, China (in 1924) New Zealand and Australia, whose prosperity accounted in so great a degree for the elevation of the total volume of trade in 1924 towards the pre-War level, have tended to trade more with each other. This tendency may be illustrated by showing the distribution of the trade of certain of these countries by continental groups.

Exports—Percentage Distribution

From:	To:	Europe	N. America	Caribbean	S. America	Africa	Asia	Oceania
U.S.A.	1913	60·4	16·5	7·7	5·9	1·1	5·1	3·3
	1924	53·3	13·9	9·9	6·9	1·5	11·2	3·4
India	1913	57·9	9·5	0·4	2·0	2·8	25·3	2·0
	1924	50·9	9·5	1·3	2·2	5·8	28·2	2·1
Canada	1913	54·7	39·0	1·8	0·9	1·0	1·1	1·5
	1924	47·9	40·5	2·3	1·9	1·1	3·7	2·6
China	1913	25·2	9·2	0·0	0·0	0·0	65·4	0·1
	1924	18·0	13·4	0·0	0·1	0·0	68·4	0·1
Australia	1913	77·6	3·6	0·0	1·1	3·7	9·3	4·7
	1924	66·0	6·2	0·0	0·1	3·8	18·2	5·7

If the imports be analysed in the same way, or the distribution by countries instead of by continental groups be taken, confirmatory evidence of this shift of trade towards the Pacific Ocean will be obtained.

There is no doubt, however, that European exports were appreciably greater in 1924 than in 1923 or 1922 and since 1918 a marked change has taken place in the balance of exports and imports. This change is illustrated for certain countries below:—

Exports as a Percentage of Imports

	1913	1919	1924
Belgium	73·6	43·9	79·2
Czechoslovakia	..	81·2	107·2
Denmark	81·9	30·4	90·4
Finland	81·3	35·1	105·4
France	77·8	33·1	103·6
Germany	91·0	31·1	70·5
Italy	70·7	36·5	73·8
Netherlands	78·7	52·5	75·8
Norway	69·6	28·8	68·3
Rumania	112·7	2·8	105·8
Russia	110·6	0·01	116·0
Sweden	95·2	61·3	92·3
Switzerland	71·3	92·1	85·1
United Kingdom	80·1	54·6	72·1
Argentina	103·6	149·8	124·7
Australia	98·5	111·7	84·6
New Zealand	103·2	179·5	108·5
South Africa	155·8	200·2	118·7
Canada	71·8	116·3	135·7
U.S.A.	138·8	209·3	117·5

The gap between the total of exports and imports may be covered in a number of different ways (*see* Balance of

PAYMENTS); but in the majority of cases the most important factors are capital borrowings, loans, interest on loans and freight. In 1919 Europe was living to a large extent upon money borrowed in the United States of America and upon short term credits advanced by countries producing raw materials. By 1924 much more normal conditions had been restored. The younger countries of the world showed a slight excess of exports on account, not of credits they were advancing, but of interest payments on old loans; and Europe showed a balance of imports and exports not greatly dissimilar from the pre-war balance.

For a number of countries it is possible to obtain an approximate idea of the changes which have taken place in the quantum of their commerce by dividing the statistics of trade by value by the trade price indices discussed above. The results are necessarily not exact, but in most cases they probably give a correct indication of the direction of recent movements.

		1913	1919	1920	1921	1922	1923	1924
Denmark	Import	100	90	88	91	113	129	130
	Export	100	35	76	90	97	131	134
Finland	Import	100	67	53	55	75	102	99
	Export	100	49	69	69	94	95	113
Germany	Import	100	..	37	53	59	45	63
	Export	100	..	37	(44)	61	53	51
Norway	Import	100	159	146	88	103	107	105
	Export	100	68	90	66	94	98	105
Russia	Import	100	..	3	15	20	11	16
	Export	100	..	0	1	5	14	20
Sweden	Import	100	109	123	78	91	118	133
	Export	100	62	77	53	82	81	93
United Kingdom	Import	100	88	88	74	86	96[1]	107[1]
	Export	100	55	71	50	69	77[1]	80[1]
	Re-export	100	78	90	78	81	86[1]	96[1]
	Total Export	100	59	74	55	71	78[1]	83[1]
Canada	Import	100	79	85	77	78	87	81
	Export	100	123	111	105	151	175	161
U.S.A.	Import	100	..	129	112	141	146	142
	Export	100	..	129	106	99	97	110
Uruguay	Import	100	86	100	79	85	(109)	123
	Export	100	119	69	83	96	108	106
Japan	Import	100	..	..	142	160	146	162
	Export	100	..	..	113	134	110	140

[1] Approximate adjustments for the Irish Free State would give:—

	Imports	Exports	Re-exports	Total Exports
1923	93	75	81	76
1924	104	76	90	78

A British Enquiry.— The (Balfour) Committee on Industry and Trade draws attention to the possibility that the British indices of the quantum of trade "give somewhat too dark a picture of the recent and present trade position. . . . There is ground for belief that some part of this wide divergence is due to a shift of export trade towards the higher and more expensive qualities of goods, which could not be fully taken into account in the calculation. . . . Exactly how much of the apparent rise is referable to this cause is difficult to estimate, but the available indications would seem to support the view that the true rise of the level of export prices has not exceeded 80%. If the consequential modifications were made in the figures given above, we should find that the volume of our exports in 1923 was 79% of the 1913 volume and that the corresponding figure for 1924 was 80%. Meanwhile the volume of our imports in the same two years was 94·9% and 106·4% respectively of the 1913 volume."[1]

[1] The word "volume" in the quotation is used in the same sense as "quantum" elsewhere in this article, *i.e.*, to mean value corrected for changes in price.

These revised percentages refer to the figures given in the footnote to the table above adjusted for the change in the status of the Irish Free State. The reduction in the British quantum export index is in part offset by an increase in the average price of the exports greater than the rise in world prices. The same fact is true of Sweden and Switzerland and countries which like the United Kingdom slowly brought their currencies back to par with the dollar by a painful process of protracted deflation.

Although the recovery from the after-effects of the War was not complete, great progress has been made since the slump of 1921. Thus the quantum of exports, (*i.e.*, the recorded values divided by the trade-price index) of Denmark increased between 1922 and 1924 by 38%, of Finland by 20%, of Norway by 12%, of Sweden by 13%. With the rise in prices in Germany towards the world level during the last stages of inflation and after the stabilisation of her prices, there was a contraction in the quantum of her trade, a contraction, however, which was more than counterbalanced by the higher prices at which she sold her wares. For France there is no quantum index, but her trade has grown steadily and is now greater than before the War.

The picture which the present state of world trade presents is similar to that which would be obtained from an array of the facts relating to the production of raw materials, or cereals or any other indicators of national prosperity. Europe and European production has been affected to some extent by agrarian reform, by tariffs and prohibitions, by the social revolution in Russia. But the main cause of the change in the balance of importance of the great continental groups into which the world is divided is that whereas elsewhere the normal progress of a decade has been achieved, Europe has still not recovered from the War and all the economic ills to which the War gave birth.

See also BALANCE OF PAYMENTS, and the sections on trade and industry in the articles on the various countries.

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(A. LY.)

TRADE BOARDS.—In Great Britain a trade board is a statutory body set up by the Board of Trade or since 1918 by the Ministry of Labour for the purpose of fixing minimum rates of wages in the industry for which it is established. Under the Trade Boards Act of 1909 trade boards were set up in eight trades, but the scope of this Act was greatly widened by an amending Act of 1918 with the result that at the end of 1920 additional trade boards had been set up in 49 trades covering about 3,500,000 persons. The Act of 1909 resulted from a long and sustained agitation, following the revelations as to the earnings and general working conditions of "sweated" workers, which were made in the late years of the last century and the first years of the present. The public conscience was stirred and action was motived by the humane desire to afford some protection to those suffering under the "sweating" system. While the prime motive was humane, the sociological and economic arguments for the protection demanded were not, of course, overlooked.

Regulation of Wages.—The humane case for the prevention of sweating does not need elaboration. The sociological and economic arguments are interdependent and are based on the view that any industry must, if it is to maintain an economically sound position, pay to the workers engaged in it wages sufficient for the maintenance of those workers and their families. Failure to do so means that the industry concerned is subsidised by Society ("Society" including other industries), in so far as the workers employed in it ultimately become a charge on the State. The charge may be direct, by way of more than normal calls on the public health services, free school meals, or, often enough, through the Poor Law itself, or it may be indirect, taking the subtle form of the mental, physical and spiritual degradation of the workers and citizens who are "sweated."

The decision to legislate against "sweating" is, however, only the beginning of the problem, and several important questions as

to the means to be adopted remain to be settled. Is there to be one minimum for all the trades concerned or a separate minimum for each trade? If separate minima are to be fixed, what bodies shall be the fixing authorities? Is the minimum to be a guaranteed income or only a guaranteed rate of wages? On what basis shall the minimum be fixed? What shall be the relation between men's and women's wages? Shall district variations in the cost of living or the nature of the work be taken into account in fixing the minima?

The multiplicity and diversity of these questions led to the conclusion that it was impossible to fix one minimum to apply equally to all "sweated" trades and, this being recognised, it was clear that each minimum might best be fixed by a body constituted of persons drawn from the trade itself. Thus trade boards were established consisting of equal numbers of employers' and workers' representatives, together with a small quota of neutral persons in order that a deadlock might be avoided. It was equally clear that the question of a guaranteed income could not be considered in relation to a comparatively small and ill-conditioned group of trades only, and hence the boards were empowered to fix, not guaranteed wages, but minimum rates of wages.

On whatever basis the trade boards may choose to fix their rates—and on this point the Acts give no specific guidance—the rates fixed are to be regarded strictly as *minimum* rates, to pay below which is an injustice to be remedied by the criminal law. Thus there is nothing of the system of compulsory arbitration in trade boards. Any worker, or his trade union on his behalf, is free to get as much more than the trade board rate as he can. But an employer may not pay less.

The remaining questions were referred to the boards for settlement, and thus have been dealt with in accordance with the customs and circumstances of each trade. There can be no doubt that this was the wisest course and the one likely to cause least disturbance and friction in the trades concerned.

It has been noted that the Acts give no specific guidance to the boards as to the basis on which rates of wages shall be fixed. In some other countries in which minimum wage legislation is effective, principles for the fixing of such wages have been laid down more or less precisely by the legislature or have been formulated in the course of practice, but in Great Britain the boards have only the known intention of the Acts to guide them. Parliament, however, retains some control over rates fixed through the Minister of Labour, by whom all rates must be confirmed before they become operative. It is an important point, however, that the Minister's power is restricted to the confirmation or reference back to the board of rates submitted to him. He may not alter any rate submitted to him, nor may he fix a rate, and thus, subject only to the veto of the Minister, the power to determine precisely what rate shall operate lies solely with the Trade Board.

As might be expected, the workers' representatives on the boards lay stress on the "living wage" argument in the proceedings of the boards. Employers' representatives pay chief regard to "what the trade can bear." It is the task of the independent members, with the intention of the Acts in mind, to bring about some compromise acceptable to both sides, or in the last resort to vote with one side against the other. As a result of this procedure the rate which is fixed may not produce in the full sense of the term a "living wage." Particularly is this the case in the early stages of a Trade Board, when the immediate fixing of a rate which would adequately fulfil the purpose of the Acts might cause disturbance of employment. In such cases, the final rate may be reached in two or more stages. In this way the trade board system enables the circumstances of each separate trade to be considered when the rate is fixed. Each trade moreover, is able to vary its own minimum rates at any time without waiting upon the remaining trades. Again, the flexibility of the trade board system permits of the adjustment, in accordance with the prevailing customs of each trade, of the relation between men's and women's wages. While, owing to varying customs, there are some exceptions, in general the rates fixed for women will be found to be round about 60% of those fixed for men, which is in accord with the prevailing custom of industry as a whole. A few, but only a few, of the boards have taken into account variations in the cost of living in different districts and have accordingly fixed varying rates for London, the larger centres of population and rural and other areas.

Basis of Wage Rates.—In view of the intention of the Acts the levels of the rates fixed are themselves of some interest. The best standards by which the rates may be judged are, perhaps, Mr. Seebohm Rowntree's "poverty line" and "human needs" figures. It will be found that the majority of trade board rates fixed for the lowest grades of workers in the trades concerned fall much nearer to the "poverty line" than to the "human needs" figure. In a very few cases only does the rate reach the latter figure. This fact leads to the consideration of the nature of the rates for "special classes" fixed by rather more than half the Boards.

These rates, higher than those fixed for the lowest grades of workers, apply to workers in skilled occupations. While such rates are still minima for workers of the class to which they apply, they may, but do not necessarily, diverge from the strictest form of the minimum wage and tend to encroach upon the field of general wage regulation. Indeed, as will be seen from a comparison of the basis of the 1909 Act with that of the 1918 Act, the spirit of the latter Act was considerably broader than that of the earlier, and was intended to meet the recommendation of the Whitley Committee that trades not sufficiently organised for adequate self-government should be provided with the means of regulation by the establishment of Trade Boards. The Act of 1909, however, remains the "principal Act," and within the narrower limits of the intention of that Act there is scope for the fixing of differential minima for the varying grades of workers within a trade.

Mr. Rowntree's "poverty line" figure (pre-War) was 26s. per week for a man. His "human needs" figure was 35s. 3d., thus leaving the substantial figure of 9s. 3d. per week as a margin between the necessities of the merest animal existence and the rather austerely reasonable needs of a human being. Owing to the rise in the cost of living this margin would be nearly twice as great in 1926. It is hardly tenable that the purpose even of the Act of 1909, much less that of 1918, was limited to the fixing of "poverty line" wages where the trades concerned could reasonably pay something more, if only to skilled workers. Where, therefore, as has happened in the case of most of the boards, the lowest rate fixed has been much nearer to the "poverty line" than to the "human needs" figure, a board may, without departing from the strict principles of the minimum wage, proceed to fix higher rates for workers of greater skill than the lowest grade up to the level of the latter figure. This view appears to be upheld by the clause of the Agricultural Wages Regulation Act of 1924—the only case in which Parliament has given guidance as to the basis on which minimum wages should be fixed—which provides that "in fixing minimum rates a committee shall, so far as practicable, secure for able-bodied men such wages as in the opinion of the committee are adequate to promote efficiency and to enable a man in an ordinary case to maintain himself and his family in accordance with such standard of comfort as may be reasonable in relation to the nature of his occupation."

In so far as trade boards have fixed special rates which range beyond the "human needs" figure, it may be admitted that they have begun to enter the field of wage-regulation rather than minimum wage-fixing. Such rates, however, are unusual, are almost invariably agreed between the employers' and workers' representatives on the board, have been fixed for the convenience of the trade as a whole and have resulted in the prevention of friction which might otherwise have occurred between employers and employed. (J. J. M.)

TRADE CYCLE.—The phrases trade cycle, business cycle and cyclical fluctuation of trade are all convenient methods of labelling those alternating upward and downward sweeps in the vol-

ume of business activity which have constituted, for at least a century and perhaps more, one of the outstanding phenomena of the modern business world. The most obvious manifestations of the trade cycle are a quasi-rhythmical fluctuation, extending over several years, in the level of prices, the level of money profits and the level of employment.

In the absence of satisfactory statistics, it is difficult to be sure how far there occurs a corresponding fluctuation in the level of production and consumption, *i.e.*, in the real income of the community affected. While it is certain that these latter quantities fluctuate to some extent, it seems probable (*a*) that the fluctuations in output are less intense than the fluctuations in prices, (*b*) that the output of ordinary goods for immediate consumption fluctuates as a rule far less than the output of instrumental or constructional goods (typified by iron and steel), and (*c*) that the fluctuations in output do not entirely synchronise with the fluctuations in prices, but that, in the later stages of a "boom" of prices, production may cease to make any significant advance, while in the later stages of a "depression" of prices production may make a marked recovery.

Nor is it safe to dogmatise about the length of the trade cycle, or about the degree to which its phases synchronise in the leading industries and the leading industrial countries. Before the War there were indications that the normal period of the cycle had shortened from about 10 to about 6 or 7 years. The dates of "crisis" or turning-point from boom to depression, during the past century, are for England 1825, 1836, 1847, 1857, 1866, 1873, 1882, 1890, 1900, 1907, 1913, 1920; while in the United States the booms of the late 'eighties and 'nineties were prolonged, somewhat precariously, to 1893 and 1903 respectively. Again, the post-War boom, which in England and America broke in 1920, was prolonged in Germany till 1923; and while the recovery in America from the great slump of 1921 has been rapid and complete (with a slight set-back in 1923), recovery in England has been partial and slow. Again, the change-over from depression to prosperity, or prosperity to depression, does not affect all trades at the same moment, or even effect these in the same order.

In the main, however, it still seems to be fair to describe the trade cycle both as a *general* movement and as a rhythmical one; and any explanation of its causes must take these two factors into account. Very many such explanations have been offered,—too many to expand or criticise fairly in the course of a short article. It must be enough to set out and classify certain roads of thought, as it were, along which economists have been led to travel in search of the truth. It must be understood that these roads are not mutually exclusive, but that they intersect and partially coalesce, so that most writers traverse parts of more than one of them. Any comments made must be taken to reflect the tentative views of an individual writer and not to embody the *ex cathedra* pronouncements of economic science, which in this matter, as in so many others, are still to seek.

Four Methods of Approach

The Psychological Approach.—The first road leads into the domain of psychology. We are invited to find the chief explanation of the trade cycle in the nature of Man himself, and especially of those men who are responsible for conducting and controlling the operations of modern industry, commerce and finance. These business leaders are bound together not only by their business dealings but by ties of sentiment and environment: they operate, necessarily, in an atmosphere of uncertainty: and any error of forecasting which they make, whether of an optimistic or of a pessimistic kind, is apt to be magnified by their mutual contact into a great wave of erroneous judgment, which gathers strength for a time and then breaks, yielding place to an equally exaggerated movement in the opposite direction. There seems to be little doubt of the importance of this factor both in aggravating the amplitude of the trade cycle and in moulding it into its quasi-rhythmical shape. But we must be on our guard against supposing that all decisions made by business men to vary the scale of their purchases or their output are erroneous. Many such decisions are clearly in the true interest of those who make them, if not of society as a whole. And it may be incumbent on us to enquire whether even erroneous decisions did not have their starting-point in some real and rational cause.

The Monetary Approach.—The second road leads into the tangled wood of monetary theory. Those who follow it lay stress on the dependence of the scale of industrial activity on the general level of prices, and on the dependence of the latter, in its turn, on the monetary policy of the Govt. and the banks. The independent leaders of business are advantaged during a period of rising prices, because the rise in many of their money costs of production (such as debenture interest, salaries and in some degree wages) lags behind the rise in their money receipts. They are accordingly both enabled, and furnished with a real inducement, to expand the scale of their operations: and owing to their habit of concentrating their attention on the movement of the price of *their own products*, the inducement is likely to seem greater to them than it actually is. Conversely, in times of falling prices, business men are both disadvantaged by the relative fixity of some of their money costs, and believe themselves to be more disadvantaged than they are: and they are impelled therefore to contract the scale of their operations. These price-movements, if left unchecked, act *cumulatively* in both directions; for as long as prices are expected to go on rising, business men continue to rush in to buy; and as long as prices are expected to go on falling, business men continue to liquidate their stocks of goods, and to refrain from replenishing them.

Now modern currency and banking systems, even when anchored to a gold standard, are of such a kind that, unless consciously operated with another end in view, they permit considerable play to these price movements. Indeed they exaggerate them by displaying an excessive timidity in altering those rates of interest whose magnitude has an important effect in determining the volume of loans issued by the banks, and consequently the volume of purchasing power put, in the form of cheque currency, into the hands of the public. In the last resort, therefore, it is held, both the unhealthy activity and speculative excesses of the period of boom, and the wasteful stagnation of the period of depression, are due to a faulty loan-policy on the part of the banks, or a faulty currency policy on the part of the Govt. or a combination of the two.

One objection to this explanation in its cruder forms is that the level of prices depends not only on the quantity of purchasing power issued to the public by the Govt. and the banks, but on the willingness of the public to *use* the purchasing power when it has got it; and that it does not seem certain that this latter factor, especially in a time of deep depression, when everybody is determined to hoard money rather than spend it, is entirely explicable in monetary terms or controllable by monetary means. Nevertheless, there seems little doubt that a monetary policy consciously aimed at keeping the general price level approximately stable, would do a good deal to damp down the violence of the trade cycle; and a policy of this kind has apparently been followed with some success by the Federal Reserve Board in the United States during the years 1922–5.

Instabilities inherent in an Economic Process.—The third and fourth groups of roads lead to an examination of certain *real*, as opposed to merely monetary or psychological, features of modern industry. The third group runs through a landscape of *physical* and *technical* features, the fourth through a landscape of *legal* and *social* ones. Let us consider the former by asking the question, "What rational reasons are there why industry as a whole should automatically increase and diminish the scale of its output?" and glancing at three possible lines of reply.

(1) Because of a self-renewing rhythm in its real costs of production. During the later stages of a depression there is a progressive advance in the effectiveness of labour, a progressive writing-off of inflated capital charges, a progressive overhauling of methods of technique and organisation, which breed renewed activity. During the later stages of a boom there is a progressive recourse to inferior instruments of production, a progressive utilisation of over-tired and recalcitrant labour, wasteful methods of management and inferior business leadership, which ultimately breed collapse.

D'ABERNON, EDGAR VINCENT, 1st Viscount (1857–), British diplomatist, was born at Slinfold, Sussex, Aug. 19 1857, the youngest son of Sir Frederick Vincent, 11th Bart., of Stoke D'Abernon, Surrey. He was educated at Eton and entered the army, but in 1880 was appointed private secretary to Sir Edmond Fitzmaurice, then commissioner for Eastern Rumelia. In 1882 he was sent to Constantinople as the representative of Great Britain, Holland and Belgium on the council of the Ottoman public debt, of which in 1883 he became president. In 1883 he went to Cairo as financial adviser to the Egyptian Govt., remaining there until 1889, when he returned to Constantinople as governor of the Imperial Ottoman Bank, a post which he resigned in 1897. In 1887 he received the K.C.M.G. Sir Edgar Vincent entered Parliament in 1899 as Conservative member for Exeter, but lost this seat in 1906. In 1914 he was raised to the peerage as Baron D'Abernon, and during the World War was chairman of the Central Liquor Control Board. From 1920 to 1926 he was ambassador to Germany and in that capacity did much to pave the way for the Locarno Pact. In Jan. 1926 he was made a viscount.

DACCA, UNIVERSITY OF.—The creation of the University of Dacca was due to the desire of the Govt. of India to provide increased educational facilities for the Mussulmans of Eastern Bengal, to set up a new residential and teaching type of university and to relieve the congestion of the (affiliating) University of Calcutta. After reports from a special committee in 1912 and the Calcutta University Commission in 1919, it was opened on July 1 1921. The university has fine buildings, inherited in part from the former Govt. of Eastern Bengal and Assam, in part from the Dacca Colony, founded in 1841 and an estate of nearly a square mile, with large playing fields, three residential halls, well equipped chemical and physical laboratories, and residences for the staff. The constitution is similar to that of the English provincial universities, but on the residential side it is more akin to Oxford and Cambridge. There are about 85 teachers and 1,500 students (1926); research is carried on in all the departments and a high standard is maintained in the examinations. The library contains about 44,000 volumes.

DAHN, JULIUS SOPHUS FELIX (1834–1912), German historian (*see* 7.734), published the final volume of *Die Könige der Germanen* in 1911. He died at Breslau Jan. 3 1912.

DAHOMEY (*see* 7.734).—This French colony extends from the Gulf of Guinea to the Niger, and includes a much greater area (41,302 sq. m.) than the old kingdom of Dahomey. The last ruling chief was deposed in 1911. The population in 1925 was estimated at 1,000,000. Europeans number about 800. Some 65% of the natives inhabit Lower Dahomey, which is but one-third of the area of the colony. The principal railway runs from the coast at Kotonu, parallel to the Nigerian frontier, to Savé (162 miles). Thence a metalled road, over 300 m. long, connects with the Niger at Mladekali. Palm oil and palm kernels remain the chief source of wealth. Oil palms cover an area of about 600,000 acres. Maize is a growing export from the colony. (*See* West Africa, French.)

DAIL EIREANN: *see* Irish Free State.

DAINGERFIELD, ELLIOTT (1859–), American painter, was born at Harper's Ferry, Va. (now W. Va.), March 26 1859. He received his early education at Fayetteville, N.C., and went to New York City in 1880 to study art. He exhibited first at the National Academy of Design in 1880. Among his best known pictures are "Christ Stilling the Tempest" and "Slumbering Fog," in the Metropolitan Museum, New York City; "Storm Breaking Up," in the Toledo Museum; "The Child of Mary," in the National Gallery, Washington; "The Midnight Moon," in the Brooklyn Museum; "The Valley of the Dragon," in the Chicago Art Institute. He executed the beautiful mural decorations in the Lady Chapel of the church of St. Mary the Virgin, New York City.

DAIRYING (*see* 7.737).—Modern scientific research has led to remarkable progress in the technical side of dairying. Agriculture, physiology, veterinary medicine, physics, chemistry, biology, bacteriology, mechanics, alimentation and sociology have been drawn upon in turn, with the results already seen at the last international dairying congress at Washington (Oct. 2–10 1923), at the international cattle breeding congress at Scheveningen (Aug. 28–Sept. 4 1923), and at the international dairying congress in Paris (May 17–19 1926).

The following are some of the sections in which progress can be reported:—

Milk Recording.—The keeping of careful records as to the quantity and quality of the milk produced has inaugurated a new era in the improvement of dairy herds. The system was first put into practice in Denmark, Germany, England, Holland, Switzerland and the United States, but an enquiry undertaken by the International Institute of Agriculture shows that it has become general in progressive agricultural countries. The work of the milk and butter recording societies has facilitated the decision of certain very important points with regard to the selection of breeding animals. The study and analysis by Gowen, Kroon, Frateur, Leroy, White, Per Tuff, Van de Plank and others of the data given in the herd books has made it possible to state definitely:—

1. that the production of milk and butter does not increase indefinitely with the increase in the ration, but reaches a fixed maximum according to the individual capacity of the animal;
2. that the fat content of the milk of a given cow remains constant during her entire milking period;
3. that hereditary milk and butter yielding qualities are compatible with the production at an early age of a well developed frame bearing meat of good quality;
4. that these qualities are transmitted to the following generation, by the male equally with the female, and that it is therefore possible to produce a breeding bull, which would be the sire of a line of milk and butter givers; and
5. that if rationing is carried on on scientific lines, the animals with mediocre yields may be eliminated from reproduction, and those with high yields selected and bred in to carry on the herd.

Heredity.—The evolution of ideas on the doctrine of variation and selection has brought out the extreme importance of the individual in selection and the necessity of careful investigation of his or her qualities both from the point of view of breeding and rearing and from that of heredity. By this must be understood the estimation of the points of an animal, of their value from the breeding point of view and of the measure in which the hereditary disposition towards those points can be transmitted with certainty to the descendants, together with the probable reaction of this hereditary disposition to environment. Careful consideration must therefore be given to:—

1. the animals as individuals;
2. the information to be had with regard to their heredity, and their milk production; and
3. the following up and the appraisement of their descendants.

In this manner there has been created a new system of improving our dairy herds; *i.e.*, selection according to the results furnished by milk-recording, the examination into ancestry and the estimation of progeny. Thus arises the importance of the information derived from pedigrees. This question of the herd books has been closely studied by Wibbens, Baashuus, Jessen, Seymour, Marcq, Jaroslaw, Krizenecky, Peters, Van Damme and by many American investigators, who have gone carefully into the available information and figures. It would seem desirable that these herd books should be kept on an international system, so that the information given with regard to individual animals should be as complete and recorded as much on the same lines as possible.

A close study of the Mendelian theories has decisively proved that a hereditary disposition towards most of the different morphological and physiological qualities remains an independent factor in the development and that, by a fixed law, the

new hereditary attributes introduced by a cross undergo in the following generation a sort of segregation. This leads to a conclusion which is very important from the point of view of animal breeding; *i.e.*, the theoretical possibility of a systematic combination of characteristics and qualities formerly diffused among different races and different hereditary types. We realise, in short, the possibility and even the most practicable method of creating by means of crosses, new hereditary types, and even new races.

It has also been proved that the method of reproduction by in-breeding, leads automatically to the increase of hereditary predisposition and that it results in the definite fixing of the desired strain. The undesirable consequences of in-breeding which show themselves particularly in the new bovine races, and in those in which it has not formerly been practised, may be immediately neutralised by the introduction of an out-cross. With regard to the various tables or notations employed to determine the intensity of the in-breeding, Wright's coefficient of reproduction is probably the best, since it shows the exact stage of in-breeding reached.

Feeding.—The researches of Fjord, Hansson, Nills, Fingerling, J. Wilson, Barron Morrison, etc., have made it possible to compare in detail the different systems of estimation from the point of view of production, of the various constituents of a given ration. The Scandinavian unit of nutrition, the starch equivalent of Kellner and Armsby's therms, must all be taken into consideration in any attempt to arrive at the essential nutritive value of a food-stuff. It has been proved that the productive value of a ration does not depend only on the animal and on the kind of production required, but also on the amount of assimilable protein, minerals and vitamines which the food contains. It is also influenced by the dietetic action of the particular blend, its flavour, its composition and by the quantity of the daily ration, as compared with the amount normally necessary to support life. The figures into which the intrinsic value for ration are translated are thus merely mean figures, which show the relative value, taking into account the kind of production that is required.

The discovery made by C. Eykmann and A. G. Voderman of the connection between the composition of decorticated rice and multiple neuritis in poultry and that between the composition of decorticated rice and beri-beri; that of Axel, Holst and Fröhlich with regard to the connection between scurvy and the diet; that made by Hopkins, McCollum, Wendel and Osborne concerning fat and water soluble factors (vitamines); the work of Hart, Mueller, Zilva, Golding, Drummond, Steenbock, Eckles, etc., on indispensable growth factors; and, finally, the discovery (to which the Germans Zuntz, Voeltz, Morgen, Windheuser and Ohlmer materially contributed) that the amino-acids derived from albuminoids are not interchangeable, have contributed to a new and important chapter in the science of dietetics.

New facts have also been brought to light with regard to the value and the effects of mineral substances, especially with regard to the metabolism of calcium. This latter discovery is due to the work of Browning, Forbes, Eckles, Meigs, Carry, Hart, Steenbock and Humphrey. This fresh information has directed attention to what are known as deficiency diseases. They have received much attention and can now be successfully dealt with. There should also be noted the progress made in the study of the food values of the various forage plants, the increase of knowledge with regard to the economic and physiological value of ensilage, and the question of electrified ensilage which has been specially studied in Germany by Kinzel, Kuckler, Schieblich, Schweizer, Mueller, etc.

Diseases.—Many diseases have been studied and important progress made towards their prevention and cure. Deserving of special mention are the researches of Theiler on trypanosomes, and sarcoptes, coccidiosis and diseases transmitted by ticks, those of F. S. Jones, J. Nathan, Frost, Nocard, Guillebeau, Savage, Smith and Brown, on diseases of the udder and their transmission by milking machines.

In the struggle against bovine tuberculosis in particular, important progress has been made almost everywhere, and especially in the United States. It has been proved that by means of public or private tuberculin tests (temperature tests, cuticle tests, eye tests, eyelid tests and intradermal tests) together with the isolation and slaughter of reacting animals and the disinfection of cowhouses, bovine tuberculosis can be slowly but surely conquered.

Mention should be made of a new method of treatment which has been studied for several years, galacto-therapy, or treatment by the milk itself, subcutaneously injected. It has been tried in numerous diseases, such as wasting fevers of cattle and pigs, gangrenous coryza, mammary affections, actinomyiosis or wooden tongue, and arthritis in foals. The injection is preferably made into muscular tissue, and the dose varies according to the species of the animal. It seems probable that its action is due to the fact that it introduces a foreign protein, which raises the proportion of disease-resisting elements, increases the number of leucocytes, and produces an important modification in the general internal economy. This new departure opens a fresh chapter in veterinary practice and in that department of medicine entitled colloidaltherapy (Dr. Windel and pupils).

Dairy Bacteriology and Biology are the two sciences which have most recently come to the assistance of the dairy industry. Their practical application is inseparable. The work of Gorini, Harthel, Burri, Orla Jensen and others has shed further light on the mammary microflora, their location in the parenchyma, their particular type, their qualitative and quantitative properties, their parasitic nature and their importance from the point of view of cheese making. There should also be mentioned the work of Orla Jensen on the systematic classification of the bacteria-producing lactic acid, that of F. S. Rettger, on the same organisms in relation to the type *Bacillus acidophilus*, the remarkable progress made as a result of the use of pure cultures in the manufacture of cheese, fermented milk, butter, etc., the work of Gorini on the regulation of the fermenting processes in cheese, and the influence of the lactic acid-forming bacteria on its ripening.

In conclusion, we must refer to the evolution of scientific knowledge concerning refrigeration, sterilisation, pasteurisation, the preservation of milk by concentration and by a drying process, the work of lactic ferments, mycoderms and oidiums, both in fresh milk and during the cheese-ripening process, and affections of milk, butter and cheese.

Physiology.—In this section of dairy science, important progress has also been made, by the work of Porcher, Terroine, W. H. Jordan, F. D. Fuller, C. H. Eckles, Isaachsen and many others on the physiology of milk secretion and the mammary gland. Lesne, Vagliano, Stepp, McCollum, Osborne and Mendel have inquired into the vitamine content of milk. They have shown that the mammary gland has not the power to compose vitamines synthetically but extracts those contained by the feeding stuffs provided for the animal, and that the food given has a great effect on the composition of the milk from this point of view. They have also demonstrated the properties of vitamines, the amount of their resistance to heat, to outside air, to light, to long keeping and the value from the point of view of vitamine-content of boiled, sterilised, pasteurised, condensed, dried and homogeneous milk. Researches into the varieties in the quality of dried milk and into the fat content of milk have, in various ways, afforded new and valuable data for the students of dairying technique. *See* AGRICULTURE; FARM.

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(P. DI.)

(1) The improved organisation of and extension of trade unionism amongst "general workers" and women, in agriculture and on the railways, and in the public services and professions;
(2) The increasing importance of the trade unions in the community, and in the administration of legislation;
(3) The consolidation of trade union forces through the processes of amalgamation and federation;
(4) The growing authority of the executive body of the Trade Union Congress.

The policy of the trade unions and their attitude towards the problems of industry, have been influenced by many different factors, among them the abnormal conditions of War time and the post-War period (with its prolonged trade depression), the advent of a Labour Government, and developments of economic theory in the Labour movement.

Growth of Membership

Trade union membership increased before and during the World War, especially among women, the curve rising rapidly during its later years, and culminating in the peak period of 1920, after which it progressively declined during the years of depression, recovering during 1924.

Trade Union Membership

All trade unions, registered and unregistered, in Great Britain and Northern Ireland

Year	No. of Unions at End of Year	Membership (000's Omitted)		Total (000's Omitted)	Percentage Increase or Decrease on Previous Year
		Male	Female		
1913	1,266	3,700	433	4,133+	21·0
1914	1,256	3,707	436	4,143+	0·2
1915	1,226	3,865	491	4,356+	5·1
1916	1,221	4,014	626	4,640+	6·5
1917	1,234	4,618	878	5,496+	18·4
1918	1,254	5,321	1,209	6,530+	18·8
1919	1,346	6,595	1,325	7,920+	21·3
1920	1,358	6,988	1,340	8,328+	5·2
1921	1,241	5,610	1,003	6,613−	20·6
1922	1,190	4,712	868	5,580−	15·6
1923	1,135	4,590	815	5,404−	3·7
1924	1,155	4,720	811	5,531+	2·2

The highest degree of organisation amongst women is to be found in the cotton industry, where about 62% of the women workers are in the unions. In the bleaching and dyeing trades, which are closely associated with the cotton industry, 50% of the women are organised; in the boot and shoe trade 48%; in printing, paper and bookbinding, 36%; in the wool textile trades, 22%; in linen and jute 28½%. Amongst shop assistants and clerks, and in the food, drink and tobacco trades, on the other hand, which employ in all over 750,000 women workers, the degree of organisation is very small. Only 8% of the women shop assistants and clerks are members of unions and 2% of the female employees in the food, drink and tobacco trades.

Before the War the battle for the recognition of trade unionism was really won and the principles of trade unionism, which had been laid down primarily by the craft unions, were applied on the one hand by the larger body of semi-skilled and unskilled workers, and on the other hand by the "black-coated proletariat"—the salaried employees and professional people, such as public servants, draughtsmen, actors, commercial travellers, teachers and journalists.

After 1914 new organisations arose and others which existed precariously before the War were put upon a firm foundation. Some of the new bodies, such as the Bank Officers' Guild, have not as yet affiliated with the Trades Union Congress, but they nevertheless exist for avowed trade union objects. The National Federation of Professional, Technical, Administrative and Supervisory Workers was established in order to bring together for consultation and common action the various organisations of non-manual workers.

The steady growth in trade unionism before the War may be attributed partly to a trade prosperity and partly to a recognition amongst almost all grades and types of workers of the need for effective organisation. Certain legislation, such as the Trade Boards Act, 1909, and the National Insurance Act, 1911, strengthened the position of the trade union movement.

The increased membership during the War was partly due to the influence of higher wages—which invariably result in enlarged trade union membership. As the War went on, high hopes were held out of a brighter future for the workers; the workers themselves, whose services, the community had realised, were essential to the prosecution of the War, and to the satisfaction of the nation's needs, visualised more clearly their power in the State and saw in trade unionism a weapon to enable them to maintain in the time of peace the place their services had won for them in time of War. But there were other factors operating. Particularly in the munition trades, trade union membership became virtually compulsory. The Government itself, and a large number of employers actually encouraged workers in the larger industries to join a union. Towards the end of the War, the publication of the reports of the committee on employers and employed (better known as the Whitley Committee) and their adoption by the Government, gave a new importance to the organisations of employers and workers, and in their desire to promote the establishment of joint industrial councils (and interim industrial reconstruction committees, when the joint industrial council was not possible), members of the Government emphasised the importance of effective organisation. (*See* Industrial Relations.)

As a consequence of these various influences, between the early days of the War and the year 1920, the membership of trade unions doubled, reaching the figure of 8,328,000, of whom 6,988,000 were men and 1,340,000 women. During this time the number of women trade unionists was actually trebled. Similarly there had been phenomenal increases in the membership of unions catering for the less skilled workers. Before the War, what are known as the general labour unions had already become factors of some importance in the trade union movement. During the War period, their strength increased rapidly. The number of organised non-manual employes also rose much above the pre-War level, and included workers hitherto practically unorganised.

But just as rising wages are closely followed by a rise in the curve of trade union membership, so unemployment and falling wages are accompanied by a decline in it. The onset of the grave trade depression after the temporary post-War boom led to a decline of trade union membership amounting to 20% in the first 12 months and a further 15.6% in 1922, the total roll of trade unionists falling in two years from 8,328,000 to 5,580,000. The net loss on the previous year's figure was less than 4%, whilst during 1924 there was a net increase.

The backwash of the trade depression, and the disillusionment which followed the shattered dreams of post-War "Reconstruction" had spent themselves. The trade union movement had shed the temporary passengers, and those who entered its ranks through the abnormal influences of the War and early post-War periods; and a definite attempt to stem the tide and re-create a powerful trade union movement had begun to take effect. The established minimum trade union membership may be taken as being about 5¼ millions, an increase of over a million on the figures of 1913. The year 1924 saw a beginning of a slow but steady increase on this minimum, though there was a further small decrease in the number of women trade unionists.

Affiliated Membership of Trades Union Congress

	No. of Trade Unions	No. of Members
1911	127	1,645,507
1912	127	1,987,354
1913	135	2,217,836
1914	190	2,866,077
1915	192	2,677,357
1916	227	2,850,547
1917	235	3,082,352
1918	262	4,532,085
1919	266	5,283,676
1920	215	6,505,482
1921	213	6,417,910
1922	206	5,128,648
1923	194	4,369,268
1924	203	4,328,235
1925	203	4,342,982

The affiliated membership of the Trades Union Congress followed the general trend of the aggregate trade union membership as will be seen from the preceding table. Though in 1925 the affiliated membership was but two-thirds that of the peak year 1920, it was practically double that of 1913.

The broad distribution of trade union membership amongst the industries of Great Britain is indicated in the following table:—

	Number of Unions	Membership at End of 1924
Mining and Quarrying	113	966,031
Metal, Engineering and Shipbuilding	115	678,974
Textile	281	609,968
Building	48	335,334
Transport	49	1,028,348
Public Employment	272	318,765
Paper, Printing, etc.	24	187,087
Clothing	30	165,111
Woodworking, Furnishing	32	94,380
General Labour	20	511,206
All other	176	639,930

From 1924 onward the General Council has pursued a policy of propaganda, first by means of a national "back to the unions" campaign and then by special activities with a view to the spread of trade unionism amongst women agricultural workers respectively, whilst individual unions, though impoverished as the result of the long depression, renewed their efforts to secure an increasing membership.

Trade Unions and the Community

The growth of trade unionism has meant that the trade unions have become an integral part of our social machinery. This development has taken two main lines. In the first place, the trade union is now regarded as the normal machinery for the prevention and settlement of disputes. The State itself regards trade unions as responsible representative bodies. They are called into consultation by the Government in times of dispute, and their leaders are invariably the spokesmen and advocates of the workers before Courts of Enquiry set up under the Industrial Courts Act. They express the workers' point of view before Royal Commissions and Government committees, and the Labour members of such investigating bodies are drawn from the ranks of organised Labour. On the Whitley Councils in the Government services, the staff side is conducted by the representatives of the Civil Service unions. The joint industrial councils concerned with services in which local authorities are interested are, like all other such councils, composed on the workers' side of trade unionists. The trade unions have won for themselves a definite place in the system of "industrial government" and they are parties to the industrial agreements which govern the relations between employers and employed, lay down the methods of consultation and negotiation, and determine wages and working conditions.

Share in State Administration.—In the second place, the trade unions play an important part in the administration of certain legislation. When the Trade Boards Act, 1909, was passed it was applied to four trades in which trade unionism was weak, and at the outset the interests of the workers were in large measure in the hands of the National Anti-Sweating League and the Women's Trade Union League. But trade unions have since been extended to almost every industry. The Trade Boards Act of 1918, which amended and broadened the original Act, extended the minimum wage to trades to which hitherto the Act of 1909 had not been applied. (*See* Trade Boards.)

The recent growth of the general labour unions is partly due to the opportunities which the establishment of more trade boards has given them to organise the workers; particularly in the case of women workers, where, however, the increased trade union membership has been obscured since the War by the withdrawal from industry and from the trade unions of women who came into the labour market to make good the shortage during the War.

The Corn Production Act, 1917, set up agricultural wages boards on which the representatives of the unions catering for agricultural workers sat. The boards were, under the law, engaged in establishing binding rates of wages. The unions obtained a new status, and the Corn Production Act gave a new impetus to the difficult task of organising these workers. When the Act was repealed in 1921 the trade unions had nearly 300,000 members employed in agriculture. In 1924 the Labour Government re-established the system of wages boards, and the unions concerned are represented on the boards, and participate in the administration of the Act.

The National Insurance Act of 1911 opened the door to trade union participation in its administration. Part I. of the Act dealt with health insurance and provided, in general, for the payment of State benefit under the scheme by approved societies. Many trade unions formed trade union approved societies to administer the health insurance scheme, and these have become important agencies in the conduct of this vast system of social insurance. A National Association of Trade Union Approved Societies exists to protect the interests of the constituent societies, and played a prominent part in the opposition to Part I. of the Economy Act of 1926, which reduced the State contribution to health insurance. The insurance activities of the unions have not only associated them with the working of an important piece of legislation, but have consolidated, and in some cases strengthened, the position of the unions with their own members.

Part II. of the National Insurance Act, 1911, dealt with unemployment insurance, but the scheme was a limited one. Compulsory insurance against unemployment was widely extended by the Unemployment Act of 1920 to cover nearly 12,000,000 workers. Provision was made whereby trade unions which ordinarily distributed out-of-work pay to their members should, subject to certain conditions, be allowed to administer the State scheme, and pay the State benefit to their members, for which service the unions received an allowance. Many unions applied this provision of the Act, but the reduction of the administration allowance from 1s. per week's benefit paid to sixpence led to some unions ceasing to administer the Act. In 1926, however, there were 15 unions with a membership of 1,126,700 still operating under Sect. 17 the Act of 1920, and in order to secure a common policy on matters affecting their position under the Unemployment Insurance Acts, the unions concerned set up a standing committee, which acts in co-operation with the Trade Union Congress General Council.

On the local employment committees and juvenile advisory committees attached to the employment exchanges and on the juvenile choice of employment committees of local authorities, the trade unions are represented; whilst since the establishment of "uncovenanted" and "extended" benefit they have been actively associated with the employment exchange rota committees for the administration of this form of benefit.

War Work of the Unions

During the progress of the War the trade unions were intimately connected with the conduct of certain phases of national affairs. In March 1915 the Government came to an agreement (known as the Treasury Agreement) regarding the production of munitions, which included compulsory arbitration, the relaxation where necessary of trade union rules, and the limitation of profits in munitions industries. From then onwards, the unions were called upon to assist in accelerating the production of munitions, in administering certain of the controls which were instituted (such as those in the cotton and wool textile industries) and in the selection of men for war service. Parts of the Treasury Agreement were embodied in the Munitions Acts, and offences under these Acts, except such as were brought before the ordinary courts, were dealt with by specially appointed munitions tribunals. Each tribunal consisted of a chairman, with either two or four assessors, drawn equally from panels representing employers and workers respectively. These bodies played a great part in the administration of the Munitions of War Acts, and dealt with many thousands of cases against both employers and employees.

A National Labour Advisory Committee on War Output was established early in the War, together with local labour advisory boards in each munitions area. The National Committee was replaced in 1917 by the Ministry of Munitions Trade Union Advisory Committee, which was divided into three sections representing the engineering group, the shipbuilding group and the general labour group. A special women's trade union advisory committee was also appointed in the same year to advise the Ministers on all questions relating to women's work. Towards the end of the War, further steps were taken arising out of unofficial strikes in Coventry and Birmingham which, though speedily settled by the trade unions concerned, led to the appointment of a Government committee (on which there was trade union representation). This committee, which was critical of the policy of the Ministry of Munitions, recommended the establishment of a joint committee of employers and trade unionists, and the closest possible consultation, both nationally and locally, upon changes and developments of policy—a proposal which the Government accepted.

The recruiting of men for the army was in the early stages of the War left entirely to the War Office. But haphazard recruitment led to the crippling of essential industries, by the withdrawal of skilled men in considerable numbers, and to industrial unrest. It was, therefore, found advisable to bring trade unions into consultation on questions of recruiting. The recruitment of miners for the army was dealt with by committees composed of representatives of the miners and mineowners, with a chairman appointed by the Government.

Similarly, when the Government imposed its control over certain industries, the trade unions primarily concerned played an active part. The cotton and wool textile controls may be taken as an illustration. The cotton control board (set up in 1917) determined the amount of machinery which was to be run upon other than Government orders, and imposed a levy upon concerns working full time to pay out of work benefit to workers employed by firms suffering from the operation of the raw cotton order (which prohibited the purchase of cotton except under licence) and the control board. The wool control board, also instituted in 1917, consisted of eleven representatives of the trade unions, the employers and the War Office contracts department respectively. All wool was purchased by the Government and the board controlled the allocation of supplies and organisation of the civilian trade. When the consumers' council was set up under the auspices of the Ministry of Food, the trade unions were officially represented on it.

After the War, these various forms of organisation came to an end; but they had given a new standing to the trade union movement. Since 1918 the chief administrative activities of the trade unions have been in connection with Health Insurance, Unemployment Insurance and Trade Boards.

The Consolidation of Trade Unions

The movement towards consolidation of trade union forces which was very pronounced between 1911 and 1926, was partly the outcome of the theoretical teaching of syndicalism and guild socialism, but it was largely due to experience and the hard facts of economic life.

Federations have changed from loose alliances to negotiating bodies acting on behalf of the constituent unions. This development is seen in the case of the Engineering and Ship-building Trades Federation and the Miners' Federation of Great Britain, both of which have achieved responsibility for national negotiation. In Nov. 1910, on the initiative of the Dockers' Union, the National Transport Workers' Federation was formed comprising practically all the Unions catering for workers employed in waterside transport, including seamen, dockers and carters.

The Triple Alliance.—The Triple Industrial Alliance which came into existence in 1914 was, in effect, a federation consisting of the Miners' Federation of Great Britain, the Transport Workers' Federation and the National Union of Railwaymen; it was thus composed of two bodies which themselves were federations and a large industrial union. The associated bodies were the unions concerned in the key industries of coal and transport, and the formation of the alliance created some consternation. But the only occasion when the Triple Alliance decided to embark upon industrial action was during the coal stoppage of 1921, when the Alliance issued notices calling a strike in support of the miners. The notices, however, were postponed and then withdrawn on April 14 (Black Friday). The effect was to destroy the alliance, but the association of the railway, transport and mining unions continued, as they formed one of the " groups " constituted by the General Council of the Trades Union Congress. In 1925 attempts were made, largely on the initiative of the Miners' Federation, to establish a new alliance on a broader basis than the Triple Alliance; but as membership of the new alliance involved in some cases an alteration of the rules of certain unions, and as the implications of the proposed association needed careful consideration, the completion of the alliance hung fire, and certain unions definitely decided against co-operation.

Textile Trades.—In June 1916 the National Association of Unions in the Textile Trade was established. Of the 36 unions of which the Association is composed, 20 represent wool textile workers. The Association, however, includes, besides workers engaged in manufacturing and finishing processes, those engaged in the textile machinery trade, and the skilled workers engaged in the maintenance of plant. The Association appoints the workers' representatives on the joint industrial council of the wool textile industry. But the association also exists to promote trade union amalgamation in the industry, and to secure co-ordination in the case of disputes. In the summer of 1925, during the stoppage which occurred in the wool textile industry, the workers' side of the dispute was handled by the association and not by the separate unions, and when the dispute was referred to an industrial court, the workers' case was submitted by the association on behalf of all the unions concerned.

General Workers.—The General Labourer's National Council (established in 1908) developed in 1917 into the National Federation of General Workers, composed of the seven chief unions of general workers with an aggregate membership of over 800,000.

Building Trades.—The National Building Trades Council (representative of the 13 chief unions in the building industry) formed the basis for the National Federation of Building Trade Operatives established in 1918. This body has become the recognised organ for consultation and negotiation with the National Federation of Building Trade Employers. In 1925, however, the Amalgamated Union of Building Trade Workers withdrew from the Federation, which thus no longer represented the whole of the organised workers in the industry.

Foundry Trades.—Early in 1918 the Federation of Foundry Trades came into existence to promote amalgamation of the unions in the industry, deal with demarcation disputes, and secure joint action wherever possible. It included about a dozen unions with a total of between 50,000 and 60,000 members. Three of the unions in the federation—the Friendly Society of Ironfounders, the Associated Ironmoulders of Scotland and the Amalgamated Society of Coremakers, in 1922 merged to form the National Union of Foundry Workers.

The G. F. T. U.—The General Federation of Trade Unions has changed its character. It does not now take any active part in trade union disputes and negotiations or in the work of promoting closer industrial organisation. The G.F.T.U. was formerly the medium of communication between the British and Foreign Trade Union Movements, but since 1920 the General Council of the Trades Union Congress has been the representative British organisation in the international Federation of trade unions. The chief work of the G.F.T.U. is in connection with dispute pay. Contributing associations pay contributions to the Federation on the basis of their membership, and receive, when involved in a stoppage of work, benefit to be paid to their members. In 1925, there were 118 unions affiliated to the Federation with a total membership of 830,316 members.

The following table gives the number and gross membership of federations in Great Britain and Northern Ireland at the end of each year:—

Year	No. of Federations	Approximate Total Membership
1913	125	4,370,000
1914	137	4,730,000
1919	134	9,896,000
1920	114	10,744,000
1921	108	8,623,000
1922	93	6,232,000
1923	90	5,654,000
1924	87	5,331,000

Amalgamations

Trade union amalgamation was hampered by the Trade Union Act of 1876, which required that each of the organisations concerned should carry a motion for amalgamation by a two-thirds majority of the whole membership. In 1917, however, the legal requirement was reduced to a 50% vote. Some important amalgamations followed upon this alteration of the law.

The N. U. R.—One of the most striking amalgamations which was carried through prior to the Act was that which resulted in the establishment of the National Union of Railwaymen. Up to 1913, when it was formed by the merging of three independent unions, the railway unions had not yet won full recognition from the companies. The N. U. R. shares with the Associated Society of Locomotive Engineers and Firemen, which is a craft union, and the Railway Clerks' Association, the representation of railway employees, and with certain other unions, the representation of the workers in the railway engineering workshops. The N. U. R. illustrates both the tendency towards larger scale organisation, for its object is "to secure the complete organisation of all workers employed in or in connection with any railway in the United Kingdom"; and also the incomplete success it has achieved and the difficulties inherent in this policy. In time, the Associated Society of Locomotive Engineers and Firemen and the Railway Clerks' Association may possibly merge into the National Union of Railwaymen; but the organisations of the Engineers, Boilermakers, Carpenters and other railway shopmen, for which other unions cater, is one which raises a conflict of principle which has not yet been settled.

Iron and Steel Trades.—A new method of consolidation was adopted in the establishment of the British Iron and Steel and Kindred Trades Association and the Iron and Steel Trades Confederation in 1917. The former was, in effect, a new union, which the various participating unions influenced their members to join. These unions admitted no further members, all new members joining the B.I.S.K.T.A., and they transferred their powers to the Iron and Steel Trades Confederation, which conducts the work of organisation and negotiation. When all the members of the participating unions have been transferred to the B.I.S.K.T.A., it will assume the duties and powers of the confederation, which will then cease to exist.

Engineering Trades.—The Amalgamated Engineering Union, one of the largest post-War amalgamations, illustrates the consolidation of craft unions. The nucleus of the present union was the Amalgamated Society of Engineers, with which nine other craft unions engaged in engineering coalesced in 1920. The A.E.U. catered for skilled mechanics but has now opened its ranks to include other grades of workers.

Other Trades.—Jan. 1921 saw the establishment of the Amalgamated Society of Woodworkers, the nucleus of the new organisation being the Amalgamated Society of Carpenters and Joiners. In the same year, the Amalgamated Union of Co-operative and Commercial Employees and National Warehouse and General Workers' Union merged to form the National Union of Distributive and Allied Workers. The Amalgamated Union of Building Trade Workers formed at the beginning of 1921 was an amalgamation of the Operative Bricklayers' Society, the Manchester Unity Operative Bricklayers' Society and the Operative Stonemason's Society. In 1922, the Dock-Wharf, Riverside and General Workers' Union formed the nucleus of an amalgamation under the name of the Transport and General Workers' Union, uniting the National Union of Dock Labourers, the Scottish Union of Dock Labourers, the National Union of Vehicle Workers, the United Vehicles (which was an amalgamation of the Tramway Workers and the Licensed Vehicle Workers) and several other unions. Originally established as the Gasworkers' and General Labourers' Union, this union became the National Union of General and Municipal Workers, when in July 1924 it absorbed the National Amalgamated Union of Labour and the Municipal Employees' Association. In 1923 the National Federation of Women Workers was merged in the National Union of General and Municipal Workers. Discussions have since taken place with other unions, *e.g.*, the Workers' Union and the Transport and General Workers' Union as to the possibility of further amalgamation. Other post-War amalgamations include the United Garment Workers (1920) which unified several sectional and local bodies, the Union of Post Office Workers formed (1920) by the combination of three unions, and subsequently enlarged by the absorption of half a dozen other organisations of post office employees, the National Union of Blastfurnacemen (1922) which took the place of the National Federation composed of five local Unions of blast furnace workers, and the National Union of Sheet Metal Workers (1921) which combined a number of small federated societies of steel metal workers and braziers.

Federations are becoming more powerful; in some cases they pave the way to the amalgamation of some of their constituent bodies; in others the federations themselves become amalgamations. The following table shows that during the five years 1920–4, there was a net reduction in the number of trade unions amounting to about 200, due in no small measure to the effect of amalgamation.

Year	New Unions Formed (other than by amalgamation	Reductions due to		Net increase or reduction
		Dissolutions	Amalgamations	
1920	119	33	82	+4
1921	45	73	85	−113
1922	28	40	36	−48
1923	16	42	16	−42
1924	26	18	14	−6

These various amalgamations have been pursued with the definite object of securing unified organisation over an extending field, so as to render negotiations more comprehensive and possible action more effective. The Trades Union Congress has passed frequent resolutions dealing with the need for improved organisation, and in 1924 adopted as its policy the reduction in the number of trade unions to "an absolute minimum," and "as far as possible, organisation by industry with every worker a member of the appropriate organisation."

The Central Organisation

In 1919, proposals were submitted to a special Trades Union Congress for the replacement of the old Parliamentary Committee of the Congress by an enlarged executive body, for the creation of a machinery of co-operation between the Congress and the Labour party, and for the establishment of joint administrative departments under the auspices of the congress and the Labour party. These general proposals put forward in the interim report of a co-ordination committee, which had been appointed by the Parliamentary Committee, were accepted by the special congress. The full scheme was submitted to the Congress in the following year. The Parliamentary Committee was superseded by the General Council, a body composed of 32 members representing the 17 groups of trades and industries into which the affiliated membership of the Congress was divided, including two women representing the women membership of the Trades Union Congress.

The following table shows the organisation of the General Council into groups:—

Group No.	Groups	No. of Members on General Council	No. of Unions	No. of Members of Affiliated Unions (1925–6)
1	Mining and Quarrying	3	9	840,543
2	Railways	3	3	454,924
3	Transport (other than railways)	2	9	397,126
4	Shipbuilding	1	4	122,850
5	Engineering, Founding and Vehicle Building	3	23	394,051
6	Iron and Steel and Minor Metal Trades	2	21	153,932
7	Building, Woodworking and Furnishing	2	16	349,658
8	Printing and Paper	1	13	167,665
9	Cotton	2	37	234,864
10	Textiles (other than Cotton)	1	17	152,307
11	Clothing	1	8	90,428
12	Leather and Boot and Shoe	1	5	86,868
13	Glass, Pottery, Chemicals, Food, etc.	1	16	186,534
14	Agriculture	1	1	30,000
15	Public Employees	1	10	150,627
16	Non-Manual workers	1	8	62,845
17	General workers	4	5	475,760
18	Women workers	2	..	..
	Totals	32	205	4,350,982

It will be seen that the mining and quarrying group is the largest in point of membership, the second being the group known as general workers.

This organisation is carried further by the establishment of group committees. For administrative purposes the 17 trade groups were formed into six group committees as follows:—

(*a*) mining and quarrying, railways, transport; (*b*) shipbuilding, engineering, iron and steel, building; (*c*) cotton; other textiles, clothing, leather; (*d*) glass, pottery, etc., agriculture, general workers; (*e*) printing, public employees, non-manual workers; (*f*) the two women members and three members appointed by the General Council from organisations with women members.

The Congress also accepted in 1920, as did the Labour party conference of 1921, proposals for the establishment of a national joint council consisting of the chairman and secretary and three members of the General Council of the Trades Union Congress, the Executive Committee of the Labour party and the Parliamentary party, making 15 members in all. This body was set up to deal with questions affecting the Labour movement as a whole. the Congress and conference, further, agreed to the establishment of four joint departments—(*a*) research and information, (*b*) press and publicity, (*c*) international and (*d*) legal. This new central machinery resulted in a great expansion of activities by the General Council of the T. U. C. itself and by the Council in conjunction with the political Labour movement. In 1925 the standing joint committee of industrial women's organisations included 25 national organisations, and represented over 1,000,000 organised working women.

The General Council of the T. U. C. deals with a wide range of questions and its authority continues to increase. It has instituted a standing trade boards advisory council, composed of representatives of organisations catering for workers covered by the Trade Boards Acts. It has its education committee which has concerned itself with the problem of adult education, whose proposals, approved by the Trades Union Congress in 1925, were designed to assist in the promotion of educational facilities for trade unionists, and had been arrived at in agreement with Ruskin College, the Education Department of the Co-operative Union, the Labour College, the Workers' Educational Association and the National Council of Labour Colleges. The object of the proposals was " to provide working class education in order to enable the workers to develop their capacities and to equip them for their trade union, Labour and Co-operative activities generally, in the work of securing social and industrial emancipation." Early in 1926, the Countess of Warwick handed over her estate, Easton Lodge, Dunmow, in Essex to the General Council of the Trade Union Congress for use as a Labour College and as a labour centre generally.

The General Council has taken an increasingly important part in large industrial disputes. At the Hull Congress of 1924, its hands were strengthened in this matter. In the event of a breakdown of negotiations in a dispute, however, " the deadlock being of such a character as to directly or indirectly involve other bodies of work-people affiliated to the Trades Union Congress in a stoppage of work or to imperil standard wages and hours and conditions of employment, the council may take the initiative by calling representatives of the unions into consultation, and use its influence to effect a just settlement of the difference." Before this resolution was carried, the General Council had, in fact, intervened by mediation or the granting of moral and financial support, in disputes in which affiliated societies were concerned. In the prolonged Boilermakers' dispute in 1924, in the Dock Workers' dispute, the Tramway dispute in the London area, the Southampton Shipyard dispute, and the Building Trade dispute in the same year, the General Council used its good offices. But the adoption of the resolution of Sept. 1924 placed greater authority in the hands of the Council. On the occasion of the dispute in the coal industry in July 1925 the General Council appointed a special industrial committee (which has since become a standing body) and took a very prominent part in the negotiations which led to the temporary settlement. The Industrial Committee in Aug. 1925, intervened in the dispute in the wool textile industry which had culminated in a stoppage of work.

In conjunction with the Labour party and the Miners' Federation of Great Britain the General Council established a committee early in 1925 to prepare a policy for the coal industry, and the proposals of this joint committee were submitted to the Royal Commission on the Coal Industry set up by the Government after the coal settlement in July 1925. After the publication of the Royal Commission's Report, the General Council, through its Industrial committee resumed its consultations with the Miners' Federation and was associated closely with the Federation during the course of negotiations. Finally, it declared a large scale sympathetic strike (erroneously called a general strike) and for the first time in its history directly conducted an industrial stoppage. This, however, was called off in a few days (*see* STRIKES AND LOCKOUTS).

The Council also takes active steps to deal with difficulties which arise between affiliated unions. For this purpose the General Council acts through its disputes committee. In 1925 this committee held no less than 32 meetings. The disputes which occur between unions vary in their character.

An important and developing side of the activities of the General Council is the forging of closer bonds with the trades and labour councils which exist in large numbers up and down the country. Before 1895 trades councils were represented at the annual Trades Union Congress. But from that date until 1924 there was no direct contact between these local representative bodies of trade union branches and the T. U. C., though the Trades councils (many of which are local Labour Parties) were affiliated to the Labour party and may send delegates to its annual conferences.

After the establishment of the General Council, efforts were made to remedy this defect in organisation, and in 1925 a model form of constitution for trades councils was worked out, arrangements made for the publication and circulation of special literature on trade unionism, and a regular monthly statement from the general council to the trades council was inaugurated. At the end of 1924, there were 476 trades councils known to be in existence in Britain, including industrial sections of local Labour parties. In 1913 the number was 328. From 1913 to 1924 the aggregate affiliated membership rose from 1,481,000 to 2,219,000, the latter figure representing about two-fifths of the total membership of trade unions.

But perhaps, the most significant amongst the activities of the General Council, is its efforts under the instructions of the Trades Union Congress to promote and assist trade union amalgamation on the lines of organisation by industry. Though the General Council has from time to time brought together unions for discussion of the possibilities of amalgamation, it has realised that much more is needed than empirical action of this kind. Judged by the results the efforts to bring about amalgamations of the General Council cannot be regarded as successful, though it is still too early, having regard to the real difficulties of amalgamation, to pronounce this work as a failure. Its real importance, however, lies in the persistent and painstaking labour to reach an ideal, and the certainty that, if need be, larger powers will ultimately be given to the general council to deal with the problem. It is significant that the consolidation of forces should be regarded as of paramount importance.

Finance.—Up to 1923, the affiliation fee of each union affiliated to the T. U. C. was 1d. per member per year. In that year the fee was raised to 3d., payable quarterly on the full membership, including probationary and free members. The increased fees were required principally for publicity purposes and to maintain *The Daily Herald*, the organ of the British Labour movement. In addition to the ordinary affiliation fees, each union contributes £1 per thousand members towards the fee payable to the International Federation of Trade Unions. Congress affiliation fees in 1924–5 amounted to £21,088. The affiliation fee to the International Federation of Trade Unions was £4,450.

THE INDUSTRIAL AND THE POLITICAL MOVEMENTS

As the Trades Union Congress really gave birth to the Labour party, it is natural that close relations should always have existed between the industrial and political sides of the Labour movement. From 1905 onward there existed a joint board representing the Parliamentary Committee of the T. U. C., the Executive

Committee of the Labour party and the Management Committee of the G. F. T. U. (which also owed its existence to the T. U.C.). The members of the board were the secretary and three members from each of the three bodies. But in 1914 the Congress decided to dissolve the tripartite joint board and to establish a new one representing the Parliamentary Committee of the Trades Union Congress and the executive committee of the Labour party. At the Congress of 1917 steps were taken to ensure close co-operation between the two committees. Regular joint monthly meetings were arranged, following the separate meetings of the two committees. These joint meetings continued, and joint action has been taken on innumerable occasions. Large questions demanding considerable enquiry are usually referred to joint committees of the two bodies. The great developments which have taken place in the activities of the General Council with all the implications they involve, led in 1926 to an understanding whereby the Council shall have research, press and international staffs under its direct control, but arrangements were made for the closest co-operation.

General Policy

During the period from 1911 to the outbreak of the War, there was considerable labour unrest due largely to the steadily rising cost of living, but receiving inspiration in some degree from the intellectual ferment in the world of labour. Syndicalism, though never a potent force in the British trade union movement prompted and encouraged the movement towards militant industrial unionism. The persistent propaganda of the Socialist societies had also begun to influence the outlook of the trade unionist. From about 1910 it is clear that the trade union movement, judged by the resolutions of the T.U.C. was socialist in temper. It was definitely in opposition to capitalism and to private ownership of the means of production. The socialism, however, to which trade unionism gave adhesion, was essentially collectivist; but a closer association with the problems of industry and a widening knowledge of the world of industry led to a sense of dissatisfaction with the arid doctrines of undiluted collectivism, which came indeed to be described as " State capitalism." Syndicalism, whilst it never commanded a large measure of support, did, by its emphasis on the workers' right to control, indicate the possibilities of a policy which whilst providing for public ownership escaped the charge of " State Capitalism " by the adoption of the principle of democratic control.

Shop Stewards Movement.—During the pre-War years, however, these ideas had not clearly emerged. The effects of State regulation during the War, however, powerfully assisted in swinging active trade union opinion round to a sympathetic appreciation of the essential doctrines of Guild Socialism. Moreover, the new importance of the Labour element in the community gave birth to new aspirations, and to the claim that the workers should enjoy increasing responsibility and power in the actual conduct of industry. One of the most powerful groups of influences which moulded the minds of organised Labour were those connected with the conditions of War-time employment. In the chief industries, the unions were parties to arrangements for the increase of output and the avoidance of stoppages of work. But the abnormal psychology of War time, unsympathetic and short-sighted administration in the munitions areas, and the knowledge that the union executives were in a position of great difficulty, led to unofficial strikes and to the evolution by the workers of unofficial machinery for securing the removal of grievances.

Shop committees sprang up in the munitions industry, and in the engineering trades they became influential organisations. Shop stewards became the real leaders of the rank and file in matters affecting the day to day lives of the workers in industry. This new re-organisation within the industrial Labour movement—the creation of the circumstances in which the trade union executives were inevitably placed—proceeded swiftly and to a considerable extent effectively. It was unknown to the general public until it had established itself. It was spontaneous—an obvious method of satisfying the need for some rapid local machinery which could deal with grievances in the workshop. It is true, of course, that there grew up a literature embodying the philosophy of the shop stewards' movement, but it gave a justification to the movement rather than an impetus to its growth. This rank and file movement strengthened the demand for self-government in industry.

It spent itself during the War. With the end of the War, it lost the passion which had sustained it; but the value of shop committees and of shop stewards was recognised, and, first in the engineering industry and subsequently in others, the unions adopted this machinery and grafted it on to their organisation.

In the meantime, the policy of self-government in industry had become crystallised, and since the War the T. U. C. has accepted the policy of public ownership combined with the association of the workers in the government and control of industry. The application of this policy may be seen in the bill prepared by the Railway Clerks' Association for the nationalisation of railways, and subsequently in the scheme for the future of the coal industry placed before the Coal Commission of 1925–6 by the Miners' Federation, with the full support of the T. U. C. General Council and the Labour party.

Reactions of the Russian Revolution.—The Bolshevik revolution in Russia had its reaction upon the British Trade Union movement. Some of the leaders of the shop stewards' movement embraced Communist doctrines, and when the Red International of Labour Unions was formed by the Moscow Communist International attempts were made to secure the adhesion of trade union bodies to the R. I. L. U. Such British bodies as are affiliated, however, are not national unions, but sectional and local organisations. Under the inspiration of communist doctrines the National Minority movement was organised, as what may be called the communist wing of the trade union movement. It consists of groups and sections of trade unions, and the voice of its spokesmen is heard on the floor of the T. U. C. in favour of an advanced policy and in support of a policy for closer relationship between Britain and Russia. The General Council of the Congress itself sent a delegation to Russia towards the end of 1923, and the Council has actively supported a policy of friendship between Britain and Russia, and has used every effort to bring about an understanding between the International Federation of Trade Unions and the Russian Trade Unions.

The National Unemployment Workers' Committee movement established during the period of heavy post-War unemployment is directed largely by people of Communist sympathies. It is impossible to assess the influence which Communism within the trade union movement is exercising; but numerically the number of trade unionists definitely attached to the Communist party of Great Britain is small. The factors which have led a minority of trade unionists into the ranks of Communism and the National Minority movement (which it may be said includes a considerable portion of workers who could not be described as Communists) have led a far greater number to a realisation of the need for a more vigorous industrial policy for the trade union movement. The establishment of the General Council of the T. U. C., the enlargement of its powers, and the large extension of its activities were an expression of this need. One of the first problems, however, is that of the organisation of trade unionism; for clearly the success of any industrial policy must depend in the last resort on the efficiency of trade union organisation.

Industrial Unionism.—So long ago as 1910 and 1911 the Congress committed itself to the principle of organisation by industry, and in 1911 urged the Parliamentary Committee to call conferences of the different industries " with a view of amalgamating the several trade unions connected with each industry." This somewhat crude principle was interpreted in a reasoned resolution adopted by the Congress in 1918, when it was agreed (*a*) that the organisation of an industrial union should allow for the maintenance within the union of each district craft combination and for the possibility of federating such combinations with like bodies outside the union for specific purposes; and (*b*) that every craft union and general Labour union should allow sectional combinations within the union, on industrial or occupational lines, so as to facilitate inter-union federations, and, if circumstances require, the transfer of a section to any more appropriate union.

In 1922 the Trades Union Congress instructed the General Council to make an enquiry into the present organisation of the trade union movement as a necessary basis for a policy of closer unification. The Hull Congress of 1924 led to the appointment of a special committee by the General Council to tackle the question of trade union organisation, and the present attitude of the Council on this matter is contained in an able memorandum by Mr. W. M. Citrine, submitted to this Committee and published in the annual report of the Congress for 1925. The General Council has boldly admitted the defects of the existing trade union structure and method—the prevailing sectionalism, the competition between different unions for workers, varied rates of contributions and benefits, demarcation of work and the lack of a co-ordinated policy. It is certain that the conflicting claims of pure and unadulterated industrial unionism, occupational unionism, federal unionism and craft unionism, will necessitate some composite method which, within the framework of the industry, permits variety of organisation to meet the needs of special crafts and groups. (A. Gd.)

II. THE UNITED STATES

The period from 1910 to 1926 has been an eventful one for trade unionism in the United States. Since 1910 notable changes have taken place in the philosophy and practices of both employers and trade unions. Business has made some progress in the stabilisation of industry and the standardisation of its products. A number of employers have made the protection of their employees' welfare a part of their labour management activity, while others have engaged actively in an " open shop " campaign against trade unions. In this period the courts have been unusually liberal with their use of the injunction and have rendered a number of decisions against the activities of trade unionism. The period has also seen the World War with its effects on the labour movement.

In response to these and other developments, American labour has evolved some remarkable trade agreements, providing for union-management co-operation, industrial courts and unemployment insurance. The trade unions have also entered the banking field and established schools and colleges for their members.

In 1912 Congress authorised the formation of a Federal Commission on Industrial Relations. This commission's investigations lasted three years. It examined 500 witnesses and prepared a report very favourable to organised labour. This was the first time in American history that a government commission has unhesitatingly pronounced the trade-union movement a fundamental and indispensable public institution.

The Clayton Anti-trust Act which became a law in 1914 declared that human labour is not a commodity and that labour organisations are not to be construed as illegal conspiracies in restraint of trade. It also limited the use of the injunction in labour disputes. This Act was hailed as labour's Magna Carta, but subsequent court decisions have left the legal status of trade unions quite as uncertain and unsatisfactory as if no such Act had been passed.

When the United States entered the World War, the American Federation of Labour pledged its unequivocal support to the Government. Placing organised labour thus at the service of the nation secured for it for a time a degree of national prestige and freedom to expand which could not have been secured by many years of agitation and strikes. The War Labour Board guaranteed to labour the right to organise, the basic eight-hour day and the living wage. In 1916 the American Federation of Labour membership was 2,072,000; by 1918 it had risen to 2,726,000; by 1919 to 3,260,000, by 1920 to a maximum of 4,078,000. Since then it has declined to 2,877,000 showing that 40% of the War-time gains have been retained. With the falling off of immigration due to the War and the passage of the immigration restriction law of 1921, the power of American trade unionism has been increased, for while certain trades had been able to unionise the immigrant, he has been a constant barrier against organisation.

Since 1910 the trade unions have had a number of set-backs at the hands of the courts. The lower courts have been free in granting injunctions against trade-union action during strikes. Of these the injunction against the railway shopmen in 1922 is one of the most sweeping decrees issued in labour disputes. The Supreme Court also handed down several decisions which greatly hamper trade-union activity. In 1915 the U.S. Supreme Court in the case of Coppage *v.* Kansas (236 U.S. 1) held unconstitutional a Kansas law preventing employers from threatening to discharge their employees unless they renounce union membership.

Two years later in the Hitchman Coal and Coke Co. *v.* Mitchell case (245 U.S. 229) the Supreme Court held that, where an employer has required his employees to sign a contract that they will not join any labour union, it is illegal to attempt to organise them. In 1921 in Duplex Printing Company *v.* Deering (254 U.S. 443) the Supreme Court held that a secondary boycott was unlawful and the employer had a right to a restraining injunction under the Sherman Act as amended by the Clayton Act. The same year in American Steel Foundries *v.* The Tri-City Central Trades Council (257 U.S. 184) the Court held that it is illegal during a strike for more than one picket to be stationed at a point of ingress or egress to a plant. In Truax *v.* Corrigan (257 U.S. 312), 1921, the Court declared unconstitutional an Arizona law, modelled on the British Trades Disputes Act, which sought to place a limit on the free use of the injunction. The law attempted to declare illegal any injunction seeking to restrain workers from ceasing to patronise or from advising others to cease patronising an employer against whom they were on strike. In 1922 the Court in U.S. Mine Workers *v.* The Coronado Coal Company (259 U.S. 344) held that a trade union may be sued under the Sherman Act for damages done to an employer during a strike.

During these years a remarkable development in productive efficiency has taken place. No reliable estimates have been made, but the gain is notable in nearly all industries. This increase in efficiency has had causes other than the technological development, though the latter is the most important factor. The U.S. Department of Commerce in 1921 began a systematic campaign for the elimination of waste in industry. Since then it has conducted some 900 conferences of business men which have set 220 committees at work on various phases of the programme. The department set out to eliminate not individual or wilful wastes, but those wastes which can be eliminated only by co-operative action of the industry or community.

The growth of efficiency in industry is probably the most important development for trade unionism which has taken place during the period since 1910. Its effect has been like that of a two-edged sword. The mechanisation of industry has eliminated the necessity of skilled labour. American trade unionism is founded upon the philosophy of the craft and the crafts are being eliminated, one by one. The great problem before the American labour movement to-day is the organisation of the unskilled, machine-tending, factory workers. On the other hand, the growth of efficiency has brought higher wages. The greater the output per worker, the greater will be the employers' wage-paying capacity and the higher will be the wages which both union and non-union labour can successfully obtain. Wages have shown considerable increases both in money rates and in purchasing power during the post-War years. The American Federation of Labour has taken note of the increases in efficiency and the elimination of waste and at its last convention went on record as approving the movement towards waste elimination. It further pointed out that if social equality and industrial stability are to be obtained, the hours of labour must be decreased and wages increased in proportion to the progress that is made in increasing production.

During the years 1910–26 there has developed a new capitalistic philosophy and a new set of labour management practices. Many employers have voluntarily set out to do for their employees the very same things which trade unions have been doing for their members. These welfare practices have originated

mainly in the unorganised industries and have greatly retarded the extension of trade unionism therein. These new labour policies have set out to protect the standard of living of employees in various ways. Some employers are voluntarily paying higher wages; some are introducing profit-sharing schemes, bonuses, wage premium plans, education, housing, community betterment, plant restaurants, vacations with pay, etc. Shop committees, works councils and systems of employee representation have also been inaugurated. Some of these plans have been undertaken in the interests of greater production. Some represent an effort to retard the development of trade unionism by making it less necessary. But regardless of motive, much good has come from them. However, there are a few shortcomings which should be noted. Such welfare work tends to tie the worker to his job and reduce his independence and gives no guarantee of permanence. A change in corporate management or a decline of prosperity may cause abandonment of the arrangements. The workers did not secure the introduction of these plans, and, being unorganised, they cannot enforce their continuance. Nor can collective dealing with company unions be considered a substitute for collective bargaining with trade unions. Even where a company union may negotiate a wage scale for the plant, its bargaining power is inferior to that of a trade union. The latter has greater membership, larger funds and more able leadership. The American Federation of Labour has felt the strength of this new development especially strong in certain industries, and has begun a careful study of the subject so that its members may better meet the issue in their organised work.

In Oct. 1919 President Wilson summoned to Washington 15 representatives of labour, 15 of capital and 15 of the public for the President's Industrial Conference. At this conference the employers stood solidly for the open shop and the labour group stood as solidly for the closed shop and collective bargaining. The conference broke up without accomplishing anything. The unsuccessful conclusion of the conference and the steel strike of the same year solidified opinion on both sides and the employers started what is known as the Open-Shop drive. The movement seemed to spring up spontaneously in practically every industrial centre in the country and was vigorously pushed by employers' associations, its purpose being to weaken trade unions, prevent unionisation and convince the public of the desirability of the open shop and the anti-union campaign.

In 1926 a number of important industries were conducted under the principles of the open shop, or the "American Plan," as its proponents often call it. Among the most important open-shop industries may be mentioned the steel, textile, automobile, book and job printing, machinery and paper industries, also the San Francisco building industry. The open-shop movement has proved a great set-back to trade unionism, but it is not known whether it has spent itself and its influence is waning.

In Feb. 1923 a co-operative plan between the Baltimore and Ohio Railroad and the railway shop crafts was undertaken with a programme for the elimination of waste, the betterment of shop organisation and the stabilisation of employment. Under the plan the unions were to be made necessary parts in the shop administration on a par with the superintendents. Regular joint local and district meetings are held. The local federated shop crafts committee meets with a committee of the shop management. The officers of the system federation and of each craft meet with the head of the road's maintenance of equipment department. After the success of this plan was demonstrated in one shop, the co-operative scheme was extended to all the shops of the Baltimore and Ohio Railroad. Recently similar arrangements have been made on the Chicago and Northwestern Railway, the Canadian National Railways and the Chesapeake and Ohio Railway. This plan has the official endorsement of the American Federation of Labour. The union management co-operation plan as adopted on these railways is a logical extension of the principle of collective bargaining and is based on a labour policy which accords the labour movement a positive function in the conduct of industry. It is the trade union's answer to the open-shop drive, the welfare work and company union policies.

The period 1910–26 has seen also a remarkable series of trade agreements which have set up a system of private industrial law and a system of private unemployment insurance. A protocol signed in 1910 by the employers and the International Ladies' Garment Workers Union of New York City may be regarded as the first real constitution in the clothing industry. In the men's clothing industry, industrial government dates from the 1911 agreement between the Amalgamated Clothing Workers and the firm of Hart, Schaffner and Marx. This agreement set up a joint and impartial judicial machinery and specified the rights and duties of the two parties. Disputes between the parties are carried to a trade board and thence, if necessary, to a Board of Arbitration. Similar agreements have been made subsequently between an association of the remaining Chicago clothing manufacturers and the Amalgamated Union. Such judicial systems have also been established in the Rochester (New York) men's clothing industry, the New York City men's clothing industry and the ladies' garment industry of Cleveland. In all these courts the decisions are recorded, precedents are established and a body of industrial common law, not dissimilar to the early English common law, is gradually accumulating.

In 1923 the Amalgamated Clothing Workers and their employers in Chicago reached an agreement on the principle of an unemployment insurance fund. There are over 400 firms in the Chicago men's clothing market which employ about 35,000 workers. There are five boards of trustees, one each for the two largest firms, one for the remaining large concerns, one for the non-association houses and one for the contractors. One man is chairman of all the boards. The union has the same members on all the boards, but the personnel on the employers' side differs with each board. One insurance office keeps the books and carries on all the statistical work. The employer deducts the weekly premium of 1·5% from the wages of each employee and forwards the total amount, together with an equal amount as his own contribution, to the treasurer. Payments of benefits began in May 1924. Benefits to those out of work amount to 40% of the unemployed worker's average wage. The maximum benefit is $20 a week and the combined wage and benefit for workers on part time cannot exceed $50 a week. This unemployment insurance scheme was later applied in the New York men's clothing market, in the ladies' cloak and suit industry, the hat and cap industry and the fur industry of New York, as well as in the ladies' garment industry of Cleveland.

Workers' education began with the establishment in 1916 of a Workers' University in New York City by the International Ladies' Garment Workers Union. In 1926 there were workers' classes and study groups, under the direction of state federations, in over 300 industrial centres of 40 states, with some 40,000 students enrolled. Two resident labour colleges with permanent teaching staffs have been established, Brookwood College at Katonah, N.Y., and Commonwealth College at Mena, Arkansas. In addition, eight workers' summer schools with resident faculties—some in connection with regular universities—have been opened, and several universities have started workers' classes as part of their extension work. During the five years to 1926 no less than 350 scholars and university instructors have been associated with the movement. In 1921 this trade union educational work was placed under the supervision of the Workers' Education Bureau in co-operation with the American Federation of Labour. Nearly 30 books and pamphlets have been issued by the bureau and half as many more are in preparation.

Trade-union activity in the banking field began with the opening in 1920 of a Washington Bank in which the International Association of Machinists had acquired half interest. During the ensuing six years various labour organisations secured control of, or organised, over 30 banks with combined resources of well over a hundred million dollars. Many of the most prominent unions entered the banking business, but as yet there is considerable difference of opinion as to the desirability of this

new development. The American Federation of Labour has begun an investigation of the subject and at its last convention adopted a resolution calling attention to the "grave responsibility assumed by those who enter into these undertakings" and sounding a note of "emphatic caution because we appreciate the potentiality of labour banking and wish to promote its wise development." Trade-union leaders who are active in labour banking maintain that workingmen's savings deposited in private commercial banks are used to promote the interests of business men and not the welfare of the labouring classes.

A number of trade-union leaders are sceptical of the desirability of entering into the banking business. They urge that banking is a foreign responsibility which will take time and attention away from the bargaining issue. Organisations which become prosperous in banking are apt to become bankrupt in unionism. It is further contended that there is a tendency for labour banks to violate safe banking principles. Interest payments have been generous. The temptation to loan to an employer who recognises the union and yields to its demands is grave and dangerous from the banking standpoint. As yet labour banking is a new and unsettled policy.

On Dec. 13 1924 occurred the death of Samuel Gompers who had organised the American Federation of Labour and had been its President for 43 years. He was succeeded by William H. Green of the Miners' Union. The passing of Gompers typifies the change that has been coming over the American labour movement. He was a pioneer leader who fought for the establishment of the movement, while Green is a business leader who has shown a desire to guide the already established movement into constructive and co-operative agreements between its membership and their employers. (J. R. Co.)

III. INTERNATIONAL ORGANISATIONS.

After the War in practically all countries trade union membership stood at a much higher level than it had done before the War.

The table below shows the growth of membership in over 20 countries from 1910 onwards.

The table covers all the most important countries in the world except Russia, where figures are not available for the pre-War years, and China, Japan and India, where trade unionism was little developed before the War.

Reliable estimates are available for the following 20 countries (United Kingdom, Germany, U.S.A., France, Italy, Belgium, Holland, Denmark, Sweden, Norway, Finland, Switzerland, Spain, Austria, Hungary, Czecho-Hungary, Canada, Australia, New Zealand and Serbia). The total trade union membership was at the end of 1910, 10,835,000; 1914, 13,222,000; 1919, 32,680,000.

In 10 years, according to these figures, trade union membership had trebled, and more than doubled in five years. A small part of the rise is due to the greater completeness of the returns, and another small part (probably about 10%) to the natural growth of the population, but even allowing for these two factors, the growth of trade unionism was considerable and it was common to all countries.

In most countries during the first part of the War the growth of trade unionism was checked. The decline was substantial in Germany, Austria, Hungary, Italy and Czechoslovakia but in these countries the numbers began to increase in 1917. After the end of the War numbers increased rapidly, especially in the Central European States. In Europe the total membership at the end of 1919 was at least 26,000,000 as against about 8,500,000 at the end of 1910.

In the 30 countries of the world for which information is available the total membership in 1919 was 42,040,000, and in 1920, 48,029,000. If we take the figures for 1919, no less than 80% of the trade unions belonged to European countries. Of the remaining 7,979,000 members outside Europe, 5,985,000 belonged to the North American continent. Six countries—Germany, Britain, the United States, Russia, France and Italy accounted in 1919 for 33,500,000 members, whilst the remaining 24 countries accounted for only 8,750,000. Two-thirds of the total trade union membership was concentrated in four countries—Germany, Britain, the United States and France.

Prior to the World War the two chief organs of the International Labour movement were the International Federation of Trade Unions and the Second International, the former industrial and the latter political. After the War, early efforts were made to reconstruct the industrial and political Internationals.

The Amsterdam International.—The International Federation of Trade Unions (the I.F.T.U.) was reconstituted in 1919 following a Congress held at Amsterdam. It consists of the various national central trades union organisations affiliated, but the General Council includes three delegates from the "international trade secretariats," (*i.e.*, representatives of the "trade internationals" such as the International Miners' Federation). The management of the I.F.T.U. is vested in the executive committee, the General Council and the Congress. The Executive Committee (or the Bureau, as it is often called) consists of the officers (*i.e.*, the president, vice-presidents and secretaries) and meets six times a year. The General Council (often referred to as the Management Committee) is a larger and more representative body. The supreme governing authority is the Congress which consists of the General Council and the representatives of the affiliated national centres (*e.g.*, the British Trades Union Congress). Representatives of the "trade internationals" take part

Membership of Trade Unions at the End of the Years 1910–9

Country	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
United Kingdom	2,400,000	2,970,000	3,226,000	4,192,000	4,199,000	4,417,000	4,677,000	5,547,000	6,645,000	8,024,000
Germany	2,960,000	3,336,000	3,566,000	3,572,000	2,271,000	1,524,000	1,496,000	1,937,000	3,801,000	9,000,000
U.S.A.	2,100,000	2,282,000	2,539,000	2,722,000	2,672,000	2,860,000	3,000,000	3,451,000	4,000,000	5,607,000
France	977,000	1,029,000	1,064,000	1,027,000	1,026,000	[1]	[1]	1,500,000	2,000,000	2,500,000
Italy	817,000	847,000	861,000	972,000	962,000	806,000	701,000	740,000	[1]	1,800,000
Belgium	139,000	189,000	231,000	203,000	203,000	[1]	[1]	[1]	450,000	750,000
Netherlands	154,000	169,000	189,000	220,000	227,000	251,000	304,000	369,000	456,000	625,000
Denmark	124,000	128,000	139,000	154,000	156,000	173,000	189,000	224,000	316,000	360,000
Sweden	115,000	111,000	120,000	136,000	141,000	151,000	189,000	244,000	302,000	339,000
Norway	47,000	53,000	61,000	64,000	68,000	78,000	81,000	94,000	180,000	144,000
Finland	15,000	20,000	24,000	28,000	31,000	30,000	42,000	161,000	21,000	41,000
Switzerland	75,000	78,000	86,000	89,000	50,000	65,000	89,000	149,000	177,000	224,000
Spain	41,000	80,000	190,000	128,000	121,000	76,000	99,000	90,000	150,000	211,000
Austria	200,000	200,000	257,000	253,000	147,000	112,000	109,000	211,000	295,000	772,000
Hungary	86,000	95,000	102,000	107,000	107,000	43,000	55,000	215,000	500,000	500,000
Czecho-slovakia	100,000	100,000	107,000	107,000	55,000	40,000	24,000	43,000	161,000	657,000
Rumania	8,000	6,000	10,000	[1]	[1]	17,000	16,000	16,000	[1]	[1]
Canada	120,000	133,000	160,000	176,000	166,000	143,000	160,000	205,000	249,000	378,000
Australia	302,000	365,000	433,000	498,000	523,000	528,000	546,000	564,000	582,000	628,000
New Zealand	57,000	66,000	61,000	71,000	74,000	68,000	71,000	[1]	[1]	100,000
Serbia (Yugo-slavia)	7,000	8,000	5,000	9,000	14,000	12,000	12,000	12,000	15,000	20,000

[1] Figures not available.

in congresses, but without the right to vote. Congresses have been held at Amsterdam (1919), London (1920), Rome (1922), The Hague (1922) and Vienna (1924). The affiliated membership of the I. F. T. U. since its re-establishment has been as follows: on Dec. 31 1921, 21,991,615; 1922, 18,185,531; 1923, 15,316,127.

The chief "trade internationals" are the metal workers (2,585,717), transport workers (2,091,840), miners (1,941,199), textile workers (1,326,030), building workers (938,940), factory workers (844,988), woodworkers (711,287) and commercial, clerical and technical employees (695,185). At the end of 1923, the total membership of the trade internationals was over 14,750,000.

The following statistics of membership of the trade union centres affiliated to the I.F.T.U. are the most recent available. Unless otherwise stated, they refer to the year 1924–5:—

Europe

Austria	828,088	Italy	269,754
Belgium	578,000	Latvia	14,639
Bulgaria	15,000	Luxembourg	13,568
Czechoslovakia	343,284	Memel	1,907[1]
Denmark	302,704	Poland	300,221
France	700,000	Rumania	40,000
Germany A.D.G.B. Afa-Bund	471,949	Spain	210,741
Great Britain	4,350,982	Sweden	360,337
Holland	187,839	Switzerland	151,502
Hungary	176,401[1]	Yugoslavia	10,000

Asia

Palestine	18,362

North America

Canada	105,912

Africa

South Africa	10,000[1]

[1] At Dec. 31 1923.

In 1924, the I. F. T. U. created an international committee of trade union women which held its first meeting in Nov. 1925. The number of women organised within the national centres of the I. F. T. U. on Dec. 31 1923, was as follows:—

Austria[1]	190,984	Latvia	..
Belgium[1]	51,612	Luxembourg	..
Bulgaria	790	Memel	319
Canada	..	Palestine	..
Czechoslovakia	54,931	Poland	44,120
Denmark	38,050	Rumania	1,543
France	78,255	South Africa	..
Germany[1]	1,201,390	Spain[1]	..
Great Britain	280,437	Sweden	32,693
Holland[1]	2,598	Switzerland[1]	13,272
Hungary	22,383	Yugoslavia	4,633
Italy	27,026		

[1] Figures for 1924–5.

Country	I.F.T.U.	Religious	Syndicalist	Communist	Various	Total Membership
Argentina	..	..	..	..	120,000	120,000
Australia	..	..	..	..	699,743	699,743
Austria	828,088[2] [39,520][5]	80,128[2]	..	..	101,500	1,049,228
Belgium	578,000[2]	172,841[2]	..	..	..	750,841
Brazil	..	..	..	..	100,000[3]	100,000
British India	..	..	..	..	407,037[2]	407,037
Bulgaria	15,000[2]	..	..	35,000	..	50,000
Canada	105,912[2] [40,000][5]	30,000	..	..	58,092	234,004
Chile	..	..	..	..	88,527[1]	88,527
China	..	..	..	..	300,000	300,000
Cuba	..	..	..	..	100,000	100,000
Czechoslovakia	343,284[2] [217,149][5]	123,769[2]	..	..	1,202,403[2]	1,886,605
Denmark	302,704 [69,588][5]	..	200	..	..	372,492
Dutch East Indies	..	..	..	..	60,000	60,000
Egypt	..	..	..	..	12,000	12,000
Estonia	..	..	..	25,000	5,000	30,000
Finland	..	..	..	..	47,633	47,633
France	700,000[2]	101,276[2]	..	35,000	163,000	999,276
Germany A.D.G.B.	4,500,000[2]	612,952[2]	100,000	..	1,300,000	6,984,901
Germany Afa Bund	471,949[2]	..	..	..	..	..
Great Britain	4,350,982[2]	..	..	..	1,076,765	5,427,747
Holland	187,839[2]	151,130[2]	7,700	13,800	192,071	291,760
Hungary	176,401	115,359[2]	..	..	..	191,542
Iceland	..	..	..	..	4,000	4,000
Ireland	..	..	..	..	373,454	373,454
Italy	269,754[2]	300,000	..	..	1,764,423[4] (Fascists)	2,334,177
Japan	..	..	..	..	230,000[2]	230,000
Latvia	14,639[2]	..	..	6,425[2]	19,385[2]	40,449
Lithuania	..	..	..	..	9,687[2]	9,687
Luxembourg	13,568[2]	..	..	..	..	13,568
Memel	1,907 [2,140][5]	..	..	..	..	4,047
Mexico	1,000,000	..	..	..	..	1,000,000
New Zealand	..	..	..	..	80,000	80,000
Norway	..	..	1,800	..	92,767[2]	94,567
Palestine	18,362[2]	..	..	..	..	18,362
Peru	..	..	..	..	25,000	25,000
Poland	300,221[2]	158,385[2]	..	..	280,000	738,606
Portugal	..	..	..	..	40,000[2]	40,000
Rumania	40,000[2]	..	..	16,148	28,812	84,960
Russia	..	..	..	6,604,700[2]	..	6,604,700
South Africa	10,000	..	..	..	25,000	35,000
Spain	210,741[2]	40,000	200,000	..	..	450,741
Sweden	360,337[2]	..	38,000[2]	..	50,000	448,337
Switzerland	151,502[2]	11,030	..	..	133,500	269,032
United States	..	..	58,000	..	3,378,297[2]	3,436,297
Yugoslavia	40,000[2]	800	..	6,000	18,055	64,855

[1] Unless otherwise stated these figures refer to 1923.
[2] 1924–5.
[3] From a Communist source.
[4] Official Fascist Government Figure.
[5] The figures in brackets indicate the membership of organisations which, though not affiliated to the I.F.T.U. nevertheless adopt its platform.

The Red International.—There are, in addition, a number of trade unionists who are linked with the Red International of Labour Unions which was brought to birth by the Communist International. The idea was, however, conceived at the Zimmerwald and Kienthal conferences. The R.I.L.U. was established in 1920 during the second congress of the Communist International, at which minority trade union representatives from various countries were present, when it was declared that " it is the duty of the working class to gather together all trade union organised forces with a powerful revolutionary class association, which, working shoulder to shoulder with the political organisation of the Communist International of the proletariat and in closest contact with this organisation, would be able to develop all its forces for the general victory of the social revolution and the establishment of a world Soviet Republic." It was also laid down that the International Federation of Trade Unions " because of its programme and tactics " could not " secure the victory of the proletarian masses in all countries." The first R.I.L.U. congress was held in July 1921, in Moscow, and has since continued its work in close association with the Communist International. Relations between the I.F.T.U. and the R.I.L.U. have been hostile. The British Trades Union Congress, however, has endeavoured to bring about an understanding, though without success.

It is not easy to ascertain the real strength of the affiliated membership of the R.I.L.U., but Losovsky, the secretary of the Red International, has analysed its membership as follows (see " *The World's Trade Union Movement,* 1925, pp. 244–5):—

The Red International of Labour Unions has eight types of affiliated organisations:—

1. National trade union centres embracing the whole trade union movement of their respective countries, such as Russia, with 6,400,000 trade union members; Bulgaria, 40,000; Greece, Egypt, 50,000; Persia, 20,000; Estonia, 25,000, and so on.
2. National trade union or regional revolutionary centres existing parallel with reformist centres and carrying on a struggle against them, our organisations being stronger than the reformist ones. Such are: France, with 480,000 members; Czechoslovakia, 300,000; Yugoslavia, 100,000; Java, 35,000; and so on.
3. National trade union centres playing a small rôle in comparison with the reformist trade union movement of their respective countries, as in Holland with 20,000 members; Belgium, 12,000; Germany, 150,000; the United States, 25,000; and so on.
4. National trade union centres identifying themselves with the principles of the R.I.L.U., but not affiliated thereto, as a result of the " White Terror," as is the case in Finland, 50,000; Rumania, 60,000; and so on.
5. Independent unions and unions formed of expelled members not belonging to the national trade union centres of their respective countries.
6. Minorities inside the reformist trade unions organised under the direct leadership of the Communist faction: Germany, Japan, Italy, Sweden, Denmark, etc.
7. Opposition blocs or minority movements co-ordinating the action of all left-wing elements both inside and outside the reformist and the Anarcho-Syndicalist unions of such countries as: the United States, Great Britain, Spain, Austria, the Argentine, Mexico and elsewhere.
8. Finally, there are the left-wing elements belonging to the unemployed committees (Great Britain), shop stewards committees, etc., generally supporting the R.I.L.U. policy."

It will be seen that no national trade union body representing the whole of the organised workers of any country, apart from Russia and certain small countries where trade unionism is an ineffective force, has associated itself with the R.I.L.U. and that outside Russia its chief support comes entirely from individual trade unions and minority groups, though Losovsky is at pains to point out that the figures of membership of the I.F.T.U. are swollen by the adherents of the R.I.L.U. It is not, however, the case, as stated by Losovsky, that " the strength of the R.I.L.U. and the I.F.T.U. is equal."

The position of trade unionism in the world, so far as it can be ascertained is given in the table on the preceding page. The figures are analysed according to the orientation of the respective national trade union centres, and unless otherwise stated, the figures refer to the year 1923.

BIBLIOGRAPHY.—The chief British publications are the *Labour Gazette,* published by the Ministry of Labour, the Reports of the Chief Registrar of Friendly Societies and the *Industrial Directory* of the Ministry of Labour.

Important publications issued by the British Labour movement, which contain official decisions and a reprint of the leading documents and correspondence are the Annual Reports of the Trades Union Congress and the Annual Reports of the Labour party. These two bodies also publish *The Labour Year Book* (see issues for 1916, 1919, 1924, 1925, 1926). See also *The Labour Bulletin of Industrial and Political Information* (monthly). On the international side, information is available in the publications of the International Federation of Trade Unions, the Communist International and the Red International of Labour Unions.

General Works.—For the history, organisation and theories of trade unionism, the chief works are Sidney and Beatrice Webb, *The History of Trade Unionism* (new edition, 1920) and *Industrial Democracy* (new edition, 1920); C. M. Lloyd, *Trade Unionism* (new edition, 1921) (these works contain Bibliographies); G. D. H. Cole, *Organised Labour: An Introduction to Trade Unionism* (1924).

International Movement.—See also A. Losovsky, *Trade Unions in Soviet Russia* (1920), and *The World's Trade Union Movement* (1925), published by the National Minority movement. The Trades Union Congress is publishing a series of pamphlets on Trade Unionism in Action, of which two have appeared—*The Story of the Trades Union Congress,* and *The General Council of the Trades Union Congress, Its Powers, Functions and Work.* The Trades Union Congress published (1924) the Report of its delegation to Russia. The International Federation of Trade Unions is publishing an International Trade Union History of which two volumes have appeared—C. Mestens, *The Trade Union Movement in Belgium* (1925) and Walter M. Citrine, *The Trade Union Movement of Great Britain* (1926). For Germany, see S. Sanders, *Trade Unions in Germany* (1916), and for Ireland, W. P. Ryan, *The Irish Labour Movement* (1920).

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TRAFFIC PROBLEMS.—Throughout the civilised world the countryman is being irresistibly drawn towards the great cities, which spread outwards, ring by ring, over the open fields, while the ancient core of the city on which millions of workers now converge retains the shape imprinted on it in mediaeval times when a small compact area amply sufficed.

I. IN GREAT BRITAIN

London.—Although the difficulties thus created are by no means restricted to Greater London, where the population had risen from $7\frac{1}{4}$ millions in 1911 to $7\frac{3}{4}$ millions in 1925, yet it is probably within this area that the typical problems present themselves in the most aggravated form. In 1923 the registrar-general published, for the first time, a report on the workplaces of residents in London and the five home counties. The preface reminds us that in a less highly organised and industrialised society localities may be self-sufficient, every residential group being supplied with its needs by members of the same groups in their working capacity. Such conditions were due to the dispersion of necessary service and production, which in the absence of transport facilities, had to be located in proximity to the population served. The subsequent development of transport and communications fostered a concentration which has changed the whole face of industry. The growth of great commercial centres calls for the concentration of an army of workers far beyond the residential capacity of their immediate neighbourhood; the housing deficiency is aggravated by the substitution of warehouses for dwellings in the centres, while the very development of transport which makes it necessary for the worker to live at a distance from his work has also made it possible for him to do so. Thus it happens that great masses of the population move in tides of daily ebb and flow, as evidenced in the City of London, whose night population of 13,709 expands thirtyfold during the day (416,150).

To gauge the magnitude of the traffic problem the following data may be of service. In the year 1904 a census was taken of vehicles of all classes passing 14 of the more congested points in London. The total reached was 291,930. In the year 1925 a

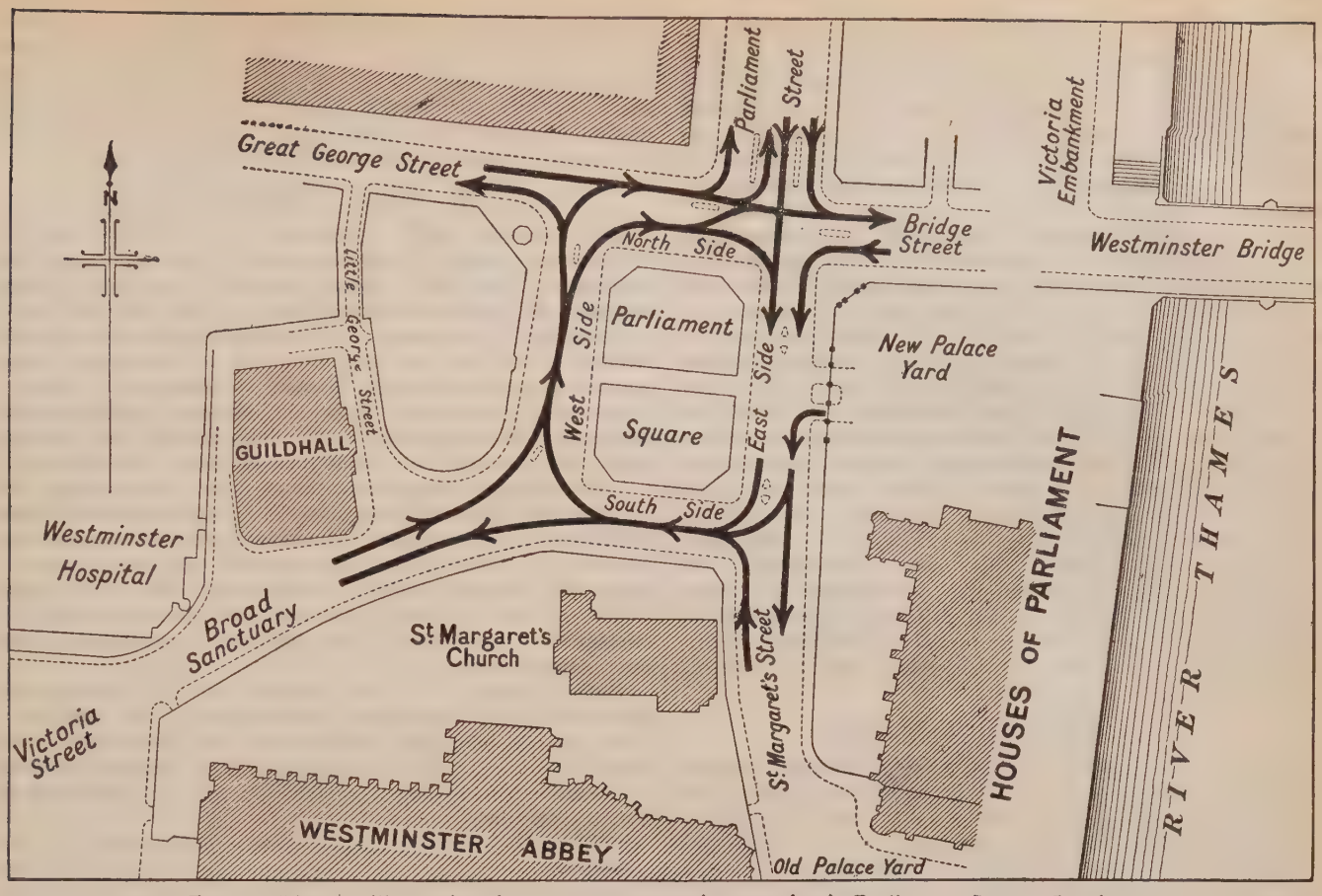


FIG. 1.—Diagram illustrating the gyratory system, in operation in Parliament Square, London.

count taken at the same 14 points gave a total of 458,376, an increase of 57.02%. The outstanding feature on the London streets is the motor-omnibus, of which in the year 1913 the number licensed was 3,664. By Jan. 1 1924, the number had risen to 5,311, and by Oct. 1 1925 to 5,502. In the year 1913 the passengers carried by omnibuses numbered 736,000,000; in 1924, 1,485,000,000; while in 1925 a total of 1,600,000,000 was computed to have been reached. The important part played by the London County Council's tramways can be estimated from the statement that their tramcars carry more than 1,000,000 passengers during the six busiest hours of the day. On the Victoria Embankment 400 tramcars pass every hour.

Expressed in millions the numbers of passengers carried by the various forms of transport in London have been estimated as follows:

Year	Suburban Trunk Railways (estimated)	Underground	Tramways	Omnibuses	Total
1913	450	298	812	736	2,296
1919	505	480	1,064	861	2,910
1923	488	367	1,001	1,214	3,070
1924	474	369	983	1,485	3,311

In 1925 a grand total of 3,524,000,000 was reached. The increase in the volume of traffic is out of all proportion to the growth of population. A principal factor in the increase of congestion on the streets is the growth and spread of the travel habit. It has been estimated that whereas in the year 1900 every Londoner, man, woman and child, travelled 158 times a year, that figure had risen in the year 1925 to 460. The burden thus thrown upon the transport agencies is even greater than these figures would indicate, owing to the fact that the "peak" periods of the day are now more compressed. The hours of industrial workers having been shortened, their travel period now tends to coincide with that of the clerk and warehouseman, with the result that travelling facilities have to be provided for a heavier peak traffic concentrated within a shorter number of hours.

Remedies.—The remedies for traffic congestion on the streets are easier to enumerate than to apply. First and foremost all wanton obstructions should be removed; fountains, clock-towers, refuges, obelisks, horse-troughs and such like structures erected in the leisurely days of an earlier century must justify their existence in the light of changed circumstances. Street traders and stalls must be relegated to side streets; slow and heavy vehicles must be prohibited from using, during the busy hours of the day, certain routes in which rapid movement is indispensable; the position of the great markets must be reconsidered in order that the streams of ponderous traffic to which they give rise may not choke all-important adjacent arteries. By extending railway sidings into markets, now served by road, much of the congestion on the latter might be relieved.

Parallel Routes.—A useful purpose may be served by the judicious sign-posting of parallel routes, so that inexperienced drivers may be induced to leave the overcrowded roads and make use of less familiar thoroughfares. A glance at the map of our great cities will show how many such alternatives are already available and how many more might be rendered feasible by the demolition of a few buildings which interrupt the continuity of a line of streets. In many instances greater advantage would accrue from the completion of an alternative route by the acquisition of such obstructive buildings than from the customary widening at enormous cost of the principal thoroughfare by the demolition of one entire frontage. Two roads are better than one, seeing that an accident may at any time have the effect of closing a single thoroughfare, however wide. Unavoidable traffic stoppages due to road repairs can be shortened in many cases by the use of quick-setting cements and the introduction of pneumatic tools for breaking up old foundations. In the

busiest thoroughfares repairs should proceed uninterruptedly day and night. Co-ordination between adjoining highway authorities would prevent the annoyance of parallel routes being simultaneously closed for repair. The extreme need of some co-ordinating body for London led to the creation in 1924 of the London and Home Counties Traffic Advisory Committee, which reports to the Minister of Transport upon all matters affecting transit in that populous area.

Single-way Traffic.—Narrow streets which are so situated as to form useful lines of communication can often be advantageously utilised as single-way routes, a practice which has been widely adopted in Paris, where no less than 105 streets are reserved for one-way traffic. Obviously the facilities for establishing alternative routes and single-way routes are greatest in cities which have been methodically laid out on a fairly rectangular plan. In cities of haphazard growth more formidable difficulties will arise. The delay inflicted upon traffic at busy cross roads can be eliminated by the enforcement of gyratory movement in the rare cases where space permits, or by the construction of a bridge or tunnel enabling one stream of traffic to pass over the other—a device that is only rendered feasible by a convenient configuration of the ground. The ample dimensions of the " places " of Paris have enabled gyratory movement to be instituted at 19 traffic centres, whereas in London the experiment was tried in Jan. 1926, for the first time, in Aldwych and Parliament Square (*see* fig. 1) where its success has led to its extension to other traffic centres.

II. IN THE UNITED STATES

New York.—A distinctive aspect is given to the traffic problem of New York by the grouping within a restricted central area (Manhattan) of sky-scrapers, (Woolworth, Singer, Equitable, etc.) accommodating thousands of workers whose movements create congestion of perilous intensity. Somewhat similar conditions prevail in the " Loop " district of Chicago, where nevertheless only some few of the buildings exceed 17 storeys in height but where the day population exceeds 2,500 per ac., as compared with 614 per ac. in the City of London. The difficulties thus created are aggravated by the almost universal ownership of motor-cars in the United States, where in some towns one car is counted for every five inhabitants (men, women and children). Europe can produce nothing comparable with the transit problems presented by the massing within the Woolworth Building in New York of a working population of 14,000 souls—exclusive of visitors. The impossibility of providing stances for motor vehicles within easy walking distance of such a building is likely to militate against the more extended urban use of the automobile. It has been pointed out by Dr. Raymond Unwin that if only one in 10 of the occupants of the Woolworth Building wished to park a car it would be necessary to provide for that purpose exclusively a carriageway 60 ft. wide and three quarters of a mile long.

Chicago.—At Chicago, within the " Loop " district, the streets which represent no less than 40% of the ground-space are quite inadequate to carry the present traffic, and of the 60,000 motor-cars owned by the occupants of the " Loop " only 3,500 can find standing-room within the district. Temporary relief is afforded by the large open space set aside for Grant Park, where as many as 25,000 motor-cars have been seen parked at one time.

Regulations of Traffic.—The ever-growing demands made upon the police for the marshalling and regulation of street traffic have led to the introduction, in many cities, of mechanical signalling devices designed to reduce the staff and lighten their labours. Among such devices are the lamps now installed at cross roads on some of the Paris boulevards, which, by means of red and green lights, signal traffic to stop on one thoroughfare and proceed on the other, reversing these instructions at regular intervals, so that in each direction the flow of traffic is alternately held up and released. In some instances the change of signals is heralded by the sounding of a bell. In the larger American cities light-towers have been introduced as a means to the more scientific marshalling of traffic. These towers, erected at convenient points, are regulated from a master control tower, so that the traffic extending for a distance of from three to seven m. can be alternately held up and released, the period of arrest being carefully calculated in proportion to the relative volume of north-south traffic and east-west traffic respectively, so that the heavier stream may have the longer period of flow.

III. SOME SUGGESTIONS

Circumferential Roads.—Whatever efforts may be made to take full advantage of the roads already in use, the vast increase in vehicular traffic will in most of our growing cities call for the provision of additional thoroughfares. While the radial roads may be tolerably adequate it will usually be found that suitable circumferential roads are wanting, save in the case of towns whose fortifications have given place to a ring road. Relief to the congested centre of a city can often be most readily afforded by the building of circular roads which enable traffic to pass round the outskirts. By suitable regulations it should then be possible to limit the passage through the crowded centre to vehicles whose business legitimately requires their presence there. Little hardship is inflicted upon drivers who are relegated to the circular road, seeing that, although their journey may be longer, the time occupied is less, owing to the absence of congestion. As a good example of this type of route may be cited the circular road, 26 m. long, in 1926 approaching completion round the north of London.

Town Planning.—For the provision of new relief-roads in areas still undeveloped much can be done by the adoption of town planning procedure which enables the line of route to be laid down several years in advance, with a view to its ultimate construction as and when the land traversed is developed for building purposes.

Co-ordination.—At the root of the traffic problem in great centres of population lies the difficulty that the present local government boundaries usually have no relation whatever to the wider traffic region upon which the welfare, the work and the very existence of the city depend. Concerted action for the common good is defeated by the multiplicity and divergent interests of the small administrative units which encircle the city. In the aggregate the resources of the greater community forming the traffic region are amply sufficient to provide the remedies which are admitted to be necessary, but the application of these resources to the desired purpose is impracticable, in the absence of some public body empowered to determine the best means of promoting improvement schemes and to apportion the cost over the traffic region which ultimately benefits. Until this power of apportionment can be exercised there are insurmountable obstacles to the execution of vital improvements in poverty-stricken administrative areas, where local conditions often generate traffic delays reacting injuriously upon the whole traffic region. An authority exercising control over such a traffic region would naturally be charged with the duty of co-ordinating the different traffic agencies and means of transit, so as to eliminate wasteful competition and the congestion to which it gives rise. Certain routes would be reserved for trams or trolley vehicles, others for motor-buses, others for underground railways. The number of vehicles plying on various routes would be restricted to the needs of the travelling public, instead of being dependent upon the varying fortunes of the struggle between rival undertakings. It is indeed questionable how much longer the interests of the citizen can tolerate the use of the public highway as the arena for unrestricted traffic competition.

Franchises.—Many great cities have already had to adopt a " franchise " system, under which exclusive privileges are conferred upon particular traffic agencies in return for guaranteed services at prescribed fares. Even if the inconvenience of traffic congestion due to free competition were less marked, the arguments for some form of " franchise " system would still be cogent, owing to the fact that the fresh capital which is urgently required for the modernisation and extension of certain traffic agencies will not be forthcoming unless some security is afforded to those operating the undertaking.

Railway Electrification.—The need for additional resources is acutely felt by congested suburban railways constructed in the days of steam traction. Electrification of such lines is often the only means of increasing their carrying capacity and great activity prevails in the application of this remedy. As an instance may be quoted the electrification of the London suburban lines of the Southern Railway, involving the conversion of 650 m. of track, at a cost of nearly £8,000,000. The traffic flow of a railway being governed in large measure by its terminal capacity, the aim must be to enable the largest number of trains to enter and leave the terminal. It has been claimed that thanks to electrification the capacity of terminals can be increased by 150%, so that five trains would run where two ran formerly (*see* RAILWAYS, ELECTRIFICATION OF).

Future Developments.—Casting a prophetic glance forward one can discern certain directions in which the development of our civic, social and industrial life may be fundamentally affected by the pressure of the traffic problem. There is already a tendency towards the creation of self-contained satellite towns of moderate size where the citizen can live within an easy walk of his work and yet within sight of the green fields. The administrative centres of capital cities can be relieved by moving to the open outskirts of towns certain offices and departments which do not require an absolutely central position. As open spaces in central districts become rarer and rarer we may see legislation promoted to safeguard such squares and gardens as have escaped the builder.

Continuous Use of Offices.—It is conceivable that the high rental value of office accommodation in the heart of great cities and the increasing closeness of business contact between countries of every latitude may lead to the continuous use of offices throughout the day and night, with the result that the volume of passenger traffic to and from the suburbs would be better distributed. It is perhaps significant that several London restaurants should remain open throughout the 24 hours. A time may indeed be in sight when the problem of transport will be the dominating influence in moulding the life of the citizen in every highly developed industrial community. (H. MY.)

TRAINING CAMPS.—Prior to 1913 the people of the United States, although certain to be involved in the approaching world crisis, had made no military preparation which would enable them to play their appropriate part in the struggle for civilisation. Impelled by an appreciation of this situation, and realising that the interest necessary for properly meeting it could best be built up through the youth of the country, Maj. General Leonard Wood took up in 1913, as chief of staff of the army, with the Secretary of War, Lindley M. Garrison, the project of establishing training camps for duly qualified youths, and obtained his approval. The project was pushed forward by General Wood in the following three years.

1913 Camps.—The 1913 camps, known as Students' Military Instruction Camps, were held at Gettysburg, Pa., and Monterey, Cal., and were made up principally of college students. The total number in camps was 244. Those at Gettysburg formed a permanent organisation, which became known as the National Reserve Corps, and had for its purpose the building up of a corps of reserve officers. The results at Gettysburg and Monterey were such that these first camps attracted immediate and favourable recognition, and were the seeds from which sprang the Plattsburg camps. The active co-operation of the universities and high schools was secured through the efforts of General Wood and President Drinker of Lehigh University, who took steps leading to the organisation of an advisory committee consisting of the outstanding university executives in the United States.

1914 Camps.—The following year (1914) camps were established at Fort Ethan Allen, Burlington, Vt.; Asheville, N.C.; Ludington, Mich.; and Monterey, California. The total number in the different camps was 667. These aroused a gradually growing interest, reinforced by considerations growing out of the outbreak of the World War, and the Department of War determined that four such camps should be established during the summer of 1915, at Chickamauga Park, Ga.; Plattsburg N.Y. (three camps); Ludington, Mich.; and at the Presidio, San Francisco, California. The total number of men who passed through the camps during this year was 3,406. The camps were no longer limited to students from colleges and high schools, but were open to men from all walks of life who had the necessary physical qualifications and showed sound qualities of leadership. As Plattsburg was the largest training centre, the camps, wherever held, began to be called "Plattsburg Camps."

The Army Report.—Speaking of the training camps, the chief of staff of the army, in his *Annual Report for 1915*, said:

> The reports show that the results have fully justified the establishment of these camps . . . . Aside from the military instructions given these students and business men, I feel that the interest in preparedness which leads these men not only to give their time to the government but to incur the expense of buying uniforms and paying for transportation to the camps is of great value to the country, and should be encouraged by the War Department. These camps have passed the experimental stage, and there can hardly be any question as to the advisability of continuing them and extending them where the conditions of service of regular troops are such as to permit the department to send troops and instructors to the camps. Men with means probably do not object to paying the necessary funds to get the military training which the government expects to use in case of need. This, however, does not make it right. Men who are not so fortunately fixed financially should be permitted to show their patriotism and interest in preparing the country for war. If these camps are of value, which undoubtedly they are, and are to be continued, certain necessary expenses of the men willing to give their time should be met by the government.

Developments in 1916.—In 1916 a series of four camps, each for a month, was held at Plattsburg, N.Y.; a camp of one month's duration for boys at Fort Terry, N.Y.; a series of six camps of two weeks' intensive training at Wadsworth, N.Y., for the police of New York City; and a series of three camps, each for a month, at Oglethorpe, Georgia. Over 16,000 men were passed through the camps. In 1917, applicants for the camps numbered 130,000, and had the United States not gone into the War in the spring well over 100,000 men would have been trained in these volunteer training camps. During the winters of 1915–6 and 1916–7 courses were opened in Boston, New York, Providence, Detroit, Pittsburgh, Philadelphia, and other cities for the instruction and examination of applicants for reserve commissions, and through them were developed a large number of officers who played a vital part in the training of the great War levies.

War Training Centers.—When the United States entered the World War these hastily but intensively trained enthusiastic men were invaluable. They furnished the nucleus of civilian officers with which to begin the great work of developing 200,000 officers, and added a valuable and indispensable force to the scanty number of regular officers and national guard officers available for the training of men. In the spring of 1917 the Federal Government took over the whole task and established a series of camps for the training of officers for the War. Under authority of Section 54, National Defence Act, 1916, the Secretary of War directed the establishment of 16 Citizens' Training Camps throughout the United States at the following points: Plattsburg Barracks, N.Y. (two camps); Madison Barracks, N.Y.; Fort Niagara, N.Y.; Fort Myer, Va.; Fort Oglethorpe, Ga.; Fort McPherson, Ga.; Fort Benjamin Harrison, Ind. (two camps); Fort Sheridan, Ill. (two camps); Fort Logan H. Roots, Ark.; Fort Snelling, Minn.; Fort Riley, Kans.; Leon Springs, Tex.; Presidio of San Francisco, California.

Officers' Training Camps.—The training camps for officers were ordered to be ready for the reception of reserve officers about May 8, for candidates for commission May 14, and the course of instruction was to begin on May 15 1917. The minimum age for attendance was 20 years and nine months; the maximum age, 44 years. In addition to the foregoing, General Order 119, War Department 1917, established a training camp at Fort Winfield Scott, Cal., for the training of members of the coast artillery section of the Officers' Reserve Corps residing within the territorial limits of the western department, and a similar camp at Fort Monroe, Va., for the balance of the coast artillery reserve corps officers. These training camps began operation on

Sept. 22 1917. A medical officers' training camp was also established in 1917 at Camp Greenleaf, Fort Oglethorpe, Georgia. Other camps for officers were established at the headquarters of the various divisions, the courses being essentially the same as those at the former officers' camps. The period allotted for the development of an officer at the government training camps was three months. The work was intensive and hard. It was an attempt, in the rush and confusion of war, to produce officers in the minimum period of time. The purpose was to turn out the largest possible number of platoon leaders and a limited number of company commanders and officers of field grade. The same general plan was carried out at the training camps for officers in the quartermaster corps, medical corps and other staff corps. The courses involved much hard work and were necessarily defective in some particulars, but they served to turn out many tens of thousands of officers with elementary training which was later supplemented by their work with the divisional organisations to which they were assigned.

Public Support.—Theodore Roosevelt gave the full support of his great prestige and influence in the upbuilding of the camps, and never lost an opportunity to impress upon the public their importance and to push forward their development. Men too numerous to mention, men who are leaders in every walk of life, co-operated to the limit of their ability in the upbuilding of these camps, and in waking the country to an appreciation of the gravity of the situation and the need of preparation. The camps were a great force in firing the public conscience and rousing the people to a realisation of their obligation to prepare the country for defence and to do their part in the great struggle then threatening the world. (L. Wo.)

TRANSCAUCASIA (*see* 27.172).—The Transcaucasian Socialist Federated Soviet Republic comprises the former states of Azerbaijan, Armenia and Georgia with an area of 195,800 sq. km. or 0·9% of the area of the Soviet Union (U.S.S.R.).

Area and Population

Soviet Republic	Area in sq. versts	Population
Azerbaijan	76,447	2,125,152
Armenia	34,288	1,400,000
Georgia	57,967	1,792,000
Total	168,702	5,317,152

Out of the total population, just over 1,000,000 or about 19% are classified as urban, the remainder being engaged in rural pursuits. The total population represents 4·1% of the population of the U.S.S.R.

Political History.—On Sept. 20 1917 a council of Transcaucasian peoples met at Tiflis and declared Transcaucasia to be a Federal Republic within the Russian dominions. The effects of the Bolshevik revolution began to be felt in the following spring; in March a Bolshevik rising took place in Baku and established a Soviet régime, and in April the council declared the complete independence of the Federal Republic. In May it opened peace negotiations with the Germans and Turks, the latter having invaded the country and captured Batoum and Kars.[1] The Federal Council dissolved, however, on May 26; Georgia declaring its complete independence and National Councils of Armenians and Tartars taking over the administration of Armenia (Erivan) and Azerbaijan. Separate treaties were signed by Georgia with Germany on May 28th and by the three republics with the Turks and Germans on June 4th, which resulted in the "friendly" occupation of Armenia by the Turks and of Georgia by the Germans. In the following month the Bolshevik administration at Baku was overthrown and on Aug. 4th the advance guard of a British force under Maj. Gen. L. C. Dunsterville landed and were soon engaged in defending the town against the Turks (*see* PERSIAN CAMPAIGNS). On Sept. 14 the British troops evacuated Baku, which was then occupied by the Turks and became the seat of the Azerbaijan Government. The Turks, however, were compelled to evacuate the whole of Transcaucasia by the terms of the Armistice with the Allies of Oct. 30, and in the middle of Nov., Baku was reoccupied by a British force which administered the district on the collapse of the existing Azerbaijan Government. Just before the close of the year further British forces landed at Batoum to occupy Georgia and Armenia.

During 1919 the three Governments gradually established themselves, under the protection of the British forces, though Armenia opened hostilities in Jan. against Georgia and in Aug. against Azerbaijan. In both cases the disputes (territorial in origin) were settled by British mediation. The British forces evacuated the whole of Transcaucasia except Batoum on Aug. 28 1919. In Jan. 1920, the Supreme Council sitting in Paris accorded *de facto* recognition to the three Governments. On April 27–28 there was a revolution at Baku and the Azerbaijan Govt. was replaced by a Soviet Republic which invited the Russian Soviet forces to occupy the country. Georgia and Armenia, however, retained their independence for a time, and the former signed treaties with the Soviet Governments of Azerbaijan (May 7) and Russia (June 6), a step which Armenia refused to take. On July 7 the British forces evacuated Batoum and handed over the district to the Georgian Govt., whose independence was recognised by Soviet Russia in a second treaty signed in August. On Aug. 10 Armenia was compelled by threat of force to sign a treaty with Soviet Russia, but was shortly afterwards attacked by the Turkish Nationalists and the Soviet Govt. of Azerbaijan, with the connivance and support of Soviet Russia. In the result an Armenian Soviet Govt. was established in Dec., whose independence was recognised in a treaty by Soviet Russia.

On Jan. 27 1921, the Supreme Council sitting in Paris accorded *de jure* recognition to the Menshevik Govt. of Georgia, but on Feb. 12 there was a rising against this Government in the country and a week later the Russian Soviet troops crossed the frontier. Turkish forces then occupied Batoum at the invitation of the Mensheviks, but withdrew on the signature of peace and the proclamation of a Georgian Soviet Republic (March 19). In the following May a treaty of Alliance was signed between the Georgian and Russian Soviet Governments. Meanwhile the three refugee Governments from Georgia, Azerbaijan and Armenia had fled to Paris and there proclaimed a Caucasian Federation, asserting that the respective Soviet Governments did not represent the wills of the three peoples. A revolt against the Armenian Soviet Govt. in the summer was easily suppressed. The three Soviet Govts. regulated their relations with Turkey in a treaty signed at Kars on Oct. 13, the provisions of which followed the lines of the Treaty concluded in Moscow between Russia and Turkey, March 16. On March 12 1922 the three Soviet Govts. signed an agreement establishing the Transcaucasian S.S.S.R. which, though in close alliance with the Russian Soviet Republic, retained a nominal independence until the creation of the Union of Socialist Soviet Republics (July 6 1923) of which it then became a constituent member (*see* RUSSIA).

Natural Resources.—Transcaucasia contains some of the finest mountain scenery in the world; the vegetation ranges from subtropical on the west coast of Georgia to the dry and arid region of Kura, where cultivation is only possible by artificial irrigation, while Armenia is predominantly pastoral. The forest area comprises some 12,000,000 ac. rich in numerous varieties of timber; beech, oak, hornbeam, pine, spruce, fir, are the chief, but the commercially valuable varieties are said to be in the neighbourhood of a hundred. The chief agricultural crop is maize, but wheat and barley are also grown, while rice and cotton are cultivated in the eastern districts. The mulberry tree is also cultivated and there the silk-worm industry is reviving, the output in 1924 being about 35% of 1913, but the raw silk is sent to Moscow for manufacture. Tea planting is steadily increasing, the area planted having risen from 405 ac. before the war to 2,700 ac. in 1924. The plans of the Georgian Government propose a further extension to 16,200 ac. by 1929. The principal mineral deposits are oil (in the neighbourhood of Baku, Azerbaijan *q.v.*),

[1] By the Treaty of Brest-Litovsk (March 3 1918) Russia had ceded to Turkey the districts of Kars, Ardahan and Batoum.

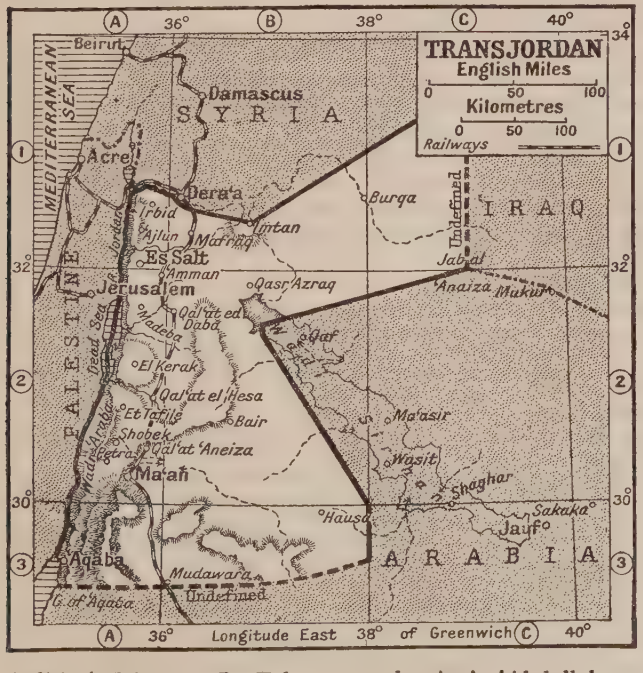
manganese (at Chiaturi), copper (in the mountains), and there are also considerable layers of rock salt.

Communications.—Baku is in direct railway communication with Moscow, by a line which runs up the shore of the Caspian and crosses over towards the Black Sea north of the Transcaucasian frontier. Another line connects Baku with Batoum via Tiflis, which town is also in rail communication with Kars and Tabriz. There is also a regular motor service over the passes connecting Transcaucasia with the Caucasus district of the Russian Socialist Federated Soviet Republic; this service is maintained by the Union commissariat of communications. The two principal ports are Batum on the Black Sea and Baku on the Caspian, the latter being connected by a regular ferry service with the Central Asian Railway at its terminus at Krasnovodsk on the other side of the Caspian. Regular air services connect Baku with Moscow (via Rostov) and with Batum, which port also enjoys an air service to Novorossisk. There are four institutes of quasi-university standing, two each at Tiflis and Baku. (*See* also RUSSIA.)

TRANSJORDAN, a territory in Asia Minor under British mandate. Its existence as a definite political entity dates from 1920 when, on the collapse of Faisal's Syrian kingdom of which it formed part, the three districts of Irbid, Balqa and Kerak, each enjoying a measure of internal autonomy under the guidance of British political officers, came under the general mandatory control of the High Commissioner for Palestine.

Boundaries.—The whole area was and still is subject to the British Mandate for Palestine, but the clauses relating to the establishment of a national home for the Jews have been specifically declared to be inapplicable to Transjordan area, which is bounded on the west by the central line of Wadi 'Araba, of the Dead Sea and of the Jordan as far as the confluence of the Yarmuk with the latter; on the north by the central line of the Yarmuk as far as the first railway bridge across it, and thence along the southern edge of the Hejaz Railway as far as Muzairib, whence it strikes across country to Nasib station and the village of Imtan.

The eastern boundary of Transjordan was fixed at the Bahra conference of 1925 (*see* ARABIA) and runs from a point southeast of Qasr Azraq along the western edge of Wadi Sirhan. On the south the boundary of this area was an east-west line crossing the railway between Jauf ed Derwish and 'Aneiza stations, pushed further southward in July 1925 to the line Mudawara-Haql (on the Gulf of 'Aqaba).



Political History.—In Feb., 1921, the Amir 'Abdullah, second son of King Husain of the Hejaz, arrived at 'Amman with a small force with the idea of attacking the French in Syria. Mr. Winston Churchill was at the time holding a Middle East conference at Cairo and, after an interview with 'Abdullah, arranged that the latter should be Amir of Transjordan with his capital at 'Amman and with a grant-in-aid from the British Govt. to assist him in the establishment of an efficient administration in the territories committed to his charge.

The arrangement was admittedly experimental, and the Amir was placed under the general control of the High Commissioner for Palestine whose representatives supervised the work of the local government. After a six month's trial and the occurrence of various untoward incidents this arrangement was modified. The chief British representative in Transjordan remained under the control of the High Commissioner for Palestine, but the Amir's government was allowed a sort of *de facto* independence. This scheme succeeded better, and in Oct., 1922, 'Abdullah visited England at the invitation of the British Govt. to discuss arrangements for the formal recognition of the independence of Transjordan. In April 1923, the High Commissioner announced at 'Amman that H.M. Govt., subject to the approval of the League of Nations, recognised the existence of Transjordan as an independent state under the Amir 'Abdullah, on the condition that its administration should be conducted on democratic and constitutional lines and should, by a subsequent agreement, place H.M. Govt. in a position to discharge their international obligations in respect of the area concerned.

This formal announcement never became operative. 'Abdullah and his government were unable to rule the country. Reckless financial administration and general misgovernment culminated in the serious rebellion of the 'Adwan tribe in Sept. 1923, which was suppressed by the Royal Air Force. The British Treasury declined to provide the annual grant-in-aid unless 'Abdullah was more closely controlled, and in April 1924, the Chief British Representative became in effect the supreme authority in Transjordan, controlling the administrative and financial administration of the Amir and his government under the orders of the High Commissioner for Palestine. By the end of 1925 Transjordan, nominally enjoying a sort of independence, had in effect become a non-Jewish province of Palestine and the Amir's civil list had been reduced to £12,000 a year, while the financial administration of his government was made subject to audit by the Palestine Government.

Population.—The population of Transjordan is about 300,000, of whom about half are Badawin. The rest include about 30,000 Circassians, inhabiting colonies planted there by the Ottoman Govt. after the Russo-Turkish war of the 'seventies, and 40,000 Christians of various sects. The chief towns are 'Amman (15,000), Es Salt (18,000), Kerak (8,000), Irbid (3,000) and Ma'an (3,000). The country comprises the biblical territories of Gilead, Moab, Edom and part of Bashan. At the beginning of the Christian era 'Amman (Philadelphia), Jarash (Gerasa), Umm Keis (Gadara) and other places were important centres of Greco-Roman civilisation. Later, part of these territories formed the independent kingdom of Chassan and were conquered by the Muslim armies in 637. During the Crusades Kerak (*see* 15.753) was the chief administrative centre of Outtic-Jourdain and afterwards it was ruled by various kings or Amirs. Under the Ottoman régime the whole of Transjordan formed part of the vilayet of Syria, but its southern part (Kerak, etc.) did not come under effective Turkish control until the Hejaz Railway, which traverses the territory from Nasib to Mudawara, was completed in 1904. (*See* also ARABIA; PALESTINE.)

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TRANSMUTATION OF ELEMENTS.—The growth of knowledge with regard to the nature and constitution of atomic nuclei which has resulted from the study of radioactive phenomena, the scattering of α-particles by matter, and the investigation of atomic masses by positive-ray analysis, has aroused considerable interest in the possibility of effecting a transmutation from one element to another by artificial means.

The Structure of the Elements.—The fundamental factor which distinguishes one element from another is the resultant positive charge on the nucleus of the atom, which, when expressed in terms of the magnitude of the electronic charge, is equal to the atomic number of the element. Thus in passing from one element to the next higher element, the nuclear positive charge increases by one unit. Corresponding to every value of the nuclear charge there is a definite configuration of electrons each of which revolves in a separate orbit round the nucleus, the number of

electrons being equal to the atomic number of the element, thus causing the system to be electrically neutral. The ordinary chemical and physical properties which characterise any element are due to its particular configuration of extra-nuclear electrons, and are thus controlled by the nuclear charge.

To bring about a transmutation from one element to another it is therefore fundamentally necessary for the nuclear charge to be increased or decreased by some means, for if this can be brought about the configuration of external electrons will adjust itself to the changed conditions. The experimental difficulties involved in effecting a change of nuclear charge would be expected to be very considerable, and up to the present time the record of definite evidence of the successful achievement of such an alteration—*i.e.*, of artificial transmutation—is not very extensive.

Spontaneous Transmutations.—The spontaneous transmutations which we have in the radioactive series of elements are transformations in the direction of decreasing atomic mass, and lead to the attainment of ultimate stability in the direction of decreasing atomic number. It does not however follow that artificial transmutation will necessarily be most easily brought about in the same direction.

Conditions of Transmutation.—There is strong evidence that protons (or hydrogen nuclei—positive particles of unit mass and unit charge), α-particles (or helium nuclei—positive particles of mass 4 and charge 2), and electrons, enter into the nuclei of the atoms of the heavier elements as constituent units. Transmutation would therefore necessarily take place if either a proton, an α-particle, or an electron, could be caused to enter or leave the nucleus of any atom.

Experimental Work.—By bombarding the atoms of various elements with α-particles, Rutherford and Chadwick, and subsequently Kirsch and Pettersson, have found that from several elements particles are produced which are capable of causing a scintillation on a fluorescent screen placed far beyond the range of the original α-particles. From experiments on the bending of their paths by a magnetic field, these particles were shown to be protons. After testing in various ways to find out whether they could have originated from hydrogen present as an impurity, either in the elementary form or in combination, it was concluded that these particles must have come from the atoms of the element under test. Nitrogen was one of the first elements for which this effect was found, but many other elements have since been shown to give rise to protons when bombarded by α-particles. The ejected proton eventually acquires an electron and settles down as an ordinary hydrogen atom. The actual proportion of the impacts which result in disintegration and the production of hydrogen is, of course, extremely small.

Ejection of Units.—In these cases we have clear instances of transmutation by the ejection of one of the units of their structure from the nuclei of atoms, the definite evidence of the transmutation being the detection and identification of the ejected portion. With regard to the ultimate condition of the remaining part of the bombarded nucleus, and the fate of the bombarding α-particles there is no evidence in the case of most of the elements, but with nitrogen a definite investigation of these problems has been made by Blackett, who, by the Wilson cloud condensation method, photographed the tracks of a very large number of α-particles through nitrogen, and was able to identify several of these tracks as showing the occurrence of a disintegrating impact. In each of these cases only one track other than that due to the projected proton could be found diverging from the point marking the occurrence of the disintegration. From this it was concluded that the bombarding α-particle was retained by the struck nitrogen nucleus, thereby producing a system of mass 17 and nuclear charge 8, a system which would be an isotope of ordinary oxygen.

The experiments conducted by Blackett could not by their very nature enable a decision to be made as to whether such a system has any permanent stability. Harkins and Ryan, and Akiyama, have on the other hand obtained photographs of α-ray tracks in air showing collisions resulting in disintegration, with three branches diverging from the point marking the occurrence of the collision. As the disintegrating atoms in air were presumably nitrogen atoms, these results seem to indicate that even in any one substance the fate of the bombarding α-particle is different in different disintegrating collisions.

Further Evidence.—In addition to the evidence of transmutation of elements resulting from α-particle bombardment of atoms, we have the evidence brought forward independently by Miethe and Stammreich, and by Nagaoka, of the conversion of mercury into gold, and the evidence recorded by Smits of the production of thallium and mercury from lead. In each case the recorded transmutation is in the direction of decreasing atomic number, but there is no evidence as to whether the changes involve decrease of atomic mass or not. The change from mercury (atomic number 80) into gold (79) might conceivably be effected either by the entry of an electron into, or the removal of a proton from, the nucleus of the mercury atom, and the same alternatives present themselves in regard to the transformation of lead (82) into thallium (81).

Nagaoka, in attempting to bring about the transformation of mercury into gold, held the view, based on a consideration of the resemblance of the non-series spectrum lines of gold and mercury, that in the mercury nucleus a proton existed as a sort of satellite to the main nucleus, which was the same as that of the gold atom, and he designed his experiments with a view to bringing about a powerful disturbance of the nucleus in the hope of ejecting the satellite proton. He passed a discharge in paraffin oil between electrodes of iron and purified mercury with a short spark gap, using an induction coil of 120 cm. spark length. After four hours he succeeded in obtaining evidence of the presence of gold, and confirmed his result by subsequent experiments. Although the experiment was designed to facilitate the ejection of a proton from the mercury nucleus, it would not preclude the possibility of a transmutation being effected by the entry of an electron into the nucleus.

Miethe and Stammreich's experimental arrangement was entirely different, for they obtained traces of gold from mercury vapour lamps in which a heavy current had been passed under a potential difference of only 170 volts. The arrangement employed by Smits was somewhat similar to that of Miethe and Stammreich. It consisted of a quartz lead-vapour lamp of special design run at voltages of less than 100 and with currents up to 100 ampères. Smits records that initially the spectrum showed only one of the mercury lines, namely $\lambda 2536$, but that after running the lamp for 10 hours the strongest mercury lines in the visible as well as the ultra-violet region of the spectrum had made their appearance, and that the most characteristic thallium line was also visible. It is difficult to believe that the electric field due to a potential difference of only 100 volts or so across the tube would be strong enough to effect the disruption of an atom and to bring about transmutation by the ejection of a proton, and the alternative possibility of the entry of an electron into the nucleus must be taken into account.

In the case of the transmutation of lead (82) into mercury (80) the change might take place either by the intermediate production of thallium by one of the processes already suggested, and the subsequent conversion of thallium into mercury by one of these processes, or it might occur as a one-stage transformation by the ejection from the lead nucleus of either one doubly charged positive particle (presumably an α-particle) or two singly charged positive particles (presumably protons) simultaneously. The fact that Smits records stronger evidence of the production of mercury than of the production of thallium seems to argue against the formation of mercury from lead by the intermediate production of thallium in his experiments.

When atoms are bombarded by high speed electrons, it is possible that occasionally an electron penetrates within the K shell of extra-nuclear electrons. If such a penetration does occur the electron will be attracted towards the nucleus and may perhaps be absorbed by it. It is possible that something of this kind occurred in the experiments of Miethe and Stammreich, and of Smits, giving rise to the detected gold and thallium respectively, though it is surprising that the penetration of the K shell of electrons could occur with the small potential differences they employed. If a nucleus were to absorb an electron in the way suggested it is possible that with some nuclei instability would result and disruption occur. This can perhaps be more readily imagined if the nuclei have satellite protons as suggested by Nagaoka in the case of mercury. In the case of an element such as lead, for which several isotopic forms occur, it is conceivable that the close approach of an electron to the nuclei of different isotopes would have different results. That the mercury detected in Smits' experiments could have been produced from the disruption of the nucleus of one of the lead isotopes following instability resulting from the close approach of an electron to the nucleus, must however, be regarded simply as a conjecture. For a discussion of the subject see Sir E. Rutherford, *Electricity and Matter in Phases of Modern Science* (1925). (F. Ho.*)

TRANSPORT: *see* FLYING; INLAND WATER TRANSPORT; MOTOR TRANSPORT.

TRANSPORTATION: *see* URBAN TRANSPORTATION.

TRANSVAAL (*see* 27.186), since 1910 a province of the Union of South Africa. Area, 110,450 square miles. Population (1921), 2,087,636, compared with 1,686,212 in 1911 and 1,269,051 in 1904. The white population increased from 297,277 in 1904 to 543,485 in 1921, a reflection chiefly of the development of the gold and coal-mining industries. Half the white population was concentrated on the Rand, where there are six large municipalities besides Johannesburg (*q.v.*), the largest city in South Africa. Brakpan is the centre of the Far East Rand, from which since 1921 the bulk of the gold has been mined. The only other big town is the capital, Pretoria (*q.v.*).

Apart from gold-mining, which maintains its position as the chief industry, there has been a notable increase in the production of coal. Copper has been produced in considerable quantities since 1914, and in 1923 a valuable discovery of platinum was made in the northern Transvaal, though up to 1926 the mines had not reached the producing stage. The Transvaal also maintained its position as a stock-raising country. The cultivation of maize and tobacco largely increased, and (since 1917) cotton has been extensively planted, while manufacturing industries have been developed on the Rand.

As in the other provinces, the bulk of provincial expenditure was on education, the provincial council being noted for its many educational experiments. On the language question from 1912 onward instruction in the lower standards was in " the home language of the child." Primary education is compulsory, and both primary and secondary education is free. Expenditure on education, which in 1915–20 averaged £1,203,000, was £2,508,000 in 1922–3. Expenditure on general administration for the same periods was £69,000 and £106,000. The subsidies from the Union Govt., which averaged £841,000 in 1915–20, were £1,456,000 in 1922–3. An item of revenue peculiar to the Transvaal is a native pass tax—24s. a year—in labour districts, paid by the employer, elsewhere payable by the native. This tax yields from £330,000 to £350,000 per annum. The provincial system of administration is as in the other provinces (*see* CAPE PROVINCE).

The Transvaal presents in its social life many extremes, the conservatism of the back-veld Boer contrasting strongly with the progressive and democratic spirit of the dwellers on the Rand. Both these elements have their counterparts in other provinces, but party feeling was more strongly expressed in the Transvaal than elsewhere, and this led to the introduction of politics into the provincial council. The white workmen on the Rand form the main strength of the Labour party in the Union.

A considerable number of Boers in the western Transvaal took part in the rebellion of 1914, but the influence of Generals Botha and Smuts kept many burghers loyal to the British connection. The disturbances on the Rand in 1913–4 and the revolt of 1922 were not on racial lines, though the majority of the white miners were Dutch-speaking. But feelings were strongly marked in the provincial council, as was shown by agitations against officials because of their nationality or their politics. Thus, after the general election in June 1924, when the Nationalist and Labour parties gained the victory, there was an agitation to remove the administrator, Mr. J. H. Hofmeyr, because he belonged to the South African party, an agitation which General Hertzog, the Prime Minister, refused to heed. Mr. Hofmeyr's predecessors as administrators had been Mr. Johann F. B. Rissik (1910–7) and Mr. A. G. Robertson (1917–24). (*See* SOUTH AFRICA). (F. R. C.)

TRANSYLVANIA (*see* 27.210), a province of Rumania, transferred to that country from Hungary by the treaty of Trianon (1920). Its area is 22,312 sq. m.; and the population (Hungarian census of 1910) 2,678,367. The Hungarian census gave 1,472,031 persons of Rumanian, 918,217 of Magyar and 234,085 of German tongue; these figures certainly over-estimate the Magyar population at the expense of the other nations. The Germans are settled in compact and largely urban settlements, mostly in the south; the Magyars in one compact settlement in the east (Székley) and on the western fringe; most of the landowners and officials were Magyar or Magyarised. The Rumanians form the majority of the rural population.

For administrative purposes, Transylvania is divided into 22 districts, each placed under a prefect appointed by the Government in Bucharest. Transylvania and the Banat send 120 deputies and 60 senators to the Parliament at Bucharest. Of these 18 represented the national minorities (1925).

In Oct. 1918 the Rumanians of Transylvania formed a national committee at Oradea-Mare which, invoking the right of self-determination, claimed separation from the Austro-Hungarian Empire and separate representation at the Peace Conference. In Nov. this committee formally demanded from the Hungarian Govt. the surrender of executive powers in the countries inhabited by Rumanians and eventually assumed administrative control throughout Transylvania and the Banat. On Dec. 1 1918 a national congress, meeting at Alba Latia, proclaimed the union of Transylvania and the Banat with Rumania. The Treaty of Trianon (June 4 1920) ratified this arrangement. The German settlements had voted for the union Jan. 21 1919, but the Magyars only accepted it under protest in 1921.

The chief measures since introduced by Rumania consist of universal suffrage and land reform. The large estates were parcelled out, the previous owners retaining a maximum of 300 ac.; over 100,000 peasant families (2,700 of which were Hungarians) received arable land through this measure. Education, which had been greatly neglected under Hungarian rule, made rapid strides. In 1917 there were five secondary and 2,296 primary Rumanian schools; in 1925 there were nearly 100 and 6,157 respectively; there were 2,231 elementary schools for the minorities (1,669 Hungarian, 403 German) and 148 secondary schools (119 Hungarian, 29 German). (G. Bo.)

TRAWLING: *see* FISHERIES.

TREATIES (*see* 27.229).—The question of the sanctity or renewal of treaties is always a very serious one at the close of a war. But before the World War many great authorities held the opinion, which was expressed by some (*e.g.*, Professor Oppenheim) actually during the War, that the apparent " breaking-up of laws," which takes place in war is usually succeeded by a stronger emphasis upon them when peace is attained.

The sanctity of treaties is a dogma open to several interpretations. For instance, many international jurists, including Bethmann-Hollweg, hold that Germany committed a breach of international law in invading Belgium in defiance of the treaty of 1839. Others, among whom is Sir Ernest Satow, an authority on both the theory and practice of diplomacy, would maintain that Germany by violating Belgium merely gave any other guaranteeing state the right to attack her. In other words, Germany risked her existence but did not specifically break international law. The difference between these two views is that the first relies upon custom, etc., to establish the sanctity of treaties, and the latter upon force. The difficulty of the first view lies in the fact that custom may change. For instance, it was thought to have been established in 1871 that no great Power which had joined with other great Powers in signing a treaty could violate the provisions of that treaty without the consent of the other signatories, *i.e.*, without a European conference. But in 1908 Austria-Hungary violated Article 25 of the Treaty of Berlin (1878) by annexing Bosnia and Hercegovina, and refused the demand for a conference. There can be little doubt that this principle had been abandoned before 1914. The peacemakers of 1919 therefore tried to set up a state of things whereby the sanctity of treaties would be upheld by the general co-operation of all states. President Wilson condensed this aspiration into a single sentence: " What we seek is the rule of law sustained by the organised opinion of mankind."

League and Regional Guarantees.—Some treaties which had proved impotent to guard certain countries, as, *e.g.*, those neutralising Belgium and Luxembourg, were abrogated altogether (*cf.* Articles 31, 40–1 of the German, Article 83–4 of the Austrian and Articles 67–8 of the Hungarian Treaties). The League of Nations Covenant, however, attempted to give a general guarantee to all the members of the League in respect of their territorial integrity and independence. This general guarantee, embodied in Article 10 of the Covenant (*q.v.*), has, on the whole, been rather watered down in its interpretation. It

has, in fact, been succeeded by a system of special or regional guarantees. Thus in the Treaty of Locarno (signed Dec. 1 1925), the demilitarisation of the Rhineland, enacted by the Treaty of Versailles, Articles 42–44, was guaranteed by France, Great Britain, Germany and Italy. This guarantee becomes effective on the admission of Germany to the League of Nations In case of need Great Britain guarantees France against the unprovoked attack of Germany, and *vice versa*. Similar regional guarantees are given by France to Poland and to Czechoslovakia. The "Little Entente Treaties" (of which the first was signed Aug. 4 1920) constitute a system of regional and special guarantees between Czechoslovakia, the Serb-Croat-Slovene kingdom and Rumania to preserve the territorial limits laid down in the treaties of St. Germain, Trianon and Neuilly (*see* LITTLE ENTENTE). Similarly it was recognised in Article 26 of the Covenant that the Monroe Doctrine was "a regional understanding," which meant a practical admission by the principal Powers that the United States guaranteed other states on both American continents against the aggression of non-American neighbours.

There can be no doubt that many smaller states now enjoy greater advantages under the Covenant and special and local guarantees than did the neutralised states of the 19th century. The Covenant was successfully invoked by Great Britain on behalf of Albania against the Serb-Croat-Slovene kingdom in 1921, and by Greece against Italy in the matter of Corfu in 1923. Also the inclusion of Germany in the League will in itself mean a strengthening of League guarantees.

Compulsory Arbitration.—It is a singular and interesting fact that many smaller Powers (*e.g.*, the Scandinavian kingdoms, the Netherlands and China) have signed the compulsory jurisdiction clause in the protocol establishing the Permanent Court of International Justice. If both litigating Powers have signed the compulsory clause a peaceful settlement can be imposed by the court. There can be no doubt that such smaller Powers as cannot depend on the guaranteed protection of larger ones feel that they are safest in this way. And it is an interesting fact that Denmark is the first state in Europe since the War to propose the reduction of her armed forces to the level of mere police, and to trust to the justice and opinion of the world for support in time of need.

If it continues, the Permanent Court will in time create a standard of international justice which it can impose upon all those who have signed the compulsory clause. Were it possible, or certain, that the principal Powers would also sign the compulsory clause the peace of the world could be reasonably assured.

Abrogation or Renewal of Treaties after War.—Highly technical points are raised by this question which, though less generally interesting than those already mentioned, are none the less of some importance for the future of diplomacy. Treaties are of two kinds, bilateral between two states, multilateral between several states. All treaties between the contending parties cease on the outbreak of war. It is clear that in the case of bilateral treaties when State A can force State B to sign a treaty of peace after the war, A can renew or refuse to renew with B all the pre-war treaties that she chooses. Germany did not question this right in bilateral treaties. In the case of multilateral treaties the Allies claimed the right to refuse permission to Germany and to the enemy Powers to keep in force treaties with states not actually then engaged in the War, as, *e.g.*, Soviet Russia, or with neutrals who had not been in the War at all though they had severed diplomatic relations with Germany, as, *e.g.*, Peru and Ecuador. In reply to the German protests, the Allies maintained and inserted in the German and other treaties their right to "reapply" all "multilateral treaties which seemed to them to be compatible with the new conditions arising out of the War," and "to indicate which of these treaties with Germany they intend to revive or allow to be revived." The Allies particularly insisted on making Germany grant for limited periods to the Allies themselves or to some of them certain terms already granted to her friends or neutrals. But they did not demand that Germany should be prevented from negotiating new instruments with states other than the Allies *after certain limited periods* had passed, *e.g.*, Article 268, of German Treaty. Nor did Germany fail to avail herself of her power. After having been compelled to abrogate the treaties of Brest-Litovsk with Soviet Russia, she negotiated the Treaty of Rapallo with them on April 16 1922. This step evoked much protest from the Allies, and it was contended that Germany had not the right to do it.

The use of power by the victor to enforce on his defeated antagonist the abrogation of treaties with neutrals is not in itself desirable; but it does not appear, on the whole, that such power, even if abused at the moment of victory, is likely to be abused for very long. The special grievances or difficulties thus created by any such abuses in 1919 will be well compensated for if the settlement of Europe has in fact brought a greater sense of security and permanence, whether through the agency of the League, of regional guarantee or of the Court of International Justice. (*See* also COMMERCIAL TREATIES.)

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(H. W. V. T.)

TREE, SIR HERBERT BEERBOHM (1853–1917), British actor and manager (*see* 27.234), died in London July 2 1917. He published a volume of *Thoughts and Afterthoughts* (1913) and other occasional papers. See Max Beerbohm, *Herbert Beerbohm Tree: Some Memories of Him* (1920).

TRENCH, FREDERICK HERBERT (1865–1923), British poet and playwright, was born at Avoncore, Co. Cork, Nov. 12 1865. Educated at Haileybury and Keble College, Oxford, he was elected a fellow of All Souls' College, and from 1891–1908 was an examiner in the Board of Education. This appointment he gave up in 1908 in order to devote himself to literary work. In 1908 he became director of the Haymarket Theatre, London, where he staged *King Lear* and Maeterlinck's *Blue Bird*. His first volume of poems, *Deirdre Wedded*, appeared in 1901. It was followed by further poems, notably "Apollo and the Seaman," included in *New Poems* (1907), and *Lyrics and Narrative Poems* (1911). Among his later publications were an *Ode from Italy in Time of War* (1915); *Poems: with Fables in Prose* (1918); and a poetic play *Napoleon* (1919), which was produced in London by the Stage Society in 1919. He died on June 11 1923. His collected works, edited by H. Williams, were published in 1924, and a volume of selected poems in the same year. See Abel Chevalley, *Herbert Trench: Notice sur sa Vie et ses Oeuvres* (Paris, 1925).

TRENCHARD, SIR HUGH MONTAGUE (1873–), British air marshal, was born Feb. 3 1873. Commissioned in the Royal Scots Fusiliers in 1893, he served in the South African War with the Imperial Yeomanry and the Canadian Scouts. From 1903 to 1910 he served in West Africa. In 1912 he qualified as an air pilot and became an instructor at the Central Flying School at Upavon, where he was appointed assistant commandant the following year. On the outbreak of the World War Trenchard assumed charge at Farnborough, but before the end of 1914 was summoned to France, and became head of the military wing of the Royal Flying Corps. His strong personality, foresight and power of command made his name a household word in France, and with the expansion of the air service he rose from major to major-general in little over a year. After the formation of the Royal Air Force he became, in March 1918, chief of the air staff. This position he resigned a month later, owing to disagreement with the first Air Minister, Lord Rothermere. But a few weeks later he received command of the newly formed Independent Air Force, whose mission was to raid Germany, a post that gave scope to his gift for inspiring men and to his development of the strategical rôle of aircraft. In the same year he was created K.C.B.; and in 1919 was again appointed chief of the air staff and received a baronetcy. In 1922 he was promoted air chief marshal.

TRENT, England (*see* 27.250).—A scheme of improvement of navigation between Nottingham and Newark has been proceeding on the river Trent for some years, and aims at encouraging industrial development. The river is to be regulated by locks so that barges of 120 tons will be able to come up to Nottingham. Locks, 190 ft. long and 30 ft. wide, were in course of construction in 1925 at Stoke Bardulph, Hazleford and Gunthorpe, and the last was completed in September.

TRENTINO: *see* TIROL.

TRENTON, N.J., U.S.A. (*see* 27.251), grew to a population of 119,289 in 1920, of whom 30,168 were foreign born; and to 132,020 in 1925 (census bureau estimate). Its factories produced goods valued at $49,115,000 in 1909; $122,478,000 in 1919; and almost as much ($116,622,782) in 1923, after some decrease in the period of depression. It maintained its leadership in the production of pottery, wire and wire rope, structural steel, and linoleum, and ranked second in the manufacture of automobile tires and other rubber goods. The public school system contained 31 schools by 1925, with 698 teachers and an enrolment of over 20,000 pupils. The Board of Health paid particular attention to measures for promoting the health of children, both in the public and in the parochial schools. Three municipal markets were established in 1920. Docks, wharves and warehouses on the Delaware river were owned by the city. A modern sewage disposal plant was under construction in 1925. In 1911 a commission form of government was adopted.

TREVELYAN, GEORGE MACAULAY (1876–), British historian, was born Feb. 16 1876, the third son of Sir. G. O. Trevelyan (*see* 27.255). Educated at Harrow and Trinity College, Cambridge, he devoted himself to historical research and became an authority on certain phases of Italian history. In 1904 he married Janet, daughter of Mrs. Humphrey Ward.

Trevelyan's works include *Garibaldi's Defence of the Roman Republic* (1907); *England in the Age of Wycliffe* (1909); *Garibaldi and the Thousand* (1909); *Garibaldi and the Making of Italy* (1911); *Manin and the Venetian Revolution of 1848* (1923); *The Life of John Bright* (1913, new ed. 1925); *History of England* (1926).

TREVES, CLAUDIO (1872–), Italian politician, was born in Turin of a Jewish family. He graduated in law and at an early age became a Socialist. He first edited *Il Tempo* of Milan, and when that paper came to an end he joined the staff of *Avanti!*, the official organ of the Socialist party, which he afterwards edited. But he soon resigned, owing to disagreements with the general tendencies of the paper, and subsequently limited his journalistic activities to writing articles in Turati's *La Critica sociale*. He entered Parliament in 1906 as member for Milan, and was re-elected at all subsequent elections, being returned as a Unitarian Socialist at the 1924 elections. In Socialism he represents the orthodox Marxian view. When the split over the reformist tendency occurred at the Reggio Emilia congress in 1912, Treves remained with the majority, but he also held out a hand to the secessionists (Bissolati, Bonomi, etc.). During the World War he adopted an uncompromising non-interventionist attitude. After the Fascist advent to power he ceased to play a prominent part in politics, but he continued to edit *Giustigia*, the official organ of his party.

TREVES, SIR FREDERICK (1853–1923), British surgeon, was born at Dorchester Feb. 15 1853, and was educated at Merchant Taylor's School, London, and the London Hospital, where he became surgical registrar. In 1881 he was appointed as professor of pathology and in 1885 as professor of anatomy at the Royal College of Surgeons, subsequently going into private practice. He served as consulting surgeon during the South African War in 1900, and was made surgeon extraordinary to Queen Victoria in that year, and surgeon to King Edward VII. in 1901. He will be particularly remembered for his skill in operating on King Edward VII. when he fell suddenly ill in June 1902. He was created K.C.V.O. in 1901 and a baronet in 1902, and later serjeant surgeon to King George and surgeon in ordinary to Queen Alexandra. During the World War he assisted in the founding of the British Red Cross. His work on the intestinal canals of man and mammals was based on hundreds of original dissections, and corrected many popular misconceptions. He died at Lausanne on Dec. 7 1923.

His publications include several surgical and medical books, of which *Surgical Applied Anatomy* (1883) is well known, and various treatises on intestinal obstruction, peritonitis and appendicitis, as well as a number of more popular books such as *The Tales of a Field Hospital* (1900), *The Riviera of the Corniche Road* (1921), *The Lake of Geneva* (1922), and *The Elephant Man and Other Reminiscences* (1923).

TRIANON, TREATY OF.—The treaty of peace between the Allied and Associated Powers and Hungary was signed at the Trianon on June 4 1920. Owing to the outbreak of Béla Kun's revolution in Hungary, the delegates of that nation were not summoned to the Peace Conference till Nov. 1919. Previous to that date, however, on June 13 1919 the Supreme Council had decided upon the new frontiers of Rumania and Czechoslovakia and had published them. The Hungarian Govt. received the treaty in Jan. 1920 and on June 4 it was signed at Trianon. It actually came into force on July 26 1921.

General Observations.—Though the separation of Hungary from Austria and its complete independence are recognised, the details of the Hungarian Treaty otherwise are very closely akin to those of the Austrian. The most important difference is that, while the treaty of St. Germain is signed with the republic of Austria, that of Trianon is signed with Hungary, or with "the national Government of Hungary," a phrase permitting her to be regarded as a Government where the monarchy is temporarily in suspense. Though Charles never abdicated the kingship of Hungary and there is no provision in the treaty for his deposition or for that of any Habsburg, he was formally deposed by a law passed by the Hungarian Assembly (after his attempted Putsch Oct. 1921) at the insistence of the Allies. (*See* HABSBURG.) On her admission to the League of Nations in 1922 Hungary submitted to the League a document pledging herself not to restore the Habsburgs without the consent of the Allies, and confirming the undertaking to the Conference of Ambassadors of Nov. 10 1921. It may therefore be said that, while an international understanding has been given by Hungary, prohibiting the election of a Habsburg to the Hungarian throne, there is no international obligation to prevent any other individual from being elected king.

Territorial Clauses.—The territorial clauses of the Hungarian Treaty reduce her to a population of 7,500,000 (1910 census), of whom 6,250,000 are Hungarians (Magyars); 500,000 are Germans, 500,000 are Jews, 230,000 are Slavs and Slovaks and 50,000 are Rumanians. Fiume was ceded to the principal Allies by article 53 and, after being erected into a free city, was eventually annexed by Italy (1924). Hungary has lost to other nations over 3,000,000 Magyars, of whom 1,500,000 go to Rumania, nearly 1,000,000 to Czechoslovakia and 500,000 to Yugoslavia. These losses have been much bewailed by the Magyars on the ground of self-determination, but their complaints are not wholly sound. Much of the Magyar population lost (as *e.g.*, the Székler area) consists of Magyar islands isolated amid a sea of Slavs or Rumanians. The Pécs area, with its valuable coal mines, has been returned and a line drawn in this area so as to give Hungary a defensible frontier. The chief offence against nationality is on the eastern border of Hungary, where the line is so drawn as to give to Rumania the three Magyar towns of Satul-Mare (Szatmár) Oradea-Mare (Nagyvárad) and Arad and the surrounding Magyar zone. But this concession was made primarily for economic reasons. Without the railway line connecting these three cities from north to south there would be no connection between north and south Transylvania.

Had the Hungarian Govt. possessed the intervening strip, it would certainly have made difficulties as to the cheap and easy transport of food from south to north. On the whole, however, whether we consider Rumania or the Serb Croat-Slovene kingdom, we must admit that both got much territory at Hungary's expense, though neither of them got as much as they wanted and demanded. The Hungarians, with complete indifference to the claims of nationality, have always asserted that they have a

right to the whole original kingdom of Hungary, including the Rumanians, Slovaks, Italians, Serbs, Croats and Germans, of which the Magyar population formed little more than half. It is entirely true to say that the Allies, in making the Treaty, showed much more respect for nationality than Hungary has ever done.

Articles 36–78 deal with the details of ceding territory to Italy, Czechoslovakia and Yugoslavia, and are similar to the corresponding section in the Austrian Treaty. Hungary is less affected by interests outside Europe than Austria, but is, none the less, compelled to cede all rights in capitulations, concessions, etc., in China, Siam, Egypt, etc.

Part V.—The military, naval and air clauses are almost exactly similar to those of the Austrian Treaty, except that Hungary is allowed an army of 35,000 instead of Austria's 30,000. Part VI., *Prisoners of War and Graves*, and Part VII., *Penalties*, are the same as in the Austrian Treaty. (*See* ST. GERMAIN, TREATY OF.)

Part VIII.—Reparation.—This section is verbally almost identical with the Austrian section, and both are a close imitation of the German. For various reasons it was not possible to fix the exact amount of reparation. But Hungary was forced to surrender all rights to her merchant ships on "the ton for ton, class for class basis," and her reparations in kind were to be fixed in three months by the Reparation Commission, which was to deliver cattle to Italy, to Rumania, and to the Serb-Croat-Slovene kingdom (Annex. iv. to Part viii.). As parts of Hungary had already been amply sacked by Rumanian soldiers in Aug. 1920, this did not leave them much livestock in hand.

Financial and Economic Clauses.—Articles 180–199 are mainly concerned with liquidating the Austro-Hungarian National Bank, thus separating the last link with Austria. Part X., the economic clauses, calls for no special remark, nor does Part XI., Aerial Navigation. The economic clauses are the same as the Austrian, the latter like that of both German and Austrian Treaties. Part XII., ports, waterways and railways, is mainly concerned with the regulation of the Danube, for which a Statute was eventually drawn up. As in the case of the Austrian Treaty (Article 311), the Hungarian in Article 294 provides for the free access of Hungary to the Adriatic, though practically nothing has been done to secure it. Part XIII., labour, is the same in all treaties and Part XIV., miscellaneous provisions, calls for no remark.

Summary.—In the Hungarian Treaty, as in all others, the war criminals and reparation sections proved impossible of execution. Indeed, it is a great misfortune that these clauses of the Hungarian Treaty were modelled so closely on those of the Austrian and German. In the result, Hungary, being an agricultural country, has proved much more elastic in her recovery than Austria and her economic and financial situation are both sound. It has not proved true, as was averred by her statesmen at the time, that the loss of so much territory and population would cripple her. She retains areas of great agricultural, and some mineral, wealth.

Her conduct is, however, open to suspicion. On her admission to the League in 1922 the military experts stated that her army was above the limit of 35,000 men, and there was an extraordinary forgery of French francs in 1926 in which a prince, a bishop, the Budapest chief of police and possibly higher officials, were implicated. The real cause of discontent is the refusal of the Magyar irredentists to accept the inevitable and their incessant pressure upon the Government. The prospect is not a good one in the political sense, but the presence on her borders of three hostile nations, each formidably armed, is probably sufficient to keep the peace for some years. That the present treaty will ever be sincerely accepted by the present governing class in Hungary no one acquainted with their mentality believes to be possible. But their energy and their resources are quite sufficient to keep the country prosperous, if they abstain from rash political projects.

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TRIESTE, Italy (*see* 27.269), a centre of Italian patriotism under Austrian rule, was ceded by Austria to Italy under the treaty of St. Germain in 1918. Italian, the official language, is generally spoken. With a population of 238,655 in 1921, Trieste is the eighth city of Italy, and the chief port of the Adriatic Harbour improvements were in hand in 1925. The Austrian-Lloyd Steam Navigation Company, which for many years has had its headquarters at Trieste, is now the Lloyd-Triestino Company. There are dockyards and an arsenal. The inland republic of Czechoslovakia has been granted rights in the use of the port. A university was opened in 1924.

TRINIDAD: *see* WEST INDIES, BRITISH.

TRIPOLI (*see* 27.291).—In 1925 the population of this seaport was estimated at 60,000. Since 1912 it has been the capital of the Italian colony of Tripolitania (*q.v.*) which is also commonly known as Tripoli. In a looser sense Tripoli includes, in addition, Cyrenaica (*q.v.*). Considerable improvements have been made in the city and harbour by the Italians. The minimum depth of water at the entrance to the port is 24 ft.; at the pier quays 20 to 24 feet. In April 1926 Signor Mussolini visited the town, this being the first occasion upon which a Prime Minister of Italy had set foot in an Italian colony. *See* A. Fantoli, *Piccola Guida della Tripolitania* (Tripoli, 1925).

TRIPOLITANIA, an Italian colony in North Africa (*see* 27.288), has an area approximately of 300,000 sq. m., mostly desert. The natives numbered, according to a 1925 estimate, between 600,000 and 700,000. European population (1921) 20,716, of whom 18,093 were Italian. The chief towns, all on the coast, are Tripoli (*q.v.*), the capital; Misurata, 14,000 inhabitants; and Homs (see Khoms) 4,000.

History.—The vilayet of Tripoli (Tripolitania), together with that of Benghazi (Cyrenaica), passed from Ottoman to Italian rule as a result of the Italo-Turkish war of 1911–2. The Italians at the end of 1912 held only the coast region, and they met with considerable opposition from the natives (Berbers and Arabs) in their occupation of the interior. Their most redoubtable opponent was the Berber chieftain Suleiman el Baruni, who set up an independent kingdom in the Nefusa hills, but was beaten by the end of 1913 and fled to Europe. By Aug. 1914 every place of importance in the vilayet was in Italian hands. Meanwhile in the coast districts the Italians had begun with great energy a big programme of public works, while towards the Arabs and Berbers they adopted a policy of confidence and trust.

Unfortunately, in the adjoining vilayet of Cyrenaica the War continued, the Turks having incited the Senussites to continue the struggle (*see* SENUSSI). In Sept. 1914 the Fezzani, many of whom adhered to the Senussi sect, rose in revolt. Turkish, German and Senussi propaganda was very active throughout Tripolitania, and the declaration of war by Italy upon Austria (May 28 1915) was the signal for a general rising. There had already been serious fighting with the rebels, and in one engagement the Libyan auxiliaries of the Italians had gone over to the enemy on the field of battle. In view of the situation in Europe the Italians now abandoned the whole country with the exception of the seaports of Tripoli and Homs (Khoms). Another seaport, Zuwara, was reoccupied in Aug. 1916. Meanwhile a brother of the Senussi chief ruled in Fezzan; Suleiman el Baruni reappeared (Sept. 1916) with a firman from the Sultan of Turkey appointing him Governor-General of the vilayets of Tripoli, Tunis and Algiers; Ramadhan el Shtewi, another powerful chieftain, established a so-called Republic of Tripoli and ruled at Misurata, which place became a German submarine base. All through 1917 el Baruni harassed the Italians, but failed to fulfil his boast to drive them into the sea. There was in fact little cohesion and much jealousy among the opponents of the Italians. The Turks sent Prince Osman Fuad to Misurata in April 1918 with instructions to compose the quarrels among the tribes, a task in which he did not succeed. Moreover, the Senussi were now divided, one section, which in the end gained the mastery, having as early as April 1917 come to terms with the Italians—a fact of more importance, however, to Cyrenaica than Tripolitania.

Such was the state of chaos in the country at the end of the World War, and the Italians were then in no mood to undertake

the reconquest of Tripolitania by force. A plan was formed to govern through native chiefs, to whom were to be attached political officers. Negotiations entered into with El Baruni, El Shtewi and other chiefs led to their acknowledgment of Italian rule, and a royal decree of June 1919 gave the country "complete local citizenship" with an elective assembly styled a parliament. The chiefs cared little for such an assembly. They were more concerned in consolidating their own authority and did not scruple to flout that of Italy. There was little real improvement in the situation until Signor Giuseppe Volpi became governor in Aug. 1921.

Under his direction a campaign, which began in Jan. 1922 with the reoccupation of Misurata, was conducted to a successful issue by the end of 1923. Thereafter, by wise and conciliatory measures and by a bold policy of economic reconstruction, Signor Volpi restored order and a degree of prosperity to the greater part of the country, though Fezzan was still troubled by rival factions. In the latter part of his governorship Signor Volpi had the full support of the Fascist Goverment. For his services he was created Count Volpi of Misurata, and on resigning his post in July 1925 he became Minister of Finance in the Italian Cabinet. His successor as governor was General de Bono.

Economic Conditions.—Owing to the disturbed state of the country little progress had been made up to 1926 in economic development, which depends for marked progress largely on the construction of costly irrigation works. The Italians, however, planted very large numbers of olive, orange, vine and other trees, and began the afforestation of the dunes. Since 1918 Italian immigrants have taken up a number of land concessions and have made fair progress. The Government has built a railway along the coast westward from Tripoli to Zuwara (75 m.) and begun a line eastward to Homs. Another railway (31 m.) runs inland from Tripoli to El 'Aziziya. The chief exports are tunny fish and sponges, henna, esparto grass, wool, dates and salt; the chief imports, foodstuffs and textiles. Trade is mainly with Italy, Malta, Egypt, Greece and Great Britain, and revenue is largely derived from import duties, which give preference to Italian products. According to a British consular report, the value of imports, in 1922 was, in sterling £985,000, while that of exports was only £145,000. The colony has been a considerable burden to the Italian Treasury, largely through military expenditure. The military establishment in 1924–5 was some 17,000 men, of whom 4,800 were Italians. In that year military expenditure was 112,300,000 lire, compared with 34,470,000 lire spent on civil administration.

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(F. R. C.)

TROELSTRA, PIETER JELLES (1860–), Dutch politician, was born at Leeuwarden and educated for the legal profession at the University of Groningen, but early abandoned it for politics and journalism. He adopted socialist opinions, but becoming dissatisfied with the leadership of Mr. Domela Nieuwenhuis, under whom Dutch Socialism had assumed an extremist complexion bordering on anarchism, he founded the Social Democratic Labour party in 1894. The new party prospered in the country and in the States-General, and for many years Dr. Troelstra was the acknowledged leader of the Socialist movement in the Netherlands. At the elections of 1918, as a result of the introduction of universal suffrage, the Social Democrats made important gains, and under the influence of the German revolution Dr. Troelstra in a remarkable speech in the Chamber called upon the Government to resign with a view to the formation of a Socialist state. His party, however, refused to support him and the attempted *coup d'état* failed (*see* Netherlands). Thenceforward Dr. Troelstra's influence steadily declined. In 1925, owing to failing health, he retired from political life.

TROELTSCH, ERNST (1865–1923), German philosopher and theologian was born at Augsburg on Feb. 17 1865 and studied at Erlangen, Göttingen and Berlin. He began his teaching career at Göttingen, and thereafter became professor first at Bonn, and then at Heidelberg and Berlin (1915). In 1919 he became a member of the Prussian National Assembly and parliamentary secretary of state in the Prussian Ministry of Worship and Instruction. For some time in 1921 he was a member of the Imperial Government. He died in Berlin on Feb. 1 1923.

Troeltsch was a contributor to the *Theologisches Rundschau*, the *Zeitschrift für Theologie und Kirche*, the *Theologische Jahresberichte*, the *Preussische Jahrbücher*, etc. Among his many works may be mentioned *Die Bedeutung des Protestantismus für die Entstehung der modernen Kultur* (1906, 1924); *Trennung von Staat und Kirche, Soziallehren der christlichen Kirchen und Gruppen* (1919); *Naturrecht und Humanität in der Weltpolitik* (1923).

TRONDHJEM, Norway (*see* 27.305), has grown considerably, and had a population of 55,030 in 1920. A garden suburb has been laid out at Lillegaarden, and costly harbour works have been undertaken. Since 1921 Trondhjem has been connected with Oslo by the Dovre railway.

TROPICAL MEDICINE.—As medicine advances from the status of an art to that of a science, so do the bounds which demarcate tropical medicine become more faint. Few major diseases are restricted to the lower latitudes, and tropical medicine, as here considered, embraces all those maladies which, for some reason, prevail especially in the tropics, though not necessarily limited thereto. Some diseases lightly regarded to-day as essentially tropical are merely commensurate with a primitive stage of civilisation, and consequent unhygienic conditions. Bubonic plague smouldered in England for centuries, every few years flaring up to epidemic degree, and ceased as an endemic infection only about 1679. Cholera was common enough in John Wesley's day to demand a paragraph in his little volume on household remedies. The Londoner of Charles II.'s time could enjoy a jest in *Hudibras* unintelligible to anyone not familiar with the stages of a malaria paroxysm. These Captains of the Men of Death, in Bunyan's phrase, no longer menace Britain, but, with many others, they still confront the increasing multitude who follow their avocations beyond the seas.

The present stimulus to the special study of tropical medicine comes from the spread of commerce and empire, from causes far back in history and from the ever-growing complexity of modern economic conditions.

Special Problems of Tropical Medicine

Liability to contract disease in the tropics is not due in the main to inherent change in the individual, but to circumstances generally favouring a luxuriance of animal life. The causative organisms of some diseases, *e.g.*, malaria and yellow fever, depend for their propagation on insects most numerous and active in tropical conditions; warmth and humidity are essential for the development of hookworm larvae in the soil; and in such surroundings bacterial life in general flourishes most abundantly. Though exceptions to these rules spring to the mind—typhus fever, a louse-borne disease, reaches its maximum range under cold weather conditions, and the factors governing the transmission of common colds and coughs determine the spread of pneumonic plague. The newcomer to the tropics is faced by all these potential dangers, with risks of infection usually intensified an hundredfold by native standards of sanitation.

Preventive medicine has done him one great disservice. Born in pre-hygiene times, he would almost certainly have acquired a natural immunity to a variety of diseases which nowadays in his own country he escapes, but to which the native, surviving childhood, is relatively immune. This resistance to disease, previously believed a racial characteristic, is now generally considered a personal immunity gained by the individual during early life. As regards this aspect of malaria in natives, Christopherson has shown that in hyper-endemic areas children pass through a period of acute infestation lasting for about two years. During this time manifestations of the disease are practically continuous. A stage

of immune infestation is then reached which lasts through childhood into adult life. Whatever the nature of the immunity it is sufficient to enable adults, under conditions that lead to intense infection in the child, to live infected but without suffering appreciably from sickness due to malaria.

The Briton, beyond most others, does not lightly resign his national prejudices and customs, and for years a red tunic and a tight leathern stock were thought suitable wear for the plains of India. So to-day the sojourner in the tropics may complicate the problems of tropical medicine, already sufficiently involved, by an unwillingness to adapt his regimen and habits to new surroundings. Therefore, physiological changes, including alterations in the functioning of the endocrine glands, may result, with a consequent train of morbid symptoms. Native customs and modes of life evolved by the empiricism of years, may repay study. A temporary adoption of the Indian fashion of wearing the shirt outside the trousers has in practise averted the threatened onset of heat stroke. The early inhabitants of Northern Africa cooled their houses by structural devices which modern architects might copy and adapt to the needs of European residents in hot climates. Even the adobe houses of the Mexican natives are designed on sounder principles than the corrugated iron furnaces occupied by white settlers in parts of the tropic zone. Wise in their generation, the Conquistadors did not disdain to learn from the aborigines of the New World, and we are the richer in possessing cincona and ipecacuanha as the result.

Methods of Tropical Medicine

Accurate diagnosis is essential to the correct treatment of any disease; this is no new knowledge—" as sayeth the prince of physic Avicenna: ' How shouldest thou hele a sore and not yknow the cause? ' " The aim of modern medicine is to prevent rather than to cure, and in like manner a close study of causation is a requisite preliminary to wise and successful prevention. Therefore a basic knowledge of bacteriology, entomology and other branches of medical parasitology is a necessary part of the training prescribed for students of tropical medicine. Not every species of *Anopheles* can be infected with malaria, nor are the breeding habits of all the malaria-carrying anophelines the same. A system of drainage which eradicates malaria in one locality may have no effect in another, and actually may intensify the disease in a third. Slight changes in the chemical reactions of water may prevent mosquito breeding, a discovery likely to have far-reaching results in malaria prevention. And thus the importance of these ancillary sciences to tropical medicine becomes more obvious every day.

Further, statistical data, when investigated and scrutinised by exact methods and correlated with clinical observations, may yield valuable information regarding the nature and origin of disease. If a malady is found to be periodic, the climatic and physical changes associated with the rise and fall of the infection may indicate the causal agents, and when their identity is established effective measures may be taken against them. Rogers' researches show that cholera begins to spread only when the degree of atmospheric humidity has reached a certain figure; in consequence, the possible commencement of an epidemic can be foreseen and appropriate prophylactic measures undertaken in advance. Already tropical research has achieved great triumphs, and when the true economy of preventive medicine is realised more fully in tropical administration, the return in the form of increased efficiency will multiply accordingly.

Results

Before the last decade of the 19th century, the agent responsible for the spread of malaria (*q.v.*) was unknown. No eye had seen the bacillus of plague; and fleas were thought merely unpleasant creatures, rather less scandalous than lice. Yellow fever mosquitoes besported themselves unheeded, except in so far as they might disturb an afternoon's siesta. But when Patrick Manson argued that some biting insect serves as intervenient host for the nematode parasite of man, *Filaria bancrofti*, and turned his theory into proven fact, he stood like Cortez on a peak in Darien, viewing a new world. Following on Manson's example and advice, and faced by difficulties which would have disheartened most, Ross carried out his laborious researches and finally *Anopheles* was incriminated as the vector of malaria.

In the old yellow fever (*q.v.*) days, a king's ship, the " Tiger " cruised off Barbados, and out of a complement of 220, buried 600 men dead of yellow fever within two years; the commander, as he reported, " still pressing men out of the merchant ships that came in, to recruit his number in the room of those that died daily." The heroic work of Reed and his collaborators proved that this infection is transmitted through the bite of a mosquito, *Aëdes argenteus* (*Stegomyia fasciata*), and Noguchi's discovery of the causative micro-organism has confirmed their work. Fortunately the peculiar breeding habits of the insect vector render it relatively easy to control, and in the West Indies to-day yellow fever is little more dreaded than in England.

Ankylostomiasis (hookworm) (*q.v.*), which reduced the vitality and lowered the efficiency of millions of people, has been laboriously investigated. Firm, constant, but inexpensive measures of sanitation prevent infection, and recent close study of the free-living stages of the worm points to still more effective methods of control. Schistosomiasis yields to the antimony treatment elaborated by Christopherson, and the labours of Miyairi and Suzuki and Leiper, showed that the parasites develop in water snails vulnerable to attack.

Prior to the recognition of the curative prope ties of intravenous antimony, kala azar (*q.v.*), which decimates rich populous tracts of Bengal and Assam, killed over 90% of those attacked. The disease is in process of investigation by a special commission, and the mode of transmission, so far baffling identification, is likely to be revealed. If the active agent proves to be a species of " sand-fly," as has been surmised, the success of the hygienic methods adopted in practice will be explained.

The progress of physiological knowledge in the special branch of endocrinology has secured success in the treatment of cases of sprue (*q.v.*), where the restoration of the calcium content of the blood has been effected by the administration of parathyroid extract.

Cholera and plague may be stayed by prophylactic vaccines, and the results of anti-typhoid inoculation were one of the medical triumphs of the World War. The incidence of tropical liver abscess has been enormously reduced by the use of emetine, and the special " liver-abscess-days "—earmarked for surgical operations—once a feature of some tropical hospitals, are now a thing of the past. Synthetic chemistry adds to the resources of the scientific physician of tropical diseases; " Bayer 205 " and tryparsamide in the treatment of African sleeping sickness have given hopeful results, while new antimony compounds are replacing tartar emetic for intravenous medication, seemingly with all its advantages and none of its drawbacks. Thus the diseases which take so heavy a toll of human life are one by one yielding to science and coming under control, and the outlook to-day is brighter than even the most optimistic would have dared to prophesy some thirty years ago. In honouring the men who thus have extended the science of medicine, we should not forget those of old time who caught glimpses of truth, often through a glass darkly, but at times with a clearer vision. Of such was Donald Monro; nearly two hundred years ago he expounded methods of preventive medicine superior, in part, even to the practice followed in our own time. In these affairs, as in others, we are too apt to forget that there were heroes who lived before Agamemnon.

Problems of the Future

Even should science succeed in finding a cure for every tropical disease, still other problems await solution. Can the individual be protected and enabled to work as efficiently as in a temperate zone? Can impairment of his vitality and nervous energy be prevented and normal health and longevity secured? Whether or not the tropics can be made a safe home for white settlers depends largely on the extent to which local administration will initiate and maintain effective and scientific systems of sanitation, and will educate the indigenous population into ways of cleanliness

and order. Panama sanitary methods, dependent on abundant capital and a soldierly precision of enforcement, are possible only in limited and specially favoured areas. The public health official who finds himself hampered on every hand by apathy, or worse, may dream enviously of some such despotic and off-with-his-head régime, alas, seldom realised in these days of government by enumeration of heads without regard to the cerebral content. And in certain tropical localities it is notorious that the practice of sanitary law bears little relationship to the excellence of the principles embodied in the statute-book.

When all these difficulties have been faced and overcome, and the life of white settlers modified in matters of housing, diet, work and play to meet their altered physical environment, there remains the great question: Can a white race settle permanently in a tropical country and after several generations still retain its original stamina and mental vigour? In spite of thousands of years of colonisation this question still awaits a final answer. Heretofore the results of disease—chronic malaria and ankylostomiasis stunting body and mind—moral decay, consequent on association with lower or even debased native modes of life, have been confused inextricably with the effects of climate. Who can assess the share of the climatic factor, *per se*, in the production of the " poor white "? An adverse environment alone can weaken mental and moral fibre in an astonishingly short space. Children reared in a Glasgow slum may appear a race far apart from their cousins-german, hardy fisher lads in the Outer Hebrides. Yet here there is no climatic difference to account for the observable deterioration.

The unfavourable factor in tropical climates has been variously identified as the heat, or light, rays of the sun, the depressing monotony of an equable temperature, or a high relative humidity; the last admittedly trying, and affecting both comfort and efficiency. Even so, the individual can be trained to withstand a degree of temperature intolerable before acclimatisation, but whether continued exposure to such temperatures results in some subtle change in the nervous system, with loss of vigour and driving power, is a matter of dispute. Whatever the responsible agency, certainly some diminution in vitality commonly occurs, as is evidenced by the accepted practice of granting home leave to government servants and to staffs of business concerns, and this from no motives of philanthropy but because it pays.

The history of the Dutch settlement abandoned and forgotten in the East Indian island of Kisser is often cited as evidence of successful tropical acclimatisation of Europeans, and the descendants of the settlers have been described as retaining their North Europe characteristics after 250 years of tropical life. Unfortunately for this contention, Elkington's researches show that the ordinarily accepted account of the colony is far from accurate. The Dutch colonists have inhabited Kisser only since the end of the 18th century, at the longest; moreover, four of the original nine settlers married women of coloured blood. When the island was rediscovered, the colonists were found to have retrogressed, and had lost both the Christian religion and the Dutch language. Elkington concludes that their lowered mental and physical state can be explained by the environmental conditions and acquired disease; that the measures adopted by the Dutch Govt. during recent years have resulted in definite improvement and regeneration, and that a European standard of mentality persists in substantial degree. None the less, the admixture with native blood vitiates what otherwise might rank as a conclusive experiment, at any rate so far as concerns climates resembling that of Kisser.

Race Problems

When two races live in association there is a natural tendency either for the weaker to disappear, or for both to amalgamate. Such a fusion has taken place over large areas of South America, and in parts of the West Indies. But the modern Nordic man views with repugnance any mass admixture with indigenous stocks, however suitable the resulting hybrid race might prove for tropical existence. This colour prejudice, though seemingly of relatively recent origin, is deeply grounded, and in any colonisation scheme affecting North Europeans the persistence of racial integrity is a fundamental principle (*see* Anthropology, Applied; Colour and Race Problems).

For reasons which need not be discussed here, the prestige of the white man has received a serious set-back of late years, and in consequence he may be excluded in increasing measure from certain tropical countries and forced to find an outlet elsewhere for his energies. In Professor J. W. Gregory's words[1]:—

" We have seen therefore that in North America the presence of the negro has introduced problems of inscrutable perplexity; that in South America a mixed race is in firm possession; that in Africa as a whole the white man has no chance as a colonist; and that in South Africa his future depends on some complex measure of segregation. In Asia only, in the north and northwest, has the white man any prospect of permanent dominion. In contrast to those restrictions, in Australia the fundamental problem is the possibility of the occupation of the whole continent by the European race."

The settlement of tropical Australia by whites, with the deliberate exclusion of other races, amounts to trade-unionism on a national scale, and raises questions of far-reaching political and economic import. It is not even known if such settlement and acclimatisation of white stocks is possible. We are assured in the most pragmatical manner that there is no physiological objection to the projected colonisation of tropical Australia by whites. The case, either way, is unproven, and a final pronouncement can be made only when five or six generations have been born, reared and married in tropical surroundings. Will the race then retain the qualities of temperament and nervous force inherent in white folk bred in the temperate zones? Can these peculiar characteristics persist in any race of Nordic blood who never see the snow fall? Prophecy is dangerous, and these questions cannot be answered here, nor within our lifetime. (W. P. MacA.)

TROTSKY, LEV DAVIDOVICH (1877–), Russian politician, whose real name was Bronstein, was born near Elizavetgrad, the son of middle-class Jews. He received an excellent education at the Peter and Paul *Real Schule* in Odessa and at the university of that town. Leaving the university in 1897, he was arrested as a revolutionary in the following year and soon after exiled to Eastern Siberia. In Aug. 1902 he escaped and made his way to England with a forged passport in the name of Trotsky (which name he used thenceforward). In London, despite his youth, he soon became an important member of the small body of Social Democrats which included Plekhanov and Lenin. He collaborated with the latter and others in the publication of *Iskra* (Spark), the most famous of the Russian revolutionary newspapers. In 1905 he returned to Russia, was elected a member of the St. Petersburg Soviet of Workers' Deputies and was chairman of the meeting at which the whole Soviet was arrested. He was exiled to Tobolsk but escaped immediately on his arrival in Siberia and went to Vienna, where he worked for the *Arbeiter Zeitung* and the *Pravda*. He also worked for some time in a chemical factory. In 1910 he attended the Social Democratic Congress at Copenhagen, defending a position of his own, midway between that of the Bolsheviks and that of the Mensheviks. In 1913 he was in Constantinople as a war correspondent. The following year found him in Zurich and Paris, taking part in the publication of a revolutionary paper. He wrote a book on the aims and origins of the World War which, published in German, earned him a German sentence of eight months' imprisonment. But he opposed the War not only in Germany but in the Allied countries, and in Dec. 1916 was expelled from France. He was arrested by the Spanish authorities on crossing their frontier but was presently allowed to leave for America, where he edited the Russian revolutionary newspaper, *Novy Mir* (The New World).

When the revolution broke out in March 1917 Trotsky's friends and subscribers to the paper collected the money for his journey to Russia. He was, however, arrested by the British authorities and taken ashore at Halifax, where he was interned until the Russian Provisional Govt. asked for his release. He arrived in Petrograd soon after Lenin. He was the leader of a small party of Social Democrats and soon joined the Bolsheviks, together with his followers, although he did not actually become a member of the Bolshevik party until July 1917, when he was

[1] Address to British Association, 1924.

arrested for being concerned in the rising which took place in that month. He played a part hardly less important than that of Lenin in organising the Bolshevik revolution in Nov. 1917 and became People's Commissar for Foreign Affairs in the new Soviet Government.

Trotsky was the most important figure in the Russian delegation during the negotiation of the Brest-Litovsk peace treaty. Believing that the moral effect of the revolution had already been such that the Germans would be unable to force their troops to move against Russia, he met the oppressive German demands with the statement that Russia would not sign a treaty on such terms but that she considered the War to be at an end and would demobilise her troops. Lenin disagreed with him, considering that the risk was too great since at that time the Germans could easily have taken Petrograd. A few days of uncertainty intervened, followed by the German advance. After a series of heated debates in the Central Committee of the Bolshevik party, Trotsky announced that he now sided with Lenin and by a majority of one it was decided to sign an even more unfavourable treaty than that which he had previously refused. Trotsky was replaced by Chicherin as Commissar for Foreign Affairs and, on taking over the Commissariat of War, he entered upon the task of creating the Red Army. In spite of opposition from many of the older Communists he made great use of officers of the old army. The results obtained by so doing were used to justify the employment of " bourgeois " technical experts in the factories. When he had made a new army that showed itself superior to those of the Whites his energies were used in preventing the complete collapse of the railways. In 1920 he organised " labour armies," using for the building of bridges and the collection of fuel armies which had been freed for such peaceful activities by their victories on the various fronts of the civil war.

Until the introduction of the New Economic Policy Trotsky urged industrial conscription, but wholeheartedly accepted the new policy which made such measures impossible. During the Polish war of 1920, he opposed the disastrous advance on Warsaw but was overruled by Lenin. In the autumn of 1923, during a discussion in the Communist party, he adopted a position whereby it was possible for the " old guard " of the Communist leaders to accuse him of canvassing for the support of the younger men. He was ill at the time but his illness did not save him from a most violent attack by Stalin, Zinoviev and others. Many of his friends were shifted from their posts and he himself was on the way to the Caucasus to take a cure, when Lenin died. Throughout the revolution the names of Lenin and Trotsky had been coupled together and the death of the one seemed to leave the other alone in the field. This was not really so. Seniority counts for much in the Communist party and the older leaders never forgot that Trotsky, in spite of his prominence, had only joined the party in 1917. The campaign to discredit him was continued and some went so far as to urge that he should be ejected from the Central Committee and even from the party. He lost his post as Commissar of War and when he returned from the Caucasus was given work of small political significance, being made head of the committee for the development of electric power in Russia. In 1925 he resigned from this post and was made head of the Central Committee for Concessions.

Trotsky stood revealed as by far the most brilliant of the revolutionary leaders, a striking orator with a gift for metaphor, an extraordinarily persuasive writer of pamphlets, an acute debater, with a power of practical organisation rare not only in the Communist party but in Russia in general. His chief recreations were writing and shooting. He wrote a number of books on the history of the revolution, on Lenin, on the civil war and on the relations between revolution and literature, besides a long series of polemic essays on questions of the day. One of the most important being *1917*, 2 vol. (Moscow, 1924) Eng. trans. of Introduction *The Lessons of October 1917* (1925). For this *Encyclopædia* Trotsky wrote the biography of Lenin. (A. R.)

TRUMBIĆ, ANTE (1863–), Yugoslav statesman, was bornat Spalato (Spljet). He became successively Mayor of Spalato, and deputy for the city in the Dalmatian Diet, and after 1907 deputy in the Austrian Parliament. In 1905 he and his fellow Dalmatians, Pero Čingrija, Smodlaka and Supilo, as delegates of the Croat National party, played a leading part in the movement for renewed co-operation between Serb and Croat, which culminated in the resolutions of Fiume and Zara in 1905, and in the parallel negotiations with the Magyar coalition parties. The programme of reform in Croatia, which was the basis of the agreement with Hungary, was soon frustrated by the intransigent attitude of the Wekerle Government. The Dalmatian Croats, and notably Trumbić and Supilo, consistently endeavoured to improve their relations with the Italians and to combat the constant efforts of Vienna to set the two races at variance.

On the eve of the World War Trumbić crossed the frontier to Venice, where he was joined by Supilo and several other Croat and Serb leaders. The first winter of the War he spent in Rome, hoping to win Italian official support. But Sonnino's anti-Slav policy and the secret agreement concluded between Italy and the Entente at the expense of the Yugoslavs in the spring of 1915, forced him to transfer his centre of operations to France and England. The Yugoslav committee, of which Trumbić was president, was formally constituted in May 1915 in London. In the summer of 1917 he and several of his colleagues conducted lengthy negotiations with the exiled Serbian Govt. in Corfu and representatives of all the Serbian parties, and the result was the so-called " Declaration of Corfu," which outlined the principles on which the united Yugoslav State was to be based. Through the mediation of his British friends Trumbić met representative Italians in Dec. 1917 and March 1918, and reached an agreement which became the basis of the congress of oppressed nationalities, held in Rome in April.

In the closing stage of the War the Yugoslav committee was handicapped by the narrowly Pan-Serb attitude of Pašić, and the Entente Govts. withheld their recognition of the Yugoslav programme pending a definite agreement between Pašić and Trumbić. The result was that after the collapse of Austria-Hungary the Italian claims were revived in their full force. When the provisional Yugoslav Govt. was formed at Zagreb in Oct. 1918 Trumbić was appointed Foreign Minister and peace delegate in conjunction with Pašić and Vesnić. In spite of his sane and convincing advocacy of Yugoslav claims he was unable to win the support of the Entente, which considered itself still bound to Italy by the secret Treaty of London. With the waning of President Wilson's influence, the Yugoslavs were obliged to come to a direct agreement with Italy, and the Treaty of Rapallo was signed Nov. 1920.

Trumbić's long absence in Paris, coupled with the policy of abstention pursued by the Croat Peasant party under Radić, placed him at a fatal disadvantage when the question of the new constitution came up in 1921. Trumbić voted in the minority and thereafter drifted steadily into stronger opposition to the new régime in Yugoslavia. His group formed part of the coalition " bloc " which was in power from July to Oct. 1924, and for a time he effected a working alliance with Radić and committed himself to federalism and even republicanism. The sudden *volte face* of Radić after the elections of 1925 left Trumbić somewhat isolated, as the leader of the newly constituted " Croat Federalist Peasant party."

TRUSTS (*see* 27.334).—The term trust is a convenient though mostly inaccurate label popularly applied to any large business concern, or amalgamation or association of business concerns, which exercises some degree of monopolistic power over output and prices in the industry with which it is connected. The " trust," as it first appeared in America in the 'eighties, was a form of organisation in which the shareholders of a number of enterprises agreed to assign the whole of their stock to a group of trustees, receiving in exchange trust certificates representing the valuation of their properties. Under this arrangement the trustees controlled all the businesses and could not only coordinate and regulate the operation of the plants thus brought under one direction, but could also dictate to some extent the output of the whole industry and the prices at which its products should be sold. Consolidations formed on " trust " lines still

exist in important industries in many countries, but they represent in Europe but a small part of the whole movement, from interbusiness competition to monopolistic combination, with which this article is concerned.

I. THE UNITED KINGDOM

This transition from competition to combination, which has been a marked feature of industrial development the world over since the latter part of the 19th century, has in each country accommodated itself to national characteristics and conditions. In the United Kingdom great consolidations wielding monopolistic and political power have not hitherto been so formidable as in America, nor have British associations of independent manufacturers developed the range of activities displayed by such organisations in Germany. The movement toward industrial combination in the United Kingdom has been relatively more cautious and less spectacular than elsewhere. The reasons for this would appear to be partly the deep-rooted individualism of the British manufacturer and partly the greater difficulty of establishing monopolistic consolidations in a country where many of the principal industries are widely dispersed, where the raw materials of most of the great industries are drawn from world-wide sources and where such shelter as monopoly might obtain from protective import duties has not been available. None the less, combination has replaced or minimised competition over a great part of the industrial activity of the United Kingdom.

Terminology.—It is usual to distinguish the various types of combination by convenient labels, but the terminology is somewhat arbitrary and the distinctions sometimes without much significance. The holding company, the " combine," the vertical consolidation and the horizontal consolidation are frequently quoted types, but they are by no means mutually exclusive; and often a concern which by origin belongs to one of these categories belongs by present nature and actual operation to another. The one feature which these four have in common is that they are permanent fusions of previously independent business concerns, which, under the new régime, are under more or less completely centralised direction and control. Under the holding company arrangement each of a number of companies sells its shares to another company established for the purpose, receiving in exchange shares in the holding company.

The " combine " might be described as another name for the holding company, except that whereas the holding company may operate firms in various lines of business and may have been initiated by outside financial interests, the term combine is usually employed to designate a merging of firms previously in the same line of business at the instance of a majority of the firms or of some dominant concern among their number. Although the holding company or combine is always subject, as already mentioned, to centralised control, there are cases in which the constituent firms retain some limited measure of autonomy. The vertical consolidation is a complete merging into one industrial and commercial entity of previously independent firms engaged in the production of a commodity at successive stages of manufacture: *e.g.*, coal and iron mining, pig iron, iron and steel, ships. The horizontal consolidation is a complete merging of previously independent firms engaged in the same line of business at the same stage of production and can only be distinguished from the holding company or the combine by having originated in the outright purchase of a number of concerns by one predominant concern in the industry or by some outside financial interest.

A more easily definable and distinct type of trade combination and one that has proved particularly applicable to British conditions, is the terminable association. Under this arrangement the firms constituting the association remain independent financial and commercial entities, but they associate for the purpose of controlling output or prices or both in the industry in which they are engaged. Such associations are properly constituted bodies having rules, constitution, officers, subscriptions, entrance fee, etc. The methods of trade regulation are various. Some associations simply fix a schedule of prices to which all must conform; others have arrangements in regard to tenders for contract work; others regulate output by allotting to each member a fixed percentage of the total production, whatever that total may be, with penalties for exceeding the quota and compensation for falling short. Some partition out the home market, or the foreign trade, among the members, and some have from time to time reinforced their control of the markets by agreements with similar foreign associations as to the amount which shall be exported from each country to certain markets. The distinguishing feature of the association is that each component firm remains a financially separate business concern, with full freedom of action in all matters that are not ruled by the association. If under stress of circumstances, or for reasons of internal jealousy, it should break up, the constituent firms revert to their original unfettered independence.

Permanent Combinations.—Permanent combinations, falling into one or more of the four categories mentioned above, are found in the United Kingdom in most of the main industries and in many smaller ones. Any amalgamation of two or more business concerns might, of course, be called a " combination," but the present article is confined to those cases in which the combination produces a concern of such predominance in its industry as to give it some degree of monopolistic power. It has been asserted that any consolidation or association which covers 80% of the output of an industry can dictate the prices at which the other 20% shall sell its competing products and so may be described as having an effective monopoly; but that formula cannot be applied indiscriminately, inasmuch as the limiting conditions of control vary greatly from industry to industry and in some industries very effective monopolies of merely local range may exist. It must suffice here to mention a few outstanding examples of consolidations in a position to exercise some degree of monopolistic power. In the cotton branch of the textile industry great amalgamations of previously independent firms are to be found. Messrs. J. & P. Coats have long occupied, as a result of growth and absorption, a pre-eminent position in the sewing-cotton industry. The Fine Cotton Spinners' and Doublers' Association is a mammoth amalgamation, dating back nearly 30 years. In the cotton spinning and manufacturing branches two other great amalgamations have come into being since the War, The Amalgamated Cotton Mills Trust and Crosses and Winkworths, in both of which previously independent concerns have been merged.

Principal Industries.—In the woollen and worsted industries combination has taken the form rather of association than consolidation; but Woolcombers Ltd. is an amalgamation dating back some years, while since the War large amalgamations have been formed in the worsted spinning and knitting wool spinning sections of the industry.

In textile bleaching, dyeing, printing and finishing the combine type of consolidation prevails. The three largest combines are the Bradford Dyers' Association, the Bleachers' Association and the Calico Printers' Association; all these had their origin in the early days of the century. In view of the terminology adopted above in describing the various types of combination, it should perhaps be emphasised that these are not terminable associations but permanent amalgamations. Two other combines in this industry are the British Cotton and Wool Dyers' Association and the English Velvet and Cord Dyers' Association.

In the chemical industry, Brunner Mond and Company and the United Alkali Company are predominant concerns in the manufacture of heavy chemicals. Lever Brothers, British Dyestuffs Ltd., the Salt Union, Borax Consolidated, and Nobel Industries Ltd. are each dominant in their respective branches of industry.

In the coal industry amalgamation has not proceeded far, except in South Wales, where there are two large groups of anthracite collieries, merged under Amalgamated Anthracite Collieries Ltd. and United Anthracite Collieries Limited. A pre-War Welsh combine is the Consolidated Cambrian Limited. Colliery combines are only to be found in occasional instances in England and Scotland.

In the iron and steel industry combination by terminable association has been accompanied by great concentrations of capital, such as Dorman Long & Co., Bolckow, Vaughan & Co., Baldwin's Ltd., the Ebbw Vale Co., Guest, Keen and Nettlefolds, the United Steel Companies Ltd. and Richard Thomas & Company. All these are what have been described as vertical consolidations, but in fact the merging which they embody has been on both the horizontal and vertical planes.

The engineering and shipbuilding industries, again, present a network of terminable associations studded by large consolidations. Foremost among these are Vickers Ltd., Armstrong Whitworth & Co., Cammell Laird & Co. and John Brown & Co., but a score more could be quoted within almost the same range of importance. Most of these great amalgamations are of pre-War origin; but they acquired additional properties during and since the War. In the post-armistice boom period some new amalgamations of considerable importance were formed.

Only a few of the principal industries are dealt with above. In other industries examples of dominant consolidations are to be found, notably in matches, glass bottles, electric lamps, shoemaking machinery, glass and tobacco.

Other Associations.—Preceding paragraphs have dealt with consolidations. As regards the terminable associations, it would avail little to mention even the most important by name or to describe their individual activities. Suffice it therefore to say that associations of manufacturers and traders for the regulation of prices or output or both are found in most, if not all, branches of British industry and trade. Even in industries already dominated by a single large consolidation there is usually to be found a trade association, of which the dominant concern is a member, and through which it can exercise more directly than otherwise its influence upon the industry as a whole.

The consolidation and the association by no means exhaust the catalogue of arrangements whereby trade and prices may be controlled. The "gentlemen's agreement" or "honourable understanding" may in favourable circumstances be as powerful an instrument for minimising competition as a formal organisation. Interlocking directorates, with or without exchange of shares, may result in two or more companies coming under concerted control without any outward change in constitution. Other examples of the tendency towards concentration of capital and economic power will be seen in the great banking amalgamations, in the multiple shop system, in the tied house system in the licensed trade and in the control exercised over tobacco, meat and other commodities by interests domiciled outside as well as inside the United Kingdom. The amalgamations of shipping companies and the maintenance of liner freights by the shipping rings are other long-standing examples of the concerted control.

The degree to which combination has supplanted competition as the ruling factor of business operations should not be overestimated. Even in the most powerfully organised industries competition plays its part with fitfully recurring intensity; while there are still industries (*e.g.*, coal, shipbuilding, textile manufacturing, as well as a host of minor industries) in which the concerted control of output or prices has made relatively little headway. But the steady trend is toward increased combination. Under the influence of war conditions not only were numbers of listless associations galvanised into greater activity and enterprise, but many new associations were formed. Also, one effect of the excess profits tax was to encourage the buying up of unprofitable businesses by prosperous concerns, for such purchases were in effect paid for by moneys which would otherwise have gone in excess profits duty to the revenue. For this and other reasons the war period was one of unusual increase in the number of amalgamations.

Advantages and Disadvantages of Combination.—Industrial combination has undoubted advantages. By combination substantial economies can be effected in buying, manufacturing and selling. As regards the buying of material and components, purchases can be made in gross instead of in detail, with the advantages of better selection, better terms and lower transport charges; middlemen can be side-stepped and, if need be, the control over the sources of material can be acquired. As regards manufacture, parts can be standardised and made interchangeable, with consequent economies and benefits, sectional specialisation can be developed, orders can be more advantageously distributed and the whole of the plant and methods of production can be raised to a uniformly high level. As regards selling, the wastes of competitive salesmanship and advertising can be greatly diminished, and a serviceable selling organisation, inspired by the interests of the industry as a whole, can be instituted. Along with all this goes another advantage; the wider and freer spread through the industry of what would otherwise have been jealously guarded knowledge of processes and costs.

Against these possible gains on the score of productive and distributive efficiency must be set some possible losses. Where an industrial unit grows beyond the compass of one man's personal detailed direction, "system" must be introduced, and system can degenerate into bureaucracy and red tape. What is gained in power and knowledge at the centre may be lost in freedom and strength at the circumference, and the over-grown unit is in constant danger of becoming inefficient and reactionary. Again, under the shelter of monopoly a comfortable somnolence may descend upon the giant concern, the fear of change is a well-known characteristic of large administrations, and the large business unit may become stagnant and even reactionary, especially if its control falls increasingly into aged hands. But whatever the balance of these influences may eventually be—greater or less productive efficiency—combination brings in its train the further danger of monopoly power being used to exact monopoly prices and conditions from the public. The problem as seen by British eyes has therefore been one of how to leave business concerns free to achieve the economies and other advantages of combination in so far as they are consistent with the general interest, and at the same time to provide means of curbing any tendency to use monopoly power detrimentally to the public and of penalising those who do so use it.

The Committee on Trusts.—The policy of "declaring war on the trusts" has found little informed advocacy in the United Kingdom. American experience of repressive legislation as embodied in the Sherman and Clayton Anti-Trust Acts has been observed, but without admiration. The committee on trusts, appointed by the Minister of Reconstruction in Feb. 1918, turned its attention rather to what might be called "policing" action than to repression. It sought for ways in which combinations might be controlled or supervised to safeguard the public interest from the abuse of monopoly power while being otherwise left free to achieve all those economies and improvements which combination alone can furnish.

Public ownership, public control, public competition, profit limitation and profit taxation were passed under review. In all these suggested schemes three main difficulties were encountered at the outset: first, that of defining a monopolistic concern; second, that of distinguishing rightful rewards of enterprise and efficiency from the exactions of monopoly; and, third, that of determining the datum on which rate of profit can be calculated. These suggestions were one by one rejected as limited in scope, difficult of application, or hazardous in reaction, and the committee turned its attention in other directions. It was thought that if fuller publicity in regard to the conduct and earnings of business concerns generally, and of the working and effects of combinations in particular, could be secured, the desired object would be in great measure achieved. It was also thought that some machinery should be provided whereby suspected or alleged abuses could be penalised.

Accordingly, the conclusion was reached that there should be established a department of state charged with the duty of informing itself as to the nature, extent and development of combination of all kinds in so far as they tend to the restraint of trade and the creation of monopolies, and of making preliminary inquiry into complaints made in regard to them; also that a tribunal should be set up to which the department could apply for powers to obtain particular information, and would refer for full investigation cases in which combinations appeared to act injuriously to the public interest. The requisite publicity would thereby be secured in two ways: the relevant facts as to offences proved before the tribunal would be made public, and the department would present annually to Parliament a report upon the nature, extent and development of combinations. Publicity thus secured would not only be in itself a considerable safeguard against the abuse of monopolistic power, but it would serve to reveal actions and developments for which publicity alone was not a sufficient safeguard, and against which further action should be taken, whether in the form of nationalisation, public competition or the control of prices and profits. These conclusions formed in substance the recommendations of the committee; but down to the end of 1925 they had not been made the subject of legislation.

Until the appointment of the committee on trusts no official investigation of the problem presented by the growth of combination in British industry generally had been made. The Report of that Committee, with its appendices, afforded for the first time to Parliament and the public authoritative information as to the position. Subsequently committees appointed under the Profiteering Acts of 1919 and 1920 issued reports upon particular industries in which much detailed information was embodied. These reports

constitute a mine of information for the student of industrial combination in the United Kingdom.

BIBLIOGRAPHY.—*Report of the Committee on Trusts* (Cd. 9236 of 1919), with *Memoranda* by Mr. John Hilton, Mr. Percy Ashley and Sir John Macdonnell. Reports of 57 committees appointed under the Profiteering Acts 1919 and 1920. A list of these reports, together with a survey of the work done by the committees, will be found in a report—*The Work of the Central Committee* (H.M. Stationery Office, 1921). Other official publications bearing closely on the subject are the *Report of the Royal Commission on Food Prices* (Cmd. 2390, 1925); *Reports* of the Committee on Industry and Trade (1925 and 1926); various *Reports* by committees appointed under the Safeguarding of Industries Acts; *Reports* on the coal industry and coal prices by committees appointed by the Mines Department (1923 and 1924); the Linlithgow *Reports* on the distribution and prices of agricultural produce by committees appointed by the Minister of Agriculture (1923 and 1924); *Reports* on prices of building materials by Ministry of Health and Board of Trade (1923 to 1925); *Report of the Royal Commission on the Coal Industry* (1926). The best account of industrial combination in the United Kingdom before the War is given in H. W. Macrosty, *The Trust Movement in British Industry* (1907). (J. H.)

II. THE UNITED STATES

The Sherman Anti-Trust Act of 1890 did not satisfy the popular demand for corporate control. The rapid industrial development brought about an even fiercer competition, which in turn brought about many consolidations. Between 1898 and 1901 there were an extraordinary number of consolidations which, while checking many of the evils of excessive competition, were attended also by many of the evils that are an inevitable part of great and sudden prosperity. With consolidation came power and sometimes the temptation to use it without a nice regard for business ethics. Moreover the feverish consolidation of business gave added impetus to the labour movement, resulting in the employment by organised labour of methods no less reprehensible than were some of the practices of their employers. To meet this situation President Wilson recommended to Congress, Jan. 20 1914, a comprehensive programme of trust legislation, embracing: (1) Laws to prevent the interlocking of the directorates of competing corporations; (2) a law giving the Interstate Commerce Commission power to superintend and regulate the financial operations of railways; (3) a legislative definition of the meaning of the Anti-trust law and of the practices prohibited thereunder; and (4) the creation of a Federal Trade Commission as a fact-finding agency for the guidance of business and the public.

Trade Commission Act.—This programme was embodied in three bills: the Federal Trade Commission bill, the Clayton bill and the Railroad Securities bill. The last-named measure was postponed on account of the disturbed conditions created by the War, but the Trade Commission bill was approved on Sept. 26 1914 and the Clayton bill on Oct. 15 1914. The Trade Commission Act provides for a Federal Trade Commission of 5 members vested with powers of regulation and investigation. It is empowered to prevent persons, partnerships and corporations, except banks and common carriers subject to the commerce acts, from using unfair methods of competition in commerce; to investigate and gather information concerning the organisation, business conduct, practices and management of any corporation engaged in commerce, except banks and common carriers; to investigate and report, upon the direction of the President or of either House of Congress, the facts relating to alleged violations of the anti-trust laws by any corporation; to investigate and make recommendations, upon application of the Attorney-General, for the adjustment of the business of any corporation alleged to be violating the anti-trust laws, to investigate trade conditions in and with foreign countries, where these conditions may affect the foreign trade of the United States, and to report to Congress thereon with such recommendations as it deems advisable. The important business practices which the commission regards as unfair methods of competition are: misbranding, local price cutting, use of bogus independents and "fighting brands," full-line forcing, boycotting and black-listing, espionage, commercial bribery, false and misleading advertising, false labelling, rebates and coercion.

Clayton Act.—The Clayton Act forbids, where the effect is substantially to lessen competition or to tend to create a monopoly in interstate or foreign commerce: (1) discriminations in price between purchasers of commodities; (2) exclusive purchase and sale arrangements in connection with any patented article; (3) the acquisition by a corporation engaged in commerce of the stock of a competing corporation, except solely for investment purposes or the formation of subsidiary corporations to carry on their immediate lawful business; (4) interlocking directorates in corporations engaged in whole or in part in commerce, other than banking and trust companies and common carriers, whose capital surplus and undivided profits aggregate more than $1,000,000, if such corporations are or have been competitors. The remedies provided against the violation of these provisions are: (1) enforcement by the Interstate Commerce Commission where applicable to common carriers, by the Federal Reserve Board where applicable to banks, banking associations and trust companies and by the Federal Trade commission where applicable to all other character of commerce; (2) suits by the U.S. Govt.; (3) suits by individuals for three-fold damages; and (4) suits by individuals for relief by injunction.

The Clayton Act further contains certain provisions desired by organised labour. These provisions, it was popularly believed, gave labour certain immunities not enjoyed by any other class. Section 6 of the Act declares

> . . . that the labour of a human being is not a commodity or article of commerce. Nothing contained in the Anti-trust laws shall be construed to forbid the existence and operation of labour, agricultural, or horticultural organisations, instituted for the purposes of mutual help, or to forbid or restrain individual members of such organisations from lawfully carrying out the legitimate objects thereof; nor shall such organisations, or the members thereof, be held or construed to be illegal combinations or conspiracies in restraint of trade, under the Anti-trust laws.

Section 20 limits the use of the injunction in labour disputes, and legalises strikes, picketing and boycotts, when carried out in a peaceful and otherwise lawful manner. The courts have held that these provisions do not introduce any new principle into the equity jurisprudence of the Federal courts, but they are merely declaratory of what was the best practice always.

Cotton Futures.—On Aug. 18 1914 a Cotton Futures Act was approved, which levies a tax upon all contracts for the sale of cotton for future delivery, except such as comply with certain prescribed conditions, such as specifying the grade, the prices paid, etc. It is required further that standard grades shall be delivered and full weights tendered. Disputes shall be settled in accordance with rules and regulations prescribed by the Secretary of Agriculture.

War Measures.—The effect of the War experiences upon the attitude of the public toward combinations was marked. The first act of the Secretary of the Treasury when the railways were placed under his charge was to order that they all be managed as one system. The emergency of war showed at once the economic mistake of the Interstate Commerce Act of 1887 in forbidding pooling under proper restrictions, a mistake to which the Interstate Commerce Commission had from its beginning called attention. Again, the services most efficiently rendered by such organisations as the leading packing companies, the great steel corporations, the American Telegraph and Telephone Co. and others, services that could not possibly have been so promptly rendered by any number of smaller competing companies, showed clearly to the general public—and, one may add, made clear also to the courts—the real advantages that may lie in consolidation. This change in public opinion has been clearly shown in the trend of later legislation and court decisions.

Other Legislation.—The Webb-Pomerene Act of April 10 1918 exempted export trade associations, not operating so as to restrain trade or to enhance or to depress prices within the United States, from the operation of the Anti-trust laws placing them under the supervision of the Federal Trade Commission; and the Capper-Volstead Act of Feb. 18 1922 extended similar exemption to agricultural associations, provided such associations operated for the mutual benefit of their members as producers;

and placed them under the supervision of the Secretary of Agriculture.

The Packers and Stockyards Act of Aug. 15 1921 classified packers, commission merchants and stockyards for special regulation under the direction of the Secretary of Agriculture. These businesses are held to be agencies of interstate commerce, and as such are subjected to the affirmative law of public service. It is unlawful for them to engage in or use any unfair, or to manipulate or control, prices, to create a monopoly or otherwise to restrain interstate commerce. Similar regulations were extended to boards of trade by the Grain Futures Act of Sept. 21 1922. The Act forbids the use of any interstate instrumentality of commerce or communication in offering or accepting sales of grain for future delivery or to disseminate prices or quotations thereof, except by the man who holds the grain he is offering for sale, or by the owner or renter of land on which the grain offered for sale is to be grown, or by members of boards of trade located at a terminal market on which cash sales occur in sufficient volume and under such conditions as to reflect the general value of grain and its different grades, and which have been designated by the Secretary of Agriculture as "contract markets." Besides this national legislation there have been numerous state laws, or amendments to state laws, regulating the intra-state activities of industrial combinations and trusts, resulting in much duplication of effort, some conflict of jurisdiction and considerable inconvenience to business.

The Relations of Government and Business.—The result of this anti-trust legislation, especially the early legislation, has been to take the Government more and more into business and business into politics, thus creating evils in many ways as serious as those which the laws were designed to correct. Furthermore, the Government has been only partially successful in preventing unfair business practices and in maintaining effective competition in business where such competition is desirable. To meet this situation there is now well under way a movement from within business to remove the causes for public regulation. This movement is based upon the theory that no matter how wisely conceived or how efficiently administered governmental regulation of business may be, it can never be as effective as regulation by business itself from within. In pursuance of this policy of industrial self-government, many trades, acting through trade associations, have formulated fair business practices codes and there have been organised voluntary co-operative agencies for investigating and prosecuting false advertising and the many forms of commercial fraud. In line with this practice is a procedure instituted by the Federal Trade Commission in 1919, under which the trade submits its trade practices to the commission for that body's information. The commission makes no ruling, but for its own information it requests the members of the trade to put into concrete form their conclusions as to the practices regarded as unfair and in several instances it has instituted formal proceedings against those who refused to conform to the standard practice.

Numerous suggestions have been made to bring about joint action between producers and distributors to eliminate business wastes. To this end the Department of Commerce has co-operated effectively. Many national trade associations are furnishing to it business data which are published monthly and the Bureau of Standards is engaged in the work of standardisation and of co-operative research with many of these trade associations, which result in enormous annual savings to business and to the Government.

Decisions of the Supreme Court.—These attempts at self-improvement on the part of trade associations, and the co-operation of these associations with the Government in the ways noted, indicate a new trust policy in the process of evolution, a policy involving less persecution and more co-operation. In 1911 the Supreme Court in *United States v. Standard Oil Company* (221 U.S. 1) applied the rule of reasonable construction to the Sherman Anti-trust law, holding that only contracts and combinations that were in unreasonable restraint of trade at common law are illegal. In 1920, in *United States v. United States Steel Corporation* (251 U.S. 417) this court refused to regard the mere size of a corporation as of itself illegal, and intimated that it did not approve prosecutions under the anti-trust laws that did not serve the public interest. And in 1925 two decisions of far-reaching importance to the industrial life of the country were given (*Maple Flooring Manufacturers' Association v. United States and Cement Manufacturers' Association v. United States*, 45 Sup. Ct. 578), holding that "trade associations or combinations of persons or corporations which openly and fairly gather and disseminate information as to the cost of their product, the volume of production, the actual price, stocks of merchandise on hand, approximate cost of transportation . . . and who . . . meet and discuss such information and statistics without however reaching or attempting to reach any agreement with respect to prices or production or restraining competition, do not thereby engage in unlawful restraint of commerce." Similar trade association activities had been held illegal in 1914 and 1921 (234 U.S. 600; 257 U.S. 377).

It is also significant that comparatively few of the corporations cited for violation of the anti-trust laws since 1910 were what are popularly known as "trusts." It is big business that is setting the higher standards. These higher standards have long been advocated by economists and by many of the great leaders of the large combinations, but the change of policy has doubtless been affected also by the tremendous increase in corporate stockholders in the years 1915–25, a movement largely instigated and furthered by special offers of stock in some of the largest corporations to their employees or of gas companies to their customers. In the meantime no amount of regulation has materially checked the integration of American business from the small independent factory, performing but a single step in the process of production, to the horizontally and vertically organised super-combinations of to-day, tending to become complete and self-sufficient industrial units. (*See* also CARTELS; FEDERAL TRADE COMMISSION; INTER-STATE COMMERCE.)

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(J. W. J.)

TSCHAKSTE, JAN (1859–), first president of the Republic of Latvia, was born in Courland Sept. 14 1859. He was educated at the Mitau gymnasium, studied law at the university of Moscow, and was for some years in the public prosecutor's department of the Courland Government. Leaving the public service in 1888 he started practice as a barrister in Mitau and began to edit the paper *Tēvija* (Fatherland). In 1902 he served on a committee appointed by the local administration to inquire into agricultural conditions in Courland, and from time to time was employed on various Imperial Govt. committees. In 1906 he was elected a member of the first Russian Duma. The German invasion of Courland, July 1915, obliged him to leave Mitau. He went to Petrograd (Leningrad) where he founded a central relief committee for war refugees. In 1916 he went to Stockholm to promote the cause of Lettish independence and published there in German, his book *Die Letten und ihre Latvija*.

In 1918 Tschakste was elected chairman of the People's Council and was later head of the delegation sent to Paris and London to secure the recognition of the Republic of Latvia. In 1920 he was president of the Latvian National Assembly, and also became professor of international law at the University of Riga. On Nov. 14 1922 he was unanimously elected president of Latvia by the first Latvian Saeima (Parliament), and on Nov. 6 1925 was re-elected for a further period of three years.

TSINGTAO, CAPTURE OF.—The first part which Japan took upon herself to play in the World War was the reduction of the German stronghold of Tsingtao, on the bay of Kiaochow. This fortress served at the outset of the War as the only base of operations in Eastern Asia for the German marauders menacing the Allied trade routes. It was imperative to make Von Spee's raiders homeless, and the military and naval operations against

the redoubtable base, which was under the command of Capt. Meyer-Waldeck and garrisoned by some 13,000 men, of whom 5,599 were German regulars, were started with the utmost dispatch. On Aug. 27 1914 the blockade of Kiaochow Bay was declared by the Japanese Navy, and Lungkow, 150 m. north of Tsingtao, was chosen as the point for landing troops.

On Sept. 2 1914 the Japanese division, under the orders of Lieutenant-General Kamio, commenced landing at Lungkow. Despite the terrible weather conditions, the vanguards arrived on the 12th at the small town of Tsimo, where they encountered the enemy for the first time. The second Japanese contingent began to land at Laoshan Bay, within the leased zone, on Sept. 18 and soon established touch with the I. Army. The Japanese forces under General Kamio thus amounted to about 22,980 officers and men, and they succeeded in some 10 days in wresting from the Germans several of their advanced positions. On Sept. 24 there arrived at the arena of campaign the British force, commanded by General Barnardiston, consisting of 910 officers and men of the 2nd South Wales Borderers and 450 of the 36th Sikhs. After the non-combatants had been permitted to leave the fortress, the general attack on the position was commenced on Oct. 31, the Japanese blockading fleet off the harbour assisting by a continuous bombardment. On the morning of Nov. 7 white flags were descried on the forts of Moltke, Bismarck and Iltis, to the pleasant surprise of the attacking army, which had expected a protracted siege. After the fall of the stronghold it was ascertained that all enemy ships, including the Austrian cruiser "Kaiserin Elisabeth," had been sunk in the port of Tsingtao. The Japanese Army lost, during the campaign, 1,968 killed or wounded, and the Japanese Navy a cruiser, a destroyer and a torpedo boat. The port of Kiaochow was reopened for trade by the Japanese on Dec. 28 1914. (*See* WORLD WAR: BIBLIOGRAPHY.)

TUAN CHI-JUI, Chinese politician, was born in Anhwei and graduated from the Peiyang military school. Rising rapidly, he was largely responsible for the re-organisation of the Northern Army and after succeeding Yuan Shih-kai as viceroy of the Hukuang Province, he became commander of the I. Army. He was one of the military leaders who signed the memorial of Jan. 1911, urging the Emperor to abdicate, and joined the first Republican Cabinet in Nov. 1912 as Minister for War. He was acting Premier from May to July 1913, Minister of War again in 1914, and Premier in April 1916. In May 1917 he was dismissed by Li Yuan-hung, but the failure of Chang Hsun's attempt to restore the monarchy brought him back to office. In Oct. 1918 he resigned, and, after an ill-advised coup on behalf of the Anfui Club, played no great part in national affairs till Nov. 24 1924, when he succeeded Tsao Kun as President.

TUBERCULOSIS (*see* 27.354).—Tuberculosis is a disease of man and animals caused by the tubercle bacillus, which belongs to the "acid-fast" group of bacteria, some of which are pathogenic and others quite harmless. The most important pathogenic varieties are the "human," the "bovine" and the "avian." Whether these are to be regarded as distinct organisms or merely as mutations is not yet settled but they are easily distinguished by their selective effects on test animals.

Tuberculosis, when it has reached the stage at which it is clinically recognisable, may be regarded as the end-result of a slow progressive and long unrecognised bacterial invasion. It should never be forgotten that, in the majority of infected persons in civilised communities, this clinically recognisable end-stage is never reached; in other words, only a small proportion of the number of infected persons becomes clinically tuberculous.

Distribution Throughout the World.—A world-survey shows that tuberculosis tends to be wide-spread in densely populated areas linked by commercial and social ties with the outside world, and is rare or absent in sparsely populated and culturally isolated communities. Climatic, geological and racial factors appear to play a secondary part. Density of population, with the opportunities for frequent and close contact with infective persons which it involves, appears to be all-important in the dissemination of the germ, while wages, occupation, housing, diet, climatic conditions and racial customs constitute ancillary factors of varying significance in so far as they bear upon the capacity of the individual to resist the infective dose or doses to which he has been subjected.

With human tuberculosis, it is where men are herded together in the centres of industry that the infection becomes so common as to be almost universal. That this statement is true is proved by the post-mortem findings of reliable pathologists in Europe and America who have investigated long series of cadavers of persons dying from all diseases. In the words of M. Fishberg "no matter what the cause of death may have been, whether the persons knew they had tuberculosis or not, between 50 and 100% of people living in large cities show active, quiescent or healed tuberculous lesions in some organ of their bodies."

These findings bring into sharp relief the importance of the distinction between infection and disease. The results of tuberculin tests applied to healthy persons (Pollak, Vienna, 1911; Mantoux, Paris, 1909 and 1910; Fishberg, New York, 1914; Calmette, Lille, 1911 and others) show that, by the age of 15 years, nearly every individual living under urban conditions has already become infected with the tubercle bacillus.

It is clear, therefore, that, in densely populated countries, tuberculous infection is far more widespread than tuberculous disease. In sparsely populated and isolated countries, on the other hand, neither tuberculous infection nor tuberculous disease is common. Borrel, for instance, found that only 3% of the Senegalese soldiers summoned to Europe for the World War gave a positive response to the tuberculin skin-test on arrival in France, while numerous investigations carried out in the African and Asiatic Colonies and Dependencies of the European Powers show that primitive tribes living under their natural conditions are almost free from tuberculosis.

It has frequently been shown, however, that the members of these primitive communities, on quitting their native surroundings and coming into contact with the "tuberculised" populations of Europe, tend to show a marked susceptibility to tuberculosis; the clinical course, in these cases, being of a rapidly progressive and usually fatal type.

It would seem, in fact, that, where there has been little or no previous exposure to infection, the individual remains completely unprotected against tuberculous disease, while, on the other hand, there is manifest in the members of communities in which tuberculous infection is wide-spread, a considerable power of resisting the development of the tubercle bacillus and of rendering latent the active foci of infection.

Clinical Manifestations.—The primary clinical manifestations of tuberculosis tend to vary with the portal of entry of the bacillus. In uninfected subjects, the germs can pass through the mucous membranes of the respiratory and alimentary tracts, without causing, at the moment, any marked local disturbance and their transit thence is easy along lymphatic channels to the nearest lymphatic glands. In these glandular filters, the tubercle bacilli tend to be arrested and there they pullulate and set up the first foci of disease.

The formation of secondary foci of infection depends upon the spread of tubercle bacilli from their primary foci in the lymphatic glands to other tissues and organs. The presence of secondary foci thus implies a generalisation of the infection chiefly by way of the blood stream. This generalisation can take place much more easily in susceptible persons than in those who are more resistant, and in the young than the old. Thus the tendency to widely disseminated tuberculosis is much more marked amongst those groups of individuals in which the "tuberculin test" shows the highest proportion of negative results.

In the infants and young children of European and American communities, the proportion of bone and joint tuberculosis and of tuberculous meningitis is far higher than in adults; while, in the adults of "primitive" communities, brought for the first time into contact with infection, the same tendency to wide dissemination of lesions is always found.

The *reactive intolerance* implied in a positive response to the tuberculin test which is only acquired as the result of a preceding infection, constitutes a factor of supreme importance in limiting the spread of tubercle bacilli within the body, by causing local inflammation, cell-proliferation and finally fibrosis, with arrest of the wandering germs and their confinement within a fibrous or calcified area. And this reactive intolerance is manifested, not only toward endogenous re-infection from pre-existing foci but to exogenous re-infection from outside the body.

Pulmonary Disease.—With this conception in mind, it is not difficult to understand why the tuberculosis of adult life in civilised and

" tuberculised " communities usually takes the form of pulmonary disease. In the generalisation of infection through the blood stream from the primary lymph-gland foci, the bacillary emboli must travel along the veins from the glands and since all the venous blood must necessarily pass through the capillary bed of the lungs before being re-distributed throughout the body, the lung tissue presents the first filter to be encountered by the blood-borne bacilli. It is into the lungs, too, that all contaminations are drawn in respiration. While both blood-borne and air-borne tubercle bacilli may pass unchecked through the " virgin " lung-tissue of children and non-infected adults, they tend, where " reactive intolerance " exists, to be arrested in the pulmonary tissue and to set up the inflammatory and ulcerative phenomena of phthisis.

I. IN GREAT BRITAIN

Changes in Clinical Type.—The statement is frequently made that the cases of pulmonary tuberculosis encountered 30 or so years ago were much more acute than those seen to-day, and a general impression exists amongst clinicians that phthisis is more acute even now in parts of Ireland, Scotland and Wales than in London and the big industrial centres. This clinical impression receives strong support from the statistical inquiries of J. Brownlee (M.R.C. Special Report Series No. 18, 1918), who has shown that, in males especially and to a less extent in females, the age-period of maximum death-rate has steadily receded from the " young adult " group to the " middle age " group in the succeeding decennia from 1851–60 to the present time.

This diminution of the " young adult " type of death-rate has, however, been less marked in certain counties of Ireland, Scotland and Wales, and indeed, in agricultural communities everywhere, than in the larger centres of population. Brownlee, in the report quoted, suggested that these differences might be due to the existence of para-tubercle bacilli of unequal virulence, but later researches by Tulloch have failed to discover any antigenic variants in a large series of " human " tubercle bacilli investigated by him. It may be assumed, therefore, that the recession of the age-period of maximum mortality from early adult to later life implies a more protracted clinical type of pulmonary tuberculosis now than formerly and in the larger centres of population as compared with the more sparsely populated agricultural districts.

Fall in Tuberculosis Mortality.—As will be seen from the appended table (extracted from the registrar general's *Statistical Review of England and Wales for the Year 1924*, Table 6, page 35) there has been, from 1838 onwards, a steady fall in the tuberculosis death-rate affecting both the pulmonary and all other forms of the disease. This fall, which has been observable in other civilised countries, though often claimed as evidence of the value of modern methods of prevention, was just as marked before the recognition of the infective nature of tuberculosis as after the discoveries of Villemin and R. Koch had given a definite direction to sanitary effort. Clearly therefore, some factor of natural adaptation must have been present to supplement the efforts of preventive medicine.

TABLE I. *Annual Mortality at All Ages Per Million Persons Living*

Period	Tuberculosis (All forms)	Tuberculosis of (Respiratory System)
1838–42 (5 years)	4,419	3,782
1847–50 (4 years)	3,714	2,889
1851–5	3,638	2,805
1856–60	3,323	2,572
1861–5	3,313	2,527
1866–70	3,201	2,447
1871–5	2,942	2,217
1876–80	2,817	2,038
1881–5	2,543	1,830
1886–90	2,324	1,635
1891–5	2,122	1,461
1896–1900	1,906	1,323
1901–5	1,743	1,218
1906–10	1,566	1,106
1911–5[1]	1,414	1,047
1916–20[1]	1,441	1,107
1921	1,126	884
1922	1,121	889
1923	1,062	836
1924	1,058	841

[1] The mortality for the years 1915–20 relates to civilians only.

The foregoing table is taken from the registrar general's *Statistical Review of England and Wales for 1924.*

Those who favour the theory of an " hereditary disposition " to tuberculous infection see in this diminution of mortality the result of the dying off of susceptible stock and the survival of the more resistant. Others consider that, with the wide dissemination of infection resulting from the agglomeration of large numbers of persons into urban communities, there has been at work a factor of natural auto-immunisation, individuals acquiring various degrees of resistance as the result of mild and repeated infections.

In favour of the latter theory, it may be said that " acquired immunity " plays a part in limiting the spread of other bacterial diseases, that even the most susceptible animals may be made relatively resistant to tuberculosis through mild laboratory infections and that a high degree of resistance in any given community, as evidenced by a relatively low death-rate and a relatively chronic clinical type, goes hand in hand with a wide diffusion of infection as proved by tuberculin tests.

Prevention.—Man is liable to infection from two main sources, the first and infinitely the more important being infected persons and the second, milk from infected cows.

Not all infected persons are equally infective. Those suffering from the chronic type of pulmonary disease with cavities are, perhaps, the most dangerous of all, such cases producing, as a rule, copious expectoration of a sputum heavily charged with bacilli while, being relatively resistant, they often survive for years and are well enough to remain at home. There exist, too, cases whose symptoms are more suggestive of chronic bronchitis or asthma than of tuberculosis and who consequently remain undiagnosed, no precautions being taken. Not only the sputum of such persons but the droplets emitted in coughing and talking are sources of danger to others, while the excreted bacilli may accumulate on the clothing and bedding used by them and in the apartments which they occupy.

Such persons establish the greatest concentration of infective matter within the home, and the smaller, the worse ventilated and the more crowded the home, the more massive the infection and the more serious the danger to others. In the home contact with susceptible persons is most likely—for the home is the nest for infants and young children. It is upon the homes and the families of infected persons that preventive measures must be focussed.

Adequate provision of hospital and sanatorium accommodation is also a prime necessity so that infected persons may be removed from amongst their still healthy relatives. The use of sputum flasks, the ventilation of rooms, provision of good food for dependants—all these will help. In France, promising results are being attained on the Grancher System by which the young children of tuberculous parents are placed with selected foster parents in country districts.

Another interesting line of prophylactic effort now under trial in France is the protection of the infants born to tuberculous parents by " vaccination " with living but attenuated tubercle bacilli. A. Calmette and C. Guerin have succeeded, by special cultural methods, in so reducing the virulence of a selected bacillary strain that it no longer produces tuberculosis but merely a transitory and benign infective process accompanied, however, by the development, in experimental animals, of a high degree of resistance against re-infection by virulent strains. This vaccine of Calmette (B.C.G.) is now being administered not only to calves but to the infants of tuberculous parents shortly after birth. So favourable have been the results of experiments on laboratory animals that there are real grounds for hope, both as to prevention of human and bovine tuberculosis. But it will take years to evaluate the success or failure of these experiments. In the interval, the want of any specific preventive measure throws us back upon general measures of hygiene, attempts to diminish the pool of infective persons by improved methods of treatment and the supervision, control and, where possible, isolation of infected persons through the machinery of the tuberculosis schemes of local authorities and by precautions against the sale or the use of milk containing living tubercle bacilli.

General measures of hygiene find their most important application in arrangements for the conscientious notification of diagnosed cases, the inspection of " contacts," the medical inspection of school children, the provision of " clean milk," the betterment of housing, the adequate disinfection of contaminated articles and places and tactful and efficient " health visiting."

Recent Methods of Treatment.—Symptomatic treatment, while often affording relief, cannot cure. Even " specific " treatment aiming at the production of immunity, while helpful in certain patients, has proved disappointing. Tuberculin, in its various forms, is no longer regarded as " a cure in the strict sense of the

term " and is not entirely free from risk. The natural power of the human body to amplify its powers of resistance is very great and many cases do well if placed under favourable conditions of life. In this lies the secret of " sanatorium treatment " in which the mode of life of the patient is carefully adjusted to the limits imposed by his disease. Within these limits he can exercise and work with benefit to himself and an increase in the amplitude of his resistance. For the more favourable types of pulmonary cases, sanatorium treatment offers a very definite prospect of restoration to average health and working capacity. Although so much stress is laid on controlled exercise and work, the basis of the treatment is *rest*. In the case of " surgical tuberculosis," too, where the bones and joints of the body are affected, we find in rest the greatest of all adjuvants to recovery. A study of the results attained at such English centres as the Treloar Hospital for Cripples at Alton, the Shropshire Orthopaedic Hospital, the North Wales Sanatorium and the Metropolitan Asylums' Board Hospital at Carshalton will suffice to prove the curability of surgical tuberculosis in children by judicious immobilisation and rest. Fresh air (*see* PUBLIC HEALTH), sunlight (*see* HELIOTHERAPEUTICS) and the artificial sunlight produced by arc lamps are being used, more and more, to help on the results of treatment by surgical rest, and wonderfully favourable results are already claimed for these methods.

In pulmonary tuberculosis, too, the method of "surgical rest " for the affected part is applicable where the disease is confined or almost confined to one lung; and new vistas are being opened up through the use of artificial pneumothorax apecolysis and thoracoplasty. Nothing is more certain than that the surgical treatment of pulmonary tuberculosis is destined to play an increasingly beneficient part in the future. But, while all these methods are of proven value in appropriate cases, none of them can be claimed as a cure, and it is to Chemotherapy that we turn in our hope for the future.

Robert Koch found that salts of certain metals, and especially gold, had a lethal effect on the tubercle bacillus but only in concentrations which were also deleterious to the tissues. Research however, has continued on these lines, and within the last two years, Prof. Möllgaard of Copenhagen has succeeded in producing a gold compound, sodium aurothiosulphate or Sanocrysin, which, while still under test, appears to have a definitely lethal effect on tubercle bacilli in the human or animal body, in concentrations which are non-toxic for the patient. Here, again, we appear to be upon the threshold of a great advance in the treatment of tuberculosis.

Tuberculosis Schemes.—Up to the end of 1910, the work of fighting tuberculosis in Great Britain was left, for the most part, to the initiative of the more progressive local authorities, supplemented by private enterprise and the work of voluntary organisations. Much knowledge was accumulated through the work of the Royal Commissions of 1890 and 1901 and through the activities of the Local Government Board, but there was no co-ordinated national effort to deal with the disease.

In Nov. 1911, it was made incumbent on every medical practitioner attending on or called to visit any person suffering from pulmonary tuberculosis to notify the case immediately to the Medical Officer of Health concerned. These regulations, the outgrowth of orders by the Local Government Board of Dec. 1908, were made applicable to *all forms* of tuberculosis in Dec. 1912.

In 1911, too, the National Insurance Act made provision for sanatorium benefit for insured persons, the Local Government Board being empowered to authorise County Councils to provide, maintain and manage institutions for the treatment of tuberculosis. Under the Finance Act, 1911, and the Insurance Act, a sum of £1,500,000 became available for provision of or grants in aid toward sanatoria and other tuberculosis institutions while the Govt. undertook to pay 50% of the annual cost of the anti-tuberculosis work carried out by local authorities. The Public Health (Tuberculosis) Act of 1921 placed a statutory obligation on each County and County Borough Council to make arrangements for the treatment of all persons suffering from tuberculosis, whether insured or not.

Finally, in 1911, a Departmental Committee, presided over by Major (now Lord) Astor, was appointed to report on the general policy in regard to tuberculosis in its preventive, curative and other aspects. The tuberculosis schemes now operative everywhere throughout England, Scotland and Wales are based, for the most part, on the report of the Departmental Committee.

The units in a complete scheme are as follows:—

1. *The Tuberculosis Dispensary or Institute.*—The functions of this unit are to be " a receiving and clearing-house and a centre for diagnosis, consultation and observation, where persons can avail themselves of the services of specially qualified medical men." On the dispensary or institute is based, too, the work of the tuberculosis nurses and visitors " who advise and instruct patients in a hygienic mode of life " and help the tuberculosis officer to keep in touch with the homes of tuberculous cases.

2. *Residential Institutions.*—These consist of sanatoria for the more favourable cases and hospitals for those patients unable, at the moment, to benefit by sanatorium treatment. The schemes, include arrangements for home nursing, dental treatment, provision of extra nourishment, training in new occupations and " after-care."[1]

The growth of anti-tuberculosis work in England since the passing of the Insurance Act may be gathered from the steady increase in expenditure shown in the following table which is quoted from Dr. Coutts' pamphlet:—

TABLE II. *Tuberculosis Expenditure (England)*

Period	Gross Expenditure of Local Authorities	Income from Insurance Committees	Payments from the Exchequer in aid of Expenditure incurred during the Period mentioned in col. 1
(1)	(2)	(3)	(4)
July 15 1912, to March 31 1913	96,000	34,000	30,000
Year ended March 31 1914	373,000	189,000	87,000
Year ended March 31 1915	595,000	227,000	176,000
Year ended March 31 1916	700,000	211,000	237,000
Year ended March 31 1917	894,000	251,000	300,000
Year ended March 31 1918	1,087,000	266,000	384,000
Year ended March 31 1919	1,285,000	314,000	450,000
Year ended March 31 1920	1,954,000	621,000	635,000
Year ended March 31 1921	2,950,000	828,000	1,011,000
Year ended March 31 1922	3,074,000	200,000	1,717,000

Large as these figures may seem, there is still a vast field to cover if tuberculosis is to be dealt with adequately on the present lines. The actual notifications, amounting for England and Wales to 57,737 persons in 1924, or 1·47 per 1,000 of population, are admittedly an under-estimate of the known cases, while the undiagnosed carriers of infection must be more numerous still. If the isolation of infective persons is to become effective—and the Public Health Act, 1925, contains clauses providing for the compulsory hospitalisation of infective cases—it will be necessary to face the public maintenance of their dependants while patients remain in residential institutions. And there is an urgent need for further expenditure to provide accommodation and treatment for cases of surgical tuberculosis. The best chance of ultimate economy would seem to lie in the endowment of research directed towards effective preventive measures and curative treatment.

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[1] For a full account of this subject a pamphlet on " Anti-Tuberculosis Measures in England," by Dr. F. J. H. Coutts, C.B., Senior Medical Officer, Ministry of Health, may be consulted.

II. IN THE UNITED STATES

A more or less continuous decline in mortality from tuberculosis had been noticeable in the United States since about 1880; but between 1910 and 1924, and especially after 1917, the decline was extraordinary. The death-rate for the disease fell from 202 per 100,000 population in 1900 to 160 in 1910; 150 in 1917; 91 in 1924; a reduction of 55% for approximately the first quarter of the century, and of 21% for the first decade, only 6% from 1910 to 1917, and 39% between 1917 and 1924. Although the statistics have not yet been compiled it is estimated that the tuberculosis mortality for 1925 will show a further decline, to about 88 per 100,000. Such a diminution of mortality in a disease like tuberculosis is unparalleled in the annals of epidemiology. In 1915 tuberculosis, which had always been the first cause of death, yielded its unenviable pre-eminence to heart disease. It has since been outranked also by pneumonia, cerebral haemorrhage (apoplexy), and cancer, so that in 1924 it occupied fifth place or near the foot of the list of major diseases. As usual, pulmonary tuberculosis accounted for about seven-eighths of all deaths due to the disease.

Urban Communities.—All sections of the country and all elements of its population participated in the great betterment. But urban communities, as exemplified in New York City, outstripped the rural districts in the control of the disease. In them tuberculosis is declining more rapidly than in the country at large. In 1900 New York City's tuberculosis death-rate was 280, or 39% higher than that for the nation; by 1920 it had fallen to 126, or only 11% greater; and in 1924 it was 93, or barely 2% in excess of the general rate. Such changes are revolutionary and, for a great and crowded city, are unparalleled in the history of tuberculosis. They may be better appreciated by reference to the accompanying chart, which suggests that in 1924 a New York citizen's chance of dying of tuberculosis was less than one-half that in 1910 and one-third that in 1900. Among infants and children the reduction of tuberculosis has been almost sensational. In New York City the death-rate for infants in 1923 was only one-sixth that of 1898 (94 in 1923 and 609 in 1898), while for children under 15 the decline between the two years was from 136 to 33.

Causes of Decline.—Much has been written about the causes of the continued, and of late the extraordinary, decline of the disease. The phenomenon is apparent in all countries under our industrial type of civilisation, although latterly it has been most marked in the United States. The presumption is therefore strong that broad economic and social movements which characterise our era, though they elude close definition, are potent factors. Undoubtedly, the amelioration of existence, a resultant of the enormous increase of wealth in the United States, has played its part. But two other instruments have also been brought to such effectiveness in that country as to be likewise decisive in the control of tuberculosis.

Organisation of Control.—The first is the National Tuberculosis Assn., founded in 1904. Through its central office in New York City and its hundred and more subsidiary state and civic bodies, this organisation extends its influence into every hamlet, as it maintains services and agencies to be applied to every phase of the disease. Its funds are recruited through the unique manner of selling, every year at Christmas-time, its so-called " Christmas seals " stamps to be affixed to postal matter but not for postage. Their sale has become so enormous as to bring an annual gross return of almost $5,000,000 though they cost but a cent each.

Sanatoria.—As organisation is the key-note of the social control of the disease, so is the sanatorium the keynote of its medical control. In no other country has the sanatorium movement been so highly developed. Twenty years ago, when death-rates were around 200, there were hardly a score of these institutions in the United States. In 1925 they numbered more than 600, with a capacity of 52,460 beds for civilian patients and 13,940 beds for Federal patients, veterans of the wars. Their annual " turnover " was approximately 150,000 patients, or perhaps one-fifth of those ill with the disease. The standard of institutional facilities has been put at one bed for every annual death. On this basis the United States, with 78,096 deaths from pulmonary tuberculosis in 1924 (Registration Area), has perhaps two-thirds the ideal equipment, omitting the beds for Federal patients.

Special Treatment.—Of special methods of treatment, artificial pneumothorax (*q.v.*) has become a standard procedure, much employed in selected pulmonary cases. Since 1920, more radical surgical measures, such as the various forms of thoracoplasty, have been on trial; their use is increasing rapidly. Heliotherapy (*q.v.*), sun treatment and other forms of light therapy are now in common use in non-pulmonary disease. Specific treatment (tuberculin) valuable only in expert hands, holds its own. Chemotherapy has made no headway; nor have the various preparations, advocated recently on the continent of Europe (*Sanocrysin, Krysolgan*, etc.) been, as yet, received kindly in the United States. Of all diagnostic measures, the X-ray (*q.v.*) has had by far the greatest development, and has become indispensable. It has not, of course, superseded physical examination; and it is noteworthy that time brings a growing appreciation, that diagnostic precision and refinement are to be attained only through the co-operation of the examining physician and the Röntgenologist. No specific or laboratory test has been found decisive in diagnosis, except the long-recognised demonstration of tubercle bacilli in tissue products.

Immunity.—The practitioner of 1925 regarded tuberculosis from a point of view quite different from that of 1910. The disclosure that tuberculosis exists as a latent infection in almost all people, and that infection confers a measure of specific immunity to reinfection, gave rise to the almost necessary presumption that adult pulmonary tuberculosis develops from infection acquired in childhood and that the adult is insusceptible to exposure to infection from without. But latterly an increasing number of studies of American authorities has brought about some modification of too rigid an adherence to this opinion. They have shown that conditions are only relative. Although early infection and a resulting immunity are conceded, it is pointed out that infection is capable of complete healing, with a consequent great diminution or even disappearance of immunity; and that, therefore, there is every likelihood that reinfections—and active disease from them—are possible at almost any period of life.

In 1915 there occurred the death of Edward L. Trudeau, the recognised pioneer and leader of tuberculosis activities in the United States. In the next year was held the first session of the Trudeau School of Tuberculosis, the first of its kind, in Saranac Lake, N.Y., to give systematic instruction to physicians. In 1917 was issued *The American Review of Tuberculosis*, a monthly scientific periodical, founded by the *National Tuberculosis Association*. It was in 1925 the only tuberculosis journal in the United States, and had done much to stimulate the study and investigation of the subject. Among the more prominent centres of research in tuberculosis were the Trudeau Foundation at Saranac Lake, the Henry Phipps Institute at Philadelphia, the Kenneth Dows Laboratories of Johns Hopkins University at Baltimore, the National Jewish Hospital for Consumptives at Denver, the Municipal Sanitarium in Chicago and the Colorado Foundation at Colorado Springs, all of which were established since 1910. (A. K. K.)

TUKHACHEVSKY, MIKHAIL (1893–), Russian soldier, was born in the government of Smolensk. He received the best Russian military education in the corps of cadets and the Aleksandrovsky military school, out of which he passed in July 1914. In Feb. 1915 he was taken prisoner by the Germans, and, after several fruitless attempts to escape, he succeeded in the autumn of 1917 and made his way back to Russia. He was at once taken into the military service of the Soviet, took part in the operations in defence of Petrograd (Leningrad), and in June 1918 received the command of an army. He commanded successively the I., VIII. and V. Armies and then the Caucasian front. After the successful conclusion of operations against Denikin, Tukhachevsky was given the command of the Western front. After the Civil War he became chief of the military academy, and in April 1924 was appointed assistant chief-of-staff.

TULSA, Okla., U.S.A. (*see* 27.368), in the midst of the rich, oil-producing area of northeastern Oklahoma, increased fourfold in population in the 10 years after 1910, reaching 72,075 in 1920 (109·3 males to 100 females), of whom 8,878 were negroes and only 2,025 foreign-born. In 1925 the census bureau estimate was 124,478. Annexations of land brought the area to 12 sq. m. in 1925.

In 1925 there were 1,500 individual firms engaged in the oil business. The International Petroleum Exposition was established in 1923, on its permanent ground of 10 acres. Manufactures developed rapidly, until in 1923 there were 106 establishments producing goods valued at $22,327,907. Debits to individual accounts in Tulsa banks amounted to $1,181,952,000 in 1923. Civic improvements, up to 1925, included the adoption of a town plan, a regional plan and zoning regulations; the extension of the park system until there were 13 larger parks, containing 2,385 ac., and numerous small playgrounds; and the completion of a water-supply system at a cost of $8,000,000 which brings soft Ozark Mountain water from a reservoir of 20 billion gal. capacity in the Spavinaw Hills, 60 m. distant, over and under rivers, hills and ravines, by force of gravity alone, although the difference in the elevation of the source and the terminus is only 90 feet. In June 1921 there was a serious race riot, in which more than 25 persons lost their lives and many more were injured. As a consequence, the county was placed under martial law by the governor for a time in 1923. The old council tree of the Creeks, a huge spreading elm, still stood (1926) in the grounds of a private residence.

TUNISIA (*see* 27.393), area about 50,000 sq. m.; population (1921) 2,093,939. The natives numbered 1,937,824, of whom 48,436 were Jews. The Europeans numbered 156,115 and included 54,476 French, 84,799 Italians and 13,520 Maltese. Tunis, the capital, had 171,672 inhabitants, Sfax 19,754 and Bizerta 20,763.

History.—The protectorate form of government was maintained, the Bey being the head of the Regency, while the French resident-general controlled the administration, the army of occupation being 25,000 strong. Mohammed en Nasr, who had been Bey since 1906, died in 1922, and was succeeded by his cousin Mohammed el Habib (born 1858). During the World War tribesmen from Fezzara, led by Turkish officers, attacked the French outposts in southern Tunisia. There was some sharp fighting in Sept. and Oct. 1915, when the French re-established order. Later on large numbers of Tunisian soldiers were employed in France. In 1919–20 by agreement with Italy the territory on the Sahara south of Tunisia forming salients between the oases of Ghadames and Ghat and between Ghat and Tummo was transferred by France to Tripolitania.

As the census figures given show, the majority of the European inhabitants are Italians or Maltese. As part of an effort to give the protectorate a more French character, decrees were issued in 1921 declaring that British (*i.e.*, Maltese) and Italian subjects, born of parents who were themselves born in Tunisia, would be deemed to be of French nationality. These decrees provoked resentment, especially among the Italians, whose right to maintain their nationality was protected by a convention of 1896 still provisionally in force, and no settlement of the question with Italy had been reached by 1926. As to the British, an arrangement was reached with France in 1923 whereby the persons affected were entitled to decline French nationality.

In 1922, in order to give Tunisians a larger share in the administration, a general council for the protectorate, consisting of 44 French and 18 nominated native representatives, and also regional councils, were established. The general council superseded the consulting conference set up in 1905, and had greater powers than that body. There had already arisen a nationalist agitation, and this in 1924–5, when the cost of living was four times as great as in 1914, was mixed up with a Communist agitation accompanied by some disturbances in the towns. The Communist agitation was not deep rooted, but among educated Tunisians there was a demand for a democratic form of government. This demand was not met, but as an educational measure further powers were conferred in 1925 on municipal councils. In archaeology important excavations were carried out at Carthage and other sites, and efforts were made to attract tourists.

Industry and Trade.—Tunisia is essentially an agricultural country, but has also very valuable mineral resources. The average annual export of wheat in the period 1915–24 was 319,000 quintals, of barley 627,000 quintals. Tunisian olive oil is of very high quality; there were in 1924 8,000,000 fruit-bearing olive trees, and the production of oil was 220,000 quintals. Tunisian wines, mostly red, are of some repute, and some 600,000 to 800,000 hectolitres are produced yearly. Of minerals the production of phosphates was 1,882,000 tons in 1912, had fallen to 819,000 tons in 1918, and had risen to 2,400,000 tons in 1924. Iron, lead, zinc and manganese ores are also exported in considerable quantities. Marine salt of a superior quality is produced to the extent of some 300,000 tons annually—it is exported to places as far apart as India and the United States.

In 1913 imports were valued at 144,000,000 fr. and exports at 185,000,000 fr.; for 1924 the figures were imports 927,940,000 fr., exports 582,350,000 francs. The Tunisian franc follows faithfully the movements of French currency, so that no exact comparison can be drawn between the figures of 1917 and 1924. More satisfactory evidence of prosperity was found in the increased production, while the excess of imports was due to the comparatively rapid development of the country's resources—only a small part of the imports were for articles of luxury. External trade was increasingly with France, the combined result of a protective tariff and the low exchange value and instability of the franc. Next to France trade is chiefly with Italy, Great Britain and the United States. The British trade was in 1924 some 17% of the total.

Considerable sums were spent, from the raising of loans, on railways, agriculture and colonisation by French settlers. The budget figures of 1924, for ordinary receipts and expenditure, showed a surplus of 40,413 fr. on a total revenue of 219,130,800 francs. In 1915 (with the franc at par) revenue had been 60,000,000 fr. and the surplus 1,470,000 francs.

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TUPPER, SIR CHARLES (1821–1915), Canadian statesman (*see* 27.410), died Oct. 30 1915.

TURBINE, STEAM (*see* 25.823 and 842, also STEAM ENGINE). *The Reaction and Impulse Principles.*—Since the kinetic energy in a jet of steam issuing from a nozzle resides entirely in the velocity of the steam, it follows that to utilise the energy efficiently the steam must be brought as nearly as possible to rest. There are two methods by which this can be accomplished. Either the nozzle itself may be caused to move backwards with such a velocity that the issuing jet of steam remains stationary in space or on the other hand the jet of steam may be made to impinge on a moving blade system and its velocity thus abstracted. The words "reaction" and "impulse" are used respectively to designate the two principles outlined, and the same terms have now come into general use as descriptive of turbines which embody, more or less, the respective principles.

The development of the steam turbine as a practical machine dates from 1884 when Sir Charles Parsons patented a design in which the total range of steam pressure which it was desired to utilise was divided up into a large number of stages, the small velocity energy due to each partial drop of pressure being absorbed before the next partial drop occurred. The complete turbine thus consisted of a number of elementary turbines working in series, each of which, having only a small steam velocity to deal with, could operate efficiently with quite a low blade speed. The Parsons principle of "pressure compounding" a turbine in this manner can be taken advantage of in two ways. If each partial pressure drop takes place in a set of fixed nozzles,

so that steam at the full velocity due to this drop impinges on the running blades, we have what is known as the pressure compounded " impulse " turbine. If, on the other hand, the steam is arranged to expand in both the fixed and running elements of the turbine, so that the moving blades are impelled chiefly by the reaction of the steam issuing from them, the machine is called a pressure compounded " reaction " turbine.[1]

Various Types of Turbine

The Parsons.—The inherently high efficiency of the reaction water turbine was well known to engineers prior to 1883, and for this reason the original compound steam turbine of Sir Charles Parsons was constructed as a " reaction " machine. The reaction principle as developed by him at Heaton Works, Newcastle-on-Tyne, has since been embodied in turbines aggregating millions of horsepower and is the principle employed in many of the largest and most efficient plants in the world. The first Parsons turbine was constructed in 1884–5. It consisted of a rotor about 3 in. in diameter carrying numerous rings of outwardly projecting brass blades which alternated with corresponding rings of fixed blades projecting inwards from the casing. Steam was admitted at the centre of the casing and flowed axially to the exhaust at each end. The partial expansion of the steam in each row of the fixed blading generated a velocity which was absorbed by the succeeding row of moving blades, while the similar partial expansion of the steam in the latter tended to urge them forward by its reactive effect. The action of the steam was identical with that employed in the reaction turbine as built to-day. This early machine was directly coupled to a 4 kw. Parsons dynamo which it drove at a speed of 18,000 revolutions per minute. It used steam at a pressure of 60 lb. per sq. in., and exhausted to atmosphere, its steam consumption under such conditions being about 200 lb. per kw. hour. It worked satisfactorily for several years, and, owing to its historic value as the prototype of the modern steam turbine, has since been placed in the South Kensington Museum (*see* fig. 1 on plate).

The De Laval.—In the year 1887 De Laval patented an improved impulse turbine, the essential feature of which was the employment of a diverging nozzle to develop the velocity due to the full pressure drop of the steam and to direct the latter on to the blades of a single wheel. The invention of the diverging nozzle was a highly important one in connection with impulse turbines, as without it only a small range of expansion could be efficiently utilised. Since in the De Laval turbine the whole of the energy of the steam was to be absorbed in a single stage, very high blade speeds were necessary, and these implied very high speeds of rotation. The wheel was of special design to withstand the severe centrifugal stresses involved and it was mounted on a very thin flexible shaft in order that it might be able to rotate about its own centre of gravity and principal axis when running. The wheel of a 5 H.P. turbine had a diameter to the centre of the blades of only 3·94 in., and ran at no less than 30,000 revolutions per minute. In a machine of 300 H.P. the wheel was 29·92 in. in diameter and made 10,600 r.p.m., giving a mean blade speed of 1,380 ft. per second. At such speeds of revolution direct driving was impossible, so De Laval incorporated double-helical gear in the design, giving a speed reduction ratio of about ten to one. Owing to greater limitations to permissible stresses in larger disks and to the difficulty of providing sufficient nozzle area round the wheel, turbines of this type have not been constructed in sizes developing more than a few hundred H.P., but within their limitations they are moderately efficient machines. By the invention of the diverging nozzle and high-speed mechanical gearing, De Laval made two important contributions to turbine development.

The Compound Impulse.—The typical impulse turbine of to-day owes its development principally to Prof. A. Rateau of Paris, whose work on steam turbines dates from 1894, when he first devoted his attention to simple impulse machines of the de Laval type. The essential feature of the modern Rateau turbine is the use of a succession of simple De Laval impulse wheels in series in the steam flow, *i.e.*, compounded on the Parsons principle of subdivided pressure drop, already described. All subsequent designers of successful impulse turbines have followed the lines laid down by Rateau, except as regards certain minor details of construction. Modern machines of the compound impulse type have been constructed in sizes up to 60,000 kw. capacity, and high efficiencies have been obtained.

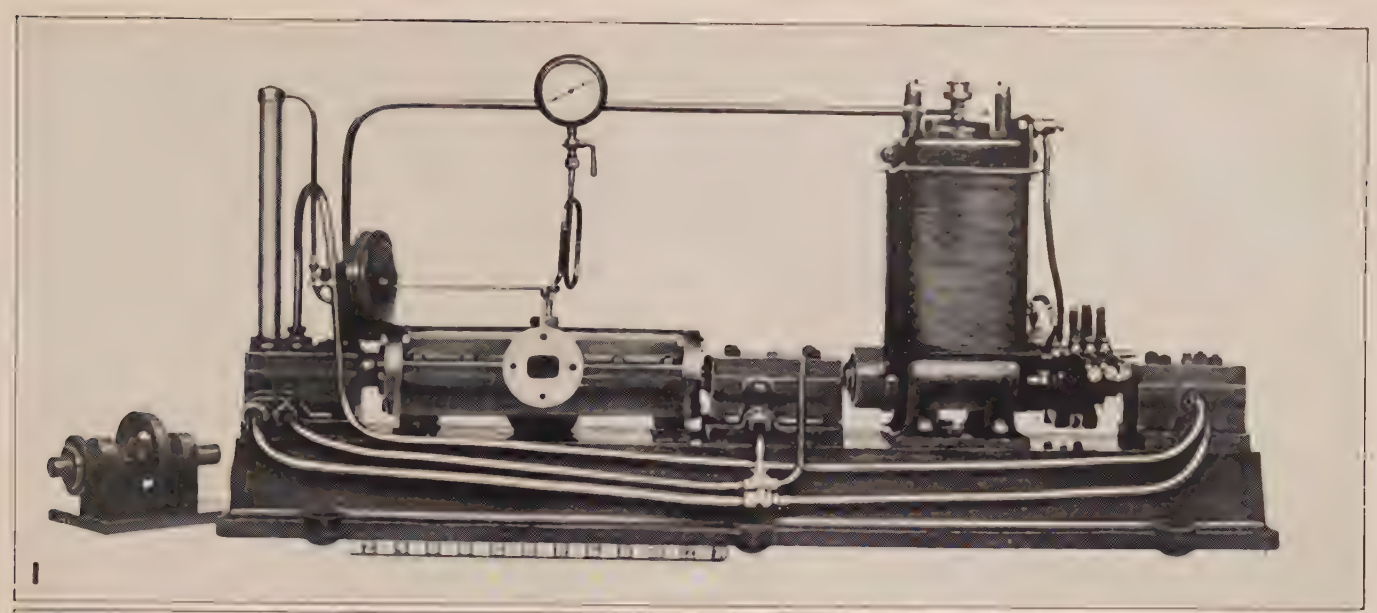
A feature that is peculiar to impulse turbines is the ease with which the admission of steam may be restricted to a part only of the circumference of the bladed wheels, by admitting steam through nozzle groups subtending only a small arc. It is now recognised that this results in a certain loss of efficiency due to the fan-action of the unoccupied blades, but on the other hand it permits the substantial advantage of using blades of a reasonably large height running at an adequate velocity at the high pressure end of the turbine, where the volume of steam to be passed through the nozzles and blading is but small. Another special feature of the impulse turbine is that, since the steam can be expanded in the nozzles to a moderate pressure before entering the body of the machine, no part of the main casing or of the wheels or blading system need be exposed to steam at the initial high pressure or temperature. The losses due to disk friction of the wheels running at high speeds in a comparatively dense medium, and those due to the comparatively high velocity of the steam through the blades, are however considerable.

The Curtis.—The essential feature of the Curtis turbine was the combination of the expanding nozzle of De Laval with " Velocity compounded " blading. The steam entered the blading of each stage at a comparatively high velocity, acting on a wheel carrying two or more rows of blades, alternating with fixed blades projecting from the casing. After acting on the first row of moving blades it was deflected back on to the second row by the fixed, or " guide " blades and so on, its velocity being continuously reduced. As many as four moving rows per wheel were adopted in some instances, and thus a high initial steam velocity could be dealt with by blading running at a very moderate speed. It is, however, very difficult to obtain a satisfactory efficiency with several rows of impulse blades working in series in this fashion, and the use of two rows only per pressure stage became general.

The Ljungström.—This is a compound reaction machine in which the alternate rows of blading are arranged to project axially from opposed discs which rotate in opposite directions. Each disc is mounted on the end of a separate shaft carrying an alternate rotor, the two alternators working electrically in parallel and each contributing half the total output of the machine. The steam is introduced between the centres of the bladed discs and flows radially outwards, escaping at their circumference to a space connected with the condenser. Since both blade systems rotate, the relative blade speed is double that which would correspond to the speed of rotation at which each of the alternators is driven, consequently the required degree of pressure compounding can be obtained with a reduced number of blade rings. The similarity of the discs and the method by which the blade rings are fixed, moreover, practically eliminate difficulties due to distortion when running, and very fine clearances can therefore be used.

Combined Types.—The velocity compounded wheel of Curtis is frequently used for the first pressure stage of a turbine of which the succeeding stages are either of the reaction or of the simple impulse type. The builders of compound impulse machines frequently seek higher efficiency by arranging for a certain amount of expansion of the steam in passing through the blading, thus partially adopting the reaction principle. The construction of turbines consisting of a multi-stage pressure-compounded high-pressure cylinder, followed by a low-pressure cylinder of the reaction type has been advocated and several such machines have been built. The idea of constructing a turbine in more than one cylinder is not new, having been first adopted by Parsons in the 2,000 s.h.p. turbine engines of the steam yacht.

[1] Throughout this article the value of one kilowatt is understood to equal 1·34 horsepower.



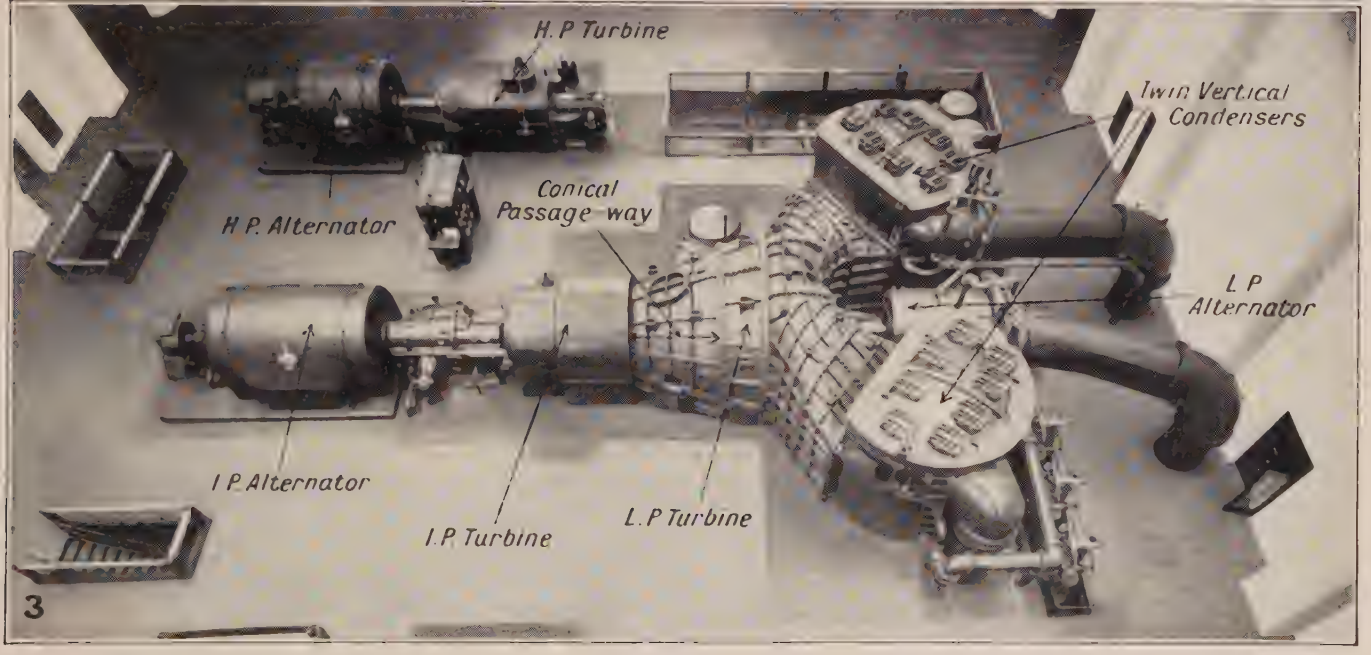


FIG. 1. The first type of Parsons machine (Science Museum, London). FIG. 2. 10,000 K.W., 3,000 r.p.m. Parsons Reaction Steam Turbo Alternator. FIG. 3. 50,000 K.W. Parsons Reaction Steam Turbo Alternator, arranged Cross Compound on 3 shafts (I.P. and L.P. in line), Speeds, H.P. and I.P. 1,800 r.p.m. L.P. 720 r.p.m.

"Turbinia" in 1879 and in the 1,000 kw. turbines constructed for Elberfeld so long ago as 1900. In the combined type referred to, the impulse portion contains an unusually large number of wheels, which are of comparatively small diameter and turned from a solid forging. The blade speeds and steam speeds are therefore low and the disk friction is also less than would be the case with larger wheels.

Present Position of the Turbine

So rapid has been the development of steam turbines since the construction of the first turbine of 10 H.P. in 1884 that their position as prime movers for the generation of electrical energy and many other purposes is now unrivalled. The successful development by Parsons of double-helical gearing for the transmission of large powers has permitted complete freedom of choice with regard to turbine speeds, so that the steam turbine, which is essentially a high-speed prime mover, can be employed with advantage for driving machinery which is required to run at any moderate or even low speed. Mechanical gearing has, for example, supplied the solution to the problem of the continuous current turbo-dynamo. Moderate speed generators have now reached an output of 3,000 kw. from a single machine, the current collected from a single commutator being as much as 6,000 amp., and with the interposition of gearing such generators can now be turbine-driven.

Turbines of only a few horsepower are now frequently used to drive fans, centrifugal pumps and auxiliary apparatus used in connection with power stations, and there appears to be almost no limit to the applicability of the turbine as a prime mover. For steam railway locomotives, the reciprocating engine still holds its own, but there are signs that the turbine may also find a place. Progress in this direction has been hindered by the two practical difficulties of reversing the locomotive easily, and of constructing a satisfactory portable condenser. The variable speeds at which locomotives must run also impose a condition adverse to the turbine. Nevertheless the construction of the Reid-Ramsay locomotive in Great Britain, and particularly of the Ljungström locomotive in Sweden, the latter operating in regular service with a fuel consumption only half that of reciprocating-engine locomotives on similar duty, indicates a possible development in this direction (*see* Railway Engineering; Locomotive Design).

Trend of Modern Design.—The broad difference in the practices of to-day lies between the so-called impulse and reaction principles as applied to horizontal compound turbines. The arguments in favour of either type may be based either on preference for the mechanical construction appropriate to it, or on the theoretical efficiency to be obtained from it. The cost of manufacture is also an important commercial factor. This last consideration tends to the construction of impulse turbines with comparatively few stages, seven or eight being commonly employed in a medium-size machine. Such machines are short and compact, but the high steam velocities inherent in the design involve serious frictional and eddy losses both in the nozzles and blades. Trouble with erosion of the blades, especially towards the low-pressure end of the turbine where the steam is wet, is also sometimes experienced. The much lower steam velocities, due to the many times more numerous stages which are usual in a reaction turbine are favourable to efficiency. Moreover, since the steam velocities in a pair of fixed and moving blade rows in a reaction turbine are identical, considerations of symmetry would indicate that a higher efficiency would be obtainable than in a turbine in which the whole of the expansion per stage took place in one element (the nozzles). It is interesting to note that builders of reaction machines have experimented with different ratios of expansion in the fixed and moving elements, but up to the present the practice of using equal ratios has proved to be the best. An approach towards the reaction principle has been advocated by some builders of impulse turbines, who consider it better to allow a certain amount of expansion to take place in the moving blades, but opinion is by no means unanimous on this point.

In modern practice the best results as regards blade efficiency are obtained with a ratio of blade speed to steam speed of about 0·85–0·90 in the case of reaction turbines, and 0·43–0·48 in the case of impulse turbines having a single row of rotating blades after each set of nozzles. The diminution of nozzle efficiency with increasing velocity of the steam has been confirmed by recent investigations of the Steam Nozzles Research Committee[1] but there yet remains to be found the exact cause of this loss of efficiency and whether its reduction or elimination is possible. Another point which bears upon steam turbine design is the experimental fact that the stage efficiency of a turbine is less with saturated or wet steam than when the steam is superheated.

Thermodynamics of Turbine Design.—These problems are closely associated with the thermodynamics of turbine design. All engineers engaged in such work are desirous of making the design of nozzles and blading a matter of exact calculation, and are also anxious to be able to agree upon a rational basis of comparison for the performances of different turbines working with different steam conditions. Up to the present these problems are not completely solved, the influence of the cumulative heat due to the inefficiency of the several stages of a turbine, and the experimental fact of decreased stage efficiency where wet steam is found, having made exact calculation somewhat difficult.

The proportion of the heat supplied to the steam in the boiler that is converted into useful work, does not depend upon the efficiency of the turbine only, but is a function of the conditions under which the heat is received and rejected. The efficiency of the thermodynamic cycle, which governs the relation between the available energy and the heat supplied to the steam, is explained in the article on thermodynamics (*q.v.*).

Attention has been turned to the possibilities of increasing the available energy itself by extension of the thermodynamic cycle, more particularly in the case of land turbines which operate under much less restrained conditions than those prevailing at sea. By the use of higher pressures and temperatures (*see* Steam Engine), the lowest possible vacuum and other devices, it is not unreasonable to expect to reach an overall thermal efficiency (from fuel to electricity) of 30% or in other words an efficiency not inferior to the best attained by oil engines, even neglecting the oil consumed in cylinder lubrication.

With regard to the possibility of increasing the thermodynamic efficiency by extending the lower end of the temperature range, which the turbine can utilise to an extent completely beyond the range of the reciprocating engine, a limit is imposed in this direction by the temperature of the cooling water available. A condenser temperature of about 70° F., corresponding to an absolute pressure of 0·36 lb. per sq. in., or a vacuum of 29·25 in. of mercury (barometer 30·00″)is about as low as can be maintained in practice under favourable conditions. The effective use of such a vacuum demands, however, the provision of adequate blade area and passage way for the low-pressure steam, which is of great volume. Throughout the stages of a turbine the criterion of efficiency is the ratio between the blade speed and the steam speed, and the areas of the blade passages must successively increase in such a manner as to maintain the desired velocity ratio.

The axial component of the steam velocity is carried on from stage to stage without appreciable loss. It is even built up to higher values as the peripheral and steam velocities increase. Its final loss at the exhaust end of the turbine, however, is practically unavoidable, and with the high peripheral speeds adopted in most low-pressure blading at the present day, an exhaust blade area which gives a perfectly satisfactory velocity ratio may entail a loss of energy in the issuing steam of considerable amount. Such loss is augmented if, for the sake of weight or cost, any sacrifice is made of the final velocity ratios, which sacrifice might otherwise be a perfectly justifiable compromise. It is evident, therefore, that the exhaust end of the turbine requires separate treatment in its design from the point of view of limitation of the

[1] See *Proceedings of the Institution of Mechanical Engineers*, Jan. 1923 *et seq.*

leaving loss, that is, the energy lost in the issuing steam. Broadly speaking, where high efficiency is the aim, this consideration imposes a limit upon the axial velocity of the steam in the final annulus. For a given vacuum, therefore, the area of the final annulus must increase in proportion to the output, and for a given output any increase in the vacuum involves an increase in the area of the final annulus. It will be seen, therefore, that any effort to extend the steam cycle, by lowering the temperature of condensation, brings at once into prominence the problem of the exhaust end.

Various expedients have been adopted for the purpose of surmounting this limitation. The area of the final annulus can be increased by increasing the blade height, and any means of extending the height permissible on a given diameter is valuable for this purpose. Thus in many turbines, the blades of the last stages are made of varying section and discharge angle, permitting a greater length ratio without unduly increasing the centrifugal stress. Another method, commonly employed in both land and marine turbines, is to carry out the final stages of the expansion by divided flow, as for example in a double ended low-pressure turbine, the steam entering at the middle and flowing in each direction towards an exhaust at each end. In such an arrangement two exhaust pipes are provided and frequently two condensers. In another example of divided flow, some makers double only the last row or last few rows of blading, employing specially shaped passages to conduct the steam to the divided portion from the preceding stages. The design of exhaust end advocated by Baumann is yet another attempt to overcome the same difficulty. In this device instead of carrying over a part of the steam by special ports to additional blade rings, it is made to flow through inner annuli of the preceding blade rings, the vanes of these inner annuli being specially shaped to reduce the resistance involved to a minimum.

If no restrictions are imposed, either upon the diameter of the exhaust end or upon the speed of revolution, a simple and probably the best solution of the exhaust area problem in large machines is to provide a separate low-speed turbine of large diameter for the final stages of the expansion, having blades of normal profile throughout, and correspondingly high efficiency. This low-speed turbine can be arranged in close proximity to the condenser, so as to reduce to a minimum both the length and the resistance of the exhaust passages.

In the exhaust passage itself, it is not sufficient to provide area to reduce the mean velocity of the steam passing through it to a moderate value, but the exhaust steam must be distributed into the passages uniformly, so that the velocity is everywhere nearly the same. Neglect of this requirement leads to unnecessary hydraulic losses, and may also cause troublesome blade vibration in the final stages.

Many attempts have been made to obtain the benefit of the diffuser principle, which has been so commonly adopted in the case of water turbines, but in the case of steam turbines without substantial success. In any attempt to carry this principle into effect, ample exhaust pipe area should be provided, with progressively larger cross section on the way to the condenser, so that the exhaust steam from the last row of revolving blades is gradually slowed down, with a possible recovery of static head. The practical difficulties in the way of such recovery of pressure in the exhaust steam are very great, and the best that can be done in this direction would appear to be to utilise the leaving velocity of the exhaust steam to overcome the resistance to flow in the exhaust passages, so that the absolute pressure at entry to the condenser is the same as at the exit from the blading.

Modern practice with regard to these matters may, perhaps, be best exemplified by the large Parsons turbine plant (see fig. 3 on plate) erected (1925) in the new Crawford avenue power station at Chicago, where, after allowing about 3% for the total power absorbed by the auxiliaries, an overall thermal efficiency (from fuel to electricity) of 27·80% is anticipated.[1]

Developments in Marine Turbines.—The design of the earlier marine turbine installations was largely a matter of compromise between the high speed of revolution desired for the turbine and the much lower speed which was more suitable for the propeller. Like all compromises, each side had to sacrifice something and although a satisfactory efficiency could be obtained in the case of high-speed vessels, it was realised that a much greater economy would be possible if both turbine and propeller could be arranged to run each at its own most efficient speed of rotation. This was of course impossible so long as both were directly coupled together. By the introduction of gearing between the turbine and the propeller, the desired freedom of each with regard to speed was obtained, and thus the turbine not only became applicable to slow-speed vessels, but better results were obtainable even in high-speed vessels, such as warships, liners and channel boats where the direct coupled drive was already firmly established.

A small example of marine turbine reduction gearing had actually been built in 1897, in connection with a twin-screw launch in which the Parsons Marine Steam Turbine Co. fitted a 10 H.P. turbine driving the two shafts by means of helical gearing with a speed ratio of 14:1. In 1909 the "Vespasian," a cargo vessel of 4,350 tons displacement, was fitted with geared turbines driving a single propeller. The vessel had previously been equipped with triple expansion reciprocating engines of the usual type and before these were removed they were put into perfect order and very careful tests were made to determine their efficiency and performance. The geared turbines drove the same shaft and propeller as the engines had done and were supplied with steam from the same boilers. The power developed was about 1,000 H.P. and the shaft ran at 70 revs., the gear ratio being 19·9 : 1 in a single reduction. The installation of the turbines resulted in an increase of about one knot in speed for the same coal consumption, or alternatively a saving of 16% in fuel consumption, and the results of the trials were convincing as to the advantages of geared turbines over reciprocating engines. After the "Vespasian" had run 18,000 m. in regular service, the pinion was examined and found to be in perfect condition, the wear not exceeding 0·002 inches. (See *Trans. I.N.A.*, 1910 and 1911.)

The success of the "Vespasian" led to rapid developments. In 1910 the British Admiralty introduced mechanical gearing, the torpedo boats "Badger" and "Beaver" being the first warships to be fitted with geared turbines. In these vessels each L.P. turbine drove its shaft directly but the H.P. and cruising turbines were geared to a forward extension of the L.P. turbine rotor. At full load about 3,000 H.P. were transmitted through each set of gearing. Six years later complete gear drives had become the standard practice for British war vessels of all types and by 1920 some 650 gears, transmitting an aggregate of 7,280,000 H.P., were fitted or on order for the Royal Navy (Tostevin, *Trans. I.N.A.*, 1920).

Numerous tests have been carried out to determine the mechanical efficiency of large marine turbine reduction gears. The efficiency of a single reduction gear at full load should be over 98%, and efficiencies of 98·5% have been recorded. With double reduction gear the efficiency is over 97%. These figures include bearing friction. No method of obtaining speed reduction by hydraulic or electrical methods has yet been devised which has approached the efficiency obtainable with mechanical gearing.

Since the introduction of mechanical gearing the marine turbine has tended to become assimilated in type to the land turbine, the same conditions making for thermal efficiency, namely, high velocity ratios, high steam pressures and temperatures and high vacua, being equally applicable. An arrangement of turbines in which the high pressure portion of the expansion is confined to a small high-speed turbine, is advantageous for the improved thermodynamic systems already referred to in connection with land practice, and such systems with high boiler pressure and temperature are now on the point of being introduced into marine work.

Assuming such a design to be adopted for an installation of about 5,000 s.h.p. with boiler pressure 500 lb., maximum temperature 700° F., feed heating to 350° F., and effective air pre-heating to give a boiler efficiency of about 84%, a careful estimate based

[1] For a full account of this plant see *Engineering*, vol. 121, p. 283.

on known performance shows that, owing to the increased available energy of the steam and when burning oil, a fuel consumption of about 0·55 lb. per s.h.p. would be obtained for turbines only and about 0·65 lb. per s.h.p. for all purposes including auxiliary machinery.

An installation on such lines is now under construction for a Clyde steamer which will therefore be the pioneer of this improved method of propulsion. The machinery will have a propulsive s.h.p. of 3,500 on two shafts with a boiler pressure of 550 lb. per sq. in. and a temperature of 750° Fahrenheit. The principle of stage feed heating is to be adopted. The feedwater will first be heated to about 200° F. by the auxiliary exhaust steam and then raised to a higher temperature in a second heater by steam withdrawn from the turbines. The boilers will be coal-fired and the air to the furnaces heated by the flue gases by means of air preheaters arranged in the uptakes. It is anticipated that this installation will satisfactorily demonstrate the practicality of applying the latest land practice to marine work and will pave the way to a considerable advance in economy in marine propulsion.

Two examples of such applications, for total outputs of 27,000 and 13,500 S.H.P., were described in a paper read by Sir John Biles,[1] and comparisons made on an economical basis with installations of other types for the same vessels with Diesel engines. When the difference in price between fuel oil and Diesel oil is taken into consideration and also allowance made for the cost of lubricating oil for the Diesel engines in excess of that for turbine, such proposals promise an economy in cost of fuel not inferior to that obtained with Diesel engines, whilst they permit the use of either coal or oil as fuel. Further the first cost of such an installation will be considerably less than the cost of Diesel engines and little, if any, greater than that of a geared turbine installation of the usual design with low pressures and moderate superheat.

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TURIN, Italy (*see* 27.418), the fourth city of Italy, and the chief town of Piedmont, is a flourishing and important industrial centre, with a population in 1921 of 502,274 (517,140 including suburbs). The city has large motor car and artificial silk industries. A fine monument to Mazzini was erected in 1915 at the junction of the Via Pomba and the Via Andrea Doria, and a memorial to Italian cavalrymen to the east of the Palazzo Madama in 1923.

TURKESTAN or Turkistan (*see* 27.419), the name applied to certain Russian territories just east of the Caspian. Russian Turkestan is divided between two independent Socialist Soviet republics, Turkmenistan and Uzbegistan, which, however, are constituent states of the U.S.S.R. Turkmenistan (capital Polterask, formerly called Askabad, with a population of 33,636 in 1925) comprises all the territories west of the Oxus and the south of the Kirghiz A.S.S.R., and also a small strip of territory on the east bank of the river. Uzbegistan (capital Samarkand, with a population in 1925 of 72,370; largest town Tashkent, with population of 263,871), comprises the territory between the Oxus on the south, where it forms the Afghan frontier, Turkmenistan on the west, the Kirghiz A.S.S.R. on the north and the Kara Kirghiz autonomous province on the east. It includes nearly the whole of Bokhara, and the districts of Ferghana and Samarkand. Comprised within its territory is the autonomous Socialist Soviet Republic of Tadjikstan (capital Durhambe), which forms the southeastern portion of Uzbegistan. These administrative divisions correspond fairly accurately with the ethnographical distribution—the three republics being inhabited principally by Turcomans, Uzbegs and Tadjiks respectively. According to estimates of 1925, Turkmenistan had a population of 914,558, of which 79% were Turcomans and 5% Russians. Its exact boundaries had not been delimited. Uzbegistan had a population of 4,150,000, of which 3,575,000 were Uzbegs, and an area of 184,800 sq. miles (250,000 versts). Tadjikstan had a population of 609,000, of which 90% were Tadjiks, and an area of 31,680 square miles.

Political History.—After the revolution of March 1917 the Amir of Bokhara asserted his independence and on April 20 granted a constitution; while the Provisional Govt. of Russia convened an All-Russian Moslem congress in May 1917, which was eventually dissolved by the Bolsheviks in May 1918. It appears to have achieved little. Following the Bolshevik revolution, a Turkestan Moslem congress proclaimed, in Dec. 1917, the autonomy of Turkestan and Khokand, and established a Provisional Govt., which, however, was overthrown by the Bolsheviks in Feb. 1918. By May the Bolshevik forces had surrounded Bokhara, and in August they had established themselves in Merv. In November "White" forces recaptured Merv, only to lose it the following May, after which event a Turkestan Soviet Govt. was formed, which in August sent a diplomatic representative to Kabul. In Sept. 1919 there was a successful anti-Bolshevik rising in Ferghana, which resulted in the formation of a Provisional Govt., which lasted until Feb. 1920. This month saw the consolidation of Soviet power in Turkestan; a rising in Khiva resulted in the abdication of the Khan, and by the end of the month only Bokhara maintained a precarious independence under the Amir. A successful Soviet campaign in August led to the establishment of the Bokharan Soviet Republic early in September. In the same month a treaty was signed with the Republic of Khwahrezm, which had been established after the capture of Khiva, and a similar treaty was signed with Bokhara the following March. In April (1921) a decree of the All-Russian Central Executive Committee formally established Turkestan as an autonomous Republic. In March 1922 Enver Pasha began a campaign against the Soviet forces in Bokhara, and he was only finally defeated on June 26 at Bairin; Enver was assassinated in the following August in Bokhara.

Thenceforward all organised opposition to the Soviet administration ceased, though the Basmachi, adherents of the ex-Amir, continued to wage a guerilla warfare against the Soviet authorities down to 1925. In Oct. 1923 Khwahrezm was converted into a Socialist Soviet Republic by a congress sitting at Kiev, and in Oct. 1924 the Republics of Turkmenistan and Uzbegistan were formally admitted to the Union of Socialist Soviet Republics.

Natural Resources.—The climate of Turkomanistan and Western Uzbegistan is very dry; rain only falls in the spring and cultivation has to be carried on almost entirely by artificial irrigation. The average summer temperature is 30° C., and for the year 17° C. The population is largely nomadic, though wheat, rice, cotton and fruit are grown. Cotton planting has lately been intensively developed and large sums spent on irrigation; the area under cotton in 1926 has been estimated at 196,000 acres. Crops of all sorts are, however, uncertain owing to irregular water supply and to the ravages of locusts. Farther east the climate improves as country becomes more mountainous, and the Uzbegs (nomads of Mongol descent) breed horses, sheep, horned cattle and camels, and cultivate the river valleys. Artificial irrigation is being developed; the area so watered in the Oxus basin is to be increased from 405,000 ac. to over 3,000,000 by 1930 at a cost of £15,000,000. The area under cotton in 1926 had been increased to 1,515,000 acres. Fruit is also grown for export. The mineral deposits are as yet undeveloped, but uranium ore is sent to Kazan for the extraction of radium; coal, mercury, Glauber's

[1] The relative commercial efficiency of internal combustion and steam engines for high-speed passenger vessels (*Trans. Inst. Naval Arch.*, vol. 67, 1925).

salt, rock salt and naphtha have been located. Silk weaving is still an important village industry.

Communications.—Considerable developments in the communications of Central Asia have taken place. The northern branch of the Central Asian railway has been extended from Tashkent to Pishpek and a further extension to Alma-Ata (formerly Vyerni) has been begun. The southern branch has been extended along the Oxus to Termez and a further extension to Dyushambe is in hand. The whole permanent way has been overhauled, and regular express services with dining and sleeping cars run to Tashkent. Road construction is also being taken in hand, and from March to Oct. regular air services link up Khiva, Termez, Dyushambe, Pishpek, Kagan and intermediate towns.

BIBLIOGRAPHY.—A. J. Toynbee, *Survey of International Affairs 1920–3*, pp. 428–445 (1925), and *id.* 1924, pp. 217–228 (1926). These works give some further references to the little literature available on this subject.

TURKEY (*see* 27.426).—The Republic of Turkey is bounded in Europe by Greece and Bulgaria, and in Asia by Syria, 'Iraq, Persia and the Union of Socialist Soviet Republics. The member of the Union which adjoins Turkey is the Transcaucasian Federal Republic, or more accurately two of its constituent States, namely the Republics of Erivan and Georgia. Inside the Republic of Georgia the port of Batum, together with that small part of the Turkish territory ceded to Russia in 1878 which has not been restored to Turkey by the Russo-Turkish Treaty signed at Moscow on March 16 1921, constitutes the autonomous republic of Ajaria, the population of which consists for the most part of Moslem Georgians.

The frontier which was last settled was that between Turkey and 'Iraq. Here the Council of the League of Nations had decided upon a certain line, but it was not until June 1926 that Great Britain and Turkey came to an agreement about it (*see* MOSUL). The present boundaries of Turkey practically coincide with those claimed in the Turkish National Pact of Jan. 28 1920 (*see* below), except that no plebiscite has been taken in Western Thrace, that the Batum district remains outside Turkey, and that most of the Mosul vilayet has now been assigned to 'Iraq. Whereas the former Ottoman Empire contained a number of autonomous territories, there is no territory within the present limits of Turkey which is not under the direct political control of the Government at Angora. The contingent autonomy provided for Northern Kurdistan under the Treaty of Sèvres was not reproduced in the Treaty of Lausanne (Aug. 6 1924). Comparing the territorial extent of Turkey in 1926 with that of the Ottoman Empire in 1911, it will be seen that the losses have been substantial in two quarters. Turkey has lost her Arab provinces in Asia and Africa, together with her suzerainty over Egypt, and she has also lost her provinces in the Balkan Peninsula west of the River Maritsa, in which the Turkish element was in a minority. The core of the Empire, including the former capital, Constantinople, as well as Eastern Thrace and Anatolia, is intact. The area of the Republic is estimated at 494,450 sq. miles.

Population.—Under this head it is practically impossible to give even approximate statistics, owing to the succession of wars and forced migrations since 1911. Pending a census, the population of Turkey within her present frontiers at the present time may be conjectured to be between six and eight millions, though Turkish authorities give a much higher estimate.

As regards towns, Constantinople, while ceasing to be the political capital, has somewhat increased in population. Smyrna has decreased, owing to the exodus of the Greek and Armenian minorities, but has retained her commercial position, which depends on her geographical situation. Next to these two cities, Samsun and Adana would appear to have the greatest future. Angora, the present political capital, is a small town, and is unlikely to increase in population very rapidly, as it has no commercial or other economic advantages.

As contrasted with the former Ottoman Empire, the present Turkish Republic displays a relative homogeneity of population, owing to the exodus of Greeks and Armenians from Anatolia and Eastern Thrace and the immigration of Moslem elements from the lost territories in Europe, particularly from those which have passed under Greek sovereignty. The change is most marked in the Smyrna district and in Eastern Thrace, in both of which the Turkish element is now greatly preponderant. The only area in which the population still displays that extreme variety which was characteristic of the former Ottoman Empire is the urban district of Constantinople, from which non-Turkish Ottoman citizens legally domiciled there since Oct. 30 1918 have not been compelled to migrate. Apart from these non-Turkish elements in Constantinople and the Lazes (Moslem Georgians) in the northeast corner of Turkey in Asia, the present population of Turkey consists entirely of Turks and Kurds (*see* KURDISTAN). It is also to be noted that with the minorities there has disappeared that non-territorial system of communal autonomy known as the Millet system.

I. HISTORY AND EXTERNAL RELATIONS

In reviewing the history of Turkey since 1910 it is important to bear in mind that from the Italian declaration of war in Sept. 1911, to the signature of the Mudaniya Armistice in Nov. 1922, Turkey was almost continuously at war. The military events of this series of wars are recorded in separate articles (*see* ITALO-

TURKISH WAR; BALKAN WARS; WORLD WAR) and the present article is confined to political and social history. In order, therefore, to see this in perspective, it must be remembered that during the period under review Turkey has hardly been at peace, and that she has lost half her territory, besides transforming her internal organisation from top to bottom. The main features of the period have been this continual state of war and the revolutionary process of westernisation which has accompanied it and has been closely related to it. The relation can be seen in such examples as the emancipation of women, a movement which was greatly accelerated by the necessity which arose during the World War, in Turkey as elsewhere, to extend the field of employment for women in order to release men for military service.

The Ottoman Empire as it existed in 1911 still reflected the Ottoman Empire as it had been at its zenith. There was still a Sultan at Constantinople, who was recognised as Caliph of Islam by a large part of the Sunni Moslem world (including Sunnis as far afield as Russian Central Asia and British India), and this Sultan-Caliph was still guardian both de facto and de jure of the Holy Cities in the Hejāz (*q.v.*). Thus, although he had been reduced to virtual political impotence by the revolution of 1908, he was still an imposing figure, and the territories over which the Ottoman Govt. directly ruled extended to the east coast of the Adriatic opposite the heel of Italy in Albania; to the head of the Persian Gulf at the mouth of the Shatt al 'Aarb; to the southwest corner of Arabia in the Yemen, adjoining the British Protectorate in the hinterland of Aden; and to the provinces of Tripoli and Benghazi in North Africa. The Sultan also retained over Egypt a suzerainty, which was valid in international law though vague in its scope and not very effective in its application.

The Balkan Wars.—The first blow which the Ottoman Empire suffered during this period was the declaration of war by Italy in Sept. 1911. The Italo-Turkish War resulted in the loss of the North African provinces and in an Italian occupation of the Dodekanese group of islands off the southwest coast of Anatolia. On the other hand, considering how remote these African provinces were from the centre of Turkish power, and also the fact that Italy commanded the sea, the Turks put up a surprisingly good resistance to the Italian invasion. They persuaded the native population of Tripoli and Benghazi to make common cause with them, and took full advantage of the difficulties of the *terrain* and the climate. The course of this war showed that under such conditions the military advantages might not be wholly on the side of the more highly organised army, and this discovery, which was made by Enver Bey in 1911 and 1912, was afterwards applied by Mustafa Kemal Bey in 1919–22, when he successfully defended the Turkish homelands in Anatolia against the invasion of a Greek Army organised and munitioned by the Western Powers.

The Balkan Wars resulted in the loss of almost all the islands still remaining under Turkish sovereignty in the Aegean Sea and of the whole of Turkey in Europe up to the Chatalja lines. But Constantinople was saved from falling into Bulgarian hands, and when the Balkan Allies fell out among themselves, Eastern Thrace, including Adrianople, was recovered. The European frontier obtained by Turkey in 1913 was retained at the end of the period under review.

The Baghdad Railway.—After these losses of territory in Africa and Europe during the years 1911–3, the centre of political contention shifted to Turkey in Asia. Here the situation had been dominated by the disagreement between Great Britain and Germany over the Baghdad Railway, and by the lesser disagreement between France and Germany over the respective railway spheres of the two Powers in Northern Syria. During the year 1914 both these controversies were settled. On Feb. 15 a secret Franco-German agreement was signed, under which France gave Germany a free hand to carry forward the Baghdad enterprise in return for German recognition of French railway rights in Syria and Northeastern Anatolia. In June 1914 a more important and very comprehensive Anglo-German draft convention was initialled in London by Sir Edward Grey and Prince Lichnowsky, as a culmination to a number of separate agreements, between the private British and German enterprises concerned, regarding river traffic on the Tigris, port construction at Baghdad, the exploitation of oil in Mesopotamia and the extension of the British Aidin Railway in Western Anatolia. Under the main agreement between the governments, Great Britain withdrew her opposition to the Baghdad Railway project, while Germany renounced the extension of the line beyond Basra to the coast of the Persian Gulf unless and until she obtained the consent of the British Government.

The World War.—These agreements between the Powers relating to Turkey in Asia, which seemed at the time to lessen the danger of a new European war over the Middle East, were thrown into the melting-pot by the outbreak of the War of 1914 and Turkey's intervention in it in the autumn of that year (*see* MESOPOTAMIA, OPERATIONS IN; PALESTINE, OPERATIONS IN; and DARDANELLES CAMPAIGN). It remains here to consider the motives of her intervention and its political consequences.

The Turkish Govt. had invited the German General Liman von Sanders to reorganise the Turkish Army immediately after the Balkan Wars, and he was appointed Commander of the First Turkish Army Corps, with Enver Pasha as his Chief of Staff, in Dec. 1913. According to the memoirs published under the name of Kemal Pasha (who with Enver and Talaat formed the triumvirate which governed Turkey during the World War) the Turco-German Alliance, binding Turkey to intervene in any general war in which Germany might be involved, had already been concluded before the War broke out. Whether or not Turkey did find her hands tied in Aug. 1914, she had powerful motives for intervention which sufficiently account for the course which she actually took. Her strongest motive was the temptation to fish in troubled waters. She had recently suffered great territorial losses. Now that the whole world was in the melting-pot might she not recover something for herself, Egypt for example? A more rational motive was the feeling that Russia was Turkey's mortal enemy, and that therefore Turkey ought to do everything in her power to prevent Russia from emerging victorious over the Central Powers. Turkish public opinion was also irritated by the commandeering of two warships which were on the point of completion in British dockyards. Her intervention was clinched by the arrival of the "Goeben" and "Breslau" at the Dardanelles. Germany promptly sold these vessels to Turkey to replace those which Great Britain had commandeered. The officers and crews were transferred to the Turkish service, and they forced the issue by shelling Russian Black Sea ports on Oct. 28.

The World War produced two general effects, one of which was favourable to Turkey and the other unfavourable. The first was the Russian Revolution of 1917, as a result of which the Tsardom in alliance with the Western Powers was replaced by the Soviet Govt., which soon came into open hostility with Russia's former allies. Thus, the country which had formerly been Turkey's most dangerous enemy was transformed into an opponent of Turkey's other enemies and therefore into Turkey's potential ally. The unfavourable factor was the Arab national movement, which was supported politically and militarily by Great Britain, with the result that Turkey lost all her Arab provinces in Asia. Meanwhile the partition of Asiatic Turkey, partly in favour of independent or semi-independent Arab States, but chiefly in favour of the Allied Powers, had been provided for under the so-called Secret Treaties (*see* EUROPE, *History*, pt. iii.) between Great Britain, France, Russia and Italy. In consequence of the Russian Revolution of 1917, the Russian claim to Constantinople, the Straits and Northeastern Anatolia was renounced. On the other hand, Greece had become a member of the Entente before the War ended. She participated in the occupation of the Straits which was carried out under the Armistice of Mudros (Oct. 30 1918), and at the Paris Peace Conference M. Veniselos put forward claims to Eastern Thrace and to the vilayet of Smyrna.

At the Peace Conference of Paris the representatives of the Principal Allied and Associated Powers failed to deal with Turkey, partly because they were pre-occupied with questions

Map showing the several partitions of the Ottoman Empire from 1908 to 26.

concerning Germany and her European allies, and partly because they were by this time in acute disagreement over the Turkish settlement, and therefore shrank from raising such a contentious issue. Meanwhile, though they were in effective naval occupation of the Straits, and in effective military occupation of the Arab provinces up to and beyond the Armistice line of Oct. 30 1918, their control was precarious in the Turkish homelands of Anatolia and Eastern Thrace. Moreover, both the Allied soldiers serving in the East and the Allied taxpayers at home were pressing their Governments to reduce as rapidly and as drastically as possible their post-War military establishments in this remote part of the world.

The Smyrna Episode.—In view of all this the Supreme Council of the Allies sought to maintain their military control over Turkey, pending the eventual settlement, by inviting Greece to land a military force at Smyrna. The landing took place on May 15 1919, under the protection of English, French and American warships. The immediate motive for landing Greek troops at this point and at this date arose from the fact that Italy had temporarily withdrawn from the Peace Conference on account of the Adriatic controversy, and that Italian troops had then landed at Adalia (Antaliya) on April 29. Both Adalia and Smyrna had been assigned to Italy in April 1917, under the secret agreement of St. Jean de Maurienne; and though this agreement was technically invalid, Italy had a certain moral claim to secure the benefits of it, and seemed inclined to make this claim good by independent action. The Greek landing had the very opposite effect to that which the statesmen responsible for it had intended. It was accompanied by atrocities, and it aroused an intense wave of national feeling in the Turkish people. The Mudros Armistice had left the Turks exhausted after seven years of war, and disillusioned with their former leaders. The triumvirate, representing the Committee of Union and Progress, which had made the revolution of 1908 and had recovered Adrianople after the Balkan Wars, had been compelled to flee the country, and their countrymen had been prepared to lose all their remaining non-Turkish provinces and even to accept the protectorate or mandate of the United States or Great Britain.

The Greek landing produced a revulsion of feeling and a revival of energy and the opportunity was seized by a new leader, Mustafa Kemal Pasha (*q.v.*), who had recently been sent by the Constantinople Govt. with the approval of the Allied authorities to Eastern Anatolia as Inspector General of the Forces. Under Mustafa Kemal's leadership a Turkish National Congress met at Erzerum in July and at Sivas in Sept., and the resistance of the local Turkish population to the Greek advance took on a national character. In Oct. Damad Ferid Pasha's ministry, which was favourable to the Allies, was replaced by one sympathetic to the Nationalists. A general election was held, the country returned a new Chamber which was overwhelmingly

Nationalist, and on Jan. 28 1920, during the session of this Parliament in Constantinople, a number of Deputies signed the so-called National Pact, which immediately became the creed of the national movement.

The National Pact.—In this document the Nationalists accepted the loss of the Arab provinces south of the Armistice Line of Oct. 30 1918; agreed to the opening of the Straits to international commerce; and proposed to grant to non-Turkish minorities the same rights as were secured to minorities in Europe under the various post-War treaties. On the other hand, the Pact demanded, either explicitly or implicitly, that Turkey should retain all territories inhabited by non-Arab Ottoman Moslem majorities, which meant not only Anatolia but Eastern Thrace and the Mosul vilayet; that Constantinople should be given military security; that the Millet system and the Capitulations should be abolished; and that there should be a reasonable settlement of financial questions.

The Allies and the Constantinople Govt. first attempted to overcome this movement by force. On March 16 1920, the Allies occupied the city of Constantinople, arrested a number of prominent Turks and deported them to Malta. In April the Sultan dissolved Parliament, and caused the Nationalists to be denounced by the religious and secular authorities of his Government. The only result was that such military control as the Allies had hitherto exercised in the interior was forfeited, and that the fugitive deputies from Constantinople reassembled at Angora, constituted themselves a National Assembly, and promulgated a law of fundamental organisation, in which they declared themselves to be the sole representatives of the Turkish national will. This seems to have been followed by the first overtures between Nationalist Turkey and Soviet Russia.

Treaty of Sèvres.—Meanwhile the terms of a Turkish settlement had at last been worked out by the Allied Powers at the San Remo Conference (*q.v.*); in May the draft terms were presented to a delegation of the Constantinople Govt., whose observations upon them were ignored; and on Aug. 10 a Peace Treaty was signed at Sèvres as well as a tripartite agreement between Great Britain, France and Italy, which gave partial effect to the secret treaties by laying out a French and an Italian sphere of influence in parts of those Anatolian territories which under the Peace Treaty were to be left under Turkish sovereignty. Eastern Thrace, almost up to the Chatalja lines and including the Gallipoli Peninsula, was assigned to Greece outright, and Greece was also given the administration of a zone round Smyrna (somewhat smaller than the territory of which she was then in military occupation), subject to a plebiscite at the end of five years.

These diplomatic instruments were a dead letter from the beginning. The Sèvres Peace Treaty had been signed by the Constantinople Govt., but meanwhile the whole of Turkey beyond the limits of Greek and Allied occupation had passed into the Nationalists' hands. When the Nationalist forces had begun to press upon the French in Cilicia and the British at Izmid, in the Asiatic hinterland of Constantinople, the Allies had accepted a proposal by M. Veniselos for a Greek offensive. This offensive had been executed successfully in June and July with British naval support, but though it brought the whole of Eastern Thrace and large additional districts of Anatolia under Greek occupation, it did not break either the military or the political strength of the Turkish Nationalists. In the autumn of 1920 the Nationalists attacked the Armenian Republic of Erivan, and at the same time the Bolsheviks produced a revolution there which resulted in the substitution for the previous Menshevik Govt. of a local Bolshevik Govt., which brought Erivan into the Soviet Union. These events in the Caucasus, together with the expulsion of General Wrangel from the Crimea, enabled Soviet Russia and Nationalist Turkey to join hands effectively against their common enemies, the Entente Powers. By arrangement with the Bolsheviks, the Turks compelled Erivan to cede about half her territory, including the fortress of Kars, which the Tsardom had taken from Turkey in 1878. The Nationalists' position was further improved by the defeat of M. Veniselos in the Greek elections of Nov., and by the plebiscite recalling King Constantine, who was not *persona grata* with the Allied Powers.

In the London Conference of Feb.–March 1921 (*q.v.*) the Nationalists successfully insisted on being represented in addition to the Constantinople Government. The Conference was abortive, but the Allied Powers recognised in principle that the Treaty of Sèvres would have to be revised, and the French and Italian delegations negotiated secret understandings with the Nationalist representatives. These understandings were repudiated by Angora as being not sufficiently favourable to Turkey. Nevertheless they marked a definite breach in the diplomatic unity of the Allies which was never completely healed, and the French Govt.'s change of front had important consequences. The French Govt. was influenced by several motives: the difficulty of persuading the French people to provide the men and money for the arduous campaign which the Turkish Nationalists had forced upon France in Cilicia; the increasing jealousy felt by France towards Great Britain, whose naval preponderance gave her the leading rôle in the joint occupation of the Straits and Constantinople; and the French hatred of King Constantine, whose return finally alienated French sympathies from Greece. France now looked upon Greece as a country governed by an ex-enemy monarch and a country which promised to be a useful satellite to the principal rival of France in the Levant. Meanwhile Yusuf Kemal Bey, the Foreign Minister of the Angora Govt., had gone to Moscow and had there negotiated two important treaties, one with Afghanistan on March 1, and the other with Soviet Russia on March 16 1921. The latter treaty was followed by a supplementary treaty with the three Caucasian Soviet Republics, signed at Kars on Oct. 13, and a treaty with the Ukraine, signed on Jan. 2 1922.

The Greco-Turkish War.—The failure of the London Conference had led to a renewal of fighting in Anatolia. This campaign proved to be the turning point of the war. At the battle of In Önü in April the Greeks met with their first serious check at the Nationalists' hands. At the battle of the Saqariya in Aug. and Sept. their supreme effort to capture Angora and break the Turkish Nationalist resistance failed when it seemed within an ace of success. The Allies had already washed their hands of the affair. On May 18 the Allied High Commissioners at Constantinople announced the neutrality of their governments, and designated four neutral zones, one on each shore of the Bosporus and the Dardanelles, upon which the belligerents were not to trespass. On Aug. 10 the Supreme War Council of the Allies pronounced that Greece and the Turkish Nationalists were engaged in a private war, and proclaimed the neutrality of France, Great Britain, Italy and Japan in formal terms. At the same time, France once more took separate action. In the autumn of 1921 M. Franklin Bouillon went to Angora, nominally on private business, and there negotiated an agreement (signed on Oct. 20), between France and the Turkish Nationalist Govt., under which France recognised that Government, evacuated her remaining holdings in Cilicia, and retroceded to Turkey a strip of territory, including the easternmost section of the Baghdad Railway, along northern border of the French mandated territory of Syria. The publication of this agreement was followed by an acrimonious correspondence between the French and British governments, but the agreement stood.

On March 22 1922 the Foreign Ministers of Great Britain, France and Italy met in Paris with the hope of persuading the governments of Athens and Angora to accept an armistice pending an agreed revision of the Sèvres Treaty. These proposals broke down on account of the Angora Govt.'s insistence that the Greeks should evacuate Anatolia as a preliminary to negotiations, and as the summer advanced the Greeks showed symptoms of desperation. On July 27, after strengthening their forces opposite the Chatalja lines, the Greek Govt. demanded permission from the Allies to occupy Constantinople. The Allies refused, and Greece accepted their decision. On July 30, again, M. Sterghiadis, the Greek High Commissioner at Smyrna, proclaimed the autonomy of the Anatolian territory under Greek occupation, with the apparent intention of continuing the

Anatolian War in the guise of a local Greek national movement, in case the Greek Govt. were compelled by diplomatic pressure to renounce their Anatolian claims. The Turkish Nationalists, however, who had also been hard hit by the life and death struggle of the preceding year, were in little better condition than the Greeks for opening another campaign, and at the beginning of Aug. 1922 Fethi Bey, the Minister of the Interior in the Angora Govt., arrived in London with conciliatory proposals for the neutralisation of the Straits under the control of the League of Nations. Fethi Bey failed to obtain an audience with any member of the British Cabinet, and on Aug. 4 (the last day of the parliamentary session) Mr. Lloyd George made a speech in the House of Commons in which such high praise was bestowed upon the military prowess of the Greeks that the speech was subsequently quoted by the Greek High Command in an order of the day. After staying for about three weeks in London without result, Fethi Bey left for Rome. It is reported that, before doing so, he telegraphed to Angora the advice to attack.

The Turkish offensive was launched on Aug. 26. The Greek army suffered a debacle. The Turkish army entered Smyrna on Sept. 9, and this dramatic decision of the Greco-Turkish War was accompanied by the wholesale exodus of the Greek and Armenian minorities from the re-conquered territory and by the Great Fire of Smyrna, which began on Sept. 13—two tragedies which might have been avoided if Western diplomacy had shown greater vision during the previous four years.

The Turkish victory over the Greeks had an immediate effect upon the military position of the Allies. With the Greek debacle, the screen of Greek troops which the Greek offensive of 1920 had interposed between the Turkish Nationalist forces and the Allied detachments on the Asiatic shores of the Straits, disappeared, and the Allied Govts. were faced with the necessity of making up their minds immediately on two points, first, whether they should oppose by force of arms any violation by the Turks of those neutral zones which the high commissioners had proclaimed on May 18 1921, and secondly, whether they should resist or accept the Turkish peace-terms as embodied in the National Pact. On the former question the British Govt. took the initiative, and secured diplomatic assurances of solidarity from France; but on Sept. 16 the British Govt. communicated to the Press a manifesto announcing that the British Dominions, Yugoslavia and Rumania, had been asked by telegram to promise military support, if necessary, for maintaining the freedom of the Straits. This manifesto not only threatened the Turks with military action at the line of the Dardanelles, but contained no reference to the Nationalists' territorial demands on the European side of the Dardanelles, in Eastern Thrace.

It thus offered the Nationalists an incentive for attacking the Allied detachments which were stationed at Chanaq, on the Asiatic side of the Narrows, before the reinforcements asked for could arrive. The consequence was that on Sept. 18 1922 the French Govt. ordered the withdrawal of the French troops from Chanaq within 24 hours. The Italian Govt. did the same, and thus, in face of the victorious Turkish Nationalists, the common diplomatic front of the Allies was utterly broken. Unity was restored by the exertions of Lord Curzon, who went to Paris on Sept. 19 and reached an agreement on Sept. 23 with M. Poincaré, under which both Powers accepted the British view regarding the temporary question of the neutral zones and the French view regarding the definitive peace terms. On the same day, in accordance with this agreement, the Principal Allied Powers invited the Angora Govt. to a Peace Conference on two bases: that Turkish sovereignty should be restored in Thrace up to the River Maritsa, and that during the interim period, pending the negotiation and entry into force of the Peace Treaty, the inviolability of the neutral zones should be maintained and the Turkish Army should be excluded from Thrace.

On the same date Turkish cavalry entered the neutral zone on the Anatolian side of the Dardanelles, and advanced almost up to the British wire at Chanaq. British troops in isolation were thus brought into direct contact with Turkish troops, and during the next few days the situation was so dangerous that hostilities would almost certainly have broken out but for the tact and courage of General Harington, the British Commander-in-Chief of the Allied Forces in the Constantinople area, and his representatives on the spot. Meanwhile the Allied invitation of Sept. 23, which satisfied the Turkish demands on the vital point of the territorial settlement in Europe, eased the tension. On Sept. 29 the Angora Govt. accepted the invitation and suggested a preliminary armistice conference. This conference opened at Mudaniya on Oct. 3 and, in spite of a succession of crises, an armistice was signed on the 11th by representatives of Angora and the Principal Allies Powers, to which Greece acceded on the 14th. This opened the way to a Peace Conference, which began at Lausanne on Nov. 20 1922, and resulted eventually in the signature of a Peace Treaty at the same place on July 24 1923. The Treaty of Lausanne came into force on Aug. 6 1924 (*see* LAUSANNE, TREATY OF).

The Nationalist Govt.—The issue of the invitations to the Lausanne Conference on Oct. 27 1922 by the Principal Allied Powers was the immediate occasion for the liquidation of the Ottoman Govt. of Constantinople. An invitation had been sent to the Sublime Porte as well as to Angora, but Rafet Pasha, who had arrived in Constantinople on the 19th as Governor of Eastern Thrace on behalf of the Angora Govt., compelled the Porte to withdraw its acceptance of the invitation. On Oct. 30 the National Assembly passed resolutions against the Sultan-Caliph. On Nov. 1 it declared itself sovereign of Turkey, abolished the sultanate and the Ottoman Empire, voided all official acts of the Sublime Porte since March 16 1920, and assumed the right to elect future caliphs itself from among the members of the house of Osman. On Nov. 4 Rafet Pasha carried out a coup d'état at Constantinople; the Sultan's Govt. resigned; and therewith there disappeared a dynasty and an empire which had existed since the close of the 13th Christian century and had ruled from Constantinople since A.D. 1453. For the first time in its history Constantinople found itself not the capital city of the State to which it belonged. Constantinople was evacuated by the Allied forces and occupied by the Turkish Nationalist forces in Oct. 1923, after the coming into force of the Lausanne Treaty.

Like most revolutionary governments that have passed through trial to triumph, the Turkish Nationalists were bitter, not only against those of their countrymen who had taken the opposite side, but even against those who had been neutral or lukewarm during the critical years when the existence of the Turkish nation had been at stake. The first to suffer was the ex-Sultan-Caliph, Mehmed Vahyded-Din Efendi. On Nov. 17 he secretly made his way on board H.M.S. "Malaya," which conveyed him to Malta, and the Caliphate (shorn of all but its "spiritual" functions) was offered to and accepted by 'Abdul-Mejid Efendi, the cousin of Mehmed Efendi and the second son of the late Sultan 'Abdul-'Aziz, who throughout the crisis had openly displayed his sympathy with the Nationalist cause. In addition to the ex-Sultan several other prominent opponents of the Nationalists, such as Damad Ferid Pasha and Riza Tewfik Bey, the philosopher, fled the country either before or at the time of the Nationalist victory. Others, including the surviving leaders of the Committee of Union and Progress, remained in discreet retirement.

A year later, the "counter-revolutionary" military courts, which the Turkish Nationalists had copied from the Bolsheviks during the time of crisis, were called back into activity by an incident of which the innocent causes were the Aga Khan and the Ameer Ali, the two distinguished leaders of the moderate element among the Moslem community in India. These gentlemen, who, from the Armistice onwards, had persevered in the rather ungrateful task of championing the Turkish Nationalist cause in Great Britain, and who had publicly based their claim to a voice on this subject upon the attachment of the Indian Moslem community to the Ottoman Caliphate, became alarmed during 1923 at the growing rumours of an intention, on the Angora Govt.'s part, to sweep away the Caliphate altogether, even in its attenuated form. They had

therefore addressed to the Angora Govt. a courteous letter explaining the Indian Moslem point of view, but they had sent copies of this letter simultaneously to certain reputable opposition journals at Constantinople, and the text had been published in their columns before it reached the hands of the Angora Foreign Office. The result was that summary proceedings were taken against the offending editors and that there was an open breach between the Turkish Nationalists and the leaders of the Indian Moslems (*see* CALIPHATE).

Relations with Russia.—It remains to follow the relations between Angora and Moscow. The overwhelming victory of 1922, which had brought the principal Allied Powers, as well as the Greeks, to their knees, released the Turkish Nationalists from their dependence on Russian support, and during the Lausanne Conference there was a significant divergence in the policy of the two Powers regarding the question of the Straits. Turkey and Russia had only been brought together by the pressure of their common struggle for life and death against the Entente Powers. When once this pressure was relaxed, their underlying difference of interest, which was founded on permanent facts of geography, began to reassert itself. Moreover, the doctrines of Communism and the new proletarian culture which the Bolsheviks were attempting to build up in Russia on that doctrinal basis had no attraction for the Turks, for Turks of all parties were under the glamour of Western civilisation in its French form, and the general aim of the Nationalists was to transform Turkey into a secularised bourgeois republic in the image of France herself. Thus, from 1923 onwards, there was a tendency for the friendship between Turkey and Soviet Russia to cool off, but this was counteracted to some extent by the continuance of controversies between Turkey and the Western Powers, and particularly by the Anglo-Turkish controversy over Mosul. The Soviet Govt. did not neglect the opportunity given to it by the decision adverse to Turkey which was rendered on the Mosul question by the Council of the League of Nations on Dec. 16 1925. On Dec. 17 1925, a new treaty was concluded between Turkey and Soviet Russia, in which either party promised the other its friendly neutrality in the event of diplomatic or military complications with a third party.

II. CONSTITUTION AND ADMINISTRATION

Under the Constitution of April 20 1924, the Turkish State is a Republic, the State religion is Islam, the official language is Turkish, the seat of government is Angora, sovereignty belongs without restriction to the nation, and the Great National Assembly is the sole lawful representative of the nation and exercises sovereignty in its name (Articles 1–4). No proposal to alter or amend Article 1, specifying that the form of government is a republic, is to be entertained (Article 102).

This constitution is as different from the autocracy of 'Abdul-Hamid, and even from the constitutional monarchy of 1908–20, as the international position of the Turkish Republic is from that of the former Ottoman Empire. The internal revolution, however, has been a by-product of the Nationalists' struggle for independence against Greece and the Principal Allied Powers. In the National Pact there was nothing incompatible with the Constitutions of 1876 and 1908. It was the hostility of Sultan Mehmed VI. towards the Nationalists and his complacency towards the Allies which led the Nationalists at Angora to carry out an internal revolution contemporaneously with their struggle against foreign enemies. In the organic law of April 23 1920, the Great National Assembly constituted a Provisional Govt. at Angora; and the liquidation of the Sublime Porte in Nov. 1922 described above, left the Angora Govt. without a rival in Turkey, in fact as well as in pretension. Nearly a year elapsed before the formal declaration of the Turkish Republic was made on Oct. 29 1923, when the office of President of the Republic was also created and was conferred upon Mustafa Kemal Pasha. Down to this point the Government still retained a theocratic element, since the Caliphate had not been abolished, though the appointment had been placed within the patronage of the National Assembly and the office had been shorn of its political powers. The expulsion of the Caliph 'Abdul-Mejid Efendi on March 3 1924 was accompanied not only by the total abolition of the office which he had held for 15 months, but by a drastic secularisation of the Turkish State in every department. The religious courts administering the Sheri'ah, or Islamic canon law, were placed under the National Ministry of Justice; Islamic educational institutions, from the mosque schools upwards, were placed under the National Ministry of Education; the Ministry of Evkaf, or Religious Endowments, was suppressed, the immense properties which it had administered being taken over by other departments of State; and the Sheikh u'l Islam, or principal jurisconsult in Islamic law, ceased to be an *ex officio* member of the Cabinet. These general measures of secularisation have been followed by divorce reform (which in Islamic countries means making divorce more difficult and not more easy), and by a law making the wearing of brimmed hats compulsory for Turkish citizens. This question is not so trivial as it might appear, and is intimately connected with religion. Hitherto, in Islamic countries, the wearing of a headdress with a brim has been the mark of an infidel, because it makes it impossible to touch the ground with the forehead in the exercises of prayer, according to the traditional Islamic ritual.

Apart from the secularisation of the State, the most interesting feature in the present constitution of Turkey is the concentration of power in the hands of Parliament.

The Assembly.—Indeed, the Constitution of 1924 explicitly confers upon the Turkish parliament powers even more extensive than the British parliament possesses by constitutional custom. The Assembly exercises the legislative power directly (Article 6), and the executive power through the intermediary of the President of the Republic, whom it elects, and through a Cabinet chosen by him (Article 7). Even the judicial power is exercised in the name of the Assembly, though the tribunals are declared to be independent (Article 8). The Assembly itself executes the Islamic law; makes, amends, interprets and abrogates secular laws; concludes conventions and treaties of peace with other States; declares war; examines and ratifies laws drafted by the Commission on the Budget; coins money; accepts or rejects all contracts or concessions involving financial responsibility; decrees partial or general amnesty; mitigates sentences and grants pardons; expedites judicial investigations and penalties; and executes definitive sentences of capital punishment handed down by the courts.

The Assembly is elected by manhood suffrage, every citizen over 18 being entitled to vote and every citizen over 30 being eligible for election (Articles 10 and 11). There has to be a general election at least once in every four years (Article 13) and a session at least once a year, lasting not less than six months, and beginning automatically on Nov. 1 (Article 14). Not only the President of the Republic or the Prime Minister, but a quorum of one-fifth of the deputies, may call a special session during recess (Article 19). The Chamber may hold secret sessions at its discretion (Article 20). The deputies enjoy the usual parliamentary immunities. No person may be a deputy and the holder of a public office simultaneously.

The executive power of the President of the Republic, as defined in the final text of the Constitution of 1924, is considerably less than it was in the first draft; but of course the actual power of President Mustafa Kemal was something very much greater than his constitutional position. This is due partly to his personal character and career, but also to the political inexperience of the Turkish nation, which can only gradually learn to avail itself fully of those wide powers of parliamentary self-government with which it is endowed by law.

The President.—According to the Constitution, the President of the Republic is elected by the Assembly from among its members for a period equivalent to that of the parliamentary term, the holder being eligible for re-election (Article 31). During his term of office the President may not take part in the discussions of the Assembly and may not vote (Article 32). He has a 10 days' suspensive veto, but the Assembly may re-pass a law over his head by a bare majority vote, and the veto does not apply at all either to constitutional amendments or to budgetary legislation (Article 35). The President represents the National Assembly as Supreme Commander over the army (Article 40). He designates the prime minister from among the deputies, and the prime minister chooses his colleagues, also from among the deputies (Article 44). The members of the cabinet, collectively and individually, and not the president, are responsible for the Government's policy (Articles 46 and 41). There is also to be a council of state chosen by the National Assembly (Article 51).

Social Organisation.—In another section of the Constitution (Articles 53–67), a judicial organisation is laid down on the most approved Western pattern, but this is still a programme rather than a reality. Another group of articles constitutes a kind of Bill of Rights, many of the clauses being practically identical with those

contained in the Minority clauses of the Lausanne Treaty (Articles 37–45 of the Treaty).

In general it may be said that if the full terms of the Constitution are eventually put into effect, Turkey will have become a thoroughly Western state; but at present this consummation is kept at a distance by the old obstacles to Turkish reform, namely, poverty and ignorance. Although primary education has been made universally obligatory and gratuitous (Article 87 of the Constitution), the percentage of illiteracy is still so great as to make effective popular self-government a distinct ideal, and even higher education in Turkey, though it is relatively more advanced, does not turn out trained and educated individuals in sufficient numbers to provide adequate candidates for any but the highest public positions. The poverty of the country, again, precludes the payment of adequate official salaries, and this not only makes the public service unremunerative and therefore unattractive compared with those business careers to which the new generation of Turks is wisely turning its attention, but it also places at least the minor officials under a constant temptation to supplement their emoluments by illegitimate means.

Administrative Divisions.—The old Ottoman Empire was divided into vilayets, or governor-generalships, which were satrapies of the dimensions of independent countries. These unwieldy areas have now been abolished, and the name vilayet has been transferred to provinces or departments of a manageable size. This change was foreshadowed from 1908 onwards by the separation of certain sanjaks from the old vilayets and their erection into independent units in direct touch with the central government. This reform has now been made systematic and universal, and at the same time the name "sanjak" has dropped out. The new vilayets, while they correspond to the old sanjaks in size, resemble the old vilayets and the old independent sanjaks in being in direct touch with the central government, and in being incorporated as juridical persons (Constitution, Articles 89–91).

Education.—The changes in Turkish education since 1911 have mostly been negative hitherto. Before that date education in the Ottoman Empire was largely provided for by the Islamic schools of all grades, from the mosque schools in the villages up to the theological seminaries; by the private educational institutions of the non-Moslem minorities; and by foreign educational institutions which were mostly of secondary, and in a few cases of university, grade. All these institutions have suffered from the wars and revolutions of the intervening period. The Islamic schools have been brought under the control of the secular Ministry of Education, the minority schools have practically disappeared with the minorities themselves, and the foreign schools have not only been brought under closer government control, but have lost a large part of their clientèle, which was formerly provided for the most part by the non-Moslem minorities. The Turkish Nationalists do not question the high standard maintained by these foreign institutions, nor the value of the standard as an example, but they point out with some justice that they had been founded originally with certain religious or political objects which may not be compatible with the free development of Turkish nationality. The foreign schools have been placed on precisely the same legal footing as private Turkish schools. They are now subject to government inspection; the teaching of Turkish language, literature, history and geography, by Turkish teachers approved by the Ministry of Education, has been made compulsory for a stated number of hours per week, and the compulsory attendance of Moslem pupils at Christian religious exercises has been forbidden. The Catholic schools were closed for some months owing to their refusal to remove the crucifixes from their class-rooms, and there were difficulties between the American College for Women at Constantinople and the Ministry of Education over the relation of the new medical department of the college to the Medical Faculty in Constantinople University. On the whole, however, the foreign schools have now successfully surmounted the difficulties which they encountered during the first years after the Mudania Armistice, and it is encouraging to note that the falling off in the number of non-Turkish pupils is rapidly being made good by the increased attendance of Turks.

In Turkish national education the chief need is the introduction of an efficient primary system throughout the country; but although this is provided for in Article 87 of the Constitution of 1924, lack of funds and lack of trained teachers are bound to make progress very slow. On the other hand, the University of Constantinople, which was nominally founded in 1900, but not effectively organised until 1918, is showing great activity in the face of financial difficulties. The old established faculties of law and medicine have been reinforced by faculties of arts and science, and co-education has become firmly established owing to the not unnatural unwillingness of the professors to deliver their lectures twice over to the men and women students separately.

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III. DEFENCE

Army.—Art. 40 of the constitution of Turkey states that, "The supreme command of the army is vested in the moral personality of the Great National Assembly and is exercised by the President of the Republic. In time of peace the command of the military forces is entrusted to the chief of the general staff within the limits of the corresponding laws. In time of mobilisation the command of the armed forces is entrusted to a person nominated by the President at the proposition of the Council of Commissars."

The land forces of the Turkish Republic in time of peace amount to: 163 infantry battalions, 42 field, 44 mountain, 5 howitzer and 27 heavy artillery batteries; 48 cavalry squadrons, 13 machine-gun mounted companies; 29 pioneer companies, 8 transport companies, 3 radiotelegraphic companies, 1 light-projector company and 8 field hospitals.

These forces are formed in 18 infantry and 5 cavalry divisions composing the IX. army corps, distributed over 3 military inspection regions. Each of these comprises 2 to 4 army corps, and is under a chief who is the designated commander of the corresponding army on mobilisation.

An army corps is normally composed of 2 infantry divisions, 1 heavy artillery regiment of 2 to 4 batteries, 1 squadron of corps cavalry, 1 technical company, 1 transport company, 1 automobile company and 1 company for communications and liaison. The VIII. army corps has no heavy artillery.

An infantry division has 3 infantry regiments of 3 battalions and 3 machine-gun companies each, 1 artillery regiment of 2 field and 2 mountain batteries, 1 pioneer company and 1 company for communications and liaison. The first 9 divisions are numbered from 1 to 9, while the remaining 9 divisions bear different numbers, inherited from the old organisation.

A cavalry division is composed of 3 cavalry regiments of 3 squadrons, 1 machine-gun mounted company and 1 to 2 mountain batteries each. The numeration of the cavalry divisions is also inherited from the old organisation.

The distribution of these forces is as follows:—

Military Inspection Region	*Army Corps and Headquarters*
1st Angora	II. Balikesir
	III. Constantinople
	IV. Eskishehr
2nd Konia	I. Afiun Qarahisar
	V. Konia
3rd Diarbekr	VI. Toqat
	VII. Diarbekr
	VIII. Erzinjan
	IX. Sariqamish
1st Cavalry Division	Jeziret Ibn 'Omar (North of Mosul)
2nd Cavalry Division	Kirk-Kilisse (Thrace)
7th Cavalry Division	Qara Kilissa (Anatolia)
8th Cavalry Division	Van
14th Cavalry Division	Urfa (Turkish Mesopotamia)

In addition, the following other forces exist within the framework of the Army Corps:—

1. The National Guard of the Great National Assembly, consisting of 1 infantry battalion, 1 machine-gun company and 1 cavalry squadron.

2. 4 frontier commissariats of 4 battalions and 4 machine-gun companies each, in Artvin, Diarbekr, Adana and Adrianople.

3. 40 heavy batteries and technical units for the fortified places, namely: Smyrna, 8 batteries, 1 projector company and 1 pioneer company; Kars, 12 batteries, 1 pioneer company and 1 liaison company; Erzerum, 20 batteries and 1 liaison company; Chatalja, 8 batteries.

4. 16 batteries of coast artillery, at Samsun and other sea coast points.

5. 1 railway battalion, 1 pioneer and 1 liaison company.

Service in the army is obligatory. Its duration is 1½ years in the infantry and transport, 4 years for the navy and 2 years for all other arms.

The Gendarmerie represents a force of about 25–30,000 men, organised in 9 flying gendarmerie battalions and numerous companies, platoons and posts. There are also 5 mounted gendarmerie regiments, one each at Angora, Chorum, Yozghad, El 'Aziz and Erzinjan respectively. The recruiting is on a voluntary basis.

The equipment of the army is satisfactory, but it is not uniform. The rifles are of diverse types. The number of automatic rifles is only 1,200 to 1,300. The machine-guns are altogether about 800, *i.e.*, 40 for each division. The field guns are estimated to be about 600 to 650, but the reserve of shells is low. The cartridge factory in Angora is being steadily developed, but the production is insufficient.

Air Service.—The air service numbers 13 incomplete squadrons of 8 aeroplanes each, 2 schools for aviation (land and naval) in Smyrna. The instructors are French officers. The air units are concentrated in Smyrna, where there are 7 hangars for aeroplanes; others are being planned for construction at Afiun Qarahisar, Mersina, Constantinople and Erzerum. A workshop for repairs exists also in Smyrna. The organisation of the meteorological service is not completed as yet and is to include 24 meteorological stations. The service will have the assistance of the existing radiotelegraphic stations and those under construction in Constantinople, Smyrna, Qastamuni, Gallipoli, Sivas, Angora, Eskishehr and Konia. Much attention is being given to the development of the air forces by the authorities and the public alike, who are raising donations and subscriptions for this end. The air services for postal and passenger service are only in embryo; it is served by aeroplanes of the German Junkers make.

Navy.—The naval forces are in an unsatisfactory condition. By the end of the World War the fleet numbered about 20 units, thanks to the German battle cruiser "Goeben" (which passed to Turkey in 1914) and some torpedo boats. By the Sèvres Treaty, only about 10 unimportant units were left to Turkey. By the Lausanne Treaty, however, Turkey got back the remnants of her fleet and moreover the liberty for further armaments. Turkey intends to entrust to a Japanese mission the development of her fleet, within the limits and necessities of a mobile defence to supplement the coast defence. To this end it is intended to repair and arm anew the cruisers Goeben, Hamidiye, seven gun-boats, two submarines and three torpedo boats. Further, within a period of 8 years, the construction is intended of 2 battleships, 2 cruisers of 10,000 tons each, 2 cruisers of 7,500 tons each, 4 destroyers, 12 torpedo boats (of 800 to 1,000 tons each), 4 submarines up to 1,200 tons each and 6 mine-layers. A sea dock is planned for construction at Izmid, where an inlet of the sea of Marmora has the shape of an easily defensible fjord. Two more naval aviation schools are planned (besides that in Smyrna); one in Constantinople and another in Trebizond, and 4 hydroplane stations. In the present situation the fleet can be used only for a defensive purpose, owing to its numerical and technical weakness and to the coastline of nearly 4,000 kilometres that has to be defended, especially the Aegean coast line where the opposite islands are in the hands of foreign states; but in the Black Sea it might to some extent take the offensive.

The mercantile fleet is developing rapidly in consequence of the provision in the Lausanne Treaty that the coastal and port services, as well as the fishing, are an exclusive privilege to the Turkish national flag, though exceptions have been made in the case of certain well-known lines. The steamship company "Seiri-Sefain" alone possesses a fleet of 60 units.

The New Turkey.—Sport and scout organisations are much in favour now all over Turkey, and are helped by the authorities. Other facts of a general character that are important from a military point of view are the reforms of Mustafa Kemal, which aim at the rousing of national pride and feeling by abolishing obsolete religious and political prejudices and introducing up-to-date methods. Moreover, the emigration and expulsion of the ethnical minorities have given a homogeneous basis to the State, and in this respect only the Kurds in the regions of the Mosul frontier remain as a source of disquiet for the Turks. The pervading conception seems to be that Asia Minor is the natural stronghold for Turkey, whose mission is rather in Asia in general, and that Thrace is only an advanced defence of the vulnerable points of approach of the Straits, in the same sense as Calais was one for England.

In the coming awakening of the Asiatic peoples, Asia Minor will probably have a paramount military importance at the meeting of the ways between East and West, and North and South, and as a reservoir of forces and a place d'armes for offensive action in any direction. The success in this rôle will be, of course, in correlation with the degree of modernisation of the railways and other means of communication, with the creation of industry and all other kinds of economic development on which military operations largely depend. All this is to a large extent lacking for the moment, although efforts are being made in that direction.

Topography.—From a topographical point of view, the salient feature of Asiatic Turkey is that it is a plateau, surrounded on three sides by the sea and by high ranges of mountains. This creates a double line of defence, one on the sea coast and another on the mountain ranges, especially on the northern and southern coast. The western coast, with its parallel valleys between the sea and the range of the inland plateau, is the more accessible one. On the east the plateau is guarded by the high Armenian mountains, extending far towards Persia and the Caucasus. In a general way and in the present situation as above described, Turkey is more advantageously situated for defensive rather than for offensive war.

Possible Theatres of War

1. *Northeastern Theatre.*—Against an enemy coming from the Caucasus and the Black Sea, the defence of Turkey is highly favoured by the mountainous character of the territory. There are four roads from Russia to Turkey. The one is along the coast, from Batum (terminus of the railway from Tiflis) to Trebizond. It passes between the coast and the mountain range of Lazistan and is not easy for movements. If the Turkish fleet is able to guard the coast, and on condition that some places are mined and Trebizond and Platana (Pulatkhane) are fortified according to their respective value, this route might be defended successfully with small forces. The second road is from Batum and Olti along the valley of the river Chorokh in the direction of Baiburt. The importance of this route consists in the possibility of turning the eventual positions along the line Kars-Erzerum-Erzinjan and of cutting the communication between Trebizond and Erzerum. The defects, however, are that not more than one or two army corps could move and act in this direction. The most important is the third route, the old classical road from Alexandretta on the Mediterranean to Tiflis and the basin of the Caspian Sea. At Erzerum it is crossed by the other classical road from Tehran to Trebizond. The railways Tiflis-Alexandropol-Kars-Erzerum, Tabriz-Nakhichevan-Alexandropol and the branch line Nakhichevan-Bayazid-Alashkerd are highly important in this respect and make possible military action on an extensive scale.

This zone contains some important centres, comparatively good roads and the possibility of movement of large forces on a wide front. The defence is favoured further by the fact that both Kars and Erzerum are successive fortresses, enabling the Command to pin the enemy until the decisive blow is delivered at his weak point. The railway in project, Angora-Qaisari-Sivas-Erzinjan-Erzerum, will be an important addition to the defence when constructed. The fourth route, giving access to Armenia and Kurdistan, runs from Erivan through Bayazid, and through the valley of the Murad-Tchai (upper course of the Euphrates) arrives at Melazkerd, from where there are roads for Erzerum, Bitlis, Diarbekr and Kharput. If the positions at Melasgerd and Rehova-Getchidi (North of Bitlis) are fortified, they might serve as a fortified camp for securing the flank. Once an enemy has succeeded in overcoming all the defences in the mountainous country of Armenia and Lazistan, and has reached the plateau of Asia Minor, he will have gained full liberty of movement towards Constantinople, encountering serious defence lines only at the rivers Yeshil Irmaq and Qizil Irmaq. Such an advance, however, will possibly imply the detaching of large forces towards Diarbekr, for guarding the approach from the direction of Mesopotamia, and towards Gazi-'Aintab, for guarding the approach from the direction of Syria.

Against an enemy from the Black Sea, Asia Minor has the advantage as already mentioned, of its double line of defence—the sea coast and the range of the plateau (the same being on the side of the Mediterranean), a first defence being offered on the sea coast and the decisive one on the range of the plateau. If the network of railway lines is completed, this will give the defence high possibilities for manoeuvre. Landings on a large scale could not be expected, therefore, on the Black Sea coast. Small landing operations, however, are possible in connection with an advance from east to west. Even these, owing to the lack of roads for the interior of the country, are possible only at Trebizond, Kiresün, Ordu, Samsun, Sinob, Ineboli, Amasra and Erégli. On the coast between Sinob and Constantinople there is only one high road for the interior of the country, *i.e.*, Ineboli-Qastamuni-Kanghri-Angora.

2. *Thracian Theatre.*—Owing to the demilitarised zones along the frontiers with Greece and Bulgaria and on the Straits (Bosporus and Dardanelles), the defence of Thrace is important in the sense of a tête-de-pont, serving for the defence of Asia Minor itself, along the important water line Bosporus-Marmora Sea-Dardanelles, on its European side. A defence far in the interior from the coast of the Sea of Marmora, *i.e.*, at Adrianople and Chorli, in some respects might be useful for Turkey, but the Straits remaining unfortified, the flanks would be highly endangered. The real line of defence remains the line of the Bosporus and Dardanelles. In this respect the Asiatic coast of the Sea of Marmora has a very important bearing,

especially with its numerous fjord-like bays. It should be remembered, moreover, that the demilitarised zones in time of war might be quickly fortified by far-seeing and well-armed people. It should be admitted therefore that the Turks might be compelled to fortify the Bosporus and the Dardanelles, these being, further, the points of contact between two great empires—Britain and Russia. Any one of them contemplating an attack on the Straits would probably compel the other to lend its help to Turkey. The defence might be greatly favoured if Turkey was in possession of a large air force and of powerful artillery, which would enable her to defend the Straits even with positions of a temporary fortification.

3. *Aegean Theatre.*—This coast is more easily accessible for an enemy than the Black Sea or Mediterranean Coast, owing to the fine harbours and numerous parallel roads to the interior far up the plateau. The country, moreover, is the richest of all Asia Minor, it being the cradle of ancient civilisations. But, although the islands off the coast, the Dodecanese, are not in the hands of the Turks, with good manoeuvring they might make difficult any landing operation, since good roads and railways are available in these regions. With a reliable fleet of submarines and torpedo boats or mine-layers, and owing to the numerous harbours, they might endanger the sea communications of the landed force. Further, and after an enemy has succeeded in getting hold of all that vast territory, he would have to face the enemy in a decisive resistance at the range of the plateau, on the watersheds of the rivers Saqariya and Meander. Greek experience in 1922 showed the difficulties even for an invader whose enemy was badly armed.

4. *Mediterranean Front.*—This coast, from Maqri to Alexandretta, has the same features in general as the Black Sea coast, presenting a double defence line. In addition, the range of the plateau, *i.e.*, the Lycian and Cilician Taurus and the Anti-Taurus are higher and steeper, with no good roads for the interior. Suitable places for landing are Mermeris, Maqri, Andifilo, Antaliya (Adalia) 'Alaya, Selendi and Peyas. Only the four latter have behind them a sufficient hinterland for the development of serious military action. Not far from the coast is the road of old military conquerors, Konia-Adana-Aleppo, through the defile of the "Cilician Gates." Parallel to it is the railway Aleppo-Damascus and Aleppo-Baghdad. A landing at Mersin would have the advantage of enabling the organising of a large tactical landing base (tête-de-pont), with greater security and quickness. The region itself, with Adana as a centre, although exposed to malaria, is rich and would help the supply of foodstuffs. From that region five operative directions radiate towards Diarbekr, Kharput, Sivas, Angora and Eskishehr.

5. *Syrian Theatre.*—This is the converging point of roads and railways between Europe, Asia and Africa. For an enemy coming from Syria, with the desert on the East and the sea on the West guarding his flanks, it would be possible to create a secure place d'armes from which he might dominate the road to Africa, cut the road to Baghdad, or else undertake an advance towards Konia, Qaisari, Kharput and Diarbekr. Further, the bay and harbour of Alexandretta are very safe.

6. *Mesopotamian Theatre.*—It is divided by the railway Adana-Mosul into two halves. The northern one, in the possession of Turkey, is inhabitable and with sufficient roads. On the north it is dominated by the Armenian Taurus, standing between the Euphrates and Tigris like a snow-covered wall in face of the immense plains of Syria and Mesopotamia. The possession of this wall between Bitlis and Kharput ensures the sally-ports from the Anatolian plateau towards Aleppo and Mosul. The southern half of this theatre includes the territory south of the railway, which is part semi-desert, part of desert and mountainous character. The territory between Birejik-Meskene-mouth of the river Khabur to Jeziret Ibn 'Omar, is of semi-desert character, although yielding good produce. It is inhabited by nomad Arabs and Kurds. Military operations are very difficult, almost impossible. The same characterisation applies to the territory along the Tigris, from Jeziret Ibn 'Omar to Jebel-Hamrin, south of Mosul. In the remaining part, from the mouth of the river Khabur to Baghdad, the territory is desert, and only west of Mosul, on the mountain range of Sinjar, where the oil deposits are situated, nomads live in the summer, coming back in the plains in the winter. The importance of this theatre of war is that from here it is possible to cut the road from Kars to Angora, or else, on the contrary, to undertake an advance towards the Persian Gulf. The remains of old fortresses in Diarbekr, Mardin, etc., show that in old times here was a theatre of serious operations. In an advance from 'Iraq, the defence of Turkey would be favoured by the mountains of Hakiari, Tur-Abdin, Diarbekr and Qaraja Dagh, being the forefront of the Armenian Taurus, where the decisive operations of a campaign could take place.

7. *Persian Theatre.*—In its northern part it has a first-class route for movement. This is the old road from the Iranian Plateau to the Black Sea, from Tehran, through Tabriz and Bayazid, to Trebizond. The other routes are of a secondary importance and do not lead to important centres; besides, they pass often through waste land. From Tehran to Van there are two roads, the one going through Tabriz-Dilman and the other through Urmia-Bash Qal'e. In a general way, this theatre has a relative importance if only for use in connection with operations from the Caucasus to Angora or from Armenia to 'Iraq. (P. D.)

IV. FINANCIAL AND ECONOMIC HISTORY

Population.—According to the official registers the population of Turkey in 1925 was 13,560,000, but as there has been no census in recent years, and as the registries of 135 kazas were destroyed by enemy action, the exact population is not definitely known. Considerable changes have taken place in the composition of the population in some districts, and since the exchange of population agreement between Turkey and Greece, 397,000 immigrants have moved into Turkey and have been settled in different localities. The Turkish Govt. has endeavoured to increas the health and strength of the population, and special measures have been taken by the Ministry of Public Health for the prevention of infant mortality, tuberculosis and malaria, which are having their effect on the population figures.

Finance.—In March 1912 an Act of Public Accountancy (loi de comptabilité) came into operation. This Act based the budget system and the accounting methods of the State upon sound financial principles adopted by most European States—in particular, the authorisation of expenditure by Parliament, the annual budget, proper auditing of the accounts and the centralisation of revenue in the Ottoman Bank. The financial reforms made by the Ottoman Government have been maintained by the Turkish Republic, and the Act of 1912 is still in force. During the first year of the Nationalist Govt. financial control was exercised by a group of deputies elected from the Great National Assembly, but in 1923 an Act was passed establishing an audit department (Divan-i-Muhassebat), the members of which are specially nominated by the Assembly and responsible to it.

Public accounts for the period under review show the following results:—

Year[1]	Ordinary expenditure authorised	Supplementary and extraordinary expenditure authorised	Revenue estimated in the budget
	£T.	£T.	£T.
1911–2	36,233,000	3,044,000	28,445,000
1912–3	33,997,000	13,131,000	30,514,000
1913–4	33,997,000	14,136,000	30,514,000
1914–5	34,012,000	16,300,000	32,607,000
1915–6	35,657,000	18,032,000	26,836,000
1916–7	39,724,000	44,249,000	25,012,000
1917–8	53,304,000	47,435,000	23,584,000
1918–9	51,969,000	79,748,000	34,016,000
1919–20	51,969,000	40,761,000	34,016,000

[1] It will be seen that the estimates show a constant and heavy deficit, which, however, must not be taken at its face value, as in practice considerable amounts of the money annually allotted to various services were not expended.

The Italian War in 1911 and the Balkan War in 1912 were disastrous for the financial situation of the Empire. The budget deficits were covered until the World War by loans obtained from France and elsewhere; but during the World War by loans and advances obtained from Austria and Germany and by certain War taxes.

In Sept. 1914 the capitulations were suppressed, which enabled customs duties to be increased and a tariff to be drawn up in conformity with the economic and financial needs of the country. When the Government of the Great National Assembly established at Angora (April 23 1920) took the financial administration of the territories under its rule, it was unable to draw up a regular budget as the nation was engaged in repelling invasion. Hence in the years 1920–4 the country was financed by advances which were under the direct supervision and control of the financial committee of the Assembly. The Treasury accounts, with the "loi de règlement définitif" for 1921 and 1922, were presented to the Assembly and published in 1925.

According to the reports of the audit department of the assembly, the allocations for the period March 1924–April 1925 were £T. 176,993,431, of which £T. 32,287,000 were not actually expended. The revenue received in that year was £T. 137,719,696 The estimated revenues for 1924–5 and 1925–6 are given in the table on the following page.

	1924–5	1925–6
	£T.	£T.
Direct contribution	43,930,500[1]	39,870,500
Stamps and registration duties	3,210,000	5,445,000
Indirect contribution	28,170,000	35,655,000
Monopolies	16,044,100	27,809,000[2]
Commercial and industrial state undertakings	703,000	1,720,000
Domains	4,480,000	14,965,000
Various receipts	5,424,010	8,731,354
Consumption tax	14,461,000	16,360,000
Extraordinary tax for war	12,792,000	2,500,000
Total[3]	129,214,610	153,046,854

[1] £T. 27,500,000 of this item was obtained from tithes. To free the peasant from the payment of a tax on all crops which he consumes, or which he can dispose of in his district, an Act was passed in Feb. 1925 suppressing this tax and replacing it by a six- to eight-fold increase of the real property tax, to allow for depreciation of the currency; and by another tax equivalent to 8–10% of the value of the crop directed to port or station.

[2] Under an agreement between the Government and the tobacco régie the concession was to expire on March 1 1925. The Assembly promulgated a provisional law authorising the Government to administer the tobacco régie in its existing form for a period of one year, subsequently extended for three further years. A state monopoly for the sale of cigarette paper was established.

[3] In comparing these figures with those given before the depreciation of the currency must be taken into account (see under *Currency* below).

Currency.—No other paper money has been issued than that put in circulation by the Ottoman Empire during the World War. The amount issued then was £T.160,018,665, of which £T.17,270,-101 has been withdrawn. At the beginning of 1926 the Turkish exchange on London was 912 piastres to the pound sterling, compared with a par value of 110 piastres. In 1924 and 1925 the highest rates were 888 and 965 piastres respectively and the lowest rates 790 and 805 respectively.

Banking.—In April 1925 the concession of the Ottoman Bank was extended, subject to a number of new conditions, until March 1935. The privilege of the bank to issue notes was confirmed, but is only to be exercised when the Turkish lira is re-established on a gold basis. The right of the State to establish a bank of issue is expressly maintained.

Banking is progressing in Turkey, and new banks have been founded with Turkish capital. The most important of these are Ish Bankassi, or Banque de Travail (capital £T.1,000,000), Banque de Commerce et d'Industrie (capital £T.1,000,000), Akhissar Tobacco Bank (capital £T.500,000), Akshehir Bankassi (capital £T.1,000,000), and a new Bank of Turkey for Mining and Industry established in April 1925. Ish Bankassi, since its establishment, has opened three branches in the chief cities of Turkey, and has given assistance in forming many industrial, financial and mining companies. It also co-operates with foreign capitalists in obtaining concessions for railway construction, timber, mining and industrial enterprises.

There is a serious credit stringency which hampers industry and commerce. While the total of exports and imports exceeds £T.500,000,000 annually, the credits given by the banks to traders do not exceed £T.40,000,000, and Turkish traders have to pay very high rates of interest. Branches of foreign banks operating in Turkey extend facilities to their own nationals trading there, but not as a rule to Turkish traders, even where the security is good; hence the need for a national credit institution is keenly felt.

Communications.—In 1914 the total length of the railway system of the Ottoman Empire was 6,733 kilometres. As a result of the World War and subsequent adjustments there was a net loss of 2,640 km. of railways. The greatest importance is attached by the Govt. of the Republic to railway development, and Ismet Pasha's Cabinet is doing all it can to further the construction of new railways, which are to be managed in future by the State. A number of railways are in process of construction and several are nearing completion, amongst which may be mentioned the Angora-Sivas line (620 km.); the Samsun-Sivas line (410 km.); the Angora-Eregli line (370 km.). In spite of comparatively small experience, the Turks have shown skill and ability in railway management and construction. The total length of Turkish railways worked in 1925 was 4,407 kilometres.

Agriculture.—Turkey is essentially an agricultural country, but the development of the very considerable natural wealth of the land has been hindered in the past by inadequate transport, by the tithe on gross produce and by very backward methods of cultivation. The Govt. of the Republic is engaged in remedying the first defect by the construction of railways; the tithe has been transformed into a tax on farm produce after it has been brought to markets other than the one local to the place of growing, and at the same time the land tenure, inheritance and mortgage laws are being modernised; finally steps have been taken to improve seed selection and to introduce agricultural machinery.

Twelve agricultural schools were established in 1922 and 1923 in different cities, and model farms have been started at Siverek and Diarbekr to encourage the use of scientific methods by the peasants. In 1924 two sericultural institutions and a seed-selecting station were founded, and a European specialist was engaged for the latter. Financial assistance is given by the Ministry of Agriculture to those engaged in the industries of dairy farming, silkworm rearing and bee-keeping.

The use of machinery is increasing, and the farmers who employed primitive methods are now utilising modern machinery. There are in Turkey 3,700 ploughs, 70 threshing machines, 1,223 tractors, 96 motor ploughs and 1,505 sorters, and large numbers of machines have been imported for the improvement of seed. Nine repairing shops have been established, and mechanical departments have been attached to the agricultural schools of Angora and Adana.

In the past great damage was done to the crops by locusts, and no effective measures were taken till 1915, when a German expert was engaged and the locusts were practically exterminated. During the Greek occupation the locusts increased again and wrought much harm. In 1925 the same measures were put into operation, and it is probable that in a few years the districts infested will be freed from the pest.

The area under cereals in 1924 in 369 kazas is shown in the following table:—

Kind of cereal	Hectares	Proportion under each crop	Proportion to total area	Production in 1913 in bushels
Wheat	1,683,501	50·30	2·60	152,000,000
Barley	956,670	28·58	1·47	93,400,000
Oats	77,731	2·32	0·11	12,700,000
Kablidja	78,407	2·34	0·10	6,714,000
Maize	296,613	8·06	0·45	21,460,000
Rice	17,971	0·54	0·02	1,892,000
Millet	79,259	2·37	0·12	4,715,000
Rye	114,428	3·42	0·17	11,971,000
Miscellaneous	69,206	2·08	0·10	1,463,000
Total	3,373,786	100·00	5·16	306,315,000

The area under cereals in 1924 was 26% less than in 1913. The following estimate shows the value of the pre-War and 1923 production of the chief agricultural products exported by Turkey:—

	1913 value of production 1,000 £ T.	1923 value of production 1,000 £ T.	
	(Gold)	(Gold)	(Paper)
Opium	1,000	562	4,500
Mohair	640	400	3,200
Wool	640	150	1,200
Cotton	840	625	5,000
Nuts	1,760	1,025	8,200
Tobacco	3,200	2,220	17,600
Silk	1,000	175	1,400
Total	9,080	5,157	41,100[1]

[1] Here again the changed value of the lira must be taken into account.

Minerals.—The legal conditions under which minerals and oil can at present be prospected and extracted are now (1926) under consideration, and amendments are proposed which it is hoped will increase the interest of capitalists, and hasten the development of the country's resources. Mining experts have discovered that the land running parallel to the Black Sea from Eregli to Ineboli is rich in coal, and that quantities of copper, lead, chrome, emery, tin and manganese are to be found in different parts of the country. The concessions of the copper mines of Ergeni, the lead mines of Bulgardagh and the chrome mines of Kiutahia have been given to two companies with capitals of £T.3,000,000 and £T.1,000,000 respectively. The Turkish Govt. has supplied 51% of the capital of these companies, while 49% is provided by German capitalists represented by the Metallgesellschaft and the Deutsche Bank. In 1924 the chief mineral output of Turkey was: 14,805 tons of emery, 132 tons of antimony, 10,007 tons of bandermite, 3,700 tons of lead, 450 tons of copper, 2,500 tons of chrome ore, 769,100 tons of coal, 200 bottles of mercury and 988 cases of meerschaum.

Industry.—The Government of the Republic is doing its utmost to encourage the expansion of industry, and for this reason has exempted industrial factories built by Turkish subjects (the capital may be foreign) from income tax and real property tax. The importation of materials for use in the construction of factories, and of a number of other important raw materials not found in Turkey, has been exempted from customs duties. Special railway and other facilities have been given in the case of sugar to encourage the erection of sugar factories, and in general the policy of the Government is to favour the setting up of factories which draw their raw material (*e.g.*, cotton, wool and sugar) from within the country. Since the establishment of the Republic 60 new factories of different kinds have been built. The following table shows the output of carpets in Smyrna and the surrounding district:—

	sq. arshins[1]
Before the World War	1,834,000
During the Greek occupation 1919–Oct. 1923	1,368,000
After the Greek evacuation Oct. 1923–Oct. 1924	1,256,000
Oct. 1924–Oct. 1925	1,646,000

[1] An arshin is 26·96 inches.

Shipping.—By the Lausanne Treaty the right of cabotage (coastwise shipping) is confined to Turkish ships, and as a result of this provision Turkish ships have increased in numbers, but their progress is hindered by the shortage of credit. In 1925 the number of Turkish steamships was 170 of 95,286 tons and the number of sailing vessels 3,745 of 115,767 tons.

The following table sets out the port traffic in 1924 at the principal ports:—

Port and dependencies	Turkish ships		Foreign ships	
	No.	Tonnage	No.	Tonnage
Constantinople	30,146	1,833,971	4,019	5,445,110
Smyrna	8,451	616,355	2,330	1,356,566
Samsoun	19,949	3,541,060	493	856,041
Mersin	5,802	257,439	2,112	736,550
	64,348	6,248,825	8,954	8,394,267

Commerce.—The principal exports from Turkey are tobacco, dried fruits and nuts, wool, mohair, opium and cotton, while the principal imports are manufactured products such as cotton goods, woollen goods, metals and machinery, leather and leather goods, etc. The following tables show the values of the chief imports and exports and their distribution:—

Year	Raisins Tons	Figs Yuk[1]	Tobacco Kilo	Cotton Bales	Acorns Tons
1922	37,400[2]	128,000	6,900,000	8,000	
1923	40,300	130,000	10,000,000	9,500	
1924	51,800	135,000	23,000,000	27,000	27,500

[1] One yuk is approximately 220 kilo. [2] Greek occupation.

Import and Export by Commodities

	1923		Six months of 1924	
	Import	Export	Import	Export
	£T.	£T.	£T.	£T.
Cereals, etc.	14,462,731	1,632,458	11,149,885	911,218
Fruit, vegetables	2,071,952	20,833,387	1,096,946	9,438,827
Provisions	15,094,098	255,068	8,590,971	1,361,196
Tobacco	188,501	20,482,517	238,017	17,264,961
Cotton goods	53,939,768	6,701,193	28,289,277	4,294,193
Manure	408	6,950	6,809	53,762
Woolens	8,897,278	8,214,554	5,516,738	5,243,234
Metals	7,750,966	2,179,532	5,619,610	2,110,736
Machinery	1,336,478	130,863	2,039,064	54,651

Direction of Foreign Trade

	Imports from		Exports to	
	1923	Six months 1924	1923	Six months 1924
	£T.	£T.	£T.	£T.
Italy	28,351,941	17,736,405	15,200,671	13,740,738
England	25,063,477	14,919,432	15,756,670	6,445,273
France	13,229,353	8,899,734	10,504,219	8,227,250
Germany	9,222,073	7,201,385	7,625,778	7,532,501
United States	11,059,352	5,047,978	6,749,602	4,000,399
Syria	7,880,087	3,337,542	6,045,927	2,070,003
Egypt	6,682,512	2,837,109	2,475,186	1,956,530
Belgium	7,413,836	3,509,880	2,226,994	1,196,693
Russia	3,039,166	3,583,606	1,732,445	867,718

(Y. K.)

Public Debt.—By Art. 47 of the Lausanne Treaty it was stipulated that the debt charges on the pre-War foreign debt should be allocated between Turkey and the territories detached from the Ottoman Empire, and that the allocation should be made within three months of the coming into force of the treaty. The council of the Ottoman debt accordingly allocated the annuities and notified the States concerned; certain States protested against the allocations, and the questions in dispute were referred to the League of Nations, which appointed Professor Eugène Borel as arbitrator. On April 18 1925 he gave his decision establishing the share of each State. Under this decision the shares are distributed in the following proportions: Turkey 62·25 %; Greece 10·57%; Serbia 5·25% (but Serbia refuses to be responsible for any part of the Ottoman debt and has withheld her signature from the Treaty of Lausanne); Syria and Greater Lebanon 8·17%; 'Iraq 3·96%; Palestine 2·47%; Bulgaria 1·63%; Albania 1·57%; Italy 0·23%; other Arab States 3·90%.

Representatives of the French, British and Italian bondholders met the Turkish Delegation in Paris in July 1925, to arrive at a *modus operandi* regarding the payment of the Turkish quota, the nominal capital of which is £T.84,597,495, and to discuss any concessions that might be granted in view of Turkey's financial condition. But by the end of Feb. 1926 no satisfactory agreement seemed possible whilst the attitude of Turkey was maintained. An incomplete payment by Palestine was the only payment made since the ratification of the Treaty. None of the States had in 1926 furnished the guarantees required by the treaty. The French Govt. had proposed to offer the customs receipts on behalf of Syria and the Lebanon, and the Greek Govt. offered the surplus of the revenues assigned in Greece. The Turkish Government continued to appropriate the revenues assigned under the decree of Mouharrem and the other loan contracts.[1]

[1] At the end of May 1926 it was announced that the negotiations which had been going on for nine months between the Turkish Government and the bondholders in Paris for a settlement of the Turkish Unified Debt had broken down. Under the decree of Mouharrem (of 1881), any interpretation of the terms of the contract with the bondholders was to be referred to arbitration. By the Treaty of Lausanne the Turkish share of the debt was reduced to £T.84,597,495, but no payments have been made, the Turkish Government having appropriated the assigned revenues to public purposes pending the settlement of the dispute. (Ed. *E.B.*)

TURKMENISTAN, a Soviet republic in Central Asia. (*See* SIBERIA; TURKESTAN.)

TURNOVER TAX.—A turnover tax, in its fullest sense, may be defined as a general excise tax charged cumulatively, though at a low rate, upon successive turnovers of goods (whether raw materials, goods in course of manufacture or finished articles) and services, or, expressed in different words, upon the gross receipts of producers, distributors, professional and commercial business men, etc. Like other excise duties, the tax is an indirect tax intended to fall ultimately upon the consumers of the goods, etc., in respect of which the duty has been levied. General sales taxes always spring from urgent financial necessity, and accordingly the demoralised condition of national finance, following the World War, led to a considerable crop of turnover or sales taxes. For example these were imposed in France, Belgium, Italy, Germany, Czechoslovakia, Hungary, Rumania and the Serb-Croat-Slovene State.

The scope of the various turnover taxes in force varies very greatly. Some extend to all transactions in goods, whether wholesale or retail. Others are limited to wholesale transactions in goods only. Usually there is a flat rate for all transactions, though differential rates for specified transactions are sometimes found. The opportunity is occasionally taken to combine luxury taxes with a turnover tax. Exemptions are granted of various kinds and weights, while services may be taxed here and exempted there or divided into categories receiving special privileges elsewhere. The treatment of imports and exports varies; public utility undertakings are exempted in one country and are liable in another. This extraordinary complexity makes it impossible to describe the actual taxes in force and, accordingly, in the paragraphs which follow, consideration is limited to the main principles of the tax.

CHARACTERISTICS OF THE TAX

Just as an income tax applies in theory to all income, so a turnover tax is applicable in theory to all sales of goods and services. Accordingly, subject to exemptions and variations, the tax attaches to almost every transaction of life and to every ingredient in those transactions.

Its second feature is its cumulative operation. Raw materials, out of which the finished goods are fashioned, pass through many processes of manufacture, treatment and distribution. Normally, these various processes are carried out by different classes of business, owned by different concerns. A turnover tax is payable on every transfer of the goods from the first sale of raw material down to the final sale to the ultimate consumer of the finished article. Value is added to the product at every stage and, accordingly, the amount of the tax grows larger at each transfer, so that an article finally sold, after passing through five stages or processes, will have borne tax five times, each transaction after the first including the price and also, of course, the tax on preceding transactions. In this way the tax, although levied at a low rate, accumulates until the total tax on the final selling price may be anything from three to six times the amount of the nominal rate.

The third characteristic of the tax is that it is an indirect tax which is intended to be finally borne by the ultimate home consumer. It follows that, in general, a turnover tax cannot, save in exceptional conditions, be levied upon foreigners, and further, that the tax, in so far as it falls upon goods to be exported, must either be remitted or must fall, contrary to the intention mentioned, upon the exporter.

Broadly speaking, therefore, a turnover tax may be defined as an *ad valorem* tax, imposed by way of a fixed percentage upon the price or value of:—

(*a*) Every sale of goods, except sales of capital assets, falling within the broad category of investments, and export sales;

(*b*) Every passage of goods, while in the same ownership, from one defined stage of production to another;

(*c*) Every service rendered, except those rendered by employed persons and those rendered by central or local governmental authorities; and

(*d*) Every import of goods.

Exemption of Exports.—As a turnover tax is intended to be a consumption tax, capital investment sales are only excluded from its scope because they are not consumable. A turnover tax cannot normally be made to fall upon foreign consumers, and for this reason most of the taxes in force provide for the exemption of exports. If no provision for exemption is made the total tax falling upon exports must rest upon the exporter and as a competitor in world markets, where price is determined by the competition of foreign producers, he is badly handicapped. In this connection *entrepôt* trade deserves special mention, as the imposition of a turnover tax on the gross values of goods entering a country in the course of that trade would, if imposed on the foreign vendors, almost immediately drive such trade to other countries, or, alternatively, if the tax is left as a burden on the domestic traders concerned, it would so penalise them as to make the business unprofitable.

The Case of Vertical Combines.—The condition that the tax should apply to every passage of goods while in the same ownership, from one defined stage of production to another, is essential if equality is to be preserved between different tax-payers and different forms of business organisation. While theoretically essential, in practice such a provision necessarily gives rise to grave difficulties. The movement towards large scale organisations in which two or more, or all of the many processes affecting any defined class of goods are carried out within the ambit of one concern, has become of such importance that, on the one hand, nothing should be done to check the economies and wealth-producing capacities of such organisations, and on the other hand, nothing should be done which should give them a striking differential advantage over their competitors through the operation of a turnover tax. In order, therefore, to preserve equality in taxation it will be necessary, in the case of combines, to assess the tax on an estimated turnover for the various stages of manufacture so combined, in order that the tax levied on the final finished product should be the same as though that product had passed through the hands of a normal number of concerns.

Inclusion of "Services."—The inclusion of services within the scope of the tax is also essential. The retail price of coal consists almost entirely of the remuneration of the services of the persons who have won it, transported it and distributed it, including in those services those rendered by capital, management and labour. Moreover the supply of goods and services is almost inextricably mixed. The dentist supplies much service with one or two false teeth. The watchmaker does the same when he provides and fits a new main spring to a watch. In practice it is impossible to sever the price of services from the price of goods when they are simultaneously provided at a single inclusive price. Finally, to exclude services would cut deeply into the productivity of the tax. On the other hand, the services of employed persons, remunerated by salaries or wages, are normally excluded from the scope of a turnover tax, because the employee is normally not able to pass on the burden of the tax. If he shifts it at all he can only do so back on his employer and in that case the employer would shift the burden again by loading it on to the price of his goods or services, and the cumulative character of the tax would be greatly increased. Similar reasons attend the normal exclusion from the scope of the tax of services of central and local governmental authorities. As the tax is of the nature of a general excise imposed upon every business transaction within the country and accordingly upon all commodities originating within the country, it follows that all goods imported must be brought within the scope of the tax. Accordingly, a turnover tax involves general customs taxation covering every article within the scope of the turnover tax.

Exemptions for Food.—Nothing in the principle of a turnover tax calls in theory for the exemption of food, and as the bulk of most nations consists of the working classes whose main expenditure is upon food, the exemption of food from the turnover tax at once makes an enormous inroad into the universality and therefore into the yield of the tax. Nevertheless the objectionable character of a general sales tax extending to food has led in most cases to wide exemptions in favour of essential foods. In practice this exemption necessarily gives rise to considerable anomalies and inequalities.

Conclusions.—To many minds a turnover tax is most attractive. This springs mainly from the universality of the tax and its cumulative nature which permit of a very low rate of tax, combined with a substantial yield. Because the rate is small it is always argued that it will not be noticed, but it enters insidiously into every phase and item of expenditure and in such a manner as to take no account whatsoever of ability to pay. Accordingly, a turnover tax offends against this great modern principle of taxation because the working classes constitute the bulk of every nation, and because their aggregate income (and expenditure), notwithstanding the smallness of the individual income, accounts nearly always for more than half the total of the national income.

A turnover tax falls with the greatest weight on persons whose ability to bear it is least. If services are excluded from the scope

of the tax this inequality is aggregated inasmuch as a considerable part of the expenditure of the richer classes consists of expenditure on services. It is notably in this connection that turnover taxes in one form or another have been adopted widely on the continent of Europe, where direct taxation according to the principle of ability to pay is least favoured, and that on the contrary they find little or no favour among Anglo-Saxon communities where direct taxation grows more strongly in favour. By its universality a turnover tax tends to enter into the cost of production of all goods and therefore to raise the costs of the marginal producer whose influence on price is almost dominant. For this reason a turnover tax is utterly unsuited to any nation which has a large international trade, or which carries on from centres located within its own boundary large manufacturing, commercial or financial business in other countries.

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TUTANKHAMUN (*see* 9.84), or, as he was originally called, Tutankhaten, must have ascended the Egyptian throne shortly after 1358 B.C. He had married Ankhesenpaaten, the third daughter of Akhenaten, and thus, on the death of Akhenaten's ephemeral successor, Sakere, who had married the second daughter, he became heir to the throne. The highest date as yet known in his reign is the sixth year, and as the body found in his tomb is said to be that of a youth of about 18 he must have been a child at his accession, and a puppet in the hands of older men, chief among whom, doubtless, was the priest Ay, his eventual successor. Presumably he reigned at first in the new city of Akhetaten, but his advisers must already have seen that Atenism, the cult of the sun's disk, established by his father-in-law, was doomed, and that a compromise with the powerful priesthood of Amun was inevitable, for even at Til el-Amarnah itself we find gravestelae bearing the names of Amun and other orthodox gods. Accordingly he moved back to Thebes, the old capital, with his court, changed his name from Tutankhaten "Living Image of the Disk" to Tutankhamŭn "Living Image of Amun," restored the names of the old Egyptian gods which Akhenaten had chiselled out on the monuments and made a formal profession of orthodoxy by celebrating the festival of Opet, a ceremony connected with the worship of Amun.

Apparently, despite the neglect of foreign affairs under Akhenaten, Egypt still retained the province of Nubia, for a scene in the tomb of one Huy, viceroy of Nubia, shows the king receiving the Nubian tribute. Another scene shows the reception of the "tribute of Retenu," *i.e.*, of Syria-Palestine. Unless this scene be a mere pleasant fiction, which is hardly likely, it indicates that the allegiance of Syria had not been quite so completely lost under Akhenaten as has been generally supposed. The king's tomb in Thebes has up to 1926 made no contribution to the history of his reign.

See A. H. Gardiner and Nina de G. Davies, *The Tomb of Huy*. (The Theban Tombs Series, 4th Memoir) 1926. (T. E. P.)

TYLOR, SIR EDWARD BURNETT (1832–1917), British anthropologist (*see* 27.498), died at Wellington, Somerset, Jan. 2 1917. He was knighted in 1912.

TYPEWRITER: *see* OFFICE APPLIANCES.

TYPHOID FEVER: *see* INFECTIOUS FEVERS.

TYPHUS FEVER: *see* INFECTIOUS FEVERS.

TYRES: *see* TIRES.

TYROL: *see* TIROL.

U-BOAT: *see* SUBMARINE CAMPAIGNS.

UGANDA (*see* 27.557) has an area of about 110,300 sq. m., including 16,169 sq. m. of water. The population in 1925 was estimated at 3,145,000. There were 1,451 Europeans and 7,229 Asiatics (mainly Indians). In 1919 Europeans numbered 847 and Asiatics 3,516. Since 1920 Uganda has become one of the main sources of the supply of cotton in the British Empire.

Frontier Questions.—Territorial changes made in 1912 gave the western shores of Lake Albert to the Belgian Congo, while Kizegi, a highland region containing some of the peaks of the Mfumbiro volcanoes, was added to Uganda (partly by transfer from German East Africa). In 1914 the most northern part of the protectorate was placed under the administration of the Anglo-Egyptian Sudan, whose authority was extended south to Nimule, the point where navigation on the Nile from Khartum ends. In return, the Sudan surrendered to Uganda some 4,000 sq. m. west of the Nile, an area which has been part of the Lado Enclave (*see* 16.60). In 1922 the Didinga district east of the Nile, was taken over by the Sudan. The whole frontier region towards Abyssinia was in an unsettled condition. Here for years Abyssinians, Turkana and Somalis carried on a gun-running trade and made raids on peaceful tribes. To gain a better control of the people and pending a readjustment of the frontier, the Kenya Govt. took over from the authorities in Uganda the administration of the Rudolf Province.

Social Conditions.—Christianity and Western civilisation increasingly made their influence manifest, while material prosperity brought new problems. Uganda being, however, a "black man's country," there was no clash between European and African interests. Officials and missionaries continued to play a leading part in the evolution of the people, and they were backed up by the native administration, which has a large degree of autonomy. By 1926 over a third of the natives professed Christianity, including the bulk of the Buganda, the most important tribe. Daudi Chwa, the Kabaka (King) of Buganda, who attained his majority on Aug. 8 1914 and was created a K.C.M.G. in 1925, was an enlightened ruler. He and his Prime Minister, Sir Apolo Kagwa, were foremost in giving aid to the British in the World War. Other rulers and tribes were equally willing, and by supplying 10,000 soldiers, a native medical corps and over 160,000 carriers Uganda helped substantially in the campaign against the Germans in East Africa.

The country suffered from a severe famine in 1919 and from the general trade depression in 1921–2. But it quickly recovered. In cultivating cotton, an industry entirely in their hands, the natives found an easy method of acquiring wealth; a fact not without danger and adversely affecting the labour supply for other work. However, there was steady growth in education and a power of adaptability to new conditions was clearly noticeable. A government Technical school for natives was opened in 1922. In 1924 its scope was extended to include higher education. Otherwise education was in the hands of the missionary societies. At a critical period of development Uganda owed much to the wise guidance of Sir R. T. Coryndon, governor from Feb. 1918 to Sept. 1922. During this period a (nominated) Legislative Council was created. It met first in 1921.

Cotton and other Crops.—A beginning in the export of cotton was made in 1904–5 when 300 to 400 bales were produced. By 1912–3 the output had reached 50,000 bales. The War caused a set-back in production, but by 1922–3 the yield was 93,000 bales and in 1924–5 was over 200,000 bales. Some two-thirds of the cotton is grown in the Eastern Province, between Lake Keoga and Mount Elgon. A railway 61 m. long from Tinja (by the Ripon Falls) to Namasagala, the first navigable point on the Nile, was opened in 1912. It is known as the Busoga Railway. To give the cotton-growing district communication with Mombasa port the building of a railway from the Kenya end was begun in Dec. 1921. Branching from the Kenya and Uganda Railway at Nakuru, it is some 320 m. long, of which 165 m. are in Uganda, where a junction is effected with the Busoga Railway. The Uganda section of the line was begun in 1925. By 1926 the area under cotton was over 600,000 ac. while the area suitable for cotton, largely served by the new railway, many times greater.

Coffee ranks second among the crops of the protectorate and is grown chiefly on European plantations. The cultivation of the sugar-cane has been developed. Chillies, oil seeds and rubber are other products. Cattle are plentiful, and there are valuable timber areas. Gold occurs over a long stretch of the Kafu river.

Trade and Revenue.—In the process of development imports for many years largely exceeded exports. The figures for 1910–1 were imports £431,000, exports, £337,000. In 1916–7 imports were £866,000 and exports £702,000. In 1917 the Customs were amalgamated with those of British East Africa (Kenya Colony) and since then only net statistics of exports are available. It was soon obvious, however, that exports had become of higher value than imports. In 1918–9 exports were £1,247,000. In 1920, owing mainly to inflated prices they were valued at over £4,250,000; in 1923, with more normal conditions, at £2,393,000. In 1924 exports had reached a value of £3,897,000, while that of imported merchandise was put at £1,975,000. Of the 1924 exports cotton accounted for £3,486,000, cotton seed for £106,000 and coffee for £167,000. Cotton goods, machinery and vehicles (including motor cars and cycles) are the principal imports.

Since 1915–6 the protectorate has been financially self-supporting. In that year revenue was £287,000 and expenditure £285,000. In 1924 the figures were, revenue £1,239,000; expenditure £918,000. The chief sources of revenue are poll taxes (over £400,000 in 1924), customs, a cotton tax, trading licences and land rents.

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UHDE, FRITZ KARL HERMANN VON (1848–1911), German painter (*see* 27.563), died at Munich Feb. 25 1911.

UKRAINE (*see* 27.564).—The Ukrainian Socialist Soviet Republic is a constituent State of the Union of Socialist Soviet Republics (*see* RUSSIA). It comprises the southwestern area of what was formerly European Russia, less the territories ceded to Poland, and Bessarabia, the union of which with Rumania was finally sanctioned by the Allied and Associated Powers in a treaty signed at Paris Oct. 28 1920.[1]

Area and Population.—The Republic covers an area of 446,400 sq. km. (3,176,567 sq. versts), and is divided into nine governments and the Moldavian Socialist Soviet Republic. The population (1924) was 27,168,962, of which just over 22,000,000 were engaged in rural occupations. These figures represented 2·1% of the area of the Union and 19·4% of its population (1924). A test census carried out in two governments during 1920 revealed a decrease in the population since 1914 of about 11%. Kharkov is the capital (population 311,525) and the other large towns are Kiev (435,060) and Odessa (316,740).

Political History.—The Ukraine formed an integral part of the Russian Empire until 1917. When however the Provisional Govt. was established in Petrograd in March 1917, a Ukrainian deputation waited on it in the following month to demand autonomy for their country, and on April 19 the first Ukrainian National Congress met at Kiev to elect a Council of Government (Rada). In June this body assumed the control of

[1] This treaty was not ratified by Italy and Japan.

Ukrainian affairs, and in Aug. the Provisional Govt. of Russia recognised the autonomy of the Ukraine. Contemporaneously with the Bolshevik revolution in Petrograd the Rada proclaimed a People's Republic (Nov. 20 1917). Negotiations between the Rada and the Russian Soviet Govt. took place in Dec. and the former sent delegates to the Peace Conference at Brest-Litovsk, who were duly recognised by the Central Powers. On Dec. 26 the first all-Ukrainian Congress of Soviets met at Kharkov. In Jan. 1918 relations between the Russian Soviet and the Rada were broken off, and the latter proclaimed its complete independence. Bolshevik troops invaded the Ukraine and in March the Rada appealed to the Central Powers against the Moscow Government.

Meanwhile the Ukrainian delegates at Brest-Litovsk had concluded a peace with the Central Powers (Feb. 9 and 11 1918) under which, *inter alia*, the frontiers of the Republic were delimitated. By the end of April German and Austrian troops had occupied the Ukraine and established a military dictatorship under Hetman Skoropadski, and early in May an armistice with Soviet Russia was proclaimed, followed in the same month by definite peace negotiations. Soon after the peasants rose against the German administration and at the beginning of June held a Peasants' congress at Kiev demanding the re-establishment of the People's Republic, and on July 30 the German Governor, Von Eichorn, was assassinated. In Nov., Petlura, a member of the former Rada, began operations against Skoropadski, whom he overthrew in Dec., and established a Directory composed of himself and Vinnichenko, which proclaimed the union of the Ukraine with the West Ukrainian (East Galician) Republic. Towards the end of the month Petlura occupied Kiev, but in Feb. 1919 a Bolshevik rising forced him to retire to East Galicia.

On March 1 the second Ukrainian Congress of Soviets met. In their efforts to support anti-Bolshevik operations the French had first bombarded and then occupied Odessa in Nov. 1918, but early in April Bolshevik risings and the advance of the Red Army forced them to evacuate the port, and it fell into the hands of the Soviet troops. In June 1919, however, General Denikin's forces captured Kharkov, and in Aug. overthrew the Second Ukrainian Soviet Government. But the Soviet forces in the Ukraine regained the ascendancy with the capture of Kharkov and Kiev in Dec., and of Odessa in Feb. 1920, whereupon a (third) Ukrainian Soviet Republic was established. Irregular warfare continued for some time and large portions of the Ukraine were occupied by Petlura's and the Polish troops in May 1920, being again expelled when the Russian army took the offensive in July (*see* RUSSIA). By the treaty of Riga (Oct. 12 1920 and March 18 1921) Poland and Russia recognised the independence of the Ukraine. On Dec. 28 1920 a Russo-Ukrainian treaty was signed defining relations between the two Soviet Republics.

During 1921 the Ukrainian Socialist Soviet Republic signed separate treaties with Georgia (Jan. 31), Lithuania (Feb. 14), Latvia (Aug. 3), Estonia (Nov. 25) and Italy (Dec. 27); and also, in conjunction with The Russian Socialist Federated Soviet Republic, with Austria (Dec. 7). In 1922 a treaty with Turkey was signed (Jan. 2) and, again in conjunction with the R.S.F.S.R., a trade agreement with Czechoslovakia (June 5). On July 6 1923 the constitution of the Union of Socialist Soviet Republics was adopted, of which the Ukraine became a constituent member. In Sept. 1924 the autonomous Moldavian Socialist Soviet Republic was formed as part of the Ukraine.

Natural Resources.—The Ukraine lies almost entirely in the great steppe belt, and the greater part of the soil is the very fertile black earth. The chief crops are wheat, rye, millet and maize; the area under grain cultivation in 1924 was 20,099,000 desoyatins and the crop 747,000,000 poods. Flax and sugar cane are also grown, and fruit trees are abundant. The inhabitants breed the big Tcherkess cattle which are used both for plough and in harness.

The Donets basin, which is the most highly developed (though not the largest) coal field in the Union, lies within the territory of the Ukrainian S.S.R. The district suffered severely during the civil war; the output, which was 1,544,000,000 poods in 1913, fell to 273,000,000 in 1920 and for 1925 was estimated at a little over 600,000,000 poods. Before the War 90% of the Russian coal output came from the Donets; in 1924, 78%. This area also contains the largest anthracite reserves in the world, and deposits of cinnabar from which mercury is obtained. Rock salt is mined on the edges of the Don ridge. There are large iron deposits at Krivoi Rog, estimated at 200,000,000 tons of ore with an average yield of 62–67% of iron, 9% of silica and ·03 to ·06% of phosphorus. The annual output in 1925 was about 250,000 tons compared with 6,600,000 tons in 1913. There are also manganese deposits at Ekaterinoslav. The principal metal industrial centres in the Ukraine are at Yusovka (in the Donets), Kharkov, Mariupol, Ekaterinoslav and Nikolaiev. Chemical works exist in the Donets basin, agricultural machinery and hemp factories at Odessa, sugar refineries in the Kiev province, while coopering and pottery are well-developed village industries.

Communications.—There are two main lines from Moscow, one through Kharkov, running down to Sevastopol in the Crimea (which does not form part of the Ukraine but is an autonomous Socialist Soviet Republic in the R.S.F.S.R.); the other through Kiev to Odessa. A main transverse line runs through Kiev and Kharkov to Rostov, while branch lines from the Odessa line link up Kiev with Warsaw and Lemberg. Subsidiary lines link up the more important towns, but though the mileage-area ratio is higher in the Ukraine than in the rest of the Union, the transport system, unsupported by any adequate roads, and further hampered by shortage of rolling-stock, is quite insufficient to meet the requirement of agriculture and industry. Kharkov is connected by regular air services with Moscow, Kiev and Odessa. The principal seaport is Odessa, whence comparatively regular services are maintained with Constantinople and with other Black Sea ports. The smaller ports of Nikolaiev, Berdjansk, Mariupol and Taganrog are principally used for coastal trade.

Education.—There are numerous schools throughout the whole of the Ukraine, and 38 institutions of quasi-university standing, of which nine are at Kharkov, nine at Kiev and seven at Odessa. (*See* RUSSIA.)

UNAMUNO, MIGUEL DE (1864–), Spanish scholar and man of letters, was born at Bilbao Sept. 29 1864, and in 1892 was appointed to the chair of Greek language and literature at Salamanca University. His mystical philosophy has exercised a great influence on Spanish-speaking peoples, and his imaginative work in prose and verse is also highly appraised. Towards the end of his academic career he began actively to participate in politics. This brought him into conflict with the military directorate and in 1924 he was exiled to the Canary Islands. Later, he refused to accept the amnesty granted and took up his residence in Paris. As a consequence he was dismissed from his professorship. His most characteristic work is *El Sentimiento Tragico de la Vida en los hombres y en los pueblos* (1913) translated into English as *The Tragic Sense of Life in men and in peoples* (1921).

UNDEN, OSTEN (1886–), Swedish politician, became professor of civil law at the University of Uppsala in 1917. Unden, who was a Social-democrat, became a minister without portfolio in the Eden Cabinet from 1917 until 1920, and minister of justice in the first Branting Cabinet in 1920. From 1920 to 1924 he was the expert on international law to the Swedish Foreign Office; and a member of the Swedish delegation at the Assembly of the League of Nations from 1921 and also at the Genoa and Hague Conferences, 1922. He became Foreign Minister in Branting's third Ministry in 1924 and after the latter's death in 1925 Unden succeeded him on the Council of the League of Nations. He was especially prominent at the special session of the Assembly held in March 1926, when he opposed the election of any other country than Germany to a permanent seat on the council.

UNDERWOOD, OSCAR WILDER (1862–), American politician, was born at Louisville, Ky., May 6 1862. He studied at the University of Virginia (1881–4), was admitted to the bar in 1884, and practised law thereafter in Birmingham, Alabama. From 1895 to 1915 he was a member from Alabama of the National House of Representatives, and during his last two years chairman of the committee on ways and means. After the Democrats came into power in 1913 he had a large share in framing the tariff bill passed the same year. In 1914 he opposed the Panama Canal Tolls Repeal Bill, but supported the resolution authorising the President to use armed force in Mexico. He was opposed to the woman suffrage amendment to the Federal Constitution, holding that the question was a state issue. He also opposed the national prohibition amendment. In 1914 he was elected to the U.S. Senate, and in 1920 re-elected. In 1919 he favoured the anti-strike clause of the Cummins rail-

way bill. A strong supporter of the Peace Treaty of Versailles, in Dec. 1919 he offered a resolution in the Senate providing that the president of the Senate should appoint a committee of 10 senators to work out some acceptable plan for adopting the Peace Treaty; but this was blocked by Senator Lodge. In April 1920 he was chosen Democratic leader in the Senate. He was a U.S. delegate at the Washington Conference on the Limitation of Armaments which assembled in Nov. 1921. At the Democratic National Convention held in New York City, June 1924, Senator Underwood was an unsuccessful candidate for the presidential nomination.

UNDERWRITING: *see* INSURANCE.

UNDSET, SIGRID (1882–), Norwegian author, was born at Kallundborg, Denmark, on May 20 1882. After completing her studies at the Christiania mercantile college, Mme. Undset entered a city office in 1899 and remained a clerk until 1909. She thus gained an intimate acquaintance with the empty and unenlivened existence of the girls with whom she came into contact, and utilised her experience in her first literary works, initiated in 1907 by *Fru Marta Oulie.* In 1912 she achieved fame by the great Christiania novel, *Jenny* (Eng. trans. 1920), remarkable for its courageous treatment of the erotic problem. After revealing in one of her minor works (1919) the religious crisis in her mind which in 1925 caused her to join the Roman Catholic Church, Mme. Undset published *Kristin Lavransdatter* (1920–22), a remarkable novel of the 14th century, by which she became known to the English-speaking world. Mme. Undset's work shows psychological depth and an ability to appraise the mind and temper of bygone ages, but these qualities are nowhere enlivened by a sense of humour. Her last work, a 13th century novel, *Olav Audunsson*, is stamped by the same qualities.

UNEMPLOYMENT[1] (*see* 27.578).—If every able-bodied man and woman were regarded as an actual or potential worker, the term unemployment would have a larger meaning than is commonly accorded to it. For it would include the withheld productive time and energy of those who figure in censuses as "unoccupied," the upper and the lower leisured classes, all who manage to live without doing work. But though such a connotation might be sound and serviceable in a general assessment of national economic waste, it would carry us too far away from the set of actual problems conventionally and conveniently grouped under the term Unemployment. That term covers the idleness of those willing and able to work that is attributable to the conditions of the trade or occupation in which they are ordinarily engaged.

Thus defined, unemployment, however, may not be equivalent to waste of productive time on the part of all "unemployed." For there are occupations that are essentially or "naturally" irregular in the volume of work they require. Such are those dependent upon climatic conditions, or seasonal requirements related to climate or weather. Agriculture, building, fishing, dock labour, are large and important examples. Most of this slackness is in winter, though there are trades, mining for instance, where employment is slacker in summer. Such fluctuations, as with some other trades, for instance printing and dressmaking, where seasonal activities are less directly traceable to climatic causes, run a fairly regular and calculable course. This regularity, indeed, enables a certain amount of inter-trade adjustment to lessen the amount of wasted time. In some countries, as in Belgium and Russia, where the ties between country and town life are closer than in England, agricultural work sensibly relieves the unemployment in town industries. A second trade, chosen as supplementary to the first, strengthens the earning power, and gives the interest of variation to the working life, though in a highly specialised industrial system the possibilities of such adjustments are severely limited, and trade union discipline raises obstacles.

Reasons for Unemployment.—There are two other important sources of unemployment in particular trades that cause trouble by their irregularity and incalculability. They are changes of fashion or taste in the consumer, and inventions or new processes on the productive side of industry. The dressmaking and to a less extent the textile trades are peculiarly prone to sudden violent changes of fashion, while in most luxury trades considerable fluctuations of employment occur from the freaks of taste, often stimulated from the selling side. New materials, new combinations, shapes and colours rapidly acquire prestige, displacing the old and shifting the currents of employment. The spread of luxury among larger sections of a people and the quicker interclass imitation give larger significance to this item of unemployment. It may, of course, be urged that no net increase of unemployment is thus caused, for the new fashion yields as much employment as the old. But from the social standpoint considerable net waste ensues from such violent fluctuations.

Inventions, involving important changes of technique, especially in labour-saving machinery, are liable to cancel much manual skill and to displace its owners, though they may indirectly enlarge employment by reducing costs and prices, so stimulating demand. An active era of inventions evidently signifies that at any given time many workers are looking out for a new job. If times are good, and industry in general active, they may not remain long unemployed, but in normal times, still more in depressed, they will encounter much difficulty in fitting themselves into a new post.

It is evident that in any changing civilisation, where all these factors of irregularity and uncertainty are operative, some unemployment is inevitable. It is true, as Mr. Charles Booth succinctly stated, that "our modern system of industry will not work without some unemployed margin, some reserve of labour." But this margin need not be as wide as it is. More mobility of occupation, inter-local and inter-occupational, should be practicable. Better information through employment bureaux and trade union organisations can speed up adjustments, and so help to reduce the percentage at any moment unemployed. But the efficacy of such measure depends largely upon those wider conditions of general trade, which are commonly brought together under the term cyclical fluctuations.

I. CYCLICAL FLUCTUATIONS

The Measure of Unemployment.—But before entering this largest and most controversial field, it will be convenient to consider briefly how far we are able to measure unemployment. There are two sources of information in Britain, the trade union returns of members out of employment (whether in receipt of unemployed benefit or not) and the returns covered by the Unemployment Insurance Acts. Up to 1920 the trade union returns were the largest statistical basis. They were, and are, a very incomplete index of the total volume of unemployment. For the trade unionists included in the returns are usually less than half of the trade unionists in the country, and the latter are only from a third to a half of the industrial manual workers. Although it is part of the policy of trade unions to secure for their members a preference in employment, it is likely that the proportion of unemployed among industrial workers who are non-unionists is rather less than among unionists. For the trade unions are strongly represented in certain trades that are exceedingly liable to trade fluctuations, such as the building, engineering, metal and ship-building trades. Moreover, a trade unionist is far less likely to seek employment in some other trade than his own, or to accept lower wages in his own trade. On the other hand, the great mass of casual labour will bring up the volume of unemployment in the low-organised trades.

These considerations serve to indicate that the returns under the Unemployment Insurance Act of 1911, extended in 1922 to cover some 11,500,000 manual workers, form a better index of the total amount of unemployment. The only large excluded classes are domestic servants, farm labourers and government employees. These classes, however, are so large and, with the exception of sections of farm labourers, so much more regular in their employment, as to cause some exaggeration to appear, if the insurance statistics are taken as a measure of the unem-

[1] As the amount of unemployment in the United States was so small during the period 1910–26 this article does not deal in detail with that country. (Ed. *E. B.*)

ployment of the working population in the aggregate. When the official figure for unemployment is 10%, the average unemployment for the workers as an aggregate might perhaps be put at 9% or even less.

As an offset, however, against such a tendency to overestimate, the habit of resorting to short time to meet trade slackness must be taken into account. In coal-mining and the textile trades, especially cotton, this practice must considerably reduce the amount of reputed unemployment. At the lowest depth of the depression in Britain, in June 1921, when 2,171,288 workers were applicants for benefit in respect of total unemployment, 832,340 workers claimed benefit for short time.

Cyclical Unemployment.—The minor leakages and fluctuations due chiefly to natural causes, or to alterations in methods of work, or of consumption, are so various and so numerous that they may be held to require a certain small percentage of " waiters " as representing the wholesome elasticity of a free progressive economic system. But can the same be said of the larger periodic movements known as trade depressions, which doom a large percentage of the available productive capital and labour to stand idle for a couple of years or more? Are we to regard these large fluctuations as inevitable, or possibly desirable? First, a word as to the size of these fluctuations. Before the War the annual averages of unemployment swung between about 2½% and 7½%, leaving an implication that our system for its free-working requires an average unemployed margin of some 5%, half of it representing the minor trade changes and leakages to which we have referred, half forming a reserve of labour to enable expansion to take place in good times. But War and post-War experience show a far more violent fluctuation. For, whereas the figure for 1918 was 0·8 and for 1919 2·4, the depression which set in at the close of 1920 reached by June 1921 the extraordinary figure of 23·1%, and the trade union average for 1921 was 15·3, for 1922, 15·4.

Two other general tendencies may be noted. The larger intercourse between industrially developed countries since 1875 has made these ebbs and flows of trade more simultaneous. The " boom " years 1873, 1874, 1900, were common to all industrial nations, so was the collapse of later 1907. The other tendency is the shortening of the cycle. Before the seventies of last century there was something like a 10 years' rhythm. Since then the periods have shortened, the years of maximum trade activity being 1873, 1882, 1890, 1900, 1907 and 1913. The post-War situation caused some disturbance of both these tendencies. " Japan began to feel the effect of trade depression in 1919 when trade in Great Britain was in full swing. In 1921 Germany was expanding her industries rapidly, while Great Britain was in the throes of the depression. Again, in 1923 economic conditions in the United States showed a very striking recovery, and indeed she attained in the spring a condition of record trade activity." (Hon. J. J. Astor, *Is Unemployment Inevitable?*, p. 11).

The Post-War Depression.—Before discussing the causes and remedies of normal cyclical unemployment, it will be well to deal briefly with the peculiarities of the post-War depression, which alike in its causation and its character is abnormal. Without prejudging the question of the part played by finance in ordinary cycles, it is evident that the War and post War inflation, practised in different forms and measures by almost all European Govts. and the consequent collapse of exchange and internal monetary values, were disturbing factors of prime importance. While inflation exercised an immediately stimulating influence on internal trade by encouraging expenditure, and upon export trade by means of an artificial cheapening of production, the consequent damages to confidence and credit, the ruin of large sections of the middle-classes, the difficulty of the import trade and the scarcity and dearness of working capital, were main contributions to the long depression.

Closely connected with this financial disease was the sabotage of commercial relations, accompanied by high tariffs and embargoes upon the movement of goods and investments, and the breaking up of the economic unity of the Austro-Hungarian empire. The virtual isolation of Russia from free economic intercourse with the outside world brought a serious curtailment of foods and raw materials for other countries, and a corresponding reduction of manufacturing exports.

New difficulties arose between town and country, due to bad money, creating food shortages, depressed wages and efficiency

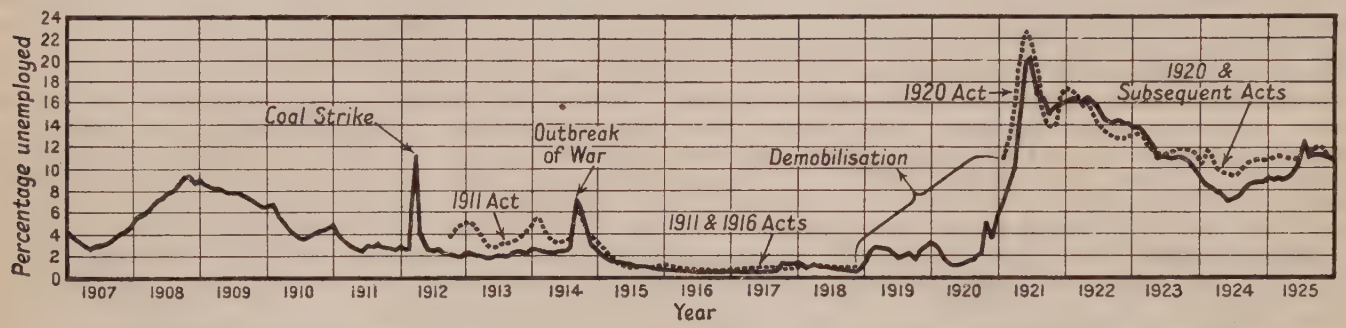

FIG. 1.—Graph showing the percentage of unemployed in Great Britain and Northern Ireland, among workpeople insured against unemployment (broken line) and members of certain trade unions (continuous line).
(*Ministry of Labour Gazette.*)

among industrial workers. Political disturbances, accompanied by strikes and labour difficulties in most countries, were a factor in low production. More important in Britain and other ex-belligerent industrial countries was the collapse of industries overstimulated for war-production whose excessive plant and labour could not be adapted readily to useful work in the after-War world. The huge depression in the iron and steel, engineering and ship-building trades, as in the mining, was largely attributable to this cause.

Monetary disturbances, commercial obstacles, industrial dislocation, revolutions and sporadic warfare have thus contributed towards a trade depression unique in its character and distribution as well as unprecedented in its magnitude and duration. These different causes operated at different times and with different stresses in the various countries. In every country there was a striking coincidence between the fluctuations of prices and of employment. When prices fell unemployment rose, and vice versa. The countries not directly implicated in the War suffered as violent fluctuations as the ex-belligerent countries. The unemployment figure in each of the Scandinavian countries (with the exception of Finland) was higher in the later part of 1921 and the opening of 1922 than the British highest figure. Switzerland touched 25% in Jan. 1922 and Belgium 32·3% in May 1921.

In Germany and Austria inflation postponed the trouble until monetary reform was carried out; then came reaction and widespread unemployment. In general the internal monetary policy played a more determinant part than the restriction of the export trade, re-absorption of the fighting forces, political animosities, tariffs or any of the other disturbing factors of the post-War world. This would seem to apply even to Great Britain, where certain of the principal export trades have been the heaviest sufferers. For " most of the trades in question are also essentially producers of capital goods which invariably suffer worst during depression, even though they produce for home consumption only. They are also the trades which were over-expanded during

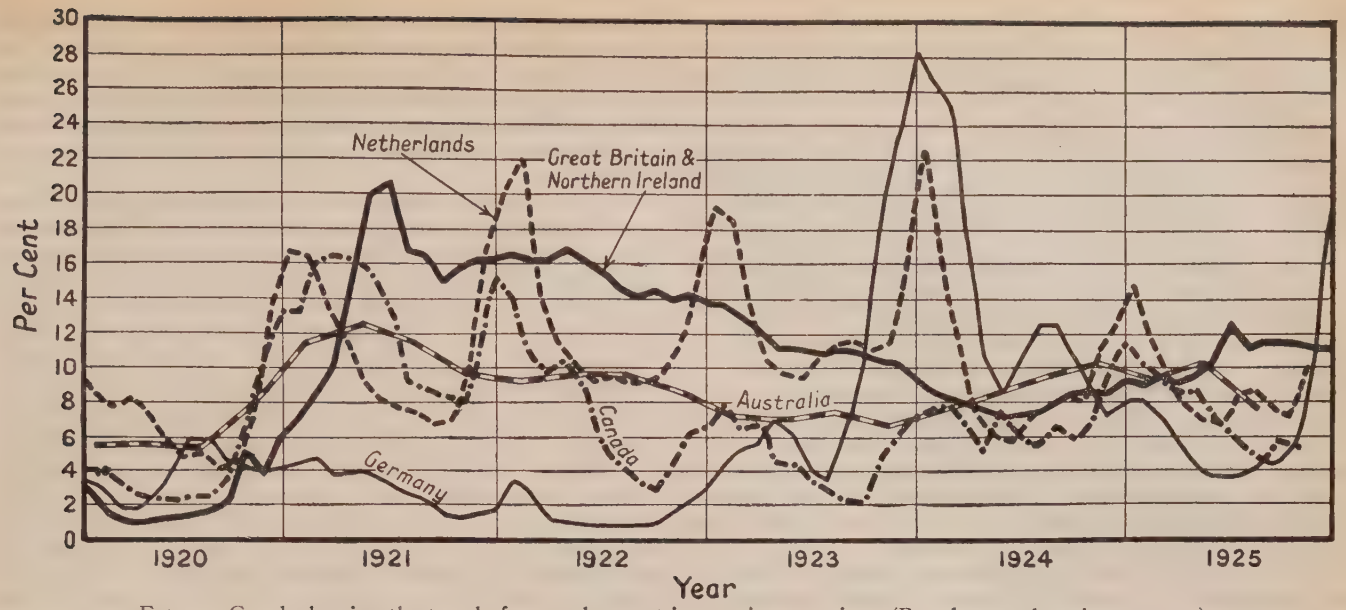

FIG. 2.—Graph showing the trend of unemployment in certain countries. (Based on trade union returns.)
(*Ministry of Labour Gazette.*)

the War and for the production of which there is now neither home nor foreign demand on the same scale as before" (*Unemployment*, 1920, 1923, p. 113: International Labour Office).

But though fresh light has thus been shed upon some aspects of our more normal economic life, especially upon its financial side, the war-origin of these phenomena disqualifies this depression from figuring as a safe study for those who seek to understand the more regular cyclical movements of industry.

II. THEORIES OF CYCLICAL UNEMPLOYMENT

The Physical Theory.—For convenience the explanations of the origin and causation of cyclical unemployment may be placed in five classes, not indeed mutually exclusive but presenting different aspects and starting points.

The first may be termed the physical theory, dealing with the meteorological factor in trade fluctuation, which first came to the attention of economists by the work of Prof. W. S. Jevons, who claimed to establish a connection of the appearance of sun spots with climatic conditions affecting harvests, and thereby the productivity and purchasing power of the world. Though later astronomical records give no support to the sun-spot theory, attempts have been made by Mr. H. S. Jevons and Sir W. H. Beveridge to relate climatic variations with food supplies and general trade. But though there is nothing inherently improbable in such correlations, the case presented in statistics is not convincing, even if allowance is made for what may be called accidental lags. The restricted scale of the crop-records, both as to areas and kinds, the dubious reliability of the earlier records, the combination of various minor and major waves, the overlapping of supplies from year to year, especially in modern times, the limited effect which such crop variations as are shown could exercise upon the total industrial activity, deprive this class of explanation from any claim to more than a minor speculative interest.

That variations in harvests, if they are considerable and widespread, will exercise some influence upon industrial output, transport and employment, is undeniable. If foodstuffs and raw materials are produced in diminished quantities at higher selling prices, the processes which work them up, carry and distribute them, will be reduced in the employment they afford. Not, however, necessarily to an extent corresponding with the crop-shortage. The effect will be greater when trade is very active than when sluggish and over-stocked. The argument, often stressed, that in bad seasons the agricultural classes, having less spending power, will reduce their purchases of other goods and services, and so spread depression, cannot be accepted without qualifications. If it were true, as is sometimes held (*e.g.*, Hull, *Industrial Depressions*, p. 45, etc.) that small crops often bring in as much money as big crops, the argument would of course collapse. But the varying elasticity of demand for different articles makes it pretty certain that a widespread bad harvest has some effect in reducing the purchasing power of the rural population. Moreover, the rise in food-prices will reduce the expenditure of the industrial classes upon other goods, causing a total shrinkage of demand that must affect employment. But having regard to better crop information, quicker and more reliable transport over wide areas, improved finance for stimulating, moving and marketing raw products, better instruments for storage and preservation, climatic causes ought to play a constantly diminishing part in cyclical fluctuations.

The Accidental Theory.—Under this head may be placed those who, discarding all general views of causation, impute trade depressions to a variety of unconnected occurrences, sometimes political, such as wars and revolutions, or natural, such as droughts or floods, or business, such as the collapse of active railroad enterprise, or financial, such as a banking crisis. Local troubles, thus brought about, spread by contagion or infection, until they have depressed the entire industry and commerce of large sections of the world. It is undeniable that one or more of such injurious occurrences, a bad monsoon, a war or revolution, a "Black Friday" or an Australian bank collapse, may and does play quite a distinguishable part in precipitating a crisis of trade and ushering in a period of depression. But most of these events belong to human conduct and are due to economic forces wider and longer in their operation than the catastrophic acts which figure as immediate causes of financial or industrial trouble. There is sufficient regularity in these cyclical fluctuations to enable us to dismiss as inadequate the view that regards them as pure accidents.

The Psychological Factor.—Business action is so dependent upon beliefs and feelings that some economists use language implying that industrial prosperity and depression are little else than reflections of a rhythmic movement of confidence and dejection in the minds of men. This psychological rhythm, operating upon industry through credit (the financial index of confidence) they regard not merely as an accompaniment and agent, but as the chief efficient cause of industrial fluctuations. Starting with the assumption that the business mind is by nature prone to these alternating elations and depressions, and that they are quickly and easily communicated by business leaders to the rank and file, the theory of independent psychological causation becomes plausible. In times of rising confidence business men seek to borrow freely from the banks, and the investing public to extend their profitable business operations. Bankers,

sharing the confidence of their customers, make large advances upon reasonable terms at such times, and new capital is forthcoming to extend existing businesses and open new ones. This wave of confidence having spent its force in thus stimulating credit and industrial activity, begins to subside, credits are restricted or called in, because of a belief that trade is going down, and this belief and restriction are the means of reducing the volume of commerce and contracting business operations. Thus a depression is brought about "because of their unbelief."

Credit Fluctuations.—This separate presentation of the psychological movement, however, is uncommon. The connection of these fears, hopes and illusions with "credit" is so close and obvious that it is here we must seek for the connection between the moral and material aspects of a cyclical fluctuation. If everyone bought with his own money alone, business operations, though more restricted and less productive, would be subject to smaller variations in volume and value. The worth of the credit and investment systems is that they permit the rapid seizure of opportunities for profitable expansion of industrial activity. The concrete productive forces of land, capital and labour are thus handled to greater advantage.

Courses of the Cycle.—How credit actually operates in the cyclical movement is best seen by following the general course which such a cycle takes. In tracing this course it is well to begin from the start of a trade revival. When a depression with low production, low prices, profits and employment, has continued for some time, the excessive stocks which, because they could not get sold fast enough, congested the wholesale markets at the beginning of the depression and brought prices down, show signs of approaching depletion. It becomes evident that the current rate of production will soon be inadequate to meet the effective demand at the present low level of prices, and that, to stimulate production, prices are going to rise. Merchants handling wholesale trade are usually most sensitive to the situation, and are the first to take action. Anticipating an early expansion of sales at higher prices, they seek to make contracts with manufacturers and other producers for future delivery of materials and goods upon a larger scale.

These producing firms seek to replenish their lowered stocks of raw materials, fuel, etc., to improve and enlarge their plant and to take on more labour. The fundamental and instrumental industries such as mining, iron and steel, engineering and shipbuilding, where depression and unemployment have been deepest, must set to work at once in order to make timely provision for the renewed activity in the later stages of production. Merchants, manufacturers and makers of instrumental capital must all seek the assistance of banks for the means of making these expansions. Since bank customers during a depression find a difficulty in getting safe or lucrative investments for their savings, bank deposits are swollen, and partly from this source, partly from the banks' own resources, the credit required, both for increased working capital by short loans, and for more permanent investment, is obtainable from the banks and the investing public.

The limits set upon such expansion are slow to appear. For, in the earlier stages of the process, the well-founded conviction of bankers that there is a genuine revival of trade which permits them with safety and profit to make advances to customers, and the possession of large unused cash reserves, seem to make liberal credits a good banking policy. Thus business men are able to go ahead with increased production, absorbing the capital and labour that had lain unemployed, and enlarging the volume of output and sales at prices which yield an increasing margin of profit. But, when the movement has gone a certain way, two things happen. As soon as the productive power of industry, especially in the great machine trades, has been in full play for a little time, merchants begin to realise that they can get quicker deliveries on easier terms than when the revival began, and as prices are still high and profits large, they become speculative holders of large supplies, applying to their banks for credit to assist them in this policy. The confidence which a genuine revival has inspired, and the belief that prices will go higher still, induce the banks to aid and abet what is in reality a speculative boom in which prices for a time may rise higher than the level to which the industrial boom has brought them. It is now generally recognised by financial experts that insufficient knowledge of actual trade conditions is largely responsible for carrying the cyclical wave of prices to an excessive height by this undue use of credit.

Wages and Prices.—The other thing that happens is even more crucial in its consequences. In the revival of trade the rise of wages continually lags behind the rise of prices. This means high profits for traders, and no considerable risk for bankers with their large cash reserves. But when the revival has reached its height and prices remain fairly stable at a high level, wages creep up and the workers demand their share of the prosperity. This brings simultaneously a cut in profits, that in some measure weakens the borrowing power of the business man, and a reduction of the bank reserves of currency to meet the weekly demands of the higher wage-bills. As cash reserves are reduced, the banker takes alarm, and, following his customary policy, raises his rates, restricts further credit and calls in loans. This forces business men to realise on their stocks, prices fall with a rush, orders fall off, production slackens and unemployment sets in. The fall of prices, accompanied by a fall in profits and later on in wages, does not stimulate enough increase of demand to check the process of depression. So the circle comes round.

This presentation of the cycle tends to support the view that trade fluctuations are pre-eminently credit cycles, the efficient causation of the movement coming from the money side. There are those who appear to hold that a stronger, clearer-sighted and more disinterested banking policy could stop altogether great trade fluctuations, except so far as they might be due to great natural or political interferences. If bankers, they argue, would rigorously check further emissions of credit to traders when industry had reached its full activity with capital and labour fully employed, the speculative part of the boom with its rocketing of prices would be stopped. Or if, again, they were more cautious in restricting credit later on when the tide was beginning to turn, the collapse of prices and restriction of output which ensued might be avoided. A more judicious and public-spirited bank policy might, at any rate, cut off the peak of the trade curve and maintain a large degree of stability of prices and production. The prime cause of unemployment, according to this diagnosis, is the inelasticity of the modern monetary system.

The Under-Consumption Theory.—A fourth school of thought fastens upon under-consumption, or failure of consumption, to keep full pace with the swelling current of production, as the main efficient cause of unemployment. Their argument runs thus: In any economic society, the current condition of the arts of production and standards of consumption will determine, not only how much productive power of capital and labour can be economically employed in the several processes of industry and commerce required for turning out the different sorts of consumable goods in their due proportions, but also how much of the current increase should be applied to taking out consumable goods for consumption, and how much to stimulating the increase of productive capital in the various processes of industry. If too little is expended in the latter way, *i.e.*, if savings are small, then there will be an insufficient provision for a rising standard of living for a larger population in the future. If too much is "saved" and too little "spent," there will come into being a larger amount of productive capital in plant, tools, materials, etc., than is required to turn out the consumable goods that get bought and consumed. Though any individual, or group of people, may save as large a proportion of their income as they like without inconveniencing the economic system, economic society as a whole is restricted in the proportion of the general income that can usefully be saved by the condition of the arts of industry.

In a primitive society very little industrial capital can be utilised: a modern industrial society affords a great scope for saving and investment. But there is always a limit in the pro-

portion of income that can be economically utilised as new capital. If that limit were passed, too much capital being created for the supply of the quantity of consumables that were purchased for consumption, a stoppage of industry would take place, some of the industrial plant standing idle or half-used, with a congestion of unsalable goods accumulated either earlier or later in the processes of production. The actual over-production of consumables, or even capital goods, need not go far; the real mischief will consist in the slowing down of the entire process of production with a stoppage of the worse-equipped or worse-placed plants. As this productive plant slows down or stops, a corresponding body of unemployment is created. Real and money incomes are thus reduced: profits, the main source of industrial savings, shrink, most other business incomes fall, so that the proportion of savings is let down for a time far below the true normal. Spending does not fall proportionately, so that gradually the congestion of the economic machine is released, goods being taken out faster than they are being replaced. Weaker firms during the depression have gone out of business, and little new plant has been created.

When this double process of depleting stocks and letting down plant has gone so far that irreducible consumption is tending to exceed current production so that prices begin to turn upwards, this indication of an approaching revival of trade stimulates merchants and manufacturers to prepare for the revival. That preparation involves primarily a renewed activity in the fundamental and instrumental industries, in order that more manufacturing plant and larger supplies of raw materials may be ready for the expansion in the later processes. The mining, metal, engineering and transport trades, which depression had hit hardest, revive earliest and fastest, for their increased output is a prior condition to full activity in the manufacturing processes. For this process of revival an expansion of bank credit and of currency is a necessary instrument and adjunct, but the efficient causation of the movement does not proceed therefrom.

A variant of this under-consumption theory attributes depression to an over-investment in the instrumental and constructional industries, due to an over-estimation of the intensity of future wants which, operating in the immediate interests of the business classes, restricts consumption by putting an excessive proportion of productive power into industries the consumable fruits of which are long delayed and cannot in fact justify the amount of productive energy directed into them. The position is thus stated by Mr. Denis Robertson:—

> Since each new investment, once it is made, will be capable of functioning for a considerable period, the rise in the utility of new constructive goods will often in any case only be temporary; a point will be reached beyond which any further investment would involve a sacrifice of present enjoyment disproportionate to the enjoyment which will be afforded by the new consumable goods which it is proposed to create. In fact, however, owing to the stress of competition, aggravated by the length of time which must elapse before the new instruments projected can be brought into working order, investment is likely to be carried beyond this point. (*Study of Industrial Fluctuation*, p. 240–1).

This view, that an opposition of interests exists between the investing classes on the one hand and the working-class consumers on the other, is reinforced by the writings of Mr. Veblen (see especially *The Engineers and the Price System*), who charges the former with practising a sabotage of industry, by chronic restriction of productivity and output in order to make larger profits out of regulated prices.

Over-population Theory.—Neo-Malthusians often explain unemployment as a necessary implication of the tendency of population in certain countries, or in the world, to increase faster than the means of subsistence, or the growth of the fund of capital required for their employment under modern industry. From the assumption that a given area can only support a limited population in employment upon such a standard of living as is required to sustain a family, they argue that in many countries the limit has been passed, and that though there may be other areas capable of bearing larger populations than exist at present, the transfer from over-peopled to under-peopled areas is so much impeded as to leave in the former a considerable surplus over the normal economic requirements of the labour market. Though for a time in certain favoured lands the pressure of the law of diminishing returns to agriculture may be offset by high productivity of manufacture, the surplus of which may be used to purchase increasing supplies of foods and raw materials from newly developed lands, the difficulties of this economy increase as the more fruitful of the backward countries advance in population and in the development of their own industries.

Moreover, the restrictions of tariffs on the one hand, and free migration on the other, make the natural adjustments more difficult. The World War not only stopped the normal emigration by which congested European countries relieved themselves, but stimulated the erection of new barriers, especially by checking the flow of European labour into the United States. On the other hand, the losses of the War and the lower birth-rate and reduced growth of population signify a considerable reduction in the numbers entering the labour-market in these countries, especially later on when the full force of the lower birth-rate is represented in adult numbers. So far as a reduced population carries with it a better distribution of income, through higher wages, it may, in accordance with the under-consumption theory, stimulate a larger volume of demand and more employment. But statistics do not sustain the view that comparatively sparsely peopled countries like the United States, Canada and Australia, escape periods of unemployment that are as large proportionately as those of thickly peopled Europe. While, therefore, the world volume of employment is evidently increased by mobility of labour, as of capital, from one country to another, retardation of migration cannot be regarded as a major cause of cyclical depressions and unemployment.

III. REMEDIAL MEASURES

Commercial Organisation.—The remedies for unemployment, of course, vary with the different theories of the causation of the trouble. Orthodox economists, attributing it to a combination of unpredictable natural causes and business miscalculations, chiefly rely upon improved organisation of markets, communications and finance, to reduce and alleviate the fluctuations. Even the natural causes can be considerably abated by increasing the dispersed sources of supply, and by better crop hygiene. But their main remedies are fuller and more reliable statistics, better business education, publicity of trade information, sound banking, with its steadying effect upon the minds and methods of business men, and, finally, the more controversial proposition of a willingness of organised labour to assist the recovery of trade by accepting lower wages when prices and profits have fallen. Misapplications of productive power, with their attendant losses and stoppages, could thus be averted. Business men, investors and workers would have the fuller confidence and security which better understanding of all factors in the business situation gives. Planning would be improved, speculation would be more enlightened and greater stability of industry, prices and credit would exist. This view is stated in the following terms by Sir W. H. Beveridge (*Unemployment*, p. 193):—

> Unemployment is a question not of the scale of industry but of its organisation, not of the volume of the demand for labour but of its changes and fluctuations. The changes are of several types; trades decay or are revolutionised by new machines. Through these changes particular parts of the labour supply get displaced. Unemployment arises through their difficulty in getting re-absorbed. The fluctuations, also, are of several types; some co-extensive with the economic life of the nation; some peculiar to certain trades; some purely local or individual. To meet these fluctuations—cyclical, seasonal and casual—there are required reserves of labour power. Unemployment arises as the idleness of these reserves between the epochs when they are called into action. The solution of the problem of unemployment must consist, therefore, partly in smoothing individual transitions, partly in diminishing the extent of the reserves required for fluctuation or their intervals of idleness, partly, when this plan can go no further, in seeing that the men of the reserve are properly maintained both in action and out of it. The problem is essentially one of business organisation, of meeting without distress the charges and fluctuations without which industry is not and probably could not be carried on. It is not a problem of increasing

the mere scale of industry. It is not a problem of securing a general balance between the growth of the demand for labour and the growth of the supply—for this general balance is already secured by economic forces—but one of perfecting the adjustment in detail.

Banking and Currency Control.—Those who hold trade cycles to be pre-eminently credit cycles seek remedies for depressions and unemployment in a more intelligent control of banking and currency. Since these fluctuations are brought about by price changes, the aim should be to stabilise prices, or at any rate to keep the fluctuations within narrow limits. If any economic events, affecting the supply of goods, tend to raise or lower prices, the supply of money should be increased or diminished so as to compensate for such disturbance. A depression in which capital and labour lay unemployed because prices were too low to cover costs of production should be met by emissions of credit which by raising prices would stimulate industry. These small doses of inflation would, it is contended, enable industry to absorb the unemployed capital and labour, by raising prices to a level which sufficed to yield reasonable rates of wages and profits. Then, when industry was brought into full activity, prices should be stabilised at that level, and a monetary policy devised to keep them stable. Some financial purists, objecting to the inflationary method, would wait for general trade causes to produce a revival and would then apply the stabilising policy.

There are various methods advocated for stabilisation. Some are based on the retention of the gold standard. The volume of currency could be expanded or contracted by increasing or reducing the quantity of gold in the unit of account. This is the essence of Prof. Irving Fisher's proposal of a "compensated dollar." Others would follow an elastic policy of expansion or contraction, operated by a central bank in conjunction with the Government, whereby alterations in the discount rate should be fortified by a selling or purchase of public securities. Others, again, regarding a gold standard as a hampering factor in the situation, would regulate the quantity of credit and currency by exclusive attention to the demands of trade, at any rate for purposes of intranational payments, gold being retained exclusively for purposes of international exchange pending the possible future development of a reliable federation of national banks pursuing an agreed international policy for the emission of credit and currency. (*See* CURRENCY.)

Various critics of established monetary systems in recent years attribute depressions to the failure of the volume of purchasing power to correspond with the actual or potential volume of goods. All that could be produced could not get sold, because of the lack of money in the hands of would-be purchasers. This is sometimes attributed to the credit system, operated by the "money power" which by financing trade raises costs of production and selling prices to a height greater than the purchasing power distributed among the owners of the factors of production at the various stages. On this view, it is necessary for the State bank, or other money-makers, to provide a supplementary supply of purchasing power in order to furnish adequate markets for all the goods which the economic system could produce.

Taxation and Income.—Between the financial doctors and the under-consumptionists there is this common ground, that both find that the reason why goods cannot get produced in bad times is that there is an insufficiency of purchasing power in the hands of the consuming public to buy them at a price covering their costs. But most under-consumptionists attribute this insufficiency to a maldistribution of income. An insufficient proportion of the actual or possible income passes to the classes who would spend most, an excessive proportion to those who would save most. This, as we saw, leads to an attempt to put into concrete shape and activity a larger quantity of capital than can function productively in turning out the volume of consumable goods that can be taken out of the productive system to be consumed. Those who accept this diagnosis find the only valid remedy in measures for a better, or more equal, distribution of income. Measures of taxation devised so as to take rents, excess profits, windfalls and other elements of income that are "surplus," in the sense that they do not evoke productive efforts from the recipient, and to apply them economically to sound purposes of current public expenditure, make for this better distribution. So do political or non-political actions that raise the proportion which workers take in wages out of the general income of the country. Economists favourable to a socialist or labour policy generally hold that a sound test alike for preventives and remedies for unemployment is the absorption of "surplus" income in wages or in public revenue.

Palliative Measures.—The different views of the origin of unemployment affect the attitude of business men, politicians, workers and economists, towards the measures adopted in various countries for the alleviation of the burdens of actual unemployment upon the working classes and the community. Leakage between jobs and other minor wastes may be repaired by employment exchanges where out-of-works may apply for vacant posts. Quick, full and reliable information may here greatly help the mobility of labour. Trade unions, either working with employment exchanges, or on their own account, make it their business to find vacant jobs for their unemployed members. In Great Britain there existed at the close of 1924, 382 employment exchanges, 772 branch employment offices and 324 local employment committees, representing employers, workers and certain other bodies. Where trade conditions are largely of local determination, it may be possible for displaced workers to find a job in some other town or district, or even in some other country. Travelling money is provided by many unions, and in certain continental countries, as in pre-War Germany, relief stations are provided in order to enable unemployed workers to move about in search of work.

Another mode of stopping leakages is a decasualisation policy applied chiefly to certain classes of dock labour, where the inherent irregularities of the trade are intensified by keeping an excessive reserve instead of tightening up the organisation of the trade. Seasonal fluctuations may be similarly remedied by transference from one seasonal trade to another. This is probably applicable only to low-skilled work. "Building, with all the country occupations—harvesting, fruit picking, hopping—on the one hand and the gas-works, the docks and all the exceptional Christmas demand in the Post Office, in shops and elsewhere, offer ample material for a start" (Beveridge, p. 210).

Schools and juvenile employment exchanges can do much to help a better apportionment of young labour among the occupations. At the end of 1924 there were in Britain 140 juvenile advisory committees attached to Employment committees and 145 choice-of-employment committees under local education authorities. Continued education for unemployed boys and girls has made some progress since the War in England, and a beginning has been made in technical or vocational training as a contribution towards improved efficiency of labour and enlarged supply of skilled workers. In Germany vocational guidance has taken on great activity, the number of offices in 1924 being 597, of which two-thirds were working with the employment exchanges.

The Ministry of Labour of Great Britain co-operates with Dominion Governments in finding employment overseas for willing emigrants, though the numbers thus placed are small. There are difficulties on both sides, unemployed workers preferring to await the chance of work at home, and the Dominions exercising a rigorous choice in the personnel of those they admit.

Publicly organised relief works are a device for dealing with unemployment widely adopted in Britain and other countries. In England the unemployment grants committee was established in Dec. 1920, to give financial aid to local authorities in executing "works of public utility designed to secure some measure of relief in districts or in trades suffering from unemployment." The committee operates partly by loans of public money, varying from 50 to 75% of the capital costs of the undertaking; partly by grants amounting to 75% of the wage-bill for unemployed men taken on. Most of the works thus encouraged were dock and harbour extensions, gas, water and electric supply, roadmaking, sewerage works, parks and recreation grounds, construction of public ferries. In addition to the employment

directly afforded by these works, an almost equal amount is provided in factories, etc., for the production of the materials required. During the four and a half years working to June 1925 the estimated capital cost of the approved works was £85,123,371, and the total grants were £68,434,280. The amount of employment thus provided was estimated at 3,181,270 man-months. This policy has conformed to the recommendations of the Minority Report of the Poor Law Commission of 1907 in seeking to even out the total volume of employment by allocating public expenditure as far as possible to periods of depression and unemployment.

Insurance against Unemployment.—By far the most effective provision for the unemployed is by insurance. This began when certain trade unions in Britain and Belgium, about the middle of the 19th century, arranged to pay regular allowances to members out of work. This method of provision has grown in various countries, and has been built into the public insurance schemes of more recent times (*see* INSURANCE, SOCIAL).

There are various outstanding problems in the development of unemployment insurance policy. The widest is concerned with the question whether the basis of insurance should be general[1] or industrial. The latter view is supported on the grounds that each industry is best qualified to deal with its own risks, which, alike in size and origin, differ from those of other industries. The former view stresses the common needs of the unemployed, the difficulty the more fluctuating trades would find in making adequate provision, and the advantages of one instead of many administrative bodies. So far, in countries where compulsory insurance prevails, the general tendency has been towards a single uniform administration, though in the British case certain exceptions are admitted in the 1920 Act. Other difficulties arise as to the interpretation of the "suitable employment" which an unemployed person may not refuse, and of the term "involuntary unemployment" when a strike or lock-out throws out of work members of other trades than that directly affected. How far should insurance cover seasonal and short-time unemployment? A large issue remains, that of the linking up or unification of unemployment with other working class risks in a joint insurance policy. (*See* TRADE CYCLE.)

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UNIONIST PARTY: *see* CONSERVATIVE PARTY.

UNITED KINGDOM OF GREAT BRITAIN AND IRELAND (*see* 27.598).—Under the Irish Peace Agreement of 1921, southern Ireland was made a Dominion of the British Commonwealth. The official name of the rest of the British Isles remained the United Kingdom of Great Britain and Ireland, no provision being made by the British Parliament for a change of title, but from 1922 onwards the name of Great Britain and Northern Ireland was much used in official documents. (*See* GREAT BRITAIN; IRELAND, NORTHERN; IRISH FREE STATE, etc.)

UNITED STATES, THE (*see* 27.612), a federal republic with an area of 3,026,789 sq. m.; and a population 105,710,620 (1920). The estimated population in 1925 was 113,493,720 (U.S. Bureau). The following article opens with a survey of the political history of the United States, this being divided into three parts, dealing respectively with the pre-War, the War and the post-War periods. The second section deals with finance and wealth; this is divided into two portions, one discussing the national finances and the other the amount and distribution of the country's wealth and income. The third section is on production, industry and trade, including agriculture, and the fourth is on population. The fifth and concluding section deals with communications. Other subjects affecting the United States are discussed in a number of articles, for instance, those on the various states of the Union, on its large cities and on its universities. The banking system of the U.S. is described under the heading BANKING, and the question of defence is discussed in the articles AIR FORCES; ARMY; NAVY; PACIFIC; etc. Other articles to which reference may be made include EDUCATION; FOOD SUPPLY; INCOME TAX; INSURANCE; MARKETING; PROHIBITION; TRADE UNIONS; WAGES.

I. POLITICAL HISTORY

The American Nation.—The people of the United States were much more conscious of themselves in 1908 than in previous periods, because they had come to recognise the variety of their make-up. In 1910 the total population of the continental United States was 92,000,000. Of these, only 50,000,000 were native whites of native parentage; 13,000,000 were foreign-born, and 19,000,000 others were of foreign-born or mixed parentage. The negroes and Indians together numbered about 10,000,000. Everybody in the United States except the American Indian is an immigrant from some other country or a descendant of an immigrant. The main race groups are: (1) the descendants of the colonists, who were mainly Anglo-Saxons, with some Germans and Scotch-Irish and small elements of other races; (2), descendants of the Europeans who came over in great numbers from 1820 to 1870; (3), the large number of recent immigrants and their children.

In the opening years of the present century the country was not yet aroused to the dangers arising from this mixture of unassimilated races. Few voices were raised against admitting not only western Europeans, whose languages and customs were much like those of the United States, but men and women from east and southeast Europe and from western Asia. The only bar to immigration based on race was the prohibition, since 1888, of Chinese immigration and the practical exclusion of Japanese labourers by a "gentlemen's agreement" with the Japanese Govt. (1907). There was no intelligence qualification, and little effective exclusion of any kind. The undigested load was becoming heavy.

The immigrants were not the only burden on the state. Millions of American-born, many of them descended from the old colonial stock, were poor or ignorant or criminal. The situation was saved by general prosperity, and by the American spirit of cheerfulness and confident waiting for things to come right. Furthermore, out of unpromising conditions had arisen such strong figures as Abraham Lincoln and William McKinley. The American Indians were a small separate race, of only about 250,000. The negroes, about 10,000,000 in number, were unorganised as a race, and were scattered over a large area, mostly in the south. Legally equals of the whites, they were subject to humiliating discriminations, and in north and south alike were held in an inferior social position from which there was no escape.

Defects in Government.—The units of American society were held together by a strong, if complicated, democratic government, well fitted to rule a diverse population. The political forms were familiar to every school-boy: (*a*) A group (in 1910) of 46 states, each with its own government rigidly confined by the traditional principle of "checks and balances" into three departments, legislative, executive, judicial; (*b*) a widely distributed franchise almost equivalent to universal suffrage for adult males; (*c*) a belief that the courts were the highest authority, not only as to questions of personal rights and duties, but as to the validity of the laws and acts of the other two departments; (*d*) local government of city and town, township and county. This combination of governments was expensive; it

[1] If it is held that the main object of insurance is merely to alleviate the effects of social risks by compensating the sufferers, this would lead to the preference of a general system of insurance against all risks, since they all equally involve the loss of wages or earnings. If it is considered, on the contrary, that insurance should aim essentially at preventing or minimising risks, and compensating the sufferers only when such prevention fails, differentiation according to risk naturally seems preferable (*Employment Insurance*, p. 134, Geneva, 1925).

was not highly skilled; but it was supported by the conviction of a large part of the population that it was the " best government on earth."

The boast of the United States was its equal opportunity—the pride of the United States was its popular government, in which the will of the people was considered to be the only ultimate force. As a nation, Americans believed that they had, more than any other country in the world, the blessings of personal liberty, of free public education, of sharing in their government, of impartial judges. Everybody was supposed to have a fair chance in life.

In the organisation and conditions of business there could be traced some startling contradictions between the word liberty and the fact. Nominally all kinds of business not prohibited by law were open to all comers in free and honourable competition. In reality, by 1908, a considerable number of both employers and employees were engaged in a combat outside the laws, constant and conscienceless. It was hard for individuals and firms to compete with corporations, and hard for small corporations to compete with large ones. The railways were among the most conspicuous of the large corporations, and they, too, tended to combine into larger and more powerful units. The states could not deal adequately with these powerful bodies because most of the railways and many of the other corporations operated from state to state, and could not be controlled at either end by anything short of federal power.

Political organisations were on nearly the same basis as business companies: they also grew bigger and more powerful and gathered into fewer groups. Nominally, parties are simply associations of voters for common ends. Actually, they are armies acting under commanding leaders who in many cases hold no offices. The evils of this " invisible government," as Elihu Root called it, were apparent. The political philosophy of Americans was based on the belief that mankind was steadily growing better. Hence a tendency to rely upon laws and political devices for correcting the ills of popular government. There was a glacier-like force of public opinion that could break down all opposition. What was most needed was the leadership of bold and far-seeing men.

Political and Social Problems Before 1917

Finances and the Tariff (1908–13).—Every growing unit in the country was harassed by questions of taxation and expenditure. The U.S. Govt. also was searching for new resources, and found them in the income-tax. This was made possible July 13 1909, by the submission of the 16th Amendment to the Constitution, which came into effect Feb. 25 1913. Another new resource of the Federal Govt. was a tax upon corporations levied on net income (Aug. 5 1909). The important question of reorganising the national banking system, so as to furnish a strong national institution, was debated from 1908 to 1912, and was the subject of an elaborate report by a National Monetary Commission; but no action was taken at that time. The net Federal debt was $1,000,000,000, or only about $11 per head of the population.

A financial resource over which Congress had sole authority was the tariff. Under strong pressure from members of the party to carry out the promises of the Republican Convention of 1908, President Taft, a few days after his inauguration, summoned Congress to meet in special session, for a " revision " of the tariff. As usual there was a long controversy, which resulted (Aug. 5 1909) in the Payne-Aldrich Tariff. The Act created a permanent court of customs appeals, with power to determine finally all questions as to the value of imports, together with a Tariff Board, expected to make investigations and recommend specific measures which Congress might adopt. As to rates, the Act was not very different from its predecessor, except for a decided increase of duties on cotton and silk manufactures. There was a loud outcry that the " revision " intended by the party platform was plainly a revision downward and not upward. Nevertheless President Taft signed the bill, and in a speech at Winona, Sept. 17 1909, surprised the country by declaring that it was the " best tariff bill that the Republican party has ever passed." In the campaign of 1912 the tariff played very little part. It was recognised that a considerable revenue must be raised by import duties; and the large import trade showed that the existing tariff was not prohibitive.

Political Reform 1908–13.—When Roosevelt left the presidency in 1909 the position of President was at the highest point of authority that it had ever known. Most presidents have found their principal legislative influence in the veto; Roosevelt had followed the McKinley method of emphasising his wishes in personal discussion with members of Congress. He did more: he revived the Jacksonian method of announcing a legislative plan, and if Congressmen hung back, of appealing over their heads to the country at large. A similar policy was adopted by President Taft, who had many of the qualities of leadership. He was large, happy, genial, fond of his many friends; a cheerful, balanced man. He had served as first civil governor of the Philippines and as Secretary of War in the Cabinet of Roosevelt, who practically designated him as his successor. Nevertheless, as an avowed inheritor of Roosevelt's policies, he drew upon himself the opposition of Roosevelt's enemies while it soon became apparent that he was not relying upon Roosevelt's friends.

At this time " the primary " method of selecting candidates was spreading rapidly through the Union. Candidates for each party were selected by the ballots of the people, thus undermining the convention system. From nominations for local officers the new method had spread, by 1911, to state officers in numerous states; and after 1910 it began to be applied to the choice of delegates to the national party conventions. An unforeseen effect was that the official ballots were made upon the basis of party nominations, with an opportunity for independent voting. The primary thus became a part of the system of public elections, and therefore the party system was engrafted on public law, as a part of the Government.

The distrust of conventions and controlled elections extended to the numerous and powerful bosses in city and state Legislatures. Three new devices were set at work to curb them and to interest the electors in public measures. The first of these, the " referendum " (*q.v.*), was by 1909 spreading rapidly through the western states, as a means of checking legislative action contrary to public sentiment. The system, both in local and state government, can be traced from colonial times: most 19th-century state constitutions were submitted to a popular vote, and also many statutes if the Legislatures so directed. The referendum system furnished a mechanism, usually imbedded in state constitutions, by which on the demand of a sufficient number of voters, a statute could be held back from effect until submitted to a vote of the electors. What was to be done if the Legislature refused to enact a statute demanded by the people? The " initiative " was invoked, by which a designated number of voters could unite on a measure, which must then be submitted to the electors for their suffrages. Objection was made to all these methods as unconstitutional because they substituted direct action for representation. The referendum had been so long and widely used that it was hard to make out a case against it. The initiative was based on the general principle that the ultimate source of authority is not the Legislature or any public officer, but the people at large. In a test case (Feb. 1912) the Federal Supreme Court declined to rule that the initiative and referendum were contrary to a " republican form of government."

A third branch of this system of appeal to the people was the " recall " (*q.v.*), under which a public officer chosen by popular vote (and in a few cases those who were appointed in some other way) could be subjected to an election; and, should the majority decide against him, be thereby removed from office. In 1911–2 the question came up in connection with the proposed constitution of the new State of Arizona, which included a provision for the recall of judges. Because of this provision President Taft vetoed the Act of admission. The state withdrew the clause, was duly admitted in 1912, and thereupon proceeded to reinsert the recall. In practice, recalls proved to be few, and recalls of judges very few. A still wider application of the

principle of the responsibility of functionaries to the voters was the "recall of judicial decisions," which was advocated by Roosevelt in 1912, but proved to be more than the country desired.

United States Senators, till then chosen by State Legislatures, were next made subject to popular choice. Urged by public sentiment Congress submitted (June 12 1912) the 17th Amendment, which was duly ratified and added to the Constitution (May 31 1913). Under this, all elections to the Senate were to be made by direct popular vote. Another evidence of a rising feeling of responsibility in Congress was a statute (Aug. 7 1911) requiring candidates for the House and Senate to submit statements of the money raised and expended in their behalf and limiting the amount which they themselves might spend. One purpose of both these measures was to make it difficult for men to purchase their way into the Senate. On July 13 1912 Senator Lorimer of Illinois was practically expelled from the U.S. Senate for buying votes in the Legislature.

Another slow reform was in the ballot system. Most cities, towns and states were loaded down with long lists of the officers to be chosen. The result was an agitation for the reform commonly known as the "short ballot," by reducing the number of elective officers and increasing the officers to be appointed by the few elective officials. Working difficulties were found in many of these reforms. It was hard to keep the public keyed up to the necessary pitch of thought and attention at every election; but it was evident that the American people intended to free themselves from the shackles of "invisible government."

Social Questions, 1908–12.—The spirit of discontent extended to many questions outside of politics. Throughout the Taft administration there was an increasing pressure for "equal suffrage"—that is, woman suffrage—which, introduced in the territory of Wyoming in 1869, had gradually spread among the far-western states, and then begun working its way eastward. Again, both state and national governments were compelled to deal with the question of alcoholic beverages. From the earliest times there had been restriction on liquor selling and liquor sellers as well as punishment for the undue use of intoxicants. By 1909 in almost all states there was some form of general legal restriction—prohibition, local option, high licence or a state dispensary system. The question became national, because the liquor trade transported its wares from one state to another; and that brought it within the Interstate Commerce clause of the Constitution and the Interstate Commerce Act. Eventually by the original Package Act of 1890, Congress adopted the policy of prohibiting shipments of liquor into prohibition states. Pure food laws in force before 1909 were supplemented by the Drug Label Act (Aug. 23 1912), which greatly aided in preventing the adulteration of drugs.

Many questions arose out of immigration. The laws in 1909 forbade the entry of labourers under a contract to work in the United States, of convicts, diseased persons and the insane; but the execution of the laws was slack. The first statute looking toward decided control of immigration was that of Feb. 1907, which increased the grounds of exclusion, and at the same time provided a plan to help the immigrants in finding work. It also created an Immigration Commission, which in 1910 made a report in 41 volumes, strongly recommending the sifting of immigrants by testing their ability to read and write some language. Meanwhile, in the decade 1901–10 the number of immigrants rose to an average of a million a year. Since, however, the record showed that from 300,000 to 500,000 annually returned to their old homes, the actual rate of increase of population by immigration was no more than about $\frac{1}{2}$% annually.

Labour Questions.—Beginning with the common law principle that a combination of labourers to raise their wages was unlawful, the Legislatures and courts gradually changed their position and for many years acted on the counter principle that strikes were lawful. No legal obstacle was put in the way of the right to organise, first, by local trade unions, then by nation-wide unions for single trades, and finally by national unions combining many trades. To this was slowly added by the unions the principle of the "right to labour," which means both that it is the duty of the community to see that the worker has a job, and also that at least the skilled workers have a kind of title in their employment, so that it is contrary to good morals for a "scab" to take the place of a striker.

The legal position of labour unions in these controversies was brought out by suits of national importance against unions. In the test case of Gompers v. Buck's Stove and Range Co., the charge was that the Federation, by posting the company in its publications as "unfair to labour," was boycotting, and thus infringing legal rights. Gompers, president of the American Federation of Labour, was convicted for contempt of Court on the ground that he had refused to obey a court order to abandon the boycott. In 1908 a suit was decided against a union of the hatters of Danbury (Conn.), who had attempted to boycott the products of a local hat manufacturer. The jury found a verdict of $74,000 damages.

In the midst of these labour controversies there sprang up a new organisation, the Industrial Workers of the World (I.W.W.) which was an attempt on a large scale to organise the unskilled labourers, and to reach the goal of "one big union" for all trades. The movement was unwelcome to the unions of skilled labour. Strikes were frequent and often accompanied by acts of violence. Another phase of the labour situation was the spread of employers' liability laws through various states, and the passing of an Act of Congress (April 22 1908) for the protection of the employees of interstate railways. In June 1912 Congress added to its previous enactment of an eight-hour maximum regular day for public employees, by providing that all contract work for the Federal Govt. must also be on the eight-hour basis. As most labourers were voters they brought powerful influences to bear on state Legislatures and on Congress in favour of labour. On the other hand, the courts, particularly those of the states, were slow to recognise the changes in industrial conditions.

In addition, the courts began to use a system of labour injunctions: workman, labour unions and their members were ordered to abstain from committing acts which if committed would presumably violate a law and would therefore lead to a prosecution, in which the question of guilt or innocence could be settled by a jury. Instead, the courts by injunction would decide on the responsibility and affix a penalty not specifically laid down in any statute.

For years there was a Labour or Socialist Labour national party, which regularly nominated a candidate for the presidency and cast a small popular vote. It could not make progress because it was undercut by a standing Socialist party which cast from half a million to a million votes. Hence, in all the shifts of politics very few avowed Labour candidates were elected to state Legislatures or Congress. Furthermore, the members of the labour unions, about 5,000,000 all told, were not more than one-eighth of the men and women in the United States who worked with their hands.

Trusts and Transportation 1887–1912.—During the 20 years ending with 1910 it became clear that the most difficult question before the U.S. Govt. was the regulation of the vast aggregates of capital, commonly called trusts (*q.v.*), which, combined into corporations, aimed at the control of particular lines of business, and also of the railways. The efforts of Congress to adjust the question were registered in two lines of restrictive statutes, headed by the Interstate Commerce Act of 1887 and the Sherman Anti-Trust Act of 1890. Upon these was built a structure of decisions by the U.S. Supreme Court. To carry out and partly to avoid these decisions, the Mann-Elkins Act of June 18 1910 widely extended the Interstate Commerce Acts by including telephones, telegraphs, express and sleeping-car companies, and setting up a Commerce Court which was to render decisions on transportation questions. Federal control of railways on the whole worked well. The commission was a striking example of disregard of the principle of separation of powers, inasmuch as it was a rule-making body, an executive body, and a court which interpreted its own rules, subject as to some questions of appeal to the Federal courts.

The great problem of the trusts was much farther from a solution than that of the railways, because the large corporations were linked together through the holding and manipulation of stocks by capitalists and banks, and through the so-called "interlocking of interests." The only effective way of dealing with large corporations whose activities extended from state to state was to bring suit against them for monopolising or conspiring to monopolise in their lines of trade. It was considered a triumph when (May 9 1911) the U.S. Supreme Court rendered decisions against two of the most powerful trusts—the Standard Oil Company and the American Tobacco Company. The Court held that the anti-trust legislation must be interpreted by the "standard of reason"—namely, that a combination was not unlawful or against the public interest unless it actually caused a restraint of trade and commerce among the Federal states or with foreign nations. Having thus set up a "rule of reason" which Congress had refused to enact, and having created an example of judicial legislation, the Court proceeded in both the pending cases to hold that the companies were guilty of attempts to monopolise their lines of trade. As to penalties, the Court contented itself with ordering the offenders to disintegrate. Thenceforth the "rule of reason" required that positive proof must be adduced that a great combination was doing harm before it could be touched. The general danger of vast aggregations of capital was left out of account.

Foreign Affairs.—The fields of the diplomacy of the United States for the last hundred years have been American, Pacific, and in a much smaller degree European. In the Second Hague Conference of 1907 the U.S. delegates urged international arbitration; and in accordance with the general principles put forth at that conference, Elihu Root as Secretary of State secured 25 arbitration treaties with as many countries (1908). The United States and Great Britain arranged (Jan. 27 1909) to refer to the Hague tribunal their long-standing dispute on the Newfoundland fisheries. The result was a decision acceptable to both sides (Sept. 7 1910). President Taft, through Secretary Knox, secured in 1911 arbitration treaties with Great Britain and France; but the Senate insisted on inserting in these documents a reservation of all questions involving the "vital interest, the independence or honour of the nation," and in 1912 it refused to approve them. A long-standing difficulty with Russia, caused by the refusal of the Russian Govt. to recognise passports issued to Jews and some other people, was suddenly accentuated when (Dec. 18 1911) the commercial treaty of 1832 with Russia was abrogated.

In 1911 the Republican majority under President Taft's leadership initiated a policy of commercial reciprocity with Canada. An agreement was made with the Canadian Govt. by which each side should by legislation reduce or abolish duties on certain raw products and manufactures. With great difficulty the necessary bill was pushed through Congress (July 1911); but two months later the Canadian electors refused to support the reciprocity agreement, and the plan broke down.

Latin America.—Notwithstanding the position of the United States as the responsible holder of the Philippine Is., and hence an Asiatic power, the tradition of isolation continued to be a strong force in the public mind. Nevertheless no formidable public protest was made to a policy of special American intervention in Mexico, the Caribbean and the Isthmus region. The arrangements of 1902 made Cuba practically a dependency, subject in the last resort to decisions from the White House. President Taft continued the occupation of the Dominican Republic; consent of the Senate under a treaty to that effect having been obtained by Roosevelt in 1907. In 1911 Mr. Taft secured a convention by which Nicaragua gave exclusive canal privileges to the United States.

The Panama Canal was now approaching completion and the little Republic of Panama, which it bisected, though nominally an independent state, was in fact under American control. An Act of Congress was passed (Aug. 24 1912) for laying tolls on shipping, from which American ships engaged in coastwise trade were to be relieved. The British Govt. lodged a protest on the ground that by its treaty with the United States the Canal was to be opened on equal terms to the ships of "all nations"; President Taft, however, stood by the Act, and the question was passed on to the next administration (*see* PANAMA CANAL).

Still more serious were the relations with Mexico, where, in 1910, a revolution headed by Madero, assailed the long established government of Porfirio Diaz and drove him after a few months out of the country. Mexico was thrown into confusion, and President Taft found it necessary to place troops on the border. In 1912 he proclaimed an embargo on the export of arms or military supplies to Mexico. Meanwhile the concessions and property of Americans in Mexico were threatened or destroyed. The Americans who had interests in Mexico began a steady pressure for intervention by the United States.

Pacific Relations, 1908–12.—Across the Pacific, clouds rose on the diplomatic horizon. The commercial treaties with Japan allowed a reciprocal freedom of residence and trade to the nationals of the two countries. The immigration of Japanese was very distasteful to the people of California, who undertook to restrict Japanese children to separate schools. Behind this difficulty was the rising power of the Japanese and their national spirit, greatly enhanced by their victory over the Russians in 1905. In 1908 Roosevelt sent round the world a powerful naval fleet, which visited Japan and was received with elaborate courtesy by a welcoming Japanese squadron exactly equal in number, ship for ship. In the Root-Takahira reciprocal note of Dec. 1 1908 (which was never submitted to the Senate), the United States practically admitted Japan's special interest in Asiatic affairs. The question of Japanese immigration was settled for the time being by a renewal of the commercial treaty (July 24 1911). It continued the previous "gentlemen's agreement," according to which, though claiming a right of immigration into the United States, the Japanese Govt. pledged itself not to issue passports to labourers.

Politics 1909–12.—In the action of Congress on many of the important issues above discussed no party lines were drawn, though such measures as the tariff and new taxes were distinctly Republican. On the tariff, some members from middle western states, particularly Minnesota, voted against the Payne-Aldrich measure of 1909. Another disturbance was due to resentment against the Speaker of the House, Joseph Cannon of Illinois, who exercised an authority that had been accumulating in the hands of Speakers for a hundred years. Through the union of various powers the Speaker virtually had a veto on any measure or proceeding which he did not like. Cannon kept too tight a hand; hence (March 19 1910) a group of Republican "insurgents" joined hands with the Democrats to reduce his prerogatives till the Speaker of the House became simply a partisan moderator.

A new issue upon which both parties were divided was covered by the general term "conservation." Although most of the arable land had passed out of its possession, the Federal Govt. was still the possessor of great tracts of forest, of mineral lands and of water power. Congress in 1902 provided for a system of irrigation, the cost to be advanced by the Govt. and repaid in instalments by the users of the water. President Roosevelt became interested in stopping the waste of timber and minerals, in preserving part of the gifts of nature for future generations, and in retaining public ownership of the utilities of the country, particularly the forests and streams. In 1910 new statutes provided for a fresh classification of land and for the reservation of coal by the Government.

Roosevelt and Wilson.—By 1910 it became clear that the Republican party was weakening, and that President Taft's popularity and influence were lessening. The state and congressional elections of 1910 were unfavourable to the Republicans. The insurgents, who soon came to be called Progressives, gained most of the Republican districts in the west, and the Democrats gained about 50 seats in Congress. This result transferred to the Democrats the control of the House, while in the Senate they secured 41 of the 92 members.

A group of dissatisfied Republicans gathered about Senator La Follette of Wisconsin as a leader and presumptive candidate

for President. Meanwhile state Legislatures were passing primary laws which included the election of delegates to national nominating conventions. This made it easier to break through the old line organisations, as La Follette had done in his own state. Taft's friends and supporters naturally expected that the President would be renominated.

All these calculations were disturbed by the greatest personality in the country, Theodore Roosevelt. A few weeks after leaving the White House (1909) he started on an expedition to Central Africa, and was thereafter received in Europe as the ex-President of the most important of republics and as a commanding personage. He returned to the United States (June 18 1910) to find political conditions little to his liking. Most of his friends had disappeared from the Administration; his policies seemed to him to have been slighted. Taft did not satisfy the ex-President, and the two drifted apart. On Aug. 31 1910, at Osawatomie, Kan., Roosevelt set forth a programme which he called "the New Nationalism," favouring publicity of the accounts and proceedings of trusts, a tariff commission, a graduated income-tax, an adequate army and navy, conservation, protection of labour, and the direct primary with the recall of elective officers. For the time being Roosevelt made no direct movement toward standing for the presidency. Meanwhile several of the western states, particularly California under the guidance of Governor Hiram Johnson, accepted a radical programme of political and social reform. A formal breach with Taft and the open candidature of Roosevelt seemed inevitable. The crisis came when (Feb. 12 1912) President Taft in a speech alluded to the Progressives (evidently having Roosevelt in mind) as "Extremists—not Progressives; they are political emotionaries, or neurotics." This was taken as a challenge, and a few days later Roosevelt openly declared himself a candidate, adding, "My hat is in the ring." In a large group of states delegates favouring Roosevelt were elected.

The Election of 1912.—As the convention held in Chicago approached, the lines of battle were developed. Behind Taft were Barnes of New York, Penrose of Pennsylvania, Crane of Massachusetts, and other "stand-pat" leaders. Among those in favour of Roosevelt were James Garfield of Ohio, Pinchot of Pennsylvania and a strong body of Republican governors. Roosevelt himself went to Chicago, established headquarters, and threw his immense energy and enthusiasm into the campaign. The convention was a scene of unusual excitement. Out of the 1,076 delegates nearly 400 were pledged to support Theodore Roosevelt.

The critical decision was made in the preliminary meetings of the national committee, which was strongly "stand-pat"; for that committee had to decide upon the right of claimants to be inscribed in the preliminary roll of delegates. In the end, every contest except one was settled in favour of the Taft claimants. The shifting of 30 delegates from one side to the other would have brought about a "stampede" to Roosevelt, but they were not to be had. Roosevelt advised his delegates to take no further part in the proceedings. At the final roll-call, June 22, there were 561 votes for Taft, 58 scattering and 107 for Roosevelt, besides 344 Roosevelt men not voting. In the last issue, therefore, Taft had a majority of 50 votes out of 1,070. In the minds of the conservative Republicans Roosevelt was extinct. In the minds of Roosevelt and most of his followers the nomination was a violation of the principles of popular government. Roosevelt openly advised a bolt. This was duly accomplished by a formal Progressive Convention. It met in Chicago in Aug. and nominated Roosevelt for president and Hiram Johnson for vice-president.

Meanwhile the Democratic Convention at Baltimore met under the guidance of William J. Bryan, who was in a position to dictate the choice. The apparently sure candidate was Champ Clark of Missouri, Speaker of the House of Representatives. But under the rules of the Democratic Convention requiring a two-thirds majority, he was finally defeated by Woodrow Wilson, Governor of New Jersey. The platforms of the two old parties were of the usual type. The Republicans declared for protective duties. The Democrats stood by their platform of a tariff for revenue only, additional regulation of the railways and presidential preference primaries. The Progressive platform was a general programme of political reform and "an enlarged measure of social and industrial justice."

Woodrow Wilson's Victory.—Not platforms, however, but men, appealed to the voters. All three candidates took the field. From the first it was clear that the real fight was between Roosevelt and Wilson. The Progressives were well organised, and their convention and campaign included many women. The final question was whether Roosevelt could draw to himself a sufficient number of Democrats to reduce the Democratic vote below the winning point. The result in Nov. showed that the Democrats in the main stood by their regular party candidates. The total popular Democratic vote, 6,286,214, was only about 120,000 less than in 1908. The total Taft and Roosevelt vote combined was almost exactly the same as that of the Republicans in 1900. Roosevelt polled 4,126,020 popular votes to 3,483,922 for Taft; but he carried only six states, with 88 electoral votes, against 2 states with 8 votes for Taft, and 40 states with 435 votes for Wilson. The centre and soul of the Progressive movement was Theodore Roosevelt. He had an ardent habit of mind; he felt intensely; he spoke with tremendous energy and conviction; he was accused by his critics of "inventing the Ten Commandments." He was not only the head of a party, he was the head of a political cult (*see* ROOSEVELT, THEODORE).

Woodrow Wilson.—In that respect he was closely paralleled by Woodrow Wilson, who, on March 4 1913, was inaugurated as President. Born in Staunton, Va., in 1856, of Scotch Presbyterian ancestry, he graduated from Princeton in 1879, essayed the practice of law, then was a professor in several colleges. From 1902 to 1910, he was president of Princeton University. He was an easy and attractive speaker, and had a remarkable literary style. (*See* WILSON, WOODROW.) As Governor of New Jersey during 1911 and 1912 Gov. Wilson had opportunity to show his skill as a party leader and his interest in reform. In 1912 Woodrow Wilson was taken up by Bryan, who saw in him an exponent of the political principles for which Bryan had stood and a President who could meet the Progressives on their own ground. On the eve of his inauguration *The New Freedom* was published, a book based on salient passages from his campaign speeches. It was in effect a confession of political faith, a forecast of what the President intended. He protests against political conditions and methods, and points out the baleful influence of corporations and trusts.

In making up his Cabinet it was only reasonable that Bryan should enter it. He was made Secretary of State, an office for which he had little adaptation. To a new Cabinet office recently created by Congress, the secretaryship of the Department of Labor, Wilson appointed W. B. Wilson, a strict labour organisation man. Lindley M. Garrison, Secretary of War, and Franklin K. Lane, Secretary of the Interior, were strong men. Albert S. Burleson, Postmaster-General, and Josephus Daniels, Secretary of the Navy, had insufficient training for their duties. David F. Houston, of Missouri, was made Secretary of Agriculture, William G. McAdoo, Secretary of the Treasury, and James C. McReynolds, Attorney-General. Most of the members of the Cabinet were men who could be trusted to follow the President's lead. One remarkable statesman not included in this list was Col. E. M. House of Texas, who for six years was the President's most trusted counsellor and political friend without holding any political office. In the minor civil service Wilson carried out his principles by enlarging the classified list of posts which could be entered only by competitive examinations.

A genial man, who could be a delightful companion, full of experience and of Scotch Presbyterian humour, President Wilson had a powerful mind, an amazing skill of expression and an intense belief in the power of ideals to arouse and inspire a people. He thought he had no need of conferences, of feeling the public pulse, of mixing with members of Congress and party leaders, of personally greeting the average voter.

Finance and Tariff 1913.—The election of 1912 carried with it a safe Democratic majority in the Senate and a two-to-one majority in the House. On April 8 1913 the President created a surprise by appearing in person to address the two Houses of Congress jointly at the opening of a special session, instead of sending a written message. This practice he followed throughout his administration, with great effect. He felt himself not only chief magistrate of the nation, but head of the Democratic party, and practically the premier of the Government from whom ought to proceed plans for important legislation.

A special session was called particularly to frame a tariff Act. Representative Underwood, chairman of the Committee of Ways and Means, gave to the new measure his name and experience. The purpose of the statute was to enlarge the free list of raw materials, foodstuffs and some manufactures, to make a moderate reduction of the protective duties, and to correct some of the things which made the Payne-Aldrich Act unpopular. Included in the statute was an income-tax, at last made possible by the adoption of the 16th Amendment (Feb. 25 1913), which was expected to supply any revenue which might be lost by the reduction of duties (*see* INCOME TAX: *United States*). A Tariff Commission was created to make researches into the workings of the Act and to find out what was the actual difference between the cost of labour in the United States and in foreign countries (Oct. 3 1913).

The powerful influence of the President was again exerted to secure a systematic banking system, with the result that (Dec. 23 1913) the Owen-Glass Federal Reserve Bank Act was added to the statutes (*see* BANKING). The principle was to create a national institution, which was to be divided into 12 regional banks, in each of which was a body of directors, besides the central organisation in Washington. In these 12 subdivisions clustered such banks, whether national or state-chartered, as chose to accept. The new institution was also to issue a new form of paper money. The system from the start was recognised as a large national asset. At the same time a Rural Credits Act was passed (July 17 1916), which created a special group of banks to lend money to farmers on the security of their farms. Both banking systems worked smoothly and efficiently.

Transportation, 1914–6.—Under a statute of March 1 1913 the Interstate Commerce Commission was authorised to enter on an elaborate valuation of the railway property throughout the country as the basis of a judgment as to what was a reasonable profit. The Supreme Court supported recent legislation by compelling the pipe-lines to accept the status of common carriers, and by breaking up some of the railway combinations, particularly that of the New York, New Haven and Hartford. Down to the middle of 1916 the railways were doing well on the prevailing low rates for passengers and freight. The Panama Canal was now approaching completion. This was the first great agency of transportation owned and managed by the U.S. Government. President Wilson used to the utmost his personal influence for a bill to repeal discrimination in favour of American-owned vessels, of which the British Govt. had complained; it became an Act, June 15 1914. On Aug. 15 the first steamer passed through the Canal from sea to sea and in a few months the Canal was paying its own way. A new question of transportation was arising through the rapid development of motor vehicles. At first a plaything, then a luxury, by 1908 they were spreading throughout the land. The attention of the whole country was called to the absolute necessity of good roads. In 1916 Congress passed an Act appropriating approximately $85,000,000 to be paid in about five years to such states as would contribute equal sums for good roads.

The Trusts, 1914.—A few hours before the end of President Taft's term a congressional committee reported against the "great and rapidly growing concentration of the money control and credit in the hands of a few men." In June 1914, in a suit involving the International Harvester Co., the U.S. Supreme Court upheld state anti-trust laws. The ring of law and justice seemed to be drawing closer round the great offenders. Yet these offenders still flourished; and huge corporations, such as the U.S. Steel Corp., paid dividends on thousands of millions in stock and bonds. President Wilson urged successfully a radical amendment of the Sherman Act (Oct. 15 1914) against discriminating freight agreements, interlocking directorates, and holding corporations.

Another branch of the same attack on the money power was the Federal Trade Commission, created Sept. 26 1914, which was an attempt to find means of dealing with corporations engaged in interstate commerce other than banks and common carriers. In the same direction went the "blue sky laws" passed in this period by many states, to break up the practice of floating the stock of companies which had no property more substantial than the atmosphere.

Labour, 1913–7.—The example of capital, in rolling itself into masses too great to be controlled by ordinary means, was followed by labour. The American Federation of Labour was a loosely woven council of representatives from the great trade organisations. It did not undertake to call strikes, though it was likely to support them, and it had great effect in bringing about combined and simultaneous demands for the various items in the labour programme. The leaders fixed upon an eight-hour day as the basic working time. The next item was the minimum wage, which made its way slowly and was not altogether acceptable to labour. Another demand was that American citizens should have preference over aliens in employment. Labour in general was unfriendly to child labour and was, therefore, interested in a Federal statute of Sept. 1 1916, to prevent the transport of products made by child labour under specified conditions.

As the labour unions gained in numbers and strength they used their energies in favour of the "closed shop," a system by which union men refused to work in any establishment where men not members of the union were also employed. From this idea rapidly developed the system of sympathetic strikes, in which members of one union back up another union by refusing to handle or use or transport products of nonunion labour. Hence boycotts, and perhaps ruin for employers who had no difficulty or quarrel with their own workmen. Never in the history of the United States had there been so many and so violent strikes as from 1913 to 1917. The I.W.W. organised long and tumultuous strikes among the silk weavers of Paterson, N.J., and the textile workers of Lawrence, Mass. In the trying years of 1916–7 violent strikes were directed not only against non-striking workmen, but against the public peace. In July 1917, at Bisbee, Ariz., the tables were turned. A kind of vigilance committee seized and carried out of town, with orders not to return, about 1,200 striking miners and their friends. No jury would convict those responsible for this illegal action. The most serious of all these labour struggles was the threatened strike in 1916 of the large and very powerful unions of railway employees. President Wilson intervened and all but compelled Congress to pass (Sept. 3 1916) the Adamson Act by which a basic eight-hour day was secured with *pro rata* for overtime. The Supreme Court upheld this statute, which went to the furthest verge of the Federal Government's authority over labour matters.

Social Movements, 1913–7.—These struggles between the railways and the courts, between the trusts and Congress, between labour and state governments, between strikers and the President of the United States, are part of American history because they were vital to the welfare of the country. Neither the capitalist nor the labourer respected the restraint of state legislation. It was apparent that in the long run the country would go back to the "might makes right" of the middle ages, unless some peaceful settlement could be made by a force that must be respected. The farmers everywhere were aroused, for they looked on railways as hostile to their interests, by overcharging for carrying their products; and they resented the trusts, which they believed raised prices. The anti-liquor forces steadily developed strength. They urged out-and-out prohibition and secured it in more than half the states. At the end of 1917 war prohibition was enacted by the Federal Govt. and also prohibition in the District of Columbia. On Dec. 19 1917 a two-

thirds majority was secured in Congress for a prohibition constitutional amendment—the 18th Amendment—which was at once submitted to the states. Woman suffrage also advanced steadily. Congress submitted a woman suffrage amendment in 1919. Thus changes that had been 50 years on the way finally were brought about by the force of public opinion. A change was also visible in the attitude of the country toward immigration which Congress was determined to reduce by an intelligence qualification. A new bill (Feb. 5 1917) was passed over Wilson's veto. Besides a literacy test it raised the head-tax to $8 and excluded oriental labourers coming from certain geographical areas, which did not include Japan but did apply to Hindus and Malays.

Educational Progress, 1909–21.—The decade following 1909 was marked by a new sense of the possibility of general education, and the need for a more direct, searching and practical type of education. The country was accustomed to a system of graded public schools, offering the "common school education," and leading up to a few endowed and private schools, and to thousands of public high schools, which were expected to prepare the small proportion of young men who went on to institutions of higher education. By 1910 girls were given about an equal chance in the public elementary and secondary schools, and in a large number of coeducational colleges and universities, besides a small group of high-class colleges open to women only. Secondary education was subdivided into literary, commercial and industrial schools. The institutions of higher learning set up new professional departments, including the intensive study of education and separate schools of science, engineering, agriculture and other specialities. Private enterprise created a great number of so-called business colleges, and a few very efficient trade schools.

Nevertheless there was general complaint that the schools did not relate themselves to the life of the community. A National Society for the Promotion of Industrial Education became the focus of a movement to organise what now became generally known throughout the country as vocational education. A national commission was appointed by President Wilson, in 1914, to consider the whole subject. The resulting Smith-Hughes Act (Feb. 22 1917) created a Federal Board for Vocational Education which framed an elaborate plan for instruction in the four vocational fields of agriculture, commerce, industry and home-making. The Act promised to appropriate Federal funds rising to about $7,000,000 in 1925 and thereafter, to be paid to such states as would match these funds dollar for dollar.

Private enterprise accompanied this movement by building up advanced engineering and trade schools of a high type, such as the Carnegie Institute at Pittsburgh; by improving the private commercial schools and by establishing advanced schools of business training in colleges. Some of the great manufacturers, especially in the automobile trade, set up schools within their own works.

When the United States plunged into the World War in 1917, Government established a variety of vocational schools to train the men for the numerous specialities of military service. It made use of the shops and other vocational facilities of the existing schools and colleges. Great sums were raised by special "drives" among the alumni and friends of the endowed institutions, and the state universities were allotted hitherto unheard-of grants. The strictly vocational schools were admitted into fellowship with the other institutions. (*See* EDUCATION: *United States.*)

Wilson's Foreign Policy.—Woodrow Wilson was naturally a man of peace, and so emphatically was Secretary Bryan. They set themselves to aid the cause of general peace by arbitration treaties. Secretary Bryan prepared a definite project for treaties by which the nations concerned should, in case of difficulties, pledge themselves to submit their grievances and claims to a special examining commission and to abstain from war or preparations for war until the commission should have had time to report. The presumption was that a sensible nation would submit to the judgment of an impartial tribunal. There was little difficulty in concluding more than 30 treaties upon this basis in the course of a year, but none was put into effect. The truth is that the American people as a whole were little accustomed to international questions and had no definite foreign policy.

Philippines and Caribbeans.—The Govt. of the Philippine Is. was altered by setting up the first Filipino Assembly in 1908. In response to the pleading of President Taft, Congress in 1909 grudgingly included them within the customs boundary of the United States. Under President Wilson, Gov.-Gen Cameron Forbes was withdrawn and Burton Harrison was appointed his successor, to carry out a policy of liberalisation and preparation for independence. The Filipinos were allowed to hold a majority of the seats in the Commission, which became a kind of administrative Upper House. Filipinos were substituted for Americans in many of the civil offices. The people were thus given a definite opportunity to govern themselves. The Jones bill, enacted Aug. 29 1916, greatly enlarged the power of the popular part of the Government, and the Commission ceased to exist. The Act promised that the Filipinos should be given their independence when their ability to govern themselves should be demonstrated.

At the other end of the American sphere of influence, Cuba, while nominally independent, remained a protectorate of the United States. On March 2 1917, the Porto Ricans were for the first time made American citizens and received a popular government of two elected Houses. President Wilson continued the administration of the Dominican Republic which dated back to Roosevelt. He also took military control of Haiti in 1914, and followed it by a controlling treaty which was ratified by the Senate (Feb. 28 1916). He carried even farther Taft's policy in Nicaragua by a treaty (ratified Aug. 14 1914) which converted that country into a virtual protectorate. Another area came under control of the United States by a treaty for the annexation of the Danish West Indies proclaimed in 1917. These islands were duly organised under the title Virgin Is. of the United States. Little opposition was made to this creation of a virtual empire, including dependent provinces.

Latin America and the Orient, 1913–7.—The peaceful policy of the United States towards its neighbours was severely tested by disturbances in Mexico. In 1913 Madero, president of that turbulent republic, was murdered, presumably by order of Huerta, an insurgent officer, who thereupon declared himself the head of the state. The almost invariable policy of the United States had been to recognise any *de facto* head of a Latin-American Govt. without inquiring into the source of his title. But on this occasion President Wilson adopted what he called a policy of "watchful waiting." He steadily refused to recognise Huerta, against rival revolutionists. In April 1914 a trifling dispute arose at Tampico as to a salute of the American flag, and Wilson, apparently yielding to strong public sentiment, ordered the navy to attack and capture Vera Cruz, of which the United States remained in possession for some months. The real object was to discredit Huerta, who was compelled to flee the country. When in 1915 the brigand Villa raided the town of Columbus, N.M., the President ordered a military expedition under General Pershing to advance into the interior of Mexico. It remained about eight months, without capturing Villa or accomplishing any other definite result. The three friendly nations of South America—Argentina, Brazil and Chile, commonly known as the "A B C Powers"—offered a kind of mediation. At their suggestion Carranza was recognised as president by the United States. Disorder continued; and in May 1920 Carranza was overthrown and killed by the troops of Obregon. For a time thereafter Mexico emerged from the state of revolution.

This long controversy was highly disturbing to the desired close relations with Latin America in general. In spite of five Pan-American congresses and several scientific congresses, in spite of visits of Roosevelt and of Root and Knox as Secretaries of State to South America, there could be no harmony if the United States were to continue "administering" small and defenceless Latin American nations and waging undeclared wars with Mexico. Nevertheless, President Wilson in a speech at Mobile (Oct. 27 1913) declared that the United States had no

designs on the territory or independence of its Latin-American neighbours. Colombia, too, had a grievance arising out of the loss of the isthmus when the Panama Canal Zone was annexed in 1904. The succeeding Republican Administration in 1921 secured a treaty to pay to Colombia $25,000,000 as a kind of reparation.

In regard to the Far East, Wilson had little opportunity to develop a policy. He began by disavowing the plans made under the advice of President Taft for a loan by American bankers to China. He argued with the people of California because they insisted on passing a statute restricting alien ownership of lands by Japanese residents. The World War soon made the United States and Japan temporary allies, and on Nov. 2 1917 the Lansing-Ishii note, on the same plan as the Root-Takahira note of 1908, set forth that the United States recognised Japan's "special interests in China." (*See* JAPAN).

Neutrality.—The United States in 1914 expected to remain indefinitely at peace, as was shown by lack of anything that could be considered national military preparation in the terms of modern warfare. When on Aug. 4 1914 President Wilson issued a proclamation of neutrality as between the two groups of European nations just engaging in a gigantic struggle, the authorised military establishment was about 107,000 men, of whom some 87,000 were enrolled. The United States had not one military aeroplane of approved type; had only four modern heavy field guns and no transport for them; had not a trench bomb or a mine-thrower; nor considerable supplies of any weapons or equipment except 800,000 excellent rifles; nor any officers experienced in the kind of warfare used in recent wars; nor any instruction camps for officers or men. The navy included a fleet of battleships recently built, but weak in small and swift vessels and particularly in submarines. The militia proved to be of little service, though Secretary Bryan publicly declared that the nation needed no preparation, for it "could raise a million men between sunrise and sunset."

Neither the foreign policy nor the diplomatic organisation of the United States was fitted for such a crisis. The traditional Monroe Doctrine was expected to keep the nation out of dangerous controversies with the other American states. The counterpart principle of isolation forbade the United States to take any part in European crises or wars. As a neutral it stood by the principle of "freedom of the seas," by which was meant in particular the right to carry on commerce with all belligerents in case of war, subject to the limitations of the then acknowledged international law as to contraband and blockade. At the beginning of the War thousands of American tourists and residents were caught in the mobilisation of the great European armies, and the Government aided in bringing them home. A few weeks later relief was organised on a large scale for the Belgian people, most of whose country was overrun and held by the Germans. This system soon included French refugees, the unhappy peoples of Serbia and Asia Minor and other combatant or non-combatant sufferers, besides the sick and wounded of the contending armies.

Difficulties with the Belligerents, 1914–7.—The United States was compelled at once to take into account the relation between the war and American industries, commerce and finance. Heavy loans were placed in the United States by Great Britain, France and Russia. As fast as the money was borrowed it was spent in the United States for the purchase of food, clothing, animals and especially munitions. President Wilson issued a proclamation (Aug. 18 1914) advising that the people remain neutral "not only in act but in word and in thought." Such neutrality was impossible. In the first weeks of the War German commerce was driven from the seas. The command of the sea by the Allies very nearly cut off trade of any kind between the United States and Germany and Austria, while commerce continued in ever-increasing volume with England and France. This disparity led to protests on the part of the German Govt., and also to lawless acts perpetrated or directed by agents dispatched by the German Govt. for the purpose of paralysing the munition factories. Violent antipathies were caused by the German methods of carrying on war, and particularly the treatment of the occupied areas of Belgium and France. The American population included hundreds of thousands of citizens of the belligerent countries, many of whom attempted to return to their homes in order to serve in the army. The road for such recruits was blocked for the Germans and their allies, but open to the Allies. For the first time in half a century the United States found within its own borders the sharpest division on questions of foreign policy.

On the other hand, the war trade brought immense profits. The favourable balance of trade rose from $690,000,000 in 1913 to $1,770,000,000 in 1915 and $3,000,000,000 in 1916. This prodigious debit was balanced by about $3,000,000,000 sent to the United States in securities and gold, besides $2,000,000,000 in foreign War bonds. Under these circumstances genuine neutrality was out of the question. A decided preponderance of sympathy developed toward the western Allies, who were profitable customers, were in close and almost undisturbed intercourse with the United States and were considered to be fighting against a ruthless, arrogant and dangerous autocracy.

International Controversies, 1914–7.—The internal tension of the United States was tightened by the insistence of Germany on the right to use new weapons, tactics and practices of war, without the traditional limitations of international law, without mercy to non-combatants, on the basis of "a law of necessity." No able-bodied German man or woman was really a non-combatant; the Germans insisted that they must regard all civilian enemies as combatants. There was no way to stop them without using similar new methods of warfare.

Great Britain, which in the London Maritime Conference of 1912 had shown some disposition to enlarge the privileges of neutral commerce, now seized American ships and shipments, and arbitrarily extended the list of contraband, until (Dec. 26 1914) a dispatch signed by Secretary Bryan, but expressing the conclusions of President Wilson, made a protest. In the course of 1915 the British Govt. began to apply the American principle of "continuous voyage" as applied by the United States during the Civil War to cover shipments to neutral ports in cases where those shipments were likely ultimately to reach Germany; and also where they might replace products of the neutral countries that could thus be spared for Germany; or if the neutral countries declined to make a hard and fast agreement not to reship.

In 1916 the British were practically blockading neutral European ports and capturing vessels, American and other, wherever they liked.[1] The Central Powers set up a new war practice of using submarines as commerce destroyers. The American Govt. protested. A crisis came through the sinking by a submarine of the British passenger liner "Lusitania" (May 7 1915), with the loss of 113 American lives. That sinking was a deliberate act of the Germans to test the temper of the United States. Apparently they were greatly surprised when the people of the United States rose in resentment. President Wilson, who had earlier insisted on "strict accountability," insisted on a sharp protest. Mr. Bryan thought milder measures sufficient, and on that issue resigned the Secretaryship of State (June 8 1915), being succeeded by Robert M. Lansing. The correspondence went on for months until (May 4 1916) Germany at last informed the American Govt. that merchant ships would not be sunk without warning and an opportunity to save non-combatant lives. Meanwhile, throughout 1915 and 1916, systematic violations of the neutrality laws of the United States by Germans and Austrians caused the dismissal of the Austrian ambassador to the United States and of the two most obnoxious members of the German ambassador's staff. It was the belief that they would hesitate at nothing during the War.

"Preparedness."—By the end of 1915 it became clear that with or without their own desire, the people of the United States might find themselves involved. President Wilson desired peace. A day or two after the sinking of the "Lusitania" he spoke of there being such a thing as "a nation that was too proud to fight." In his message of Dec. 1915 he urged national defence and the protection of American shipping. Long before

[1] For a discussion of the legal principles involved *see* BLOCKADE.

this time the War had brought about a violent change in the economic conditions of the country. The great demand for foodstuffs raised the price of grain and other farm products. The high cost of living became a political issue. The munition factories offered unheard-of wages and drew hundreds of thousands into improvised towns. The War caused a great change in immigration. Hundreds of thousands of men left the United States for Europe, while the net immigration fell from 1,200,000 in 1914 to 300,000 in 1916.

The Election of 1916.—In the midst of this turmoil and confusion of business came the preliminaries of the presidential election of 1916. President Wilson carefully abstained from taking sides between the Allies and the Central Powers; but the aggressive submarine policy of Germany provoked a much sharper tone than did the aggressions by the English. He felt the need of caution, particularly because a growing group of men inside and outside Congress, among them Roosevelt, were coming to the conclusion that eventually the United States would have to join in the War.

The Republican nominating Convention met in Chicago, June 7. A strong effort was made by friends of Roosevelt to capture the Republican Convention, but the "stand-pat" Republicans had control of the party machinery. The Progressives—who in Nov. 1914 had cast 1,800,000 votes for congressional and state candidates—also met in convention in Chicago. Their purpose was to compel the Republicans to nominate Roosevelt as the only means of healing the breach. That effort failed: the Republicans nominated Justice Hughes of the Supreme Court, who had been a reform governor of New York State. The days of the Progressive party were numbered.

In the Democratic Convention (June 14) there was practically no opposition to Wilson and his running-mate T. R. Marshall. The platform in many respects was similar to that of the Republicans. Both favoured woman suffrage, the conservation of national resources and national enforcement of child-labour laws; both reaffirmed the Monroe Doctrine. But the Democrats upheld tariff for revenue only; they endorsed the promise of ultimate independence to the Filipinos; they commended the establishment of a Federal Trade Commission; and they approved a merchant marine owned and operated by the Federal Government. In the campaign Roosevelt publicly supported Hughes, though it was well known that he felt no enthusiasm for him. The only "slogan" that caught the public ear was favourable to Wilson: "He kept us out of war." On election day Wilson received about 9,000,000 popular votes against 8,500,000 for Hughes, and was chosen by a very close vote in the electoral college.

The War and the Peace

President Wilson stood in a very strong position in the United States and in the world. He had been re-elected. His policy was approved. He felt that he had the nation politically united. He soon began to take a firmer tone against the Allied system of neutral blockade. Wilson hoped that the one great neutral nation might bring about peace. On Dec. 18 1916 he sent an appeal to the warring Powers to come to an understanding of each other's demands. On Jan. 22 1917 in an address to the Senate on foreign affairs the President described the replies he had received to the identic note of Dec. 18.

The Central Powers united in a reply which stated merely that they were ready to meet their antagonists in conference to discuss terms of peace. The Entente Powers have replied much more definitely, and have stated, in general terms indeed, but with sufficient definiteness to imply details, the arrangements, guarantees and acts of reparation which they deem to be indispensable conditions of a satisfactory settlement.

He went on to speak of an "organised common peace," and of a "peace without victory"; he outlined the principle of self-determination, declaring that "Governments derive all their just powers from the consent of the governed," and that "no right anywhere exists to hand people about from potentate to potentate as if they were property." The practical German answer was a brief note communicated by Ambassador Bernstorff to Secretary Lansing (Jan. 31 1917), withdrawing the conditional pledge given in May 1916 and announcing that the Germans would shortly resume unrestricted submarine warfare. High military authority in Germany was convinced that the Americans would never sacrifice the large profits of export trade and incur the huge expenses of war merely for the sake of a question of neutral maritime rights.

Immediate steps were taken to make the American Navy ready for war. For a time the President dallied with a plan of arming merchant ships. One result of the controversy was the adoption by the Senate (March 8) of a mild and cumbrous method of cutting short debate by closure. During Feb. and March 1917 a few American vessels were torpedoed by German submarines. On Feb. 8 the Government published an intercepted German despatch to the Mexican Govt. asking it to join in the War, promising it the "former Mexican provinces," long incorporated in the United States. The participation of the United States in the War was now inevitable. A formal declaration of a state of war was signed by the President (April 6) after a House vote of 373 to 50 and a Senate vote of 82 to 6, which stated that war had already been begun by Germany. Relations with Austria and Turkey were at once broken off, but the declaration of war with Austria was delayed until Dec. 7 and no declaration was ever made against Turkey or Bulgaria.

The breach with Germany was a spontaneous national action representing a national belief that the United States could no longer live in peace with such a nation as Germany had become. As President Wilson put it the War was to make the world "safe for democracy."[1] Moreover, there was widespread sympathy with the three western Powers closest to the United States in their political principles and system of government. Wrath was aroused by the German treatment of the people of Belgium and other conquered countries. In some minds there existed a genuine and well grounded fear of a future attack upon the United States by Germany if the resistance of the Allies should be destroyed. Amid all the motives for the War, the one thing was that the American people recognised Germany as an enemy, and the enemies of Germany as natural friends and partners in the great enterprise of subduing "the Hun."

War Measures.—Passionate national spirit, patriotism and urgent reasons for war were all useless unless the United States could enrol, train, equip, convey and continuously supply an immense army. The American Navy, though the vessels were good and the crews skilled and well commanded, was in no position to give direct aid in the process of destroying the German Army. What was most needed was to raise and convey to the fighting front a large force of American troops.

Soon after the declaration of war by the United States, missions from the various Allied countries were sent to America. The British Mission, headed by Arthur (now Lord) Balfour, British Foreign Secretary, reached Halifax April 20 and proceeded to Washington. The French Mission, headed by René Viviani, the former Premier, and including Marshal Joffre, landed April 24. Other missions came from Italy, Belgium, Russia, Rumania and Japan. The United States was able at once to help the western Allies in their pressing financial difficulties. Taxes were low and little felt; money abounded. Under Acts of Congress beginning Oct. 17 1917, the Allies received essential credits, which amounted eventually to $9,500,000,000.

These enormous payments were made possible by the Liberty Loans. In June 1917 4,000,000 people joined in offering $3,000,000,000 to the Government; and at the end of the War the interest-bearing debt had increased from $972,469,290 on Dec. 31 1916 to $25,234,496,000 in 1919. These loans were supplemented by the War Revenue Act (Oct. 17 1917) and later statutes, which laid a variety of new taxes, increased the income-tax heavily, and combined with it an excess-profits tax to bring

[1] "To fight thus for the ultimate peace of the world and for the liberation of its peoples, the German peoples included; for the rights of nations great and small and the privilege of men everywhere to choose their way of life and of obedience. The world must be made safe for democracy." (Message to Congress April 2.)

into the Treasury unreasonable profits likely to be made in the war industries.

All traditional limitations on raising an army were discarded. Ex-President Roosevelt asked permission to recruit a division for a special volunteer force, but the President refused him a commission. On May 18 the Selective Service Act was passed which provided for the enlistment of a million men by "selective draft." When called up, the men had to be clothed, housed, fed and drilled. Thousands of officers were necessary, and training camps, both for men and officers, were established on a vast scale. In May 1917 a few American destroyers reached England. On June 9 Gen J. J. Pershing, who had been selected as commander-in-chief, arrived in England. On June 26 a small detachment of U.S. troops reached Europe. New branches of military service were established, among them the Chemical Warfare Service which provided materials for lethal gases and for gas-masks and other means of resisting the enemy attacks. Congress, on July 24, appropriated $640,000,000 for aviation. By Aug. about 700,000 men were enrolled in the army and 230,000 in the navy.

Control of Industry and Transportation.—The establishment of huge war industries put a great strain on the industry and transportation of the United States. On Aug. 10 1917 a Food Control Act gave the President powers never before conferred with regard to food and fuel (*see* FOOD SUPPLY). Herbert C. Hoover, of California, who had distinguished himself in the management of the Red Cross in Europe, was made Food Administrator with large powers. Before the War ended he had established "meatless" and "wheatless" days; the price of grain was fixed; eventually the farmers were assured $2.20 a bushel for their wheat crops. H. A. Garfield, Fuel Administrator, carried through drastic measures for stimulating the production of fuel, regulating shipments and distributing supplies. On March 21 the Federal Control Act placed the management of all the railways in the country in the hands of the Government during the War, and for a period after its close. W. G. McAdoo, Secretary of the Treasury, was made director-general of the railways; later Walter D. Hines, an experienced railway man, succeeded him. One of the most serious needs of the times was a merchant fleet adequate to carry across the Atlantic the army and its supplies. The Government undertook the great task of improvising such a fleet, and vast construction was authorised in both steel and wood.

War Activities at Home.—At once after the declaration of War the American people through official and unofficial channels gave support by civilian service and money contribution. Among the multifarious public agencies was a Committee on Public Information, of which George Creel, journalist, was chairman, which kept up a lively system of publicity aided by the National Board for Historical Service. A Censorship Board censored all communications—mail, cable, radio—passing between the United States and foreign countries. As early as Aug. 29 1916 a Council of National Defence was created by Act of Congress. Under it were created numerous special organisations. The Council of National Defence appointed a Women's Committee to co-ordinate the patriotic work of the women throughout the country. The Advisory Commission of the Council of National Defence created a Committee on Transportation and Communication. A Railroad War Board undertook to secure unity of operation among all the railways, to subordinate private interests and to eliminate competition. Important coastwise steamship lines were added to this system. The four large express companies were combined under the name American Railway Express Company. In 1918 the Government assumed control of telegraph, telephone, marine cable systems and radios. Many scientists were engaged in research throughout the country under the National Research Council. Commerce also was regulated.

By the Espionage Act of June 15 1917 the President was empowered to control exports, and he created a Bureau of Export Licenses and a Trade Board. A list was prepared of firms throughout the world with whom Americans should not trade. The Government formally took charge of all foreign trade Feb. 15 1918, and seized all German ships interned in U.S. ports and ships under the Dutch and other neutral flags.

Samuel Gompers, president of the American Federation of Labour, co-operated in organising a Committee on Labour, and a Mediation Commission was appointed. A National War Labour Board (April 9 1918) acted throughout the country as a kind of "supreme court" to settle labour disputes. For the recruiting of essential labour and directing it into necessary industries a U.S. Employment Service was created.

Several private war agencies were established. Chief among these were the American National Red Cross, which was to be found wherever there was fighting, sickness, suffering or starvation; the Y.M.C.A.; Y.W.C.A.; Knights of Columbus (Catholic); Salvation Army; Jewish Welfare Board; American Library Assn. and War Camp Community Service.

Enemies in the United States.—While the people of the United States were practically a unit in favour of a vigorous prosecution of the War, a few, chiefly foreign-born or sons of foreign-born, were opposed to the War or more often to the nations in concert with which, and partly for whose salvation, the United States was fighting. Ever since 1914 the country had been irritated and aroused by a series of illegal, violent and often murderous acts which were traced to German and Austrian agents. Such were determined efforts to blow up the international bridge at Vanceboro, Me., and the locks of the Welland Canal, Ont. Bopp, German consul-general at San Francisco, was convicted and imprisoned for aiding German vessels in the Pacific in defiance of neutrality laws. Rintelen (after the War specially rewarded by the German Govt.) was sent to the Federal Prison at Atlanta for aiding in placing bombs on outgoing vessels with intent to destroy them. In 1910 Eugene V. Debs, presidential candidate four times of the Socialist party, was sentenced to ten years' imprisonment for advising men not to enlist. Victor Berger, member of Congress from Wisconsin, was convicted and sentenced for disloyalty, then re-elected to Congress, which refused to seat him.

The I.W.W. took advantage of the general confusion to engage in a campaign of disturbance and violence in the west; as many as 97 leaders of that order, including William Haywood, were convicted of disloyal conduct by one court at one time. These prosecutions were supported by the Trading with the Enemy Act of Oct. 6 1917, the Espionage Act of June 15 1917 and the Act of April 18 1918, relating to alien enemies. Several thousand German and Austrian citizens who were believed to be dangerous were interned. Two pro-German editors were punished for disloyal utterances in a German-American paper. These prosecutions against American-born citizens, naturalised citizens and unnaturalised foreigners continued for two years after the end of hostilities. On Dec. 25 1921 President Harding commuted the sentences of Debs and 23 others who had been convicted under the Espionage Act, but a number of persons still remained in jail under sentences for disloyal action.

The Navy.—Beginning with patrol work on the American coast as soon as War was declared, the activities of the U.S. Navy extended to co-operation with the British and French in the hunting down of submarines and the protection of convoys and in the laying of the North Sea mine barrage, extending from the Orkneys to Norway. The American Navy had some part in blockading the Austrian coast of the Adriatic, and it participated in maintaining that Allied command of the sea which in the end was fatal to Germany. By a remarkable convoy system over 2,000,000 troops were carried safely 3,000 m. overseas to France. In this work the utmost secrecy was necessary. In June 1917 a few cruisers and transports were provided and the first troops sent across. At intervals vessels assembled and sailed on definite routes under the protection of destroyers. According to the report of the Secretary of the Navy (1920), 911,047, or nearly half of the American troops, were carried on U.S. Navy transports; the rest chiefly by the British. Not one east-bound American transport was torpedoed by the German submarines; and only three ships were sunk on their return voyage. Three small fighting ships were destroyed by the enemy.

During the campaign of 1918 efforts were made to extend the possible field of enlistment by the passage of the Man Power Act of Aug. 27. All men between 18 and 45 were required to register with a view to service if needed, and 11,000,000 were registered. By a statute of Oct. 6 1917, provision was made for a system of military and naval insurance available for all men in the service.

The American Army at the Front, 1918.—To the army was given the general name of American Expeditionary Force (A.E.F.). General Pershing officially reported that at the date of the Armistice, Nov. 11 1918, there were in Europe 2,071,463 American officers and men (approximately 82,000 officers). On the same date, according to figures compiled by the War Dept., the number of troops encamped in the United States was 1,634,499 including 104,155 officers, a total of 3,700,000 enrolled. Actual contact with the enemy was first established by the American troops Nov. 3 1917, at a point between Arracourt and Parroy. During the year 1917 the transport and supply service was perfected, Bordeaux and other French ports having been assigned by the French Govt. as American bases. The rail communication to the front was improved and troops as they arrived were drilled and organised. The military errors of the Civil War and the Spanish War were not repeated. No civilians received commissions to command large bodies of troops. In theory no soldier was sent under fire unless he had been trained in trench and shock warfare, though many green troops were put into the front line in the crises of the campaign. The intention of Marshal Foch was to use the Americans to reinforce the Allied armies. General Pershing, supported by President Wilson, insisted that the American Army should be operated as a unit subject to the supreme command of Foch (March 28); this arrangement was accepted also by the English.

The first offensive against the Germans was on May 28, when Cantigny was captured by the Americans. From that time on to the end American troops were on the firing line. Belleau Wood was taken by them on June 11. Next day American airmen made their first hostile ascent. On July 15 the Germans began their last desperate attempt to reach Paris and were stopped by the French and Americans who tenaciously clung to Château-Thierry. A small American detachment was sent also to the Italian front. During Aug. the Germans were steadily giving ground. From Sept. 11–3 the Americans, operating alone, broke the Saint-Mihiel salient and drove out the Germans, capturing 443 guns and 16,000 prisoners. More troops were steadily reaching the front. From Sept. 26 to Nov. 11 the army took part in the heavy fighting of the Meuse-Argonne campaign. These operations terminated in the capture of Sedan, which (Nov. 6) broke the German rail connections and led to a request next day for an armistice. In these operations the casualties, to Nov. 11 1918, were as follows: killed in action, 35,556; died of battle wounds, 15,130; died of other wounds, 5,669; died of disease, 24,786; total deaths, 81,141; wounded, 179,625; missing, 1,160; prisoners, 2,163; total casualties, 264,089.

The fierce campaign of 1918 was the final effort of the Germans. No one can say positively that the American Army in the field was the chief element that insured victory; but there is not a doubt that the triumphant success in raising and transporting incessantly troops, provisions and supplies was to the German mind convincing and disheartening evidence that the Govt. and the people of the United States, with all their power and potentiality, would stand by the Allies indefinitely. On Nov. 11 1918, by the Armistice in which the American armies shared, the Germans admitted their defeat and at once began to evacuate the occupied regions and also portions of their own national territory.

Rehabilitation in America, 1919.—The task of *post bellum* economic adjustment was long and costly. At the end of the War the Federal Govt. by means of War statutes was controlling the food supply and its distribution, manufactures, the coal supply and shipments, railways, telegraphs and telephones, foreign commerce and shipping. It took over the property of aliens through an Alien Property Custodian. It settled conditions of interstate labour and of labour in other fields. For foreign commerce there was still a Shipping Board, an Emergency Fleet Corporation, a War Trade Board and a War Finance Board. Two million American soldiers were overseas and wanted to come home as soon as possible. The United States spent on the War about $35,500,000,000, including $9,500,000,000 lent to the Allies. Expenditures after peace came continued on a scale far beyond any previous experience of the country.

In the course of six months after the Armistice, about two-thirds of the troops were brought back, leaving behind them enormous stores, large parts of which were sold at heavy discounts to European Governments. General Pershing, the only U.S. military man of high rank whose achievements caught the public eye, received the reward of the permanent rank of general. In Sept. 1919 the American Legion, incorporated by Act of Congress, was formed to look after the interests of the ex-soldiers. By 1920 the only American troops left in Europe were an Army of Occupation on the Rhine of about 17,000.

The Election of 1918.—The Armistice came a few days after the State and Congressional elections of the autumn of 1918. The War was a national war. Enlistments, whether volunteer or by draft, had no relation to politics. Nobody paid any attention to the party affiliations of officers or men or civilian administrators and aids. Nevertheless, a few days before the elections, Oct. 15, President Wilson issued a circular letter urging the voters to return a Democratic majority to the Senate and the House; because, if the Republicans were successful, it would be considered an imputation upon the President. The warning was in vain: the result of the election made the new House decidedly Republican and the Senate Republican by two votes. It was apparent, therefore, that the Administration in making the necessary adjustments after the War must take into account the preponderant opposition in both Houses of Congress.

Throughout the year 1918 the influence of Theodore Roosevelt was manifestly growing. He was by his whole nature a supporter of the War. He and his four sons volunteered for service, though, as he put it with plaintive humour: "Wilson has kept *me* out of war." He was recognised as a Republican and the most powerful Republican. Even his strongest political enemies admitted that the party must reckon with him. As the months passed it became clear that he would be nominated by the Republican Convention of 1920 and in all probability would be elected President. But he died suddenly, Jan. 6 1919, leaving behind him a long roll of achievements and a place among the greatest of American statesmen and world figures.

The Task of Peace.—Three great tasks remained for the United States when active war ceased. The first was to secure a settlement and register it in a treaty or series of treaties, thus returning so far as possible to normal international relations. The second was to help in reconstituting the world and protecting it, if possible, against future wars. The third was internal reconstruction, putting an end to the special War laws and conditions and readjusting business, transportation and labour. The first two of these tasks are described in detail elsewhere (*see* LEAGUE OF NATIONS; PARIS, CONFERENCE OF). In addition to the suggestions made in the winter of 1916–7 President Wilson put forward on Jan. 8 1918, during the height of the War, "fourteen points" (*see* FOURTEEN POINTS) which he considered a necessary basis for the peace of the nations and a subsequent world agreement. These points he enlarged in later addresses to twenty-seven. The Germans afterwards asserted that the 14 points were an essential part of the Armistice.

Several changes came about in the Cabinet at the end of 1918. McAdoo resigned and was followed in the Treasury by Carter Glass, a representative from Virginia, who gave way in turn to Houston, transferred from the Dept. of Agriculture, where he was succeeded by Meredith.

The Peace Conference.—In Dec. 1918 President Wilson decided that he would attend the necessary Peace Conference in person, and designated as peace commissioners with himself four others—Secretary Lansing, Col. Edward M. House of Texas (his most intimate friend and political adviser), Gen. Tasker Bliss of the army, and Harry White, formerly minister to France.

These commissioners were not confirmed by the Senate; only one of them was a Republican, and not one was a member of either the Senate or the House. To Republicans it seemed that the President meant it to be a Democratic peace as well as a Democratic war.

In the Peace Conference of 1919 President Wilson, as representative of the richest and most powerful nation in the world, became one of the representatives of the four Great Powers—Great Britain, France, Italy and the United States—who engineered the treaty. He had, and used, the opportunity to draw up a League and Covenant which was a crystallisation of long-debated suggestions for a world confederation of states. President Wilson was so interested in the project for the League of Nations that when he found the French were not ready to adopt such a plan without some guarantee of protection, he signed a treaty of alliance between the United States, France and Great Britain, pledging the United States to join in war in case of invasion of France by Germany.

American Action on the Treaty, 1919.—No one familiar with the temper of Congress and of the American people should have supposed that such a treaty would be ratified. President Wilson returned home for a short stay (Feb. 24 – March 4) defending the general terms of the treaty and the Covenant of the League of Nations. On his return to Paris, he reversed decisions made in his absence by Col. House; and thereafter the close co-operation between the two able men diminished. On June 28 1919 Wilson and his four commissioners signed for the United States the formal Treaty of Versailles, including the Covenant of the League of Nations, which was so interwoven into the text of the treaty that it was impossible to ratify one without the other. Upon one of the subjects covered by the territorial adjustments of the treaty in which the American people felt a deep national interest—the continued occupation of Shantung by the Japanese—the President reluctantly gave way and consented to its retention by the Japanese, in spite of the general adverse opinion in the United States.

The treaty had many powerful supporters among all parties, particularly ex-President Taft, the League of Free Nations Association and the League to Enforce Peace, in which A. Lawrence Lowell, president of Harvard University, was the leading spirit. The Senate was divided into strongly opposed groups. Most of the Democrats, under the lead of Senator Hitchcock, followed the President in favouring the treaty with the Covenant as it stood. A group of Republicans, headed by Senator Lodge of Massachusetts, favoured "amendments" to the treaty and "reservations" to the League, which would have maimed but not killed the two projects. Another group desired reservations that would practically destroy both. A small but implacable junto, headed by Borah of Idaho and Johnson of California, were against both the treaty and the Covenant in any form or with any reservations.

The contest ostensibly centred about Art. X of the Covenant, under which the members of the League undertook "to respect and preserve as against external aggression the territorial integrity and existing political independence of all members of the League." The implacable group expressed fear lest the United States be drawn into foreign wars and insisted that "no American soldiers or sailors must be sent to fight in other lands at the bidding of the League of Nations." The President, on the other hand, regarded Art. X as the heart of the whole treaty. He declined at the critical moment to accept either amendments or reservations, except certain minor alterations. After strenuous debate and by a test vote, Nov. 19 1919, the Senate refused to ratify the Peace Treaty with reservations—the vote being 55 to 39 in favour, but not the necessary two-thirds. Thus after five months' discussion the treaty was rejected, and the United States was left in the situation of technically remaining at war with Germany and Austria though all hostilities had ceased a year before.

President Wilson believed, until the last moment, that he could force ratification of the treaty by his logic and influence. On Sept. 26 1919, while on a speaking tour through the country in favour of the treaty, he was struck down by paralysis; when he rallied sufficiently to think of public business he continued to hope that he would recover. His advisers and closest friends joined in an attempt to minimise the extent of the President's illness, though for months he was unable to see even members of his Cabinet.

The difficulty with the Treaty and the League was that both were signed in Paris by a body of so-called commissioners who represented no lawful authority except that of the President. Whether President Wilson, or the statesmen who opposed him in the Senate, had the clearer view of the state of the world and the duties of the United States, whether the opposition could have been avoided by taking counsel with a larger group of competent men, cannot yet be decided. The fundamental fact is that the opposition to the Covenant was strong enough to prevent the ratification of the treaty even with serious reservations.

On March 4 1921 Woodrow Wilson accompanied President-Elect Harding to the Capitol as the last act of his official life. He had been president for eight years, during six of which he was the undisputed leader of his party and of the nation. Up to the fall of 1919 he carried all his points. He was responsible for a group of important revenue, banking and labour laws. He had a great hold on the affections and opinions of millions of his fellow citizens, and maintained the country's dignity in war and peace. The people stood behind him in entering the War. He supported measures for organising and transporting millions of American soldiers. For a time in Paris he was the foremost man in the world, and he succeeded in inducing foreign statesmen to accept a League of Nations. At the height of his career he suddenly lost the prestige gained as War president of the whole country, was no longer accepted by his party, and ceased to be the one man who could appeal from Congress to the people. Before illness disabled him, he had already lost his hold upon the minds of the majority of his fellow countrymen. The ex-President lived in Washington in retirement, physically unable to take any part in public affairs. He died Feb. 3 1924.

Post-War Problems

Presidential Election of 1920.—The peace revealed underlying elements of dissatisfaction. The soldiers received in many states a money bonus varying in amount, and demanded a similar bonus from Congress. The general public complained bitterly against the high cost of living, while many corporations continued to make War profits in time of peace. A multitude saw their incomes and expectations reduced by the fall in the purchasing power of the dollar. As the presidential election came near, the Democratic party was paralysed by internal dissensions over the Peace Treaty and by lack of the trusted leadership of the President; it had no fixed policy in foreign relations or reconstruction, and no commanding figure to put forward for the presidency.

The Republicans were rent by personal rivalries. The supporters of Gen. Leonard Wood, Gov. Lowden of Illinois and Herbert C. Hoover of California struggled against each other for the nomination. The Convention at Chicago (June 9 1920) passed them all by, and gave the nomination to Senator Warren G. Harding of Ohio. He was backed by a strong group of stand-patters to whom, however, he seems to have made no pledges as to policy or appointments. Calvin Coolidge, Governor of Massachusetts, was put on the ticket as vice-president. The Democratic Convention held at San Francisco was confronted with similar difficulties. The nomination went to Gov. Cox of Ohio, a man little known in national affairs, with Franklin D. Roosevelt, a cousin of the former president, as candidate for the vice-presidency. In the campaign for the first time women were eligible to vote in every state. The election was a complete triumph for the Republicans, who elected Harding by a popular majority of about seven millions, and an electoral majority of 404 against 127 for Cox, besides securing solid majorities in both Houses of Congress.

The presidency was thus transferred to a man little experienced in national politics, whose task it was to take over the discordant elements and build out of them a coherent policy. President Harding began his administration under favouring auspices, although several members of his Cabinet had been chosen in the face of

strong opposition from various quarters. The new President early showed tact and ability in leading his party in favour of constructive action. Within four months an epoch-making bill providing for a Federal budget system was passed under his pressure (June 9 1921). He displayed keen interest in all attempts to restore business to a sound basis and urged prompt action in the assistance of the railways. By nature conservative, he laboured to bring the country back to a state of "normalcy."

Harding's foreign policy was set on remaining outside the League of Nations, while coming to amicable understandings on all relations with foreign nations. Hence special treaties of peace negotiated with Germany, Austria and Hungary were ratified by the U.S. Senate Oct. 18 1921. Of world-wide importance was his call for a conference at Washington of the different Powers bordering on and interested in the Pacific Ocean, to discuss both questions of the Pacific and the limitation of armaments. The conference assembled Nov. 12 1921, and closed Feb. 6 1922. The nine participants were the United States, Great Britain, France, Italy, Holland, Belgium, Portugal, China and Japan. Important agreements were signed: to limit construction of capital warships; against improper use of submarines; against gas warfare; for maintenance of the status of Pacific insular possessions; and other questions involving relations with Japan and China (*see* WASHINGTON CONFERENCE).

Before Harding came to the Presidency, two constitutional amendments had crystallised some of the results of the War. The various prohibition measures passed by Congress on the ground that the use of liquor impeded the success of the War were powerful aids to the general arguments against liquor. Twenty-eight of the states had absolutely prohibited the sale of liquor; and on Jan. 16 1919, the 18th Amendment, prohibiting the manufacture, sale, transportation or gift of intoxicants (submitted in 1917) was ratified by the necessary 36 states—eventually 46 states. It went into final effect Jan. 16 1920, enforced by the Volstead Act (passed Oct. 28 1919, over President Wilson's veto), which declared all liquors containing more than one-half of one per cent of alcohol to be intoxicating and therefore prohibited (*see* PROHIBITION).

The active War patriotism and service of women, together with the votes they already enjoyed, caused Congress (June 7 1919), to submit the 19th Constitutional Amendment, annulling all sex restrictions on suffrage. It was warmly supported by the former Progressives and by President Wilson, received the ratification of the 36th state, Aug. 24 1920, and went into force Aug. 26.

Conditions of the United States, 1921–6.—A study of the political, social, economic and international history of the United States must take account of the extraordinary national elation following the World War. The War produced a profound and permanent effect upon the national mind. It was the beginning of an enlargement of national life in every direction. From a World War out of which Great Britain and the British Dominions and France obtained the administration of immense areas of territory under mandates subsequently confirmed by the League of Nations[1] the United States claimed not a single square yard; but the nation felt free to enlarge its influence in the Caribbean[2] and the Pacific. Hence the maintenance and enlargement of a policy of paramount interest in the three normally independent Caribbean countries—Cuba, Haiti and the Dominican Republic; hence a strengthening of the control over the isthmus states of Panama, Honduras and Nicaragua.

To carry out great national policies, the United States could call upon a population expanding from year to year beyond any experience of mankind. The total population rose from 92,000,000 (not including the Philippine Is.) in 1910 to 106,000,000 in 1920 and (estimated) to about 115,000,000 in 1926. Net immigration of 818,000 in 1910 sank to 19,000 in the War year 1918, but rose in 1924 to 663,000. The wealth of the country, estimated at 187 thousand million dollars in 1912 was counted at 321 thousand millions in 1922, and still swelled in volume. Against these figures, what were such burdens as a national debt of twenty or twenty-five thousand million dollars, bearing nearly a thousand million of annual interest, besides five and a half thousand millions of state and municipal debts? Manufacturing, transportation, mining, distribution and financial business were all prosperous and profitable.

Political Survey, 1921–6.—Political rancour and party spirit somewhat diminished. President Harding was a man of great personal charm, and he drew into his Cabinet in March 1921, several strong men. Secretary of State Hughes had been a Justice of the U.S. Supreme Court and candidate for the presidency in 1916. Secretary of the Treasury Mellon was a rich and successful banker and financier who had never before appeared in public life. Herbert C. Hoover, Secretary of Commerce, was brought in on account of his extraordinary gift of business organisation. Henry C. Wallace, Secretary of Agriculture, was the editor of a great agricultural newspaper. James J. Davis, Secretary of Labour, was a Welsh immigrant who had grown up in a steel mill. The other members of the Cabinet were: Will H. Hays, Postmaster-General; Edwin Denby, Secretary of the Navy; John W. Weeks, Secretary of War; A. B. Fall, Secretary of the Interior; and Henry M. Daugherty of Ohio, Attorney-General.

President Harding steered the ship of state easily, though without the commanding influence of a Roosevelt or a Wilson. He stood steadfastly against a high scale of expenditure. As a Middle Western man he was especially interested in the depressed state of agriculture. His foreign policy was strong and successful. His career was broken by a very brief illness, from which he died in San Francisco Aug. 2 1923.

Vice-President Coolidge, formerly Governor of Massachusetts, a quiet unostentatious man, set up a new régime in the White House. He was always approachable, courteous and on good terms with the newspaper correspondents of Washington, who have great influence over even presidential fortunes. He proved to be also a man of strong character, who consulted those whom he trusted, and then made up his own mind and stood by his decisions. His plain common-sense mode of life, his good temper, his patience with the two Houses of Congress, his ability to get on with other men, were combined with a keen judgment in public affairs. Coolidge for the time being continued Harding's Cabinet, but later many changes were made, so that at the end of five years, Secretary of the Treasury Mellon, Secretary of Commerce Hoover and Secretary of Labour Davis were the only men left of Harding's first Cabinet.

Investigations of Officials.—This growth in wealth and enterprise reacted upon the Govt. where even the President's Cabinet was disturbed and dismembered by a painful series of accusations and investigations. For some years the Govt. had conserved certain oil-bearing areas of public land as a supply of oil fuel for the navy. On April 7 1922 jurisdiction over this matter was transferred from the Navy Dept. to the Interior Dept. by an order of President Harding, the purpose of which the President did not understand. Under this supposed authority Secretary of the Interior Fall leased to the Sinclair interest a large tract in the Teapot Dome district in Wyoming, and also leased one of the California reserves to Doheny, another oil magnate. For reasons never publicly stated, Doheny turned over to Fall $100,000 in cash. These published facts led in 1924 to an investigation by a Senate Committee under the chairmanship of Senator Walsh of Montana. Secretary of the Navy Denby's part, though no corrupt relation appeared, so aroused public opinion that he was forced to resign. He was replaced by Judge Wilbur of California. Meanwhile Attorney-General Daugherty was shown to be in close relation with shady characters: a special committee of the Senate under Senator Wheeler unearthed unexplainable transactions. Daugherty refused to allow the files of his office to be examined by the Senate Committee; whereupon President Coolidge

[1] Under these mandates, Mesopotamia ('Iraq), Palestine, a part of the bulk of the German possessions in Africa, including Tanganyika, and most of Cameroons, and Nauru were attributed to Great Britain; Samoa was attributed to New Zealand; former German South West Africa to the Union of South Africa; and the former German South Pacific possessions (except Nauru and Samoa) to the Commonwealth of Australia. (Ed. *E. B.*)

[2] The Virgin Is. (Danish West Indies) had already been acquired from Denmark by unopposed purchase on Jan. 25 1917.

demanded his resignation (March 28 1924). An attempt was made by Republicans to turn the tables by prosecuting Senator Walsh and his colleague Senator Wheeler on trivial and technical charges, but the Courts dismissed the proceedings. Criminal proceedings were instituted against Doheny and Daugherty, but every possible legal technicality was invoked by the defence so that two years after the trouble began neither prosecution had been brought to trial. President Coolidge took rather a neutral attitude in these proceedings, which he considered to be outside the scope of the executive power. Daugherty was succeeded as Attorney-General by Stone of New York; then Stone was placed on the Supreme Court Bench and Sargent of Vermont became Attorney-General.

Politics and Elections.—In the congressional elections of 1922 the Republicans retained small working majorities in both House and Senate. There was, however, a return of earlier conditions in the appearance of a small group of radical Republicans, with Robert La Follette of Wisconsin as leader, who were able sometimes to hold the balance of power between the regular Republicans and the Democrats. In 1925 this group attempted to influence the nominations for the presidency. President Coolidge's year and a half in office seemed to justify the confidence of his party; and when the Republican Convention met in Cleveland there was no rival candidate. On the first ballot the vote was Coolidge 1,065, La Follette 34 and Hiram Johnson 10. The vice-presidency offered difficulties. In the end the choice fell upon Charles G. Dawes, known to the American public through his association with the Commission of 1923, which had devised the scheme for the payment of reparations by Germany. The Democratic Convention, held in New York, was the longest and fiercest in 60 years. The vote was divided between McAdoo, former Secretary of the Treasury, and "Al." Smith, a Roman Catholic, who had won a national reputation as Governor of New York.

The Convention balloted 103 times; but neither candidate could secure the necessary two-thirds. The convention finally nominated John W. Davis of West Virginia, former ambassador to Great Britain, with Charles Bryan (brother of William J. Bryan) as vice-presidential candidate. The campaign was quiet, and the result was that in the election (Nov. 1924) Coolidge received 15,725,016 votes, as against 8,386,503 for Davis and 4,822,856 for La Follette, who gathered up many discontented Republicans and the considerable vote usually cast for Socialist and other minor candidates. La Follette, however, had only the 13 electoral votes of his own state as against 136 for Davis and 382 for Coolidge. It was a substantial Republican victory, accompanied by a Republican majority over all of 59 in the House and 16 in the Senate. Vice-President Dawes on taking his seat in the Senate for the first time (March 4 1925) seized the occasion to suggest that the procedure of that body needed reform; and that its first duty was to pass an efficient rule of closure.

The Coolidge Administration.—Throughout both his terms of presidential service Coolidge addressed himself to a policy of economy. He stood by the budget bill which President Harding had secured from an unwilling Congress and continued the appointment of Gen. Herbert M. Lord as chief budget officer. This reform meant simply that Congress would not begin to act on the main appropriation bills until a budget based upon the ascertained needs of all the various departments had been drawn up, totalled and submitted by the budget officials.

In 1913 the United States adopted an income tax, made possible by the going into effect of the 17th Amendment of the Constitution. During the World War the tax was raised to high rates, intended in part to transfer some of the immense War profits to the public treasury. Thenceforward that income was the largest factor in the national revenue, and was vigorously collected from individuals and corporations. The policy of the Govt. was to break down the high scale of War expenditure, to dispense with superfluous employees and so to come back to the public needs in time of peace. Several acts of Congress, begun in 1921, reduced the rate of income tax. There was a running fight between those who wished to relieve the small taxpayer and those who thought it more important to bring down rates in the large amounts. The result was that the amount paid in income taxes which was $1,269,630,104 in 1919 came down to $703,962,165 in 1923 but rose to $1,761,659,049 in 1925. By the Act of Feb. 26 1926 the rates were still further lowered; and the provision in the statute of 1924, under which the amounts paid by individuals or corporations were open to the public, was repealed.

The tariff was not a serious issue in this period. The Underwood tariff of 1913, passed by the Democrats and somewhat altered in 1916 and 1921, was repealed by a Republican majority after the inauguration of President Harding; and an emergency Act was passed (May 27 1921). It provided for penalty duties on foreign commodities that might be dumped on the United States. Soon afterwards the Republicans framed a new bill, the Fordney-McCumber Tariff, signed by President Harding Sept. 21 1922. It included a provision, never before a part of a United States statute, under which the President was to have power (informed by a Tariff Commission) to alter rates of duty if necessary to "equalise the differences in cost of production in the United States over similar articles produced elsewhere." The receipts from duties and imports, which were $326,000,000 in 1910 and $325,000,000 in 1920, rose to $545,000,000 in 1925. The public debt, which for many years previous to 1919 stood at about a thousand million dollars was $25,478,592,113 soon after the close of the War (Aug. 31 1919); but on March 31 1926 had been reduced to $19,736,292,774, partly by selling the surplus War material, and partly by payments made out of surplus.

Industry and Commerce.—However much the wealth of the country increased, it was not equally diffused; and large areas of the country were far from prosperous. The rural credits banks (*see* FEDERAL FARM LOAN SYSTEM), established under Wilson, furnished needed capital, and the farmers from 1917 to 1919 had a guaranteed government price of $2.20 per bushel for wheat. When that protection was taken off after the War, a group of members of Congress in both House and Senate, commonly called the Agricultural Bloc, demanded special consideration for the agriculturists. Their prices had tumbled, and agricultural land values, inflated during the War, fell back to or below antebellum prices. The cost of living and hiring farm labourers had been nearly doubled. Considerable areas of farm land, even in favoured parts of the country, stood untilled because it cost more to cultivate the crops than they would realise. This discontent was reflected in the large popular vote for La Follette in 1924. Various propositions were made by farmers' associations and sympathetic members of Congress that the Federal Govt. permanently guarantee a price for the principal staples. The South was also affected by this movement because the inroads of the boll weevil for a time greatly reduced the output. In some degree the conditions of 1885–95 were reproduced; only it was no longer East against West, so much as the farmers of all sections against the group of manufacturers and distributors wherever established.

Organised capital in banking, in manufactures, and in trade, was rolling up in this period notwithstanding the Sherman Act, the Mann Elkins Act and other measures against combinations. In spite of Federal suits and Supreme Court decisions substantially upholding Federal control, combinations and consolidations of capital went on steadily. The railways, which had been sustained during the War by the Govt., were returned to their owners in 1920. For several years, notwithstanding a great increase in passenger and freight rates during the War, they were unable to make what they thought a fair profit. Under the Esch-Cummins Act of 1920 they were allowed to retain a profit of $5\frac{1}{2}\%$ earnings, plus one-half of one per cent to make provision for improvements chargeable to capital accounts, all excess over 6% to be evenly divided with the Government. Meanwhile the administrative commissions which had been so powerful lost prestige. The Tariff Commission was weak and disregarded. The Labour Board was unable to enforce its decisions. The Interstate Commerce Commission and the Federal Trade Commission suffered in prestige and influence from internal strains and quarrels. The special Shipping Commission, created during the War to build up a national merchant fleet, was left with a large number of vessels for which profitable business could not be found. The Supreme Court de-

cisions, under which great corporations like the Standard Oil Co. and the American Tobacco Co. were regulated, left them more prosperous than ever. The hold of the great banks and the smaller banks and bankers on the finances of the country was unshaken. Deposits in national and state chartered banking institutions in 1925 aggregated over 40 thousand million dollars.

It took some years to restore to a normal basis the external commerce and shipping arrangement of the United States. The Govt. received a large tonnage of German ships as part of an indemnity, including the great liner "Leviathan." Slowly the fleets, cargoes and passenger lists of the transatlantic lines returned to the frequency and swiftness of antebellum days. Americans in increased numbers found their way to Europe and European visitors to America. This intercourse tended to an international appreciation of other countries. In 1926 the United States reached its highest point, up to that time, in production, wealth, internal commerce, manufacturing, transportation, banking and exchange, and international trade and finance.

Social Questions.—Many phases of social life went through a similar exaggeration and transition. During the War the United States offered extraordinary wages in order to activate the pursuits necessary to keep up the army. This led to a general raising of the scale of wages of skilled workers, some increase for the unskilled and considerable increase in the earnings of domestic and agricultural labourers. The Labour Unions made it their business to see that no systematic reduction of wages should succeed. Fuel was especially important: the whole anthracite supply comes from a small region in Pennsylvania. In 1923 and again in 1925 came serious strikes of the miners' unions. The last one endured 170 days, and was only settled with great difficulty by a return to previous conditions.

Prohibition.—The most serious social question and most difficult governmental problem of this time was national prohibition (*see* PROHIBITION). In 1918 more than 30 states had laws on their statute books for the restriction of the liquor traffic and 28 states prohibited it outright. During the War Congress prohibited the sale of liquor to soldiers, and then to the general public. A prohibition (Eighteenth) Amendment to the Federal Constitution was easily put through Congress, was ratified by a vote of 46 State Legislatures out of 48, and became a part of the Constitution Jan. 16 1919. On Oct. 28 1919 the Volstead Act for enforcing the Amendment was passed by Congress over the veto of President Wilson. It forbade the sale or transportation of "intoxicating liquor" which was defined as any liquor which contains one-half of one per cent of alcohol. To administer this Act required a large force of officials distributed over the country. The Amendment contained a clause under which the states were to have "concurrent jurisdiction," which appears to mean that state laws might continue in force and be carried out by state courts at the same time with the Federal system. From the very beginning there was an organised system of evasion of the laws through forged or excessive permits for the manufacture of "denatured" alcohol, and alcohol for the arts. As late as 1924 about 80,000,000 gallons of whiskey, alcohol and denatured alcohol was thus released by the Government. A regular system of "bootlegging," illegal sale and transportation sprang up, It was informally countered by "high-jackers"—that is bandits who seized bootleggers' supplies and carried them off by force, knowing that they were not likely to be followed by legal proceedings. An organised marine bootlegging trade placed a line of foreign sailing craft and steamers just outside the three-mile limit of the United States, whence they supplied the markets of the adjoining coasts.

The United States entered into treaties by which Great Britain and other nations agreed that vessels carrying their flags might be captured within that distance from the U.S. Coast which can be traversed in one hour by the vessel suspected of endeavouring to commit an offense. This might possibly be as much as thirty nautical miles. Within the United States large numbers of otherwise law-abiding persons bought and sold or gave away bootleg liquor, and the difficulties of executing the law are shown by the figures of national enforcement. In one fiscal year (1924–5) 20,000,000 gal. of distilled and fermented liquors were seized; 77,000 persons were arrested; 50,000 criminal cases were entered against bootleggers; 35,000 pleas of guilty were entered and 38,000 convictions were obtained. A national law regulating the traffic in habit-forming drugs was enacted May 26 1922.

The chief unofficial agency for the enforcement of the law was the Anti-Saloon League, which made it its business to back up prosecutions and to keep the public informed. The law was denounced, and disregard of the law was defended by a considerable number of men and women of repute and influence; but Congress continued to make the necessary appropriations and to refuse all propositions to modify the enforcement of the law, with which the Supreme Court declined to interfere.

National Defence.—A remarkable phenomenon connected with the War was its effect upon the minds of those who served in the army and navy. The dangers, the hardships, the sufferings, the tortures of trench and hospital life were such that hardly any "service man" showed inclination to tell of his experiences or to encourage war. The armies were returned and disbanded as fast as possible; but a demand was made at once by soldiers and officers for some immediate acknowledgment of their sufferings and services. The Government attempted to head off this movement, first by an elaborate system of life insurance during the War with the privilege of continuing afterward, then by money bonuses, passed by a number of the states. The Federal Govt. instituted an elaborate rehabilitation system for training wounded or otherwise injured men in some pursuit in which they could earn their own living. The Govt. also provided hospitals and care for sick and disabled soldiers. Provision was made for special privileges of alloting government land in favour of ex-soldiers. On Sept. 20 1922 a bonus bill was defeated by President Harding's veto. On March 18 1924 a Federal bonus was enacted by a large majority vote in Congress, and President Coolidge allowed it to become law.

Notwithstanding the experience of the United States in 1917, when it declared a war without any mobile army, strong pressure was put on Congress to reduce the regular army. By an Act of Feb. 12 1925 the force of the regular army was set at 125,000 enlisted men and 7,953 enlisted men of the Philippine Scouts. A drive was directed against the system of training young men in summer camps, so that they might be available as officers if needed sometime in the future. Most of the veterans were interested in the American Legion, the most widely distributed society of service men; and that body had considerable influence in the matter of legislation for ex-soldiers.

Another serious controversy relating to defence came to a head in 1925 over the air service. The great dirigible "Shenandoah" was wrecked by a storm in Sept. 1925, the commander, Lansdowne, and thirteen men being killed. The wreck called public attention to the state of air defence. Col. William Mitchell, ignoring military law and custom, made a public attack upon the whole air service, insisting that it should no longer be divided between the army and navy departments, but should be a third separate branch of national defence. He was court-martialled, convicted, suspended for five years and allowed to resign and leave the service.

International Relations.—The foreign affairs of the United States are always much affected by changes in party and in personnel. President Coolidge, accepting the resignation of Charles E. Hughes from the Department of State, appointed as his successor (Feb. 1925) Frank B. Kellogg, previously a Senator and Ambassador to Great Britain. To the powerful chairmanship of the committee on foreign relations, after the death of Henry Cabot Lodge of Massachusetts, who had been head of the opposition to the ratification of the League and Covenant, succeeded William E. Borah of Idaho (Dec. 1924), the famous freelance of the Senate. A great improvement in the conduct of foreign relations was introduced by the Rogers Act, which took effect July 1 1924, under which the consular and diplomatic services were merged and the policy of training young men with the prospect of life-long service was entered upon.

The general policy of the United States towards other nations was much affected first of all by changes in international trade caused by the disruption of the World War; then by the refusal

of the Senate in 1919 to approve the Versailles Treaty and further by a strong popular opposition to any formal relation with the League of Nations. A treaty with Germany (June 28 1919) formally restored peace, provided for commerce and arranged for an adjustment of claims. A similar treaty was made with Austria under date of Sept. 10 1919. Turkey, on entering the War in 1914, declared that the capitulations were no longer in effect. The American administration nine years later accepted that policy in the American Lausanne Treaty dated July 24 1923. But a strong protest was made by friends of the Armenians and others in America, and down to 1926 ratification by the Senate had not been obtained.

Immigration.—An important question, partly social and partly international, was that of immigration, which went through a new phase because of the rush of people from other parts of the world as soon as the war conditions were cleared up. Complaint was made that in the previous two decades the greater part of the immigrants came from southern and eastern Europe, and was made up of persons who were not by tradition and inheritance of the same type as most of the previous immigrants. Several changes were made in 1918 and at other dates so as to reduce the number of undesirables; and by the Act of 1924, a permanent quota system was enacted, based on 2% of the number of nationals of that country shown to be in the United States by the census of 1890. This made a total of about 165,000 permissible each year from all countries, besides about 150,000 transient visitors. Unrestricted immigration from Canada and Mexico and some other sources brought the total immigration in 1924 and 1925 up to about 300,000, out of which should be taken about 100,000 emigrants, leaving a total permanent addition of about 200,000 annually.

Reparations.—The United States was no party to the provisions of the Versailles Treaty providing for German reparations, particularly to France, and the payment of an indemnity by Germany. However, an American force of occupation was left in the Rhine belt, the costs of which amounted to about $200,000,000 and were to be paid by Germany. In 1921 Germany did not pay the stipulated sums to the Allies and therefore the French occupied the Ruhr Valley. The United States suggested a commission, which, headed by Charles G. Dawes (later Vice-President of the U. S.), succeeded in working out a scheme (1924) that was acceptable to France, Great Britain and Belgium, for a method of payment secured by a lien on German railways and factories. Financially the importance of the Dawes plan to the United States was that it cleared the way for considerable investments of private capital in German municipal and corporate securities.

General Foreign Relations.—Among the incidents of foreign relations since the War has been the recognition of various new countries created by the Treaty of Versailles: Poland, Latvia, Lithuania, Estonia, Finland, Czechoslovakia, Yugoslavia, Hungary and the enlarged Rumania. In 1924 the United States received Prof. Timothy A. Smiddy as minister from the Irish Free State. The British Govt. consented to the appointment of a direct Canadian representative at Washington, and in 1924, a diplomatic agreement was made between the United States and Canada as regards halibut fishing, for which, however, the United States insisted upon a formal approval by the British Government. This was granted in due course.

The last American troops were withdrawn from Germany in 1923. Meanwhile a joint commission on German claims was far advanced in its task. A troublesome difficulty was that a treaty with Prussia, entered into in 1828 and assumed in 1871 by the German Empire, entitled German citizens in case of war to nine months to dispose of their property in the United States and leave the country. Instead, all discernible property of Germans, and particularly of German corporations, was seized at the beginning of the War and placed in the hands of a Custodian of Enemy Property. A group of valuable German patents were turned over, for a very small payment, to American manufacturing chemists. Seven years after the end of the War the question of the legal ownership of those patents was still unsettled.

Allies' Debts.—A very serious and difficult issue was that of the sums lent by the United States to foreign governments during the War, aggregating nine and a half thousand million dollars. Without those enormous advances the Allies would have broken down economically before an American Army could have been placed in Europe. Nearly all the allied European countries shared in these advances. For several years interest accumulated, until, at the end of 1922, the total principal was ten thousand million dollars and the accumulated interest one and a half thousand millions more. This enormous sum was funded in United States Govt. bonds placed at about four per cent interest, mostly in American hands, upon the same footing as other obligations of the government. The interest was paid by the U. S. Treasury. In 1923 the first important adjustment of the debt was made by an agreement with England (Feb. 28 1923). The whole amount of the principal and interest then due was funded at $4,000,000,000 to be paid in annual instalments beginning with 23 millions a year and increasing, until in the sixty-second year the debt and accruing interest would be extinguished. Similar settlements were made with Finland and other small nations. The obligations of Armenia and Russia were practically written off.

Negotiations followed with other countries and a settlement was made with Italy (Nov. 1925), ratified (April 1926), to pay $5,000,000 a year for five years, and thereafter rising payments for 57 years. The principal was reduced from a nominal value of two thousand million dollars to a present value at 5% of £430,000,000, the very low rate of interest on long-deferred payments being thus equivalent to a reduction of about one-half the debt. In April 1926, following an unsuccessful visit of a French debt commission to the United States in Sept. 1925, a settlement was finally arrived at with France.

The total amount of the French indebtedness to be refunded, after a cash payment to adjust the sum to round figures, was declared to be $4,025,000,000, and the repayment of this amount with interest was spread over 62 years as in the other war debt settlements. The total sum to be received by the United States under this agreement amounted to $6,847,674,104, being an increase of approximately $627,000,000 over the previous French offer made by M. Caillaux, and there was no "safeguard" clause as had been previously demanded.

Comparing the French settlement with those of Great Britain and Italy, the figures worked out as follows: Great Britain's agreement discounted represented slightly over 80% of her total obligation, France's approximately 50% and that of Italy 26%. The House of Representatives voted approval June 2, but ratification by the Senate was deferred pending the action of the French legislature. The various agreements made to the end of April 1926 left only $295,000,000 unfunded war debts to the United States, including $193,000,000 owing by Russia. In nearly all cases the period of payment is so long and the interest so low that the settlements involve payment at the value of from one-quarter to over three-quarters of the original advances by the United States.

Latin America.—With Latin America the United States in the main enjoyed peaceful relations. The long-standing question over the Isle of Pines was adjusted by a treaty (March 13 1925), under which the title of Cuba was acknowledged. At the request of Chile and Peru President Harding agreed in 1922 to arbitrate the obstinate dispute over the ownership of the Tacna-Arica region. After Harding's death President Coolidge took up the task and rendered his decision (March 4 1925) to the effect that the delayed plebiscite of the inhabitants should now be taken; and General Pershing was made the head of a commission to preside over this process. Chile objected, and towards the end of 1925 it seemed doubtful whether or not the award would be carried out. (*See* TACNA-ARICA.) With Mexico relations became strained by a dispute over the application of the new Mexican constitution of 1917 under which aliens were forbidden to hold lands or concessions. Mexicans claimed that this was in accord with the practice of several states in the United States. In 1925 Secretary Kellogg protested against the attitude of Mexico as unfriendly and declared that the Govt. of Mexico was on trial before the world.

In March 1926 a financial understanding was reached. The United States was also concerned in the outbreak of anti-foreign feeling in China and her representatives took part in a conference at Peking in Oct. 1925 upon questions relating to the withdrawal of the foreign limitation on the laying of tariffs by the Chinese Government. (*See* CHINA.)

The League of Nations.—After the refusal of the United States to ratify the Treaty of Versailles or to take part in the League of Nations, no official relations with the League were established. However, large numbers of American citizens were interested in the work of the League and some of them were appointed to advisory committees in which, however, they did not represent the American Government. Eventually the United States consented to appoint official delegates or " observers " to commissions on the Opium Traffic and other matters, instituted by the League and operating in its headquarters in Geneva. The United States became a party to treaties with regard to the white slave trade and other matters, drawn up by the League, but to take effect for only such countries as might ratify them. Gradually even the warm friends of the League accepted the conviction that it was useless for the time to urge participation in the League by the United States.

The World Court.—Down to 1914 the International Court at The Hague, founded in 1899 and strengthened in 1907, was in being and rendered occasional decisions. It was, however, entirely ignored by the contending parties in the six large wars that broke out from 1900 to 1914 and after the War it remained ineffective. Elihu Root, who had a share in framing the court, came forward in 1920 as the leader of an unofficial group of experts in international affairs, to propose a new world court with wide powers and jurisdiction. An advisory committee of jurists sat at The Hague and drew up a plan for a Permanent Court of International Justice. The League of Nations modified the project but established the Court (Dec. 1920) and chose the judges (Sept. 1921). (*See* PERMANENT COURT OF INTERNATIONAL JUSTICE.) The United States had no official relation with the Court; but the force of American public sentiment for a World League concentrated on a proposition for qualified entrance of the United States into the World Court.

This was warmly urged by President Harding and later by President Coolidge. Senator Borah, Senator Hiram Johnson of California and others strongly opposed. The progress of the movement was checked by a proposal, originally drawn by a group headed by Professor J. T. Shotwell of Columbia University and the Carnegie Endowment, who desired to enlarge the jurisdiction of the World Court and give it a compulsory character. The League of Nations modified this proposal into the so-called Geneva Protocol, which was unanimously approved by the Assembly of the League of Nations (Sept. 1924), and sent for ratifications by the nations of the world. Strong opposition was made in the United States on the plea that the Court was to decide whether a controversy was justiciable, and could assert jurisdiction over all nations and also arbitrate regarding nations, even if not members of the League of Nations. Great Britain declined to accept the compulsory jurisdiction and the whole plan fell to the ground.

This set-back left the statute constituting the World Court intact, and great pressure was exerted upon the U.S. Senate to take part in the World Court; it was urged by President Coolidge and Secretary Kellogg. On Jan. 27 1926 the Senate, by a majority of 76 to 17, voted the adhesion of the United States to the Court, with several important reservations: the United States should not be bound by advisory opinions or be subject to any obligatory jurisdiction; should participate in the election of the judges; might withdraw at its will; and no case involving the United States was to be submitted without its consent. If all the 50 or more nations that are members of the League of Nations assent to these conditions, the United States becomes so far forth a participant in a world tribunal for the settlement of international disputes and difficulties, while at the same time steadfastly disavowing any official connection with or responsibility to the League of Nations.

The 69th Congress.—The first session of the 69th Congress adjourned July 3 1926, its most important measures being the passage of Secretary Mellon's revenue bill which is estimated to have lightened the tax burden by $350,000,000, and the action of the Senate in voting the adhesion of the United States to the World Court with reservations. At the date of adjournment a Senate committee was investigating the expenses of candidates in recent primary contests for the Senate.

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II. NATIONAL FINANCE AND WEALTH

THE PUBLIC FINANCES

The dominating feature in Federal public finance since 1910 has been the financing of American participation in the World War with the subsequent readjustments necessary for returning to peace conditions. Although several significant alterations and innovations in the fiscal system had their origin in the pre-War period, 1910–6, it was the necessity for war expansion or for post-War contraction that made most of these changes important. For example, income taxation had its beginnings in the tariff Acts of 1909 and 1913, but it was due primarily to war experience that it rose to its present pre-eminent position in the revenue system. Similarly, the Federal Reserve System had begun operation in 1914, but the use of the Federal reserve banks as fiscal agents of the Government was a war development. And it was the need for retrenchment after the War that brought about the adoption of the executive budget, a measure which had been steadilyadvocated by successive administrations since 1910 or thereabouts.

Public Debt.—Although taxation was used to an unprecedented extent in financing the participation of the United States in the World War, it was necessary to borrow the greater portion of the required revenues. Four classes of interest-bearing obligations were authorised and issued: (1) Treasury certificates of indebtedness, with maturities not exceeding one year; (2) Treasury notes, with maturities from one to five years; (3) bonds, with maturities exceeding five years; and (4) war savings certificates, with maturities not exceeding five years. All were issued at not less than par except war savings certificates, on which interest was discounted in advance.

The Treasury was placed in funds through the issue of short term Treasury certificates of indebtedness, and from time to time outstanding certificates were funded into loans, discharged from tax receipts or replaced by new issues. Five war loans were issued during the War and post-Armistice periods. The War Loan Organisation, directed from the Treasury and centred at the Federal Reserve Banks, with associated Liberty Loan Committees formed in every part of the country, conducted the selling campaigns. The results are shown in table below.

The peak of the War debt was reached on Aug. 31 1919, when the gross amount outstanding stood at $26,594,267,878. Congress, in the Victory Liberty Loan Act (March 3 1919), provided for definite and systematic discharge of the permanent debt through provision for the cumulative sinking fund, effective on July 1 1920, and through reaffirmation of directions to apply to domestic debt reduction any repayments of loans to foreign governments. The Federal budget is balanced annually on such basis. There remained the problem of the temporary or short-dated debt. Many of the maturities came at inconvenient times and in inconvenient amounts. In order to render this short-dated debt more manageable and to arrange maturities on dates and in amounts that could be discharged without undue strain the Treasury entered on a refunding programme. It resorted to issues of Treasury notes in moderate amounts from time to time, with maturities not exceeding five years. The first issue was made on June 15 1921. Other issues followed. On Oct. 16 1922, the programme was varied and a series of Treasury bonds was issued with further issues of bonds on Dec. 15 1924, March 15 1925 and March 15 1926. Each year since the War the volume of maturities has been considerably larger than the amount that could be retired, so that refunding operations have been continuously necessary and will continue to be necessary in the future. The maturities of all refunding issues are arranged for tax payment dates, and with respect to the bonds provision was made for call before maturity. Thirteen refunding issues aggregating $6,553,693,300 have been made to March 31 1926.

Included in the short-dated debt to be discharged or refunded were the outstanding Victory notes. Approximately $1,200,000,000 were retired through purchase for the sinking fund and other accounts, approximately $1,500,000,000 were exchanged for other issues, and approximately $1,800,000,000 were paid on call date or at maturity.

On March 31 1926 the outstanding debt was as follows:—

Interest-bearing debt—	
Bonds:	
Pre-War issues	765,860,170.00
Liberty Loans	13,946,307,500.00
Post-War issues	2,305,933,900.00
Treasury notes	1,612,403,600.00
Certificates of indebtedness	821,002,000.00
Treasury Savings certificates	362,218,809.60
Total interest-bearing debt outstanding	$19,813,725,979.60
Matured debt on which interest has ceased	20,678,670.26
Outstanding debt bearing no interest	248,365,358.49
Total gross debt	$20,082,770,008.35
Net debt, after adjustments for matured interest obligations, balance held by Treasurer of the United States, etc.	$19,736,292,774.63

$5,369,257,859 of the interest-bearing debt matures within 5 years (before April 1 1931).

Taxation.—There were three notable features in the history of Federal taxation in the period 1910–26. The first was the

Issue	Amount Subscribed	Amount Allotted and Issued	Number of Subscribers (estimated)
First Liberty Loan, 3½ per cent, June 15 1917	$3,035,226,850	$1,989,455,550	4,000,000
Second Liberty Loan, 4 per cent, November 15 1917	4,617,532,300	3,807,865,000	9,400,000
Third Liberty Loan, 4¼ per cent, May 9 1918	4,176,516,850	4,175,650,050	18,308,325
Fourth Liberty Loan, 4¼ per cent, October 24, 1918	6,992,927,100	6,964,581,100	22,777,680
Victory Liberty Loan, 3¾–4¾ per cent, May 20 1919	5,249,908,300	4,495,373,000	11,803,895
Total	$24,072,111,400	$21,432,924,700	

adoption of an income tax with progressive rates and its rapid growth to a position of pre-eminence in the revenue system. The second was the unprecedented expansion of taxation during the War, which made it possible to pay nearly one-third of the War costs, including loans to the Allies, from current revenues. The third feature was the post-War reduction in taxation, made possible by an aggressive campaign for economy in public expenditures and by the adoption of an executive budget.

Until 1913 practically all the Federal revenue had been derived from customs and internal excise duties on alcoholic beverages and tobacco. In 1910, customs duties were furnishing 50% of the total ordinary receipts of the Federal Govt., while 40% came from internal taxes on tobacco and alcoholic beverages. The ratification of the 16th Amendment in 1913 permitted the Federal Govt. to "lay and collect taxes on incomes from whatever source derived," a privilege that was immediately made use of by a provision in the Tariff Act of Oct. 3 1913. With the War came an expansion in all taxes, but the new income tax supplied the major portion of the increased revenues. By 1925, after two reductions had taken place in the maximum rates, income and profits taxes still yielded almost as much as all other sources of ordinary revenue combined, while customs duties provided only about one-seventh, and tobacco taxes less than one-tenth, of the total ordinary receipts. The following table shows the growth in importance of the income tax from 1910 to 1925.

Relative Importance of Principal Federal Taxes 1910–25

Fiscal year ending June 30	Income and profits (1)	Customs (1)	Tobacco (2)	Spirits and liquors (2)	Total ordinary receipts
	(In millions of dollars)				
1910	(3) 21	334	58	209	676
1915	80	210	80	224	678
1920	3,957	324	296	140	6,704
1925	1,762	549	345	26	3,608
	(In percentages of ordinary receipts)				
1910	3·1	49·4	8·6	30·9	..
1915	11·5	30·1	11·5	32·1	..
1920	59·0	4·8	4·4	2·1	..
1925	48·8	15·2	9·6	0·7	..

(1) On warrant basis.
(2) On basis of reports of collections. Includes special taxes relating to manufacture and sale.
(3) From a 1% "excise tax" on corporation incomes. Adopted 1909.
Source: Annual Report of the Secretary of the Treasury, 1925, pp. 485, 497.

Under the stimulation of War necessity, not only were former taxes increased to maximum rates, but a multitude of new and temporary taxes came into being. In each successive Revenue Act from 1914 to 1918, both of these tendencies were illustrated. The climax came in the Revenue Act of 1918, approved Feb. 24 1919, which constituted the high water mark for tax levies in American history. Under this law, rates on personal incomes earned in 1918 began with 6% on the smallest incomes and rose to 77% (65% surtax) on net incomes of over $1,000,000. For years subsequent to 1918, a small reduction in the normal tax was provided, which reduced the rate applicable to the highest incomes to 73%. Corporations were taxed 12% on their net incomes, 1% on their capital stock, and, under a combined War-profits and excess-profits tax, an additional amount up to 80% of the profits in excess of certain credits (based on 8% of invested capital and the rate of pre-War earnings). Estates of decedents were made taxable at rates reaching a maximum of 25%. Excise and occupation taxes were increased from the already high rates of 1917, and many new levies were made on transactions and articles of consumption.

This law was in effect until 1921, when the new Republican administration upon coming into office began an aggressive campaign to decrease expenditures in order to permit a reduction in the high taxes. The success of this economy programme was greatly enhanced by the establishment in 1921 of an executive budget system, which permitted, for the first time, the formulation of a comprehensive fiscal programme by the administration. In spite of the increased cost of government and continued war liabilities for the public debt, disabled veterans and unliquidated War-time agencies, it was found possible to reduce taxes to some extent immediately. Accordingly, the Revenue Act of 1921 repealed the excess-profits tax on corporations (although the corporation income tax was increased as a partial offset), and the maximum rate on individual incomes was reduced from 73% (65% surtax) to 58% (50% surtax). Several of the more unpopular excise taxes were also repealed, such as, for example, duties on transportation, soda-fountain products, toilet and medicinal preparations and articles of clothing.

By 1924 the reduction in expenditures had made considerable progress, resulting in a surplus of about $500,000,000 in ordinary receipts over expenditures chargeable against ordinary receipts. Congress found it possible, therefore, to make more extensive tax reductions in the Revenue Act of 1924. The maximum rate on personal incomes was reduced from 58% to 46% (40% surtax), while the smallest taxable incomes paid only 2%. Numerous excise duties, including taxes on telegraph and telephone messages, manufacturers' sales, drafts and checks, and admissions, were repealed in whole or in part.

In 1926 a thoroughgoing tax revision was undertaken in an attempt to devise a more scientific system. It was felt that some of the taxes, especially the excessive surtaxes, had a depressing effect upon industry, and, furthermore, were fiscally unnecessary. Accordingly, the maximum rate on individual incomes was fixed at 25% (20% surtax), while corresponding reductions were made in the lower brackets. Several taxes, including the gift tax and capital-stock tax, were repealed altogether, and reductions were made in many of the excises.

Tariff.—Two thorough revisions of the tariff have taken place since 1910. In 1913, the new Democratic administration supplanted the "cost of production" duties of the 1909 law with schedules designed to secure "effective competition" between American and foreign producers. There was a reduction in rates on many manufactured products, notably textiles, and the free list was extended to include some important raw materials and foodstuffs, as well as a few manufactures. A Tariff Commission was created to make researches into comparative costs of production, upon which future tariff rates could be based.

With the return of the Republican party to power in 1921, an emergency Act was immediately provided to be effective until a comprehensive tariff revision could be undertaken. There was a general increase in rates, and duties were imposed on many articles which had been on the free list. The new Tariff Act of 1922, as finally framed, reinforced and extended this upward revision of rates. A "flexible" provision was included which gave the President power to increase or decrease rates by not more than 50% of the statutory amount, as occasion demanded, but this privilege has been rarely used.

Loans to Foreign Governments.—The total principal amount of obligations of foreign governments originally held by the Treasury was $10,338,058,352.20. Such obligations were acquired by the United States (1) under the authority of the Liberty bond acts which authorised the Secretary of the Treasury, with the approval of the President, to establish credits in favour of foreign governments engaged in war with enemies of the United States against cash advances made for the purpose, in general, of enabling those governments to meet commitments made in the United States in connection with the prosecution of the War; (2) under the authority of the Act of July 9 1918, which authorized the President, through the head of any executive department, to sell any surplus war supplies on such terms as the head of such department deemed expedient; (3) under the authority of the Act of Feb. 25 1919, appropriating $100,000,000 as a revolving fund for the participation by the United States, in the discretion of the President, in the furnishing of foodstuffs and other urgent supplies to certain populations in Europe and countries contiguous thereto; and (4) under the authority of the Act of March 30 1920, which authorized the U.S. Grain Corporation,

with the approval of the Secretary of the Treasury, to sell or dispose of the flour in its possession, not to exceed 5,000,000 bbl. at such prices and on such terms or conditions as might be necessary to relieve populations in the countries of Europe or countries contiguous thereto, suffering for the want of food. The table below (taken from the annual report of the Secretary of the Treasury, for the fiscal year 1925) shows by countries the total principal amount of such obligations received by the United States and payments on account of principal thereof.

Country	Total principal amount of obligations received under Liberty bond Acts	Total principal amount of obligations received for surplus supplies sold on credit under Act of July 9 1918	Total principal amount of obligations received for relief supplies furnished on credit under Acts of Feb. 25 1919, and March 30 1920	Payments on account of principal of obligations so received	Total net principal amount of obligations received by Treasury pursuant to Acts mentioned
Armenia	..	..	$11,959,917.49	..	$ 11,959,917.49
Austria	..	..	24,055,708.92	..	24,055,708.92
Belgium	$349,214,467.89	$29,872,732.54	..	$ 2,057,630.37	377,029,570.06
Cuba	10,000,000.00	..	..	10,000,000.00	..
Czechoslovakia	61,974,041.10	20,604,302.49	9,301,327.44	..	91,879,671.03
Estonia	..	12,213,377.88	1,785,767.72	..	13,999,145.60
Finland	..	..	8,281,926.17	..	8,281,926.17
France	2,997,477,800.00	407,341,145.01	..	64,302,901.29	3,340,516,043.72
Great Britain	4,277,000,000.00	..	..	202,181,641.56	4,074,818,358.44
Greece	15,000,000.00	..	..	..	15,000,000.00
Hungary	..	..	1,685,835.61	..	1,685,835.61
Italy	1,648,034,050.90	..	..	164,852.94	1,647,869,197.96
Latvia	..	2,521,869.32	2,610,417.82	..	5,132,287.14
Liberia	26,000.00	..	..	..	26,000.00
Lithuania	..	4,159,491.96	822,136.07	..	4,981,628.03
Nicaragua	..	166,604.14	..	82,513.86	84,090.28
Poland	..	83,682,708.66	75,984,263.73	..	159,666,972.39
Rumania	25,000,000.00	12,922,675.42	..	1,794,180.48	36,128,494.94
Russia	187,729,750.00	406,082.30	4,465,465.07	..	192,601,297.37
Yugoslavia	26,780,465.56	24,978,020.99	..	720,600.16	51,037,886.39
Total	$9,598,236,575.45	$598,869,010.71	$140,952,766.04	$281,304,320.66	$10,056,754,031.54

Debt-funding agreements executed pursuant to the authority of the Act of Feb. 9 1922, as amended, providing for the funding of $9,811,094,094.03, principal amount of obligations of foreign governments held by the Treasury, have been concluded with the Govts. of Belgium, Czechoslovakia, Estonia, Finland, France, Great Britain, Hungary, Italy, Latvia, Lithuania, Poland, Rumania and Yugoslavia. Below is a statement showing by countries the principal amount of obligations funded and the amount of accrued interest thereon included in the principal of the debt as funded:—

Country	Date of agreement	Principal of obligations funded	Accrued interest funded	Funded bonds received or to be received
Belgium	Aug. 18 1925	$377,029,570.06	$40,750,429.94	$417,780,000.00
Czechoslovakia	Oct. 13 1925	91,879,671.03	23,120,328.97	115,000,000.00
Estonia	Oct. 28 1925	[1] 12,066,222.15	1,763,777.85	13,830,000.00
Finland	May 1 1923	8,281,926.17	718,073.83	9,000,000.00
France	Apr. 29 1926	3,340,516,043.72	684,483,956.28	4,025,000,000.00
Great Britain	June 19 1923	4,074,818,358.44	525,181,641.56	4,600,000,000.00
Hungary	Apr. 25 1924	1,685,835.61	253,164.39	1,939,000.00
Italy	Nov. 14 1925	1,647,869,197.96	394,130,802.04	2,042,000,000.00
Latvia	Sept. 24 1925	5,132,287.14	642,712.86	5,775,000.00
Lithuania	Sept. 22 1924	4,981,628.03	1,048,371.97	6,030,000.00
Poland	Nov. 14 1924	159,666,972.39	18,893,027.61	178,560,000.00
Rumania	Dec. 4 1925	36,128,494.94	8,461,505.06	44,590,000.00
Yugoslavia	May 3 1926	51,037,886.39	11,812,113.61	62,850,000.00
Total		$9,811,094,094.03	$1,711,259,905.97	$11,522,354,000.00

[1] Credit of $1,932,923.45 allowed for loss of cargo on ship sunk by mine deducted.

The Budget.—The Budget and Accounting Act of June 10 1921, directed the President to submit annually to Congress a budget prepared by a Bureau of the Budget whose duties were to be performed directly under the President. By this means it is possible for the President to exercise a much more effective control than formerly over the estimates of appropriations submitted by the executive departments and officers. The first budget was submitted in 1921, for the fiscal year ending June 30 1923. By that same law, the Government accounting system was removed from the Treasury and an independent General Accounting Office was established under the Comptroller-General of the United States.

The Federal Reserve Banks as Fiscal Agents.—The organisation of the Federal Reserve System has made a fundamental change with respect to the conduct of the fiscal business of the Government. The Secretary of the Treasury may require the Federal reserve banks to act as fiscal agents of the United States and as depositaries of public moneys. They have been utilised in both capacities, and since the discontinuance of the independent Treasury system on July 1 1921 they have been the principal agents for the administration of receipts and expenditures, the depositary system, the public debt and paper currency changes.

Other Agencies.—During the War period and subsequently the operations of many governmental agencies created by Congress had more or less connection with and influence on national finance. Mention may be made of the Federal control of railways and the post-War assistance given the carriers under the Transportation Act of Feb. 28 1920 and of the several War emergency corporations, the capital stocks of which were subscribed for by the Treasury and served as revolving funds, such as the Emergency Fleet Corp., the U.S. Housing Corp., the U.S. Sugar Equalisation Board, the U.S. Spruce Products Corp., the War Finance Corp. and the U.S. Grain Corporation. The United States subscribed to the capital stock of the Federal Land Banks, now repaid for the most part, furnished the capital for the Intermediate Credit Banks, and purchased Federal farm loan bonds when their public sale was inopportune. In 1910 a Postal Savings System was established that has received deposits aggregating $1,295,753,979, while withdrawals have amounted to $1,163,580,768. Deposits bear interest at 2% and may be converted into 2½% U.S. bonds.

Adherence to the gold standard has been one of the important factors contributing to the stability of the American financial structure. During the War actual payments in gold, though discouraged, were never suspended, and in 1922 the unrestricted payment of gold in the ordinary course of business was reinaugurated.

Table I. below sets forth the receipts and expenditures of the U.S. Govt. on a warrant basis during the period July 1 1910 to June 30 1925 by fiscal years, classified as to ordinary receipts and expenditures, and public debt receipts and expenditures. The surplus or deficit of ordinary receipts and of total receipts are also shown for each year.

TABLE I. *Receipts and Expenditures of the United States Government by Fiscal Years from 1911 to 1925*[1]
On basis of warrants issued.

Fiscal year	Ordinary receipts							Surplus (+) or deficit (−) ordinary receipts compared with expenditures chargeable against ordinary receipts[2]
	Customs	Internal revenue: Income and profits taxes	Internal revenue: Miscellaneous	Sales of public lands	Surplus postal receipts covered into the Treasury	Miscellaneous receipts	Total ordinary receipts	
1911	314,497,071	33,516,977	289,012,224	5,731,637	..	59,075,002	701,832,911	+10,631,399
1912	311,321,672	28,583,304	293,028,896	5,392,797	..	54,282,535	692,609,204	+2,727,870
1913	318,891,396	35,006,300	309,410,666	2,910,205	..	57,892,663	724,111,230	−400,733
1914	292,320,014	71,381,275	308,659,733	2,571,775	$3,800,000	55,940,379	734,673,167	−408,264
1915	209,786,672	80,201,759	335,467,887	2,167,136	3,500,000	66,787,373	697,910,827	−62,675,975
1916	213,185,846	124,937,253	387,764,776	1,887,662	..	54,759,011	782,534,548	+40,537,821
1917	225,962,393	359,681,228	449,684,980	1,892,893	5,200,000	81,903,301	1,124,324,795	−961,717,309
1918	182,758,989	2,838,999,894	857,043,591	1,969,455	9,557,701	290,095,526	4,180,425,156	−9,611,482,739
1919	183,428,625	2,600,762,735	1,239,468,260	1,404,705	18,000,000	611,316,574	4,654,380,899	−14,297,760,281
1920	323,536,559	3,956,936,004	1,442,213,241	1,910,140	300,000	979,518,493	6,704,414,437	+562,669,107
1921	308,025,102	3,228,137,674	1,351,835,935	1,530,439	..	694,987,895	5,584,517,045	+693,241,726[2]
1922	357,544,713	2,086,918,465	1,121,239,843	895,391	81,494	536,916,625	4,103,596,531	+485,558,734
1923	562,189,039	1,691,089,535	935,699,504	656,508	..	657,411,097	3,847,045,683	+199,397,834
1924	545,012,115	1,841,759,317	952,530,768	522,223	..	544,216,719	3,884,041,142	+479,746,075
1925	548,521,795	1,761,659,049	827,786,838	623,534	..	469,052,948	3,607,644,164	+676,937,181

[1] This statement does not include postal revenues and expenditures, except surplus postal revenues covered into the Treasury and postal deficiencies paid out of the general fund of the Treasury.
[2] Beginning with 1921, figures represent surplus or deficit after taking into account public debt expenditures chargeable against ordinary receipts.

Fiscal year	Expenditures chargeable against ordinary receipts									
	Civil and miscellaneous[3]	War Department (including rivers and harbours and Panama Canal)[4]	Navy Department[5]	Indians	Pensions[6]	Postal deficiencies[7]	Interest on the public debt	Total ordinary expenditures	Public debt retirements chargeable against ordinary receipts[8]	Total expenditures chargeable against ordinary receipts
1911	173,838,599	197,199,491	119,937,644	20,933,869	157,980,575	..	21,311,334	691,201,512	..	691,201,512
1912	172,256,794	184,122,793	135,591,956	20,134,840	153,590,456	1,568,195	22,616,300	689,881,334	..	689,881,334
1913	169,802,304	202,128,711	133,262,862	20,306,159	175,085,450	1,027,369	22,899,108	724,511,963	..	724,511,963
1914	170,530,235	208,349,746	139,682,186	20,215,076	173,440,231	..	22,863,957	735,081,431	..	735,081,431
1915	200,533,231	202,160,134	141,835,654	22,130,351	164,387,942	6,636,593	22,902,897	760,586,802	..	760,586,802
1916	199,555,048	182,139,305	155,029,426	17,570,284	159,302,351	5,500,000	22,900,313	741,996,727	..	741,996,727
1917	1,153,677,360	459,539,678	257,166,437	30,598,094	160,318,406	..	24,742,129	2,086,042,104	..	2,086,042,104
1918	6,306,354,995	5,705,136,249	1,368,642,794	30,888,400	181,137,754	2,221,095	197,526,608	13,791,907,895	..	13,791,907,895
1919	6,805,124,746	9,265,325,159	2,009,272,389	34,593,257	221,614,781	343,511	615,867,337	18,952,141,180	..	18,952,141,180
1920	3,133,100,982	1,100,865,666	629,893,116	40,516,832	213,344,204	..	1,024,024,440	6,141,745,240	..	6,141,745,240
1921	1,811,016,060	580,794,891	647,870,645	41,470,808	260,611,416	130,272,845	996,676,804	4,468,713,469	$422,561,850	4,891,275,319
1922	989,922,678	402,058,450	458,794,813	38,500,413	252,576,848	64,345,235	989,485,410	3,195,684,847	422,352,950	3,618,037,797
1923	1,169,528,360	355,722,856	322,532,909	45,142,763	264,147,869	32,526,915	1,055,088,486	3,244,690,158	402,957,691	3,647,647,849
1924	1,047,269,519	348,606,247	324,129,998	46,754,026	228,261,555	12,638,850	938,740,772	2,946,400,967	457,894,100	3,404,295,067
1925	617,537,364	357,957,420	326,365,467	38,755,457	218,321,424	23,216,784	882,014,950	2,464,168,866	466,538,114	2,930,706,980

[3] Includes civil expenditures under War and Navy Departments at Washington to and including fiscal year 1920.
[4] Exclusive of civil expenditures under War Department at Washington to and including fiscal year 1920.
[5] Exclusive of civil expenditures under Navy Department at Washington to and including fiscal year 1920.
[6] Includes only army and navy pensions for service prior to World War, and fees of examining surgeons. Does not include salaries under Bureau of Pensions or payments to the veterans of the World War, the expenditures for which are made by the Veterans' Bureau and included in the figures covering "civil and miscellaneous."
[7] Exclusive of the following amounts transferred to the Civil Service Retirement and Disability fund (Interior Department) on account of salary deductions of 2½% under the Act of May 22 1920: 1921, $6,519,683.59; 1922, $7,899,006.28; 1923, $8,300,779.81; 1924, $8,679,658.60; 1925, $10,266,977.47.
[8] At par.

Fiscal year	Public debt expenditures chargeable against public debt receipts and surplus revenue[1]			Public debt receipts			Surplus (+) or deficit (−) public debt receipts compared with public debt expenditures (exclusive of public debt expenditures chargeable against ordinary receipts)	Recapitulation of total receipts and expenditures		
	Public debt retirements, exclusive of retirements chargeable against ordinary receipts	Redemption of national bank and Federal reserve bank notes	Total public debt retirements chargeable against public debt receipts and surplus revenue	Public debt receipts, proceeds of bonds and other securities	Deposits to retire national bank and Federal reserve bank-notes	Total public debt receipts		Total ordinary and public debt receipts	Total ordinary and public debt expenditures	Surplus (+) or deficit (−) of all receipts
1911	246,496	34,976,840	35,223,336	17,641,634	40,232,555	57,874,189	+22,650,853	759,707,100	726,424,848	+33,282,252
1912	120,616	28,527,712	28,648,328	32,817,646	20,078,365	52,896,011	+24,247,683	745,505,215	718,529,662	+26,975,553
1913	102,575	24,089,036	24,191,611	1,929,840	21,471,010	23,400,850	−790,761	747,512,080	748,703,574	−1,191,494
1914	109,127	26,852,200	26,961,327	3,118,940	19,902,283	23,021,223	−3,940,104	757,694,390	762,042,758	−4,348,368
1915	47,533	17,205,958	17,253,491	933,540	21,553,415	22,486,955	+5,233,464	720,397,782	777,840,293	−57,442,511
1916	35,903	24,633,011	24,668,914	1,803,500	56,648,903	58,452,403	+33,783,489	840,986,951	766,665,641	+74,321,310
1917	636,980,667	40,564,116	677,544,783	2,390,724,755	37,203,045	2,428,017,800	+1,750,473,017	3,552,342,595	2,763,586,887	+788,755,708
1918	7,685,267,850	21,611,225	7,706,879,075	16,964,609,560	10,279,650	16,974,889,210	+9,268,010,135	21,155,314,366	21,498,786,970	−343,472,604
1919	15,813,848,117	23,717,893	15,837,566,010	29,053,331,758	22,644,758	29,075,976,516	+13,238,410,506	33,730,357,415	34,789,707,190	−1,059,349,775
1920	17,013,020,107	23,424,165	17,036,444,272	15,835,273,962	17,071,988	15,852,345,950	−1,184,098,322	22,556,760,387	23,178,180,512	−621,429,125
1921	8,721,751,533	37,460,631	8,759,212,164	8,824,738,839	40,186,945	8,864,925,784	+105,713,620	14,449,442,829	13,650,487,483	+798,955,346
1922	6,500,584,643	107,251,870	6,607,836,513	5,910,931,276	107,086,627	6,018,017,903	−589,818,610	10,121,614,434	10,225,874,310	−104,259,876
1923	7,486,747,506	74,414,564	7,561,162,070	7,250,180,890	90,547,571	7,340,728,470	−211,433,600	11,196,774,153	11,208,800,919	−12,035,766
1924	2,814,718,038	33,084,377	2,847,802,415	2,178,675,627	28,453,557	2,207,129,184	−640,673,231	6,091,170,326	6,252,097,482	−160,927,156
1925	3,351,798,909	68,974,392	3,420,773,301	3,047,015,791	105,447,372	3,152,463,163	−268,310,138	6,760,107,327	6,351,480,281	+408,627,046

Note 1. For public debt expenditures chargeable against ordinary receipts, see preceding section of this table.

Table II. is a statement of ordinary receipts, and expenditures against such receipts, together with the surplus or deficit, stated on a current cash basis, by fiscal years from 1917 to 1926. Table III summarizes by fiscal years the history of the public debt since 1917.

TABLE II. *Ordinary receipts, and expenditures chargeable against such receipts, together with the surplus or deficit, on a current cash basis, by fiscal years from 1917 to 1926.* (In thousands of dollars—000's omitted)

Fiscal Year	Total Ordinary Receipts	Expenditures chargeable against ordinary receipts			+Surplus or −Deficit	Fiscal Year	Total Ordinary Receipts	Expenditures chargeable against ordinary receipts			+Surplus or −Deficit
		Ordinary	Public Debt	Total				Ordinary	Public Debt	Total	
1917	$1,124,325	$ 1,977,688	$ ..	$ 1,977,682	−$ 853,357	1922	$4,109,104	$3,372,608	$422,695	$3,795,302	+$313,802
1918	3,664,583	12,696,702	1,134	12,697,837	−9,033,258	1923	4,007,135	3,294,626	402,250	3,697,478	+309,657
1919	5,152,257	18,514,880	8,015	18,522,895	−13,370,638	1924	4,012,045	3,048,678	458,000	3,506,678	+505,367
1920	6,694,565	6,403,344	78,746	6,482,090	+212,475	1925	3,780,149	3,063,105	466,538	3,529,643	+250,505
1921	5,624,933	5,115,928	422,282	5,538,209	+ 86,724	1926	3,962,756	3,097,612	487,376	3,584,988	+377,768

TABLE III. *Transactions in the Public Debt of the United States Government from July 1 1916 to June 30 1925*
(In thousands of dollars—000's omitted)

Detail	Fiscal year ended June 30 1917	Fiscal year ended June 30 1918	Fiscal year ended June 30 1919	Fiscal year ended June 30 1920	Fiscal year ended June 30 1921	Fiscal year ended June 30 1922	Fiscal year ended June 30 1923	Fiscal year ended June 30 1924	Fiscal year ended June 30 1925
Total gross debt outstanding (from previous year)	$1,225,146	$2,975,619	$12,243,629	$25,482,034	$24,297,918	$23,976,250	$22,964,079	$22,349,688	$21,251,120
Public debt issues:									
Pre-War issues	52,151	20,171	289	189	179	112	39	33	102
Certificates of indebtedness	918,205	9,017,648	16,955,328	14,728,726	8,486,965	3,905,090	4,292,259	2,014,892	1,926,579
First Liberty Loan	1,466,335	523,112	8	..	..	..	..	..	..
Second Liberty Loan	..	3,807,864	..	..	..	..	..	..	..
Third Liberty Loan	..	3,243,045	932,104	501	..	..	..	..	..
Fourth Liberty Loan	..	..	6,959,505	5,071	5	..	..	..	..
Victory Liberty Loan	..	..	3,467,845	1,027,527	2	1[1]	..	..	..
Treasury notes	..	..	..	..	311,192	1,935,405	2,000,938	210	50,000
Treasury bonds	..	..	..	..	..	..	763,962	..	1,047,089
Treasury (War) savings securities	..	352,769	738,248	73,240	26,418	70,326	201,991	163,540	23,246
National bank notes, retirements	37,293	10,280	22,645	17,072	40,187	107,086	90,548	28,454	105,447
Total issues	$2,473,984	$16,974,889	$29,075,972	$15,852,326	$8,864,948	$6,018,019	$7,349,737	$2,207,129	$3,152,463
Public debt redemptions:									
Pre-War issues	50,373	27,381	82,245	441	152	57	245	44	117,075
Certificates of indebtedness	632,572	7,578,272	15,046,533	15,588,704	8,552,217	4,775,874	5,096,403	2,238,167	2,157,554
First Liberty loan	..	656	4,003	32,338	200	415	80	240	5
Second Liberty loan	..	61,050	180,357	241,150	8,770	5,939	111,560	94,450	28
Third Liberty loan	..	14,935	201,660	296,338	51,156	137,772	66,001	410,587	111,823
Fourth Liberty loan	..	..	165,000	405,222	39,499	9,477	16,818	4,070	14
Victory Liberty loan	..	..	..	249,007	332,587	1,907,986	1,911,442	80,640	6,942
Treasury notes	..	..	..	..	..	..	143,340	356,973	1,373,392
Treasury bonds	..	..	..	..	..	..	8	6	..
Treasury (War) savings securities	..	2,972	134,048	199,819	159,732	85,416	543,808	87,435	50,861
Miscellaneous	40,566	21,613	23,720	23,425	42,303	107,253	74,416	33,085	69,617
Total redemption	$723,511	$7,706,879	$15,837,566	$17,036,444	$9,186,616	$7,030,189	$7,964,121	$3,305,697	$3,887,311
Gross debt outstanding:									
Interest-bearing debt	2,712,550	11,985,882	25,234,496	24,061,095	23,737,352	22,711,035	22,007,590	20,981,586	20,210,906
Matured debt on which interest has ceased	14,232	20,243	11,110	6,748	10,939	25,251	98,172	30,241	30,243
Debt bearing no interest (less gold reserve)	248,837	237,504	236,429	230,075	227,958	227,793	243,925	239,293	275,123
Total gross debt	2,975,619	12,243,629	25,482,035	24,297,918	23,976,249	22,964,079	22,349,687	21,251,120	20,516,272
Deduct:									
Net balance (adjusted) held by Treasurer U. S.	1,066,984	1,319,348	1,002,733	32,971[2]	162,703	32,337[2]	193,801	73,075	77,038
Net Debt	1,908,635	10,924,281	24,479,302	24,330,889	23,813,546	22,996,416	22,155,886	21,178,045	20,439,234
Net debt increased	902,353	9,015,646	13,555,021	..	..	..	..	..	..
Net debt decreased	..	..	..	148,413	517,342	817,131	840,530	977,842	738,811

[1] Adjustment—deduct. [2] Adjustment—add.

In state and local finance the two most prominent features are (1) the remarkable growth of expenditures and debts after the War, due primarily to the demand for increased educational facilities and highway improvements; (2) the widespread movement for budgetary reform in the States. The latter, although strongly pressed has not, as yet completely passed beyond the experimental stage.

BIBLIOGRAPHY.—Annual Reports of the Secretary of the Treasury on the State of the Finances; Message of the President of the United States transmitting the Budget (annual, 1924–7); The Bureau of the Census, *Wealth, Debt and Taxation*, 1913, 1922; *Financial Statistics of States* (annual); *Financial Statistics of Cities Having a Population of over 30,000* (annual); The National Tax Association, *Proceedings* (annual). (A. W. M.*)

WEALTH AND INCOME

Increase of Wealth.—The increase in the total and *per capita* wealth in the United States since 1900 is shown by the table in the adjoining column.—

Estimated National Wealth of the United States

	Total (*in dollars*)	*Per Capita*
1900	88,517,000,000	1165
1904	107,104,000,000	1318
1912	186,300,000,000	1950
1922	320,804,000,000 [1]	2935

Based on *The Statistical Abstract of the United States, 1924*, p. 271.

The table shows the increase in terms of dollars. The decline in the purchasing power of the dollar since 1900 accounts, in part at least, for the upward trend, and is a reflection of the cheapening of gold. Since this is a world-wide phenomenon it does not destroy the usefulness of these figures for purposes of comparison with other countries. All such comparisons are based on estimates which are generally not made by the same persons, and cannot, therefore, be taken as mathematically exact. The following table shows how the leading countries compare in total and *per capita* wealth at approximately the same dates.

The details of the estimate are as follows:—

National Wealth, 1922

Items of Wealth	Total value (in thousands of millions of dollars)	Per cent of total	Amount *Per Capita*
Real property and improvements taxed	$155·9	48·6	1,427
Real property and improvements exempt	20·5	6·4	187
Live stock	5·8	1·8	53
Farm implements and machinery	2·6	0·8	24
Manufacturing machinery, tools and implements	15·8	4·9	145
Railroads and their equipment	20·0	6·2	183
Motor vehicles	4·6	1·4	42
Street railways	4·9	1·5	45
Telegraph systems	·2	0·1	2
Telephone systems	1·7	0·5	15
Pullman and other cars not owned by railroads	·5	0·2	5
Pipe lines	·5	0·2	5
Shipping and canals	3·0	0·9	27
Privately owned waterworks	·4	0·1	4
Privately owned central electric light and power stations	4·2	1·3	38
Agricultural products	5·5	1·7	50
Manufactured products	28·4	8·9	260
Imported merchandise	1·5	0·5	14
Mining products	·7	0·2	6
Clothing, personal adornments, furniture, horse-drawn vehicles and kindred property	39·8	12·4	364
Gold and silver coin and bullion	4·3	1·4	39
Total	320·8	100·0	2935

(In " 1913 " dollars—000,000 omitted)

Nations	Pre-War Wealth			Post-War Wealth		
	Population 1914 in Millions	Amount	*Per Capita* Actual Figures	Population 1923 in Millions	Amount	*Per Capita* Actual Figures
Great Britain	46	70,000	1,522	47	70,000	1,489
France	40	57,900	1,447	39	57,900	1,485
United States	98	200,000	2,062	110	230,000	2,091
Germany	68	80,500	1,184	61	55,000	902

Figures taken from *The Inter-Ally Debts* by Harvey E. Fisk, Bankers Trust Co., New York, 1924.

Increase of Income.—The significance of these figures is less than that of the estimates of the national and *per capita* income. It is the annual income of the people rather than the value of the property which they own that sets their standard of living and their material well-being.

The following table shows the estimated national and *per capita* incomes in various countries in 1914.

Country	Estimates based upon the work of	National Income Millions of Dollars	*Per Capita* Income Dollars
United States	National Bureau of Economic Research	$33,200	$335
United Kingdom	Bowley, Stamp	10,950	243
Germany	Helfferich	10,460	146
France	Pupin	7,300	185
Italy		3,890	112
Austria-Hungary		5,350	102
Spain	Barthe	1,120	54
Australia	Official, Knibbs	1,260	263
Canada	Giffen	1,460	195
Japan	Stamp	1,580	29

Taken from *Income in the United States* vol. I, by the Staff of the National Bureau of Economic Research, Inc., Harcourt, Brace & Co., 1921.

Diffusion of Wealth.—Even more significant than the total or the *per capita* income of the various countries is the question of the diffusion of income. A high average income may go with widespread poverty if the few have immense incomes and the many very small incomes. It is important to know how evenly or unevenly the income is distributed or how widely actual personal incomes deviate from the average. This is a question that presents many difficulties to the statistician. Income-tax statistics throw some light on the question, wage statistics further light.

The table at top of p. 888, based on income-tax returns, shows the number of incomes of different classes in the United States, 1916-22.

The difficulty of reducing this table to a graph is insurmountable. However, the following tells a part of the story. In order to show incomes of a million or over on this scale, the curve would have to start several inches above the top of the page. At the same time the percentage of such incomes is so small, less than 0.002%, that it could not be shown on a graph without a micrometer and a magnifying glass. Such a curve, however, would show the distribution of taxable incomes of $20,000 or less.

S. N. Procopovitch in an able article in the *Economic Journal* for March 1926, makes some interesting comparisons of the degrees of inequality of incomes in different countries. Comparing the United States and Australia with Germany, he finds that the incomes of the wealthiest 0.5% of the population deviate less from the average in the two English-speaking countries than in Germany; during the World War, instead of increasing, as was the case in Germany, they declined. He also finds that of the incomes coming last in the table (his table covers only the wealthiest 20% of the population) 4 to 20% in the United States and Australia are definitely higher, on the average, than in Germany.

The following table shows his estimate of the inequalities of income of the richest 40% of the population in Prussia, Saxony, United States of America and Australia. The richest 10% have respectively incomes 5·6, 5·7, 5·5 and 5·8 times as large as the average income or budget unit. The incomes of the other 60% of the population, which would presumably fall below the budget unit, or the average, are not indicated.

Percentage of Population	Prussia 1913	Saxony 1912	U.S.A. 1918	Australia 1914–5
0–10%	5·6	5·7	5·5	5·8
10–20%	1·9	1·9	2·3	2·4
20–30%	..	1·3	1·7	1·4
30–40%	..	0·9	1·1	0·5

In the following table, he shows, in another form, the degrees of inequality in the United States, Australia and Saxony:—

	Coefficient of inequality	Income per head of population
United States	0·53	557 dollars
Australia	0·64	241 dollars
Saxony	0·70	157 dollars

For the distribution of incomes below the income-tax level we have no statistics. However, some idea of the general diffusion of prosperity among wage-workers may be gained from wage statistics. The following table shows, in the form of index numbers, based on the cost of food alone, comparative wages in a number of cities. Philadelphia, the only American city stands first.

Base: London, July 1 1924 = 100

City	Oct. 1 1925	City	Oct. 1 1925
Amsterdam	81	Paris	..
Berlin	65	Philadelphia	176
Brussels	51	Prague	49
Copenhagen	109	Riga	45
Lisbon	34	Rome	..
Lodz	54	Stockholm	82
London	94	Sydney	133
Madrid	56	Tallinn (Revel)	39
Milan	44	Vienna	43
Oslo	89	Warsaw	47
Ottawa	158		

From *International Labour Review* (League of Nations), Jan. 1926.

Personal Income Tax Returns 1916 to 1922

Income Class (net income)	1916	1917	1918	1919	1920	1921	1922
No. of returns	437,036	3,472,890	4,425,114	5,332,760	7,259,944	6,662,176	6,787,481
Under $1,000	..	..	..	..	..	401,849	402,076
$1,000– $2,000	..	1,640,758	1,516,938	1,924,872	2,671,950	2,440,544	2,471,181
2,000– 3,000	..	838,707	1,496,878	1,569,741	2,569,316	2,222,031	2,129,898
3,000– 5,000	157,149	560,763	932,236	1,180,488	1,337,116	1,072,146	1,190,115
5,000– 10,000	150,553	270,666	319,356	438,851	455,442	353,247	391,373
10,000– 25,000	80,880	112,502	116,569	162,485	171,830	132,344	151,329
25,000– 50,000	23,734	30,391	28,542	37,477	38,548	28,946	35,478
50,000– 100,000	10,452	12,439	9,996	13,320	12,093	8,717	12,000
100,000– 150,000	2,900	3,302	2,358	2,983	2,191	1,367	2,171
150,000– 300,000	2,437	2,347	1,514	1,864	1,063	739	1,323
300,000– 500,000	714	559	382	425	239	162	309
500,000–1,000,000	376	315	178	189	123	63	161
1,000,000 and over	206	141	67	65	33	21	67

(From Statistical Abstract of the United States, 1924, 162.)

The tendency of wages in the United States is shown by the following table:—

Index of Union Wage Rates for all Reporting Trades (including building, metal, printing and publishing) compared with Cost of Living Index

Year	(1913 – 100) Index of wages per week full time	(1913 – 100) Cost of Living Index	(1913 – 100) Index of Real Wages derived from Columns 1 and 2
1910	95	..	..
1915	102	105·1	97·1
1920	189	200·4	90·6
1924	214	172·5	125·4

Statistical Abstract (1924), p. 317, for index of " rate per week full time." *Survey of Current Business*, Feb. 1926, p. 30 for Bureau of Labour Statistics Index of Cost of Living. Index of Real Wages computed.

The statistics of savings deposits and the assets of building and loan associations and of insurance companies (especially industrial insurance) are instructive.

Savings Deposits in all Banks and Trust Companies (About June 30)

Date	Amount (in thousand dollars)
1913	8,820,192
1920	14,672,178
1923	19,567,953
1924	20,844,508
1925	23,134,052

Statistical Abstract, p. 259. 1925 figures supplied by American Bankers Association.

Building and Loan Associations

Date	Associations	Members	Assets (In thousand dollars)
1910	5,937	2,216,912	945,569
1915	6,806	3,334,899	1,484,206
1920	8,624	5,026,781	2,534,320
1924	11,844	8,554,352	4,765,937

(By H. F. Cellarius, Cincinnati, Sec. of U.S. League of Local Building and Loan Associations.)

If we add together the premiums paid to life-insurance companies during the last five years and count them among recent savings, and then add to this sum the savings deposits and the assets of building and loan associations, we get an aggregate of about 35 billions of dollars in these popular forms of saving.

The last few years have witnessed a striking increase in the number of small investments in corporate securities. Mr. H. T. Warshow (*Quarterly Journal of Economics*, Nov. 1924) has shown that the number of stockholders increased from about 4,400,000 in 1900 to about 14,400,000 in 1922, or about 250%. He shows further that an increasing percentage of all dividends paid by corporations goes to persons of small or moderate incomes, and a correspondingly decreasing proportion to persons with large incomes. Since 1916 especially, decreasing proportions of total dividends have been paid to persons with incomes of $20,000 or above, constant proportions to those with incomes from $5,000 to $20,000 and increasing proportions to those with incomes under $5,000.

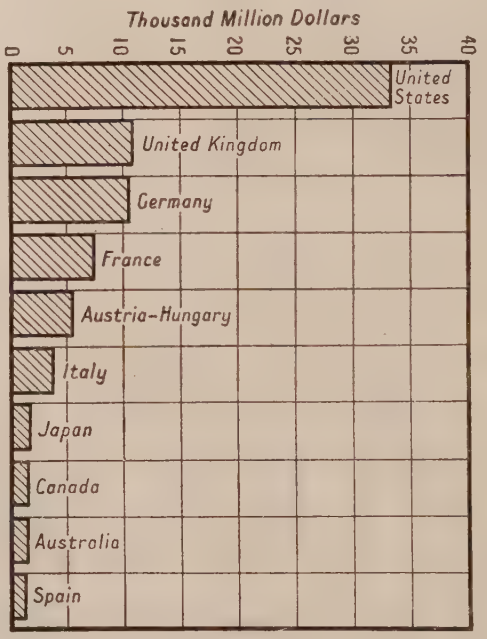

FIG. 1.—Diagram showing the estimated national income in various countries, in 1914. (Based on figures given in table p. 887.)

Several years ago the number of labourers buying the shares of corporations began to be noticeable. In many cases this was merely a response to a selling campaign on the part of corporate managers, a campaign which was strikingly successful, and the employees surprised their employers by the avidity with which

Life Insurance (Outstanding Policies)

Date	Number of policies (thousand policies)				Value of Outstanding Policies (in thousand dollars)			
	Ordinary	Industrial	Group	Total	Ordinary	Industrial	Group	Total
1910	6,964	23,034	..	29,998	$13,227,213	$ 3,177,048	..	$16,404,261
1915	9,890	33,142	..	43,032	18,349,285	4,434,906	..	22,784,191
1920	16,695	49,805	..	66,499	35,091,538	7,189,852	..	42,281,390
1924	22,082	68,248	38	90,368	49,241,424	11,343,740	3,194,576	63,779,740

(*Statistical Abstract*, p. 284.)

they purchased the shares offered. In fact, some old and well-established industries have found that they need not go outside the circle of their own employees to raise any new capital needed for ordinary expansion. In at least one case, that of a large rapid-transit company, the employees own enough voting stock to hold the balance of power.

In 1924 the *Financial World*, by means of a questionnaire, found that in the cases of 104 of the leading corporations of the country, employees below the grade of officials owned stock. Of those only 54 had offered special inducements to persuade employees to buy stock. In one case 50,020 employees owned

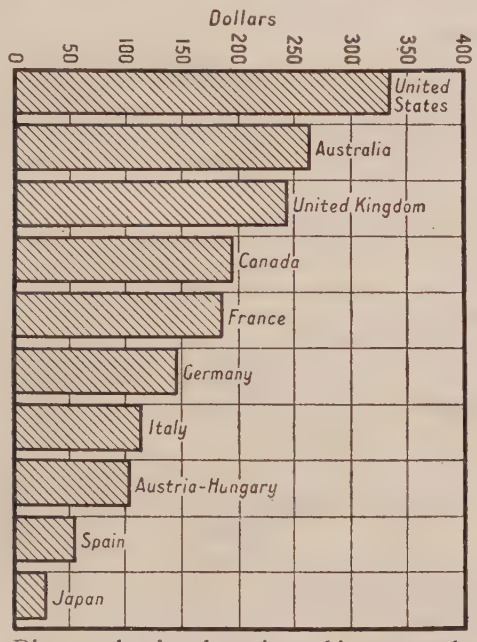

FIG. 2.—Diagram showing the estimated income per head of population, in various countries in 1914. (Based on table p. 887.)

689,703 shares. In two other cases, 15,000 employees owned stock; 450,411 shares in one case and 200,000 shares in the other. Still another company reported that 12,000 of its 18,000 employees owned stock. Other sources of information show that corporations not included in those that replied to the questionnaire of the *Financial World* have sold considerable quantities of stock to their own employees. In Aug. 1921, the Metropolitan Life Insurance Co. published a report on Employees Thrift and Savings Plans which contains much valuable information. In one large motor company, 94% of the employees were buying stock on the instalment plan.

The following summary gives an analysis of the general increase in the number of shareholders of the leading American corporations between 1918 and 1925.

Source of Increase in Stockholders—1925 over 1918

Industries	From Employees	From Customers	From General Public
Railways	70,262	45,003	203,216
Express and Pullman	..	2,996	7,827
Total rail and allied services	70,262	47,999	211,043
Street Railways	15,000	..	260,000
Gas, electric light and power companies	75,000	815,955	470,324
Telephone and telegraph	62,649	..	201,922
Packers	7,000	..	28,000
Ten oil companies	21,153	800	115,724
Five iron and steel companies	87,696	..	4,530
Ten high-grade miscellaneous manufacturing and distributing companies	..	..	19,337
Total	338,760	864,754	1,310,880

Proceedings of Academy of Political Science, vol. 11, No. 3, p.34.

The growth of labour banks from nothing to their present dimensions has been a phenomenon of the last five years. The statement of Financial Condition of Labour Banks in the United States, Dec. 31 1925, gives the names of 36 labour banks and investment companies. The total capital of these banks on the above date was $9,064,358; surplus and undivided profits, $3,403,429; and total resources, $114,894,305.[1]

Productivity.—The great natural resources of the United States help to explain the general prosperity of the country, but not the diffusion of that prosperity. The explanation is rather to be found in the way in which the human resources have been developed and utilised. Prof. Taussig (*Quarterly Journal of Economics*, Nov. 1924) has collected some significant evidence as to the product per worker in different countries in certain manufacturing and mining industries where comparison is possible. It appears that the product per worker is higher in the United States than in other countries. This higher product per worker in manufacturing industries cannot be shown to depend upon superior manufacturing sites. It is correlated with a larger quantity of engine-power and of power-driven machinery per worker. In the steel industry, for example, the total number of workers is very little greater in the United States than in Great Britain, though the total product in tonnage is more than twice as great. In other words, the product per man is about twice as great in the United States. The American industry uses almost exactly twice as much horse-power per man as the British. According to Sir Richard Redmayne the output of coal per worker (underground and above ground) in 1923 was as follows: United States, 693 tons; Great Britain, 229 tons; Germany (excluding brown coal) 103 tons and France 134 tons (*see* COAL).

The output per labourer is four times as great in the United States as in Japan. Also "a Japanese cotton-mill requires approximately four times as many employees for the same amount of machinery as does an American mill." Figures 3 and 4, which will be seen on the following page, show how the product and the power per worker have increased in iron and copper mining in the United States.

In agriculture, a comparison between Iowa and Bavaria was made, some years ago, by E. A. Goldenweiser. It appeared that in most crops except Indian corn, which is not a Bavarian crop, Bavaria produced more per acre, but Iowa produced nearly four times as much per person engaged in agriculture.

The Reasons for American Prosperity.—The conclusion is warranted that the higher wages per worker are a market expression of the fact that the product per worker is higher in the United States than elsewhere, and that the higher product, at least in manufacturing, and to a certain extent also in mining, is a result of superior equipment and direction. Why does the United States equip and direct its wage-workers more efficiently than other countries?

First among the factors in prosperity of the American people and its wide diffusion must be mentioned the democratic spirit or the absence of the spirit of caste. American democracy is not limited to the form of government: it is a spirit which permeates everywhere and determines the popular attitude toward men and careers. It recognises no basis for esteem except individual achievement. It presents an open road to talent wherever it exists, whether in the newly arrived immigrant, the child of a ditch digger, or the homes of the educated and the wealthy. The road from log cabin to White House is as open as that from the palatial home. That the son of a labourer may fill the highest position in any field is so much a matter of course as to occasion no surprise or comment.

This means, first of all, the fullest development of human resources. When a person who is capable of doing work of great importance is found doing work of less importance because of social handicap, that person's full productivity is not realised. When he is encouraged and enabled to do the most important work of which he is physically and mentally capable, he makes a greater contribution to the national life than he could have made

[1] Courtesy of Research Department, Amalgamated Clothing Workers of America.

under any other condition. When one who would otherwise have been an unskilled workman becomes a skilled workman, his productivity is increased. The same principle applies to every increase in skill or talent, however high in the social or economic scale the case is found. When such cases of increased productivity are numbered by the tens of millions, they count largely in the creation of national prosperity.

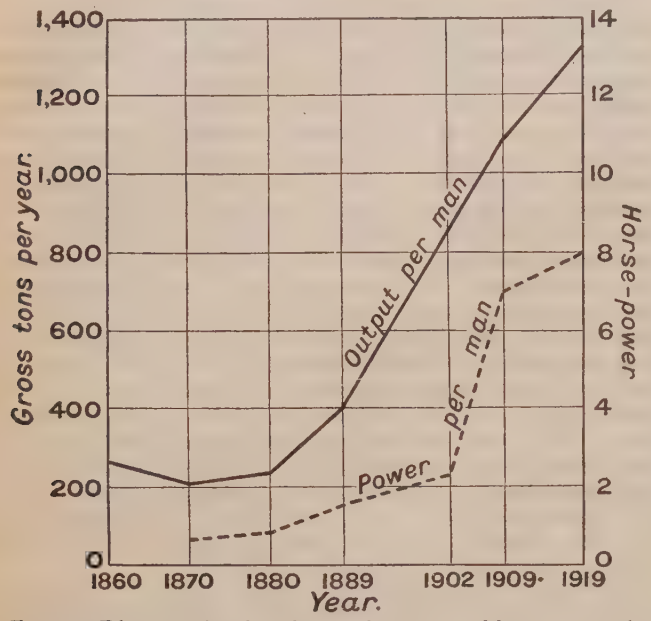

FIG. 3.—Diagram showing the yearly output of iron per worker employed at iron mines in the United States, and the horsepower used per man. The broken line should be read in connection with the vertical scale on the right, and the output per man, in connection with the vertical scale on the left.

Another factor of vast importance is that the country has no leisure class and that it is not the ambition of any typical American to retire from business as soon as he has accumulated a competency. Where the idea prevails, as to some extent it does in Great Britain, that the successful man should retire from business as soon as he can afford it, there will always be a scarcity of active talent of the highest grade. The more capable the man, the sooner he will be able to retire. The result would be that industries would be managed by young and untried men, or else by third- and fourth-rate men who never could accumulate enough on which to retire. Industry would be poorly managed, the product per man would be low, and by no possibility could high wages be paid.

Next in importance to the democratic spirit with its open road to talent—in fact a part of it—is the American system of popular and universal education. Until recently this had its fullest development in the northern and western states, where prosperity has been greatest and to which immigrants have preferred to come because in these states industry expanded most rapidly, the demand for labour was greatest and wages were highest. These results came, not because of superior natural resources in the North and West, but because there the available human resources were more fully developed and utilised than was the case in the southern states.

The question of prohibition is still a controversial question. Whatever may be said for or against it on other grounds, there cannot be much doubt that it is a factor in the diffusion of prosperity. In spite of the vast amount of bootlegging, the fact is that wage-workers are spending much less of their money on drink, because bootleg liquor is too expensive. Much of the wage-money formerly spent on drink is now spent on other articles; much of it also is saved and helps to explain the growing financial power of labour. More important is the effect of increasing sobriety among wage-workers on wage-rates. First, it increases the efficiency of labour. Second, it facilitates the promotions of the more capable into higher ranks, thus relieving the congestion in the lower ranks of labour. Anything which relieves that congestion tends to raise wages.

The restriction of immigration, inefficiently as it is administered, and in spite of the many who are smuggled in, is a vital factor in the present prosperity of the American wage-workers. If, however, the United States had not been a good country for labourers, there would have been no immigration to restrict. It became a good country for labourers at an early day because of

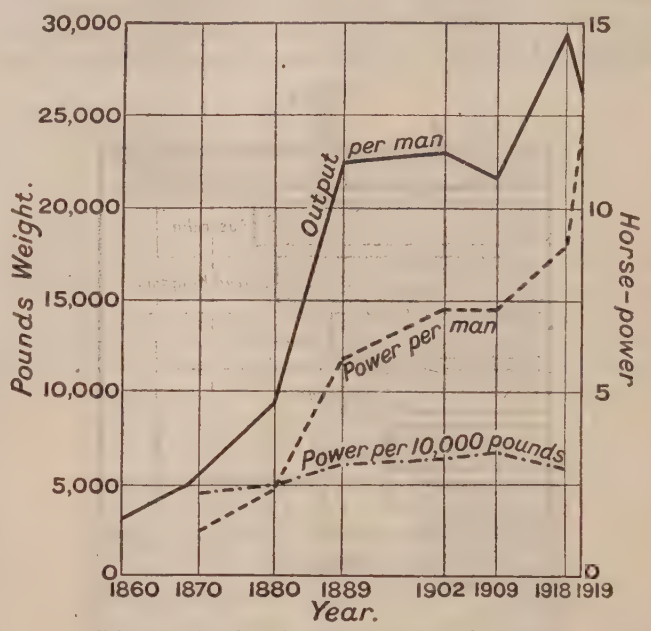

FIG. 4.—Diagram showing the yearly output of copper per worker employed at copper mines in the United States and the horsepower used. Broken lines should be read in connection with the vertical scale on the right, and the output per man, in connection with the vertical scale on the left.

the gifts of free land and has become a still better country for labourers since the free land was exhausted, because of the factors mentioned above, which caused American industries to expand, which increased their product per man and enabled industries to pay higher wages than elsewhere. The restriction of immigration merely safeguarded the results which had been thus secured.

The principles of economics are, of course, universal. No country has a monopoly of any of them. The factors and forces that have made the United States prosperous and have diffused that prosperity will produce the same results wherever they are permitted to operate. Any country, up to the limit set by its physical resources, can prosper by the same methods and diffuse its prosperity to the same degree. The whole process may be summarised in a single formula: the fullest development of human resources by training every individual to the highest degree of skill and usefulness. This will not only increase the national dividend; it will, through the occupational redistribution of labour-power, increase those kinds of skill and talent that are now scarce, and correspondingly decrease those forms of labour that are now superabundant. A consistent pursuit of this policy will diffuse prosperity and abolish unemployment, low wages and poverty in any country, although not perhaps as completely as in the United States, where the conditions are so favorable to a rapid increase of wealth.

BIBLIOGRAPHY.—*Statistics of Income*, annually published by the Bureau of Internal Revenue, analyses in detail the Federal income returns. Of especial value for recent years are the annual reports and monthly bulletins of the Federal Reserve Board, and the monthly bulletins issued by the several district banks. The annual volume, *Statistical Abstract of the United States*, assembles data on money, banking and national wealth. The *Annual Report of the Secretary of the Treasury* contains a mass of information regarding the national wealth. See also W. I. King, *The Wealth and Income of the People of the United States* (1917), a scholarly analysis and interpretation of official statistics, and the publications of the National Bureau of Economic Research (New York). (T. N. C.)

III. PRODUCTION, INDUSTRY AND TRADE

The Land.—During the decade 1910–20 the number of farms showed a slight gain, 1·4%. In 1920 there were 6,448,343, as compared with 6,361,502 in 1910. A comparison of these numbers with the total population shows that in 1910 there was one farm for every 14 of the population, and in 1920 one farm for every 16. According to the preliminary figures of the agricultural census in 1925, there was a decrease of 75,735 farms, or 1·2%, between 1920 and 1925. Between 1910 and 1920 the percentage of increase in population was 14·9, and for improved farm land 5·1. The number of acres *per capita* of total population in improved farm land in 1910 was 5·20; and in 1920, 4·76. The percentage of farm land improved for the total area of the United States in 1910 was 54·4; and in 1920, 52·6. The decrease in the number of farms was particularly marked in states east of the Mississippi; for example, in Connecticut, 15·5%; Massachusetts, 13·4%; New York, 10·5%; Ohio, 5·6%; and Illinois, 5·8%. In New England the number of farms decreased by 32,238, giving in 1920 one farm for every 47 persons. The total farm acreage increased somewhat more rapidly than the number of farms, from 878,798,325 ac. to 955,883,715 ac., nearly 8·8%. The greater portion of this increase was due to the use of land for dry farming in the arid states of the Rocky Mountain section and also to the enclosure of large areas for grazing. In 1919 there were 503,000,000 ac. under cultivation. One-half of the total land area of the United States was in 1920 included in farms, as compared with 46·2% in 1910. Of the 956,000,000 ac. included in farms, 105,012,000 in 1924 was devoted to corn; 54,209,000 to wheat; 76,385,000 to hay; 42,452,000 to oats; and 40,115,000 to cotton.

Nearly one-third of the farm area and nearly one-sixth of the total land area is used for the growing of these five products. The average size of farms slightly increased between 1910–20, from 138·1 ac. to 148·2 acres. Notwithstanding the small increase in the number of farms, and of acreage in farms, the value of all farms, lands and buildings increased from $35,000,000,000 in 1910, to $66,000,000,000 in 1920 or nearly 90%. This increase, however, was due largely to the abnormally high prices prevailing in 1920, rather than to new investments and improvement of property. For the same reason the average value of land and buildings per farm for the United States as a whole greatly increased, rising from $5,471, in 1910 to $10,284 in 1920. In 1910 62·1% of farms were owned by their cultivators, and in 1920 60·9%. In New England, New Jersey, New York and Pennsylvania, there was a decline in tenancy, but there was a marked increase in the Mountain and Pacific states. During the decade 1910–20 native white farmers increased from 4,721,063 to 4,917,386; foreign-born white farmers decreased from 669,556 to 581,068; coloured farmers increased from 920,883 to 949,889.

The United States is an agricultural country, but the question is frequently asked whether agriculture is keeping pace with the growth of the population. A comparison of the annual crop for the three-year period 1912–4 with that for the period 1922–4 for corn, wheat and oats gives the following:—

TABLE I. *Corn, Wheat and Oat Crops*

	Average 1912–4 bushels	Average 1922–4 bushels
	millions	millions
Corn	2,748	2,799
Wheat	795	846
Oats	1,227	1,355

A comparison of these figures with the population at the respective dates shows that the *per capita* product was slightly less for all three in 1920 than in 1910. Table II. shows the estimated annual crop of some of the most important agricultural staples.

The annual production of cotton from 1910–9, which did not greatly change in this decade, averaged 13,200,000 bales. In 1916 a record crop of 16,000,000 bales was reached. The five years 1920–4, however, showed a decline to an annual average of less than 11,000,000 bales. Domestic consumption slowly increased until 1924, leaving a smaller amount for export, and from 1910–4 the annual average export was 8,811,000 bales,

TABLE II. *Annual Crops (In Millions)*

	Corn (bu.)	Wheat (bu.)	Oats (bu.)	Cotton (bales)	Irish potatoes (bu.)	Tobacco (lb.)	Wool (lb.)
1910	2,886	635	1,186	11·6	349	1,103	321
1915	2,995	1,026	1,549	11·2	360	1,062	286
1916	2,567	636	1,252	11·4	287	1,153	288
1917	3,065	637	1,593	11·3	442	1,249	282
1918	2,503	921	1,538	12·0	412	1,439	299
1919	2,811	968	1,184	11·4	323	1,465	298
1920	3,209	833	1,496	13·4	403	1,582	278
1921	3,069	815	1,078	8·0	362	1,070	274
1922	2,906	868	1,216	9·8	453	1,247	261
1923	3,054	797	1,306	10·1	416	1,515	267
1924	2,437	873	1,542	13·2	455	1,243	282

and from 1915–9, 6,310,000 bales, or a decline of 28%. In the five years 1920–4 the average export was 6,138,000 bales, a further decline of 3%. The production of wool also remained fairly constant, approximately 300,000,000 lb. annually. Imports in the years 1915–24 were larger than in the preceding decade, and the total consumption therefore larger, as exports were insignificant. The average annual consumption, domestic and foreign, 1921–4 was 590,000,000 lb., as compared with 508,000,000 lb. in 1911–5. With the exception of two years, 1920 and 1924, the United States since 1914 has been dependent on foreign countries for more than one-half its wool consumption, as compared with two-fifths or even one-third in the earlier years of the century.

Strenuous efforts were made during the World War period, even before the entry of the United States, to increase the production of wheat. In 1916 the average farm value per bushel for the first time since the decade following the Civil War was above $1, and in 1919 was as high as $2.15. A record crop was produced in 1915 amounting to over a thousand million bushels. The average annual production for the five years 1910–4 was 697,000,000 bu., 1915–9, 822,000,000 and in 1920–4, 837,000,000 bushels. This gives an average annual increase of 140,000,000 bu.; on the basis of an annual *per capita* consumption of five bushels this provides bread for 28,000,000 additional people. In the years 1915–9 the average annual export was 240,000,000 bu., and in 1920–3, 256,000,000 bushels.

The domestic beet-sugar industry during the ten years 1910–9 became firmly established. In 1917 the volume of beet sugar production was less than that of cane sugar. In later years it has been far in excess. The production, in millions of pounds, was 1,775 in 1910 (cane, 750; beet, 1,025); 1,697 in 1920 (cane, 244; beet, 1,453); and 2,086 in 1924 (cane, 324; beet, 1,762). The outlying possessions of the United States (Porto Rico and the Philippine Is.) provide an amount of sugar greater than that produced at home. However, the United States is still dependent upon foreign countries for more than half its needs. The annual *per capita* production of sugar was approximately 100 lb. in 1924, as compared with 70 lb. in 1900.

The crops of hay, sweet potatoes, rye, barley and rice, with their farm values, are seen in Table III.

TABLE III. *Hay and Other Crops*

	1924		1910	
	Amount	Farm Value	Amount	Farm Value
	millions	millions	millions	millions
Hay (tons)	112	$1,468	69	$842
Sweet potatoes (bu.)	72	92	60	40
Rye (bu.)	63	68	35	25
Barley (bu.)	188	137	174	100
Rice (bu.)	34	47	25	17

In 1924 the production of apples was 179,443,000 bushels. The peach crop amounted to 51,679,000 bushels. Approximately 2,300,000 were devoted to truck crops.

The number of cattle on farms, as reported by the Bureau of the Census, in 1924 was 66,506,000 (as compared with 61,804,000 in 1910. This increase did not keep pace with the growth in population. The number of swine in 1925 (preliminary) was

54,234,000, as against 58,186,000 in 1910. The number of sheep fell off from 52,448,000 in 1910 to 39,134,000 (preliminary figure) in 1925. The wool crop in 1924, according to the Dept. of Agriculture, was 282,330,000 lb. as compared with the maximum 318,548,000 lb. in 1911. In 1924 the wool product of Wyoming was 19,760,000 lb.; Idaho, 16,800,000 lb.; Montana, 19,314,000 lb.; Utah, 16,884,000 lb.; New Mexico, 12,408,000 lb.; Texas, 22,223,000 lb.; Ohio, 13,899,000 pounds. (These latter figures are preliminary.)

The Dept. of Agriculture in its *Year Book* of 1918 estimates that 350,000,000 ac., or nearly one-fifth of the land area of the United States, is too rough or hilly for the successful cultivation of crops. It may, however, be adapted to the growth of forests, or used for grazing purposes. Nearly one-third of the land area, or 600,000,000 ac., receives insufficient rainfall for the profitable production of crops at normal prices, and affords no possibility of irrigation. A total of 40,000,000 ac. is absolute desert. It is estimated that 200,000,000 ac. of forest, " cut-over " land, and woodland including that in farms, could be used for crops after clearing. This, if divided into farms averaging 160 ac., would provide 1,250,000 farms, or an addition of about 20% to the number of farms in the country. Moreover, 60,000,000 ac. of swamp land can be drained, and 30,000,000 ac. of potentially irrigible land can be converted into farms if available sources of water supply are fully utilised. In all there are about 850,000,000 ac. of land at present in crops and potentially available. A little over 1,000,000,000 ac. of non-arable land consist of 360,000,000 ac. of absolute forest land, 615,000,000 ac. of grazing land, 40,000,000 ac. desert land and 40,000,000 ac. in cities, roads and railway rights of way. It is also estimated that 360,000,000 ac. of forest will not be sufficient to supply a population of 150,000,000, but that 450,000,000 ac. will be needed for that number. To provide food, therefore, more intensive methods of farming will be required. For corn the average yield per ac. in the five years 1900–04 was 24·2 bu., and in 1919–23, 29·5 bushels. The yields for wheat were 13·4 and 13·3 bu.; for oats 31 and 29·9 bu.; and for barley 25·7 and 23·6 bu., respectively, for the two periods in question.

Manufactures.—A quinquennial census of manufactures was taken between 1899 and 1919. Beginning with 1921 data are collected every two years; as the returns for 1921 and 1923 did not include establishments having products valued at less than $5,000, subsequent years are not strictly comparable with those antecedent. Although small establishments having products less than $5,000 constitute in 1921 21% of the total number of establishments, the number of wage-earners, and value of products in this class were less than 1%, and comparison of 1921 with previous years given in Table IV. is fairly accurate except as to number of establishments. Figures for values, however, were greatly affected by the change in the general level of prices and wages between 1914 and 1919.

TABLE IV. *Manufactures*

	Establishments	Wage-earners	Value of products	Value added by manufacture
1909	268,491	6,615,046	$20,672,052,000	$8,529,261
1914	275,791	7,036,247	24,246,435,000	9,878,346
1919	290,105	9,096,372	62,418,079,000	25,041,698
1921	196,267	6,946,570	43,653,283,000	18,316,666
1923	196,309	8,778,156	60,555,998,200	(not available)

The great increase between 1914 and 1919 was due to the expansion of manufacturing activity and change in prices, occasioned by the World War. For wage-earners the percentage of increase was 29·3%; for value of products, 157·4; and for value added by manufacture, 153·5.

Arranged by the 14 general groups of industries according to the classification of the Bureau of Census Table V. shows number of wage-earners, capital invested and value of products in 1923.

TABLE V. *Groups of Industries, 1923*

Group	Wage-earners	Value of product in millions of dollars
Food and kindred products	682,137	9,524
Textiles and their products	1,719,434	9,487
Iron and steel and their products	892,660	6,829
Lumber and its manufactures	931,748	3,633
Leather and its finished products	344,545	1,880
Paper and printing	526,795	3,770
Chemicals and allied products	384,493	5,707
Stone, clay, and glass products	347,619	1,539
Metals and metal products other than iron and steel	296,911	2,634
Tobacco manufactures	146,337	1,044
Transportation equipment, air land and water	606,328	5,333
Railroad repair shops	523,430	1,520
Miscellaneous industries	271,815	1,687
All industries	7,674,252	54,587

In 1919 ten cities: New York, Chicago, Philadelphia, Detroit, Cleveland, St. Louis, Baltimore, Buffalo, Boston and Pittsburgh, with a combined population of approximately 15,300,000, or about 14% of the total population, manufactured 27% of the total product value. Some manufacturing industries tend toward local concentration; for example in 1921, measured by value of product, Michigan produced 47·6% of the products of the motor-vehicle industry in the United States; Massachusetts, 33% of the boot and shoe industry; Connecticut, 30·6% of brass, bronze, and copper products, and 59·5% of ammunition; California, 47·6% of canning and preserving fruits and vegetables; Illinois, 41% of the agricultural implement industry; New York, 43% of men's clothing, 76% of women's clothing, and 59% of leather gloves and mittens.

The total value of product in 1919 was nearly three times that of 1914, increasing in dollars from 24 billion to 62 billion due to abnormal war activity and change in value of monetary unit; in 1921 there was a decline to 43·7 billion dollars. Table VI. shows the product of specific industries in 1923, with a comparison for 1914.

TABLE VI. *Individual Industries*
(Production in millions of dollars)

	1923	1914
Boots and shoes	1,000	502
Bread and other bakery products	1,123	492
Cars and general shop construction and repairs by steam railway companies	1,434	514
Clothing, men's	1,179	458
Clothing, women's	1,407	474
Confectionery and ice cream	626	210
Cotton goods	1,901	677
Electrical machinery, apparatus, and supplies	1,293	335
Flour-mill and grist-mill products	1,049	878
Foundry and machine-shop products	2,338	867
Furniture	776	266
Iron and steel, steel works, and rolling mills	3,154	919
Knit goods	848	259
Lumber and timber products	1,494	715
Motor vehicles	3,163	503
Paper and wood pulp	907	332
Petroleum refining	1,794	396
Printing and publishing, book and job	738	307
Printing and publishing, newspapers and periodicals	1,268	496
Rubber goods	958	301
Silk goods, including throwsters	761	254
Slaughtering and meat-packing	2,586	1,454
Worsted goods	698	276

In order to show how far the increases given in Table VI. were due to higher prices and how far due to greater volume of production, the following figures are presented showing quantity production in 1914 and 1921 with respective values at each date.

In the silk industry there was manufactured in 1914, 216,000,000 yd. of broad silk, and in 1921, 273,600,000 yd.; the value nearly trebled from $137,720,000 to $341,000,000. Pig-iron production declined from 23,270,000 tons to 16,618,000 tons, but the value increased from $312,762,000 to $408,582,000; window-glass decreased in quantity from 401,000,000 sq. ft. to 265,000,000 sq. ft., but the value increased from $17,496,000 to $24,026,000. Fertilisers decreased in quantity from 8,432,000 tons to 5,994,000 tons, but owing to higher prices they gained in value from $153,000,000 to $175,000,000.

In food products condensed and evaporated milk doubled in quantity from 873,000,000 lb., to 1,759,000,000 lb., while the value nearly trebled from $58,747,000 to $158,890,000; beet sugar increased in quantity from 743,000 tons to 1,030,000 tons, and the value from $58,590,000 to $128,363,000; wheat flour decreased from 116,404,000 bbl. to 110,846,000 bbl., but increased in value from $548,000,000 to $872,000,000. The growing demand for automobiles greatly expanded not only their manufacture, but also the refining of petroleum, and the rubber industry. The number of passenger cars manufactured in 1923 was 3,432,308, as compared with 569,000 in 1914 for all motor vehicles. The petroleum-refining industry showed a phenomenal development due, in large part at least, to the immense increase in the number of motor vehicles.

The output of gasolene increased in seven years from 1,195,000,000 gal. to 5,098,000,000 gallons. The increase in quantity was more than four-fold and in value eight-fold. The manufacture of rubber goods greatly expanded, increasing from a value of $301,000,000 in 1914 to $958,518,000 in 1923. In the latter year, $569,041,000 represented tires. The maximum production of lumber was reached in 1909, 44,510,000,000 ft.; in 1923 it was 37,166,000,000 ft., the decline being due to the fact that readily available timber was becoming less and less accessible. Portland cement is manufactured in larger amounts and has a wide use in the building industry. During the years 1900–9 the average production was 33,000,000 bbl.; in 1924 it reached 148,859,000 barrels. The production of tin plates, terne plates and taggers tin showed a steady development; in 1910 the output of tin plate was 1,410,000,000 lb., and in 1924, 2,975,000,000 pounds. An export trade was developed, the export of domestic tin plate, terne plate and taggers tin rising from an annual average in the years 1910–4 to 109,706,000 lb., to 507,159,000 lb. in 1920, and 360,633,000 lb. in 1924; import of this product has practically disappeared.

The cost of new buildings in the principal cities is estimated by the U.S. Geological Survey (by the Bureau of Labour Statistics beginning with 1920) as follows: 1910, $726,000,000; 1915, $700,413,000; 1920, $1,343,000,000; 1924, $3,216,000,000. The figures show that, although the War checked building, the total value of the buildings constructed immediately after was much greater; costs were swollen by high prices and increased wages and do not accurately represent the volume of new building measured by physical units.

After 1909 there was but a slight increase in the number of manufacturing establishments, notwithstanding the gain in the number of wage-earners and value of product. Excluding factories with product valued at less than $5,000, in 1914 there were 177,110 establishments, with 6,896,190 wage-earners, and products valued at $23,988,000,000, or $135,440 per establishment; in 1919, 214,383 establishments, with 9,000,059 wage-earners, and products valued at $62,042,000,000, or $289,398 per establishment; in 1923, 196,309 establishments, with 8,778,950 wage-earners, and products valued at $60,555,998,000, or $308,472 per establishment. Of the 12,818,524 persons engaged in manufacturing and mechanical industries in 1920, 10,888,183, or 85%, were males, and 1,930,341, or 15%, were females.

The Output of Minerals

The value of the output of mineral products, as estimated by the U.S. Geological Survey, increased from $1,987,844,000 in 1910 to $6,981,340,000 in 1920, and $5,318,000,000 in 1924. Nearly three-fourths was represented in 1923 by six products, as follows (in millions of dollars): bituminous coal, 1,636 (469 in 1910); pig-iron, 936 (412 in 1910); petroleum, 931 (128 in 1910); anthracite coal, 492 (160 in 1910); copper, 211 (137 in 1910); cement, 260 (69 in 1910). Lead increased in value from $33,055,000 in 1910 to $76,138,000 in 1923; zinc from $27,268,000 to $69,134,000; aluminium from $8,956,000 to $28,305,000; and natural gas from $70,756,000 to $250,000,000. Platinum had a remarkable development, the product increasing from 8,665 oz., valued at $479,000 in 1915, to 66,007 oz., valued at $7,611,000 in 1924.

The production of iron-ore increased from 57,015,000 long tons in 1910 to a maximum record of 75,289,000 tons in 1917. After the War it fell to 29,491,000 tons in 1920, and recovered to 70,018,000 tons in 1923. More than half of the iron-ore produced is mined in Minnesota, amounting in 1923 to 44,498,000 tons, followed by Michigan, 14,312,000 tons; Alabama mined 6,837,000 tons. In 1912 the National Conservation Commission estimated the total supply of iron profitable to mine at 4,784,930,000 long tons, and 75,000,000,000 tons not worth mining. According to this estimate, the profitable ore deposits might be exhausted in 60 years, allowing for no increase in national rate of production. The ore deposits being worked in 1923 were for the most part in high surfaces in the region of the Great Lakes. (*See* IRON and STEEL.)

The production of anthracite coal in 1910 was 75,433,246 tons (of 2,240 lb.); in 1920, 79,998,000 tons, and in 1923, 85,218,000 tons, an increase of 13% over 1910, or about 1% per annum. The estimated production in 1924 was 90,214,000 tons. The bituminous coal production in 1910 was 417,111,142 short tons, as compared with 545,000,000 tons in 1923, a gain of over 2% per annum. The estimated production in 1924 was 483,280,000 tons. About two-thirds of the coal consumed goes into the production of power, about equally divided between the industries and transportation; about one-sixteenth is used in raw material for making products employed industrially as coke, gas, coal-tar products; about one-sixteenth for heating homes and for buildings. (*See* COAL.)

The mining of copper does not follow a regular ascending curve of production. It reached a high point in 1906, 409,735 long tons; declined in 1907; rose to 487,925 tons in 1909; again declined in 1910; rose to 555,031 tons in 1912; fell to 513,454 in 1914; again advanced to 860,648 tons in 1916; declined to 225,708 in 1921, due to lack of European demand, and in 1923 recovered to 640,625 tons. More than one-third is produced in Arizona, the principal producing state. In 1924 it was estimated that the world's production was 1,499,143 short tons. (*See* COPPER.)

The increased demand for gasolene for automobiles raised the price and led to efforts to discover new supplies of petroleum. Since 1910 the production in California nearly trebled; in Texas it trebled; in Oklahoma more than doubled; in Wyoming new oil-fields were opened. The total production in 1924 was 707,265,000 bbl. as against the annual average yield of 363,000,000 for the years 1916–20, and 179,000,000 in 1908. (*See* PETROLEUM.)

The Director of the U.S. Geological Survey estimated in 1920 that the country's oil reserves were over 40% exhausted and that the supply at the existing rate of consumption would be exhausted within 20 years. Attention has been turned to the possibility of extracting petroleum from the oil shales of Utah, Colorado and Wyoming. Petroleum ranks second only to coal in value among mineral products.

The volume of natural gas products has risen steadily since the beginning of the century. In 1910 the production was 509,000,000 cu. ft., in 1920, 798,000,210 cu. ft., and in 1923, 1,800,135,000 cu. feet. Natural gas is found in 24 states, but chiefly in West Virginia, Pennsylvania, Ohio, Oklahoma and California. More than 3,000,000 domestic consumers are supplied. One-third is used for domestic purposes and two-thirds for industrial plants. The production in 1910 and 1923 is shown in Table VII. The total value of yield increased from $71,000,000 in 1910 to $250,000,000 in 1923.

TABLE VII. *Natural Gas Production*
(In million cubic feet)

State	1923	1910
West Virginia	203,867	191,000
Pennsylvania	112,562	127,000
New York	6,497	6,000
Ohio	53,812	48,000
Arkansas	24,215	
Louisiana and Texas	186,566	8,000
Kentucky	11,953	
Illinois	4,049	7,000
Oklahoma	203,082	50,000
Kansas	32,072	59,000
California	131,434	3,000
Wyoming	35,523	
Other states	2,503	10,000
Total	1,008,135	509,000

The production of gold reached its maximum in 1915, valued at $101,035,700. During the War it declined, owing to advance in material and labour, and the decreased purchasing power of gold. (*See* GOLD.) In 1922 the production was valued at $48,849,100, less than in any year since 1896. In 1924 production slightly gained to a value of $51,912,000. California furnished $631,000 oz. fine; Colorado, $409,000; Alaska, $301,000; South Dakota, $297,000. Silver reached its maximum in 1911, showing a commercial value of $66,485,000; in 1923 the value was $60,135,000. Preliminary figures for 1924 show a further fall to $43,540,000. Montana and Utah in recent years have forged ahead as great silver-producing states, Nevada remaining stationary.

Fisheries.—According to an estimate made by the Bureau of Fisheries the annual fishery product during the decade 1910–9 amounted to 2,500,000,000 lb., valued at about $80,000,000. The industry employs about 200,000 persons. The total quantity of fish landed at Boston and Gloucester, Mass., and Portland, Me., the three principal fishing ports in New England, amounted in 1924 to 182,948,000 lb., having a value to the fishermen of $6,992,952. Cod represented $2,138,306 and haddock $2,308,605. The product of the fisheries of the Great Lakes in 1917 was 104,269,000 lb., valued at $6,295,000. One-half of the product, 53,529,000 lb., was ciscoes (whitefish). The product of the fisheries of the gulf states in 1918 was 130,924,000 lb., valued at $6,510,000. The principal products were: mullet, 28,641,000 lb.; shrimp, 27,143,000 lb.; and oysters, 23,754,000 lb. At Seattle, Wash., the fishing fleet landed, in 1924, 28,233,000 lb., valued at $2,719,222. The principal product was halibut. The total catch of salmon and steelhead trout on the Pacific coast in 1919 including Alaska was 767,000,000 pounds. It is estimated that the annual yield of oysters for the whole United States is about 30,000,000 bu., giving a return to the fishermen of nearly $15,000,000. About one-fifth, 5,942,000 bu., come from the coast of the Middle Atlantic states.

Production.—Prof. Edmund E. Day of Harvard made an ingenious statistical study of the physical volume of production in the United States for the period 1888–1919, published in *The Review of Economic Statistics* (Harvard University, Sept. 1920–Jan. 1921), and continued by the Harvard Economic Service through the year 1924. The conclusions are shown in Table VIII. With 1899 as the base (100), index numbers for subsequent years were calculated for agriculture, representing 12 important crops—for mining, representing 10 minerals—and for manufacturing, representing 12 groups, covering 34 branches of manufacture. The indices for population are added in order to compare the growth of production.

Table VIII. shows that the physical volume of agricultural production has closely followed the growth of population. As Prof. Day points out: "Mining output, on the other hand, completely out-distanced population growth. Since 1897 the development of mining has been phenomenal . . . . Crops are an annual harvest from a soil the fertility of which scientific cultivation carefully preserves; mineral production is a continuing exhaustion of irreplaceable natural deposit. Mining typically lives upon its capital; agriculture upon its income. The rate of production in mining is consequently open to an acceleration which in agriculture is altogether impossible . . . . The fluctuations of manufacturing output appear to be much more cyclical than the variations in agricultural production. In general the fluctuations of production in manufacture resemble closely those in mining."

TABLE VIII. *Index Numbers of Production*

Year	Population	Agriculture	Mining	Manufacture
1899	100	100	100	100
1900	102	101	106	101
1901	104	89	115	112
1902	106	114	123	122
1903	108	105	135	124
1904	110	116	136	122
1905	112	118	162	143
1906	115	125	170	152
1907	117	112	186	151
1908	119	119	154	126
1909	121	118	189	155
1910	123	122	208	159
1911	125	115	207	153
1912	127	137	221	177
1913	130	121	237	184
1914	132	137	225	169
1915	133	144	239	189
1916	135	126	269	225
1917	137	134	288	227
1918	138	135	289	223
1919	140	137	257	218
1920	142	150	293	231
1921	144	124	233	179
1922	146	138	254	240
1923	148	138	348	283
1924	150	139	322	262

BIBLIOGRAPHY.—See *Fourteenth Census of the United States 1920*, vol. V., VI., *Agriculture;* vol. VIII.–X., *Manufactures*, vol. XI., *Mines and Quarries. The Biennial Census of Manufactures 1921*, appeared in 1923, and *The Biennial Census of Manufactures 1923* in 1925. The annual volume *Mineral Resources of the United States* contains the bulletins of the Geological Survey of the Dept. of the Interior. Statistics of commerce are analysed in the *Commerce Yearbook* published by the Dept. of Commerce. The U. S. Tariff Commission has published several volumes in which commercial statistics are rearranged for use in tariff discussion, *e.g., The Wool-Growing Industry.* Price statistics for retail and wholesale trade are gathered and published by the Federal Bureau of Labour Statistics. A valuable series of studies on price statistics of different groups of commodities during the World War was published under the editorship of W. C. Mitchell by the War Industries Board under the titles *History of Prices during the War* and *Government Control over Prices.* The Bureau of Labour Statistics also issues frequent bulletins showing wages in different trades in different parts of the country. See also the annual reports and the monthly bulletins of the Federal Reserve Board which contain a large variety of commercial and trade statistics, more detailed data on which may be found in the monthly bulletins of the several district banks. The *Statistical Abstract of the United States* assembles data on agriculture, fisheries, forestry, manufactures, mines and shipping. See also Raymond Pearl, *The Nation's Food* (1920); and W. M. Parsons, *Indices of General Business Conditions* (1919).

TRADE WITH FOREIGN COUNTRIES

Extraordinary movements in foreign commerce, due to the World War, began with 1915. During the years 1900–9, inclusive, the excess of exports over imports of merchandise varied in value from a maximum of $666,000,000 in 1908 to a minimum of $188,000,000 in 1910. Beginning with 1915 the annual excess was over a thousand million dollars, reaching in 1919, $4,016,000,000. Gradually there was a return to pre-War balances, showing $375,000,000 in 1923 but rising to $981,000,000 in 1924. Table I. shows the movement by years, and the excess of exports over imports in each year.

The excess of exports over imports in trade with European countries was even greater than the balance from total trade with all countries, amounting in 1919 to $4,437,000,000. In 1924 this balance was lowered to $1,348,134. Trade with South America uniformly showed an excess of imports over exports

TABLE I. *Foreign Trade*
(in millions of dollars)

	Exports	Imports	Excess of Exports over Imports
1910	1,745	1,557	188
1911	2,049	1,527	522
1912	2,204	1,653	551
1913	2,466	1,813	653
1914	2,365	1,894	471
1915	2,769	1,674	1,094
1916	4,333	2,198	2,136
1917	6,290	2,659	3,631
1918	5,920	2,946	2,974
1919	7,920	3,904	4,016
1920	8,228	5,278	2,950
1921	4,485	2,509	1,976
1922	3,832	3,113	719
1923	4,167	3,792	375
1924	4,591	3,610	981

ranging from $73,700,000 in 1911 to $252,800,000 in 1918, $151,406,000 in 1924; and trade with Asia also gave adverse balances ranging from $128,000,000 in 1911 to $416,766,000 in 1924. The figures given here relate to values of exports and imports, and do not even approximately reflect the changes in the physical volume of foreign commerce. For some of the commodities recorded in official statistics of exports and imports it is possible to give quantities as well as values; for others only values. In order to illustrate the influence of prices on abnormal values of commodities entering into foreign trade during the war period, quantities are given in Table II. of exports for five commodities: wheat, cotton, bacon, mineral oil and tobacco; for other principal commodities only values are stated. Table III. shows the similar influence of change in price level on imports.

The enormous excess of exports of merchandise over imports, which began to be so marked in 1915, resulted in unprecedented gold transfers to the United States. In 1916 the import of gold exceeded the export by $403,759,000, and in 1917 by $685,255,000. Thus in two years the gold holdings were increased by $1,089,000,000. In the years 1918–20 $436,532,000 of this gold was exported, leaving a net additional balance of $652,000,000. In the years 1921–4 the flow of gold to the United States amounted in excess of exports to $1,587,882,000.

BIBLIOGRAPHY.—Statistics of commerce are compiled by the Dept. of Commerce and published in two annual volumes, *Foreign Commerce and Navigation*, and *The Commerce Yearbook*. The annual volume, *Statistical Abstract of the United States*, also published by the Dept. of Commerce, contains valuable data on foreign commerce. A useful statistical handbook is *The Financial Review*, an annual published by the *Commercial and Financial Chronicle*, New York.

(D. R. D.)

AGRICULTURE IN THE UNITED STATES

In the United States agriculture is in the hands of 6,400,000 farmers, a number which has not changed appreciably between 1910 and 1926.

Effect of the War.—The outbreak of war in 1914 caused a violent disturbance of the price relationships of American agricultural products. In general, prices advanced; but for cotton, particularly, the market was demoralised. As the struggle progressed commodity prices rose sharply and production of exportable foodstuffs was greatly stimulated. During the last two years of the War and the year following, prices ruled very high, and this condition was accompanied by expanding credit facilities and a marked increase in the price of land. The economic reaction which set in during 1920 affected agriculture very severely. Demoralised financial conditions in Europe resulted in sharp reductions in the prices of agricultural exports, and these affected directly the prices of the vastly larger volume of these same commodities consumed at home. After many months of uncertainty and distress, conditions began slowly to mend so that at the close of the period there were evidences of definite improvement.

The major agricultural industries of the United States include the production of cereals or breadstuffs, hay and forage,

UNITED STATES

TABLE II. *Exports of Principal Commodities, 1910–23*

Years	Wheat		Cotton, raw		Bacon		Mineral Oil		Tobacco unmanuf.		Wheat Flour	Copper and manuf.	Lard	Automobiles, including chassis	Cotton manuf.	Iron and Steel	Leather, and manuf. of
	Bushels (mil.)	Dollars (mil.)	Bales (mil.)	Dollars (mil.)	Lb. (mil.)	Dollars (mil.)	Gallons (mil.)	Dollars (mil.)	Lb. (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)
1910–4 av.	57	55	8·5	552	182	23	1,734	117	392	45	51	118	52	19	45	139	58
1915–9 "	159	271	6·0	566	669	169	2,512	235	424	84	158	207	97	81	141	601	141
1920	218	597	6·2	1,136	636	156	3,080	548	480	245	224	142	143	212	402	661	192
1921	280	433	6·5	534	415	68	2,789	384	523	205	118	98	113	43	117	324	61
1922	165	206	6·1	673	342	52	2,922	331	442	146	85	104	91	60	139	189	62
1923	98	116	5·3	807	457	60	3,987	350	497	153	88	129	130	100	138	234	65
1924	166	237	6·8	951	287	37	3,919	392	546	163	91	157	126	132	133	408	69

TABLE III. *Imports of Principal Commodities, 1910–23*

Year	Coffee		Hides and skins, except furs		Silk, raw		Sugar-cane		Wool, unmanuf.		Rubber, crude	Cotton, manuf.	Jute and manuf. of	Vegetable expressed oils	Wood and manuf. of	Tobacco	Paper and paper basic stock
	Lb. (mil.)	Dollars (mil.)	Lb. (mil.)	Dollars (mil.)	Lb. (mil.)	Dollars (mil.)	Lb. (mil.)	Dollars (mil.)	Lb. (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)	Dollars (mil.)
1910–4 av.	899	101	532	105	24	77	4,341	104	208	39	86	67	41	27	42	37	32
1915–9 "	1,166	120	573	152	32	148	5,422	231	403	153	158	47	61	61	53	45	67
1920	1,297	252	510	244	30	285	8,029	1,009	260	127	243	138	108	108	120	99	189
1921	1,341	143	348	68	45	259	5,967	235	321	60	74	75	51	40	78	60	133
1922	1,246	161	551	107	51	366	9,722	252	377	87	102	87	63	59	97	74	159
1923	1,410	190	532	119	49	392	7,709	380	394	130	185	100	85	65	122	67	205
1924	1,417	249	357	75	51	328	8,272	363	268	93	174	91	74	60	112	84	212

meat and wool, dairy products, fruits and vegetables, sugar, tobacco, cotton and forest products, in which are included lumber, naval stores and paper. Some of these industries are rather definitely localised to one or more sections of the country, while others are contributed to from nearly every section. In the 15 years between 1910 and 1925, there have been no significant changes in the relative importance of these industries except possibly in the group of fruits and vegetables where there appears to have been a marked increase in certain classes.

Cereals.—The production of cereals is carried on to some extent in nearly every part of the country, but is of major importance in the Mississippi Valley and westward to the Pacific coast. These crops occupy approximately 225,000,000 ac. each year, of which nearly half is devoted to corn or maize. The total cereal crop of the country fluctuates annually, mainly owing to climatic conditions, and during the period under review it has ranged from 125,000,000 to 150,000,000 tons. One new cereal crop, grain sorghum, has been added to the list in recent years. It occupies about 5,000,000 ac. each year, chiefly in the southern Great Plains and in the irrigated southwest, where it has proved a safer crop than maize under arid conditions. Improved varieties of winter wheat have made it possible to extend this crop further northward than it was formerly grown. Rice production, formerly confined to the central gulf coast region, has been established also in California.

Hay.—Hay and related forage crops occupy about 70,000,000 ac. and yield approximately 100,000,000 tons each year. One new hay crop, sudan grass, has come into use in recent years. It is a species of sorghum, closely related to Johnson grass, and grown chiefly in the southern Great Plains region. In the dairy sections, maize stored as silage is an increasingly important fodder crop.

Meat.—The production of meat includes cattle, hogs and sheep. The cattle and sheep are bred on range pastures in the western half of the United States. From these breeding grounds the young stock is moved eastward to finish their growth and fattening in the corn belt of the Upper Mississippi Valley. Some lambs are fattened on irrigated lands adjacent to the western ranges where the by-products of beet-sugar factories are utilised together with alfalfa hay. A part of the young cattle are kept on the ranges during the growth period, while others are moved into the western edge of the corn belt. The final fattening in both cases takes place on corn-belt farms so that the great bulk of the corn (maize) crop is converted into meat on the farms where it is produced. The production of pork is more localised. Some pork is produced on western irrigated lands, where the growing pigs are pastured on alfalfa to be fattened locally or to be shipped eastward to be fattened with cattle on corn. For the most part, however, hogs are bred in the corn belt to be fattened locally, utilising the wastes from cattle feeding.

The meat-producing potentialities of the cotton belt are very great, including, in addition to pasture and corn lands, the by-products from the manufacture of oil from cotton seed. In the past, the full use of these resources has been hindered by the prevalence of a serious cattle disease known as Texas fever. Definite progress has been made in controlling this disease and thus in extending the areas available for efficient meat production. The sheep of the United States, of which the number ranges from 40,000,000 to 50,000,000, yield wool as well as meat. The annual wool crop ranges around 150,000 tons which is slightly less than half the total consumption of the country.

Dairy Products.—Dairy products are obtained from about 25,000,000 cows in the United States. The number has increased from about 20,000,000 in 1910. Of the milk produced by these cows, about half is directly consumed. About 35% is used for making butter and about 4% goes into each of the three other important products, viz.: cheese, condensed milk and ice cream. While the dairy industry is carried on in every section of the country, it is most highly developed in the north-central states. Only eight of the 48 states have more than a million dairy cows. The significant developments of the dairy industry in recent years have been the improvement by breeding and selection for higher production, the control of bovine tuberculosis and the centralisation of the manufacture of dairy products. The country is practically self-sustaining with respect to these products.

Fruits and Vegetables.—The production of fruits and vegetables constitutes in the aggregate a most important feature of agriculture in the United States; but it comprises a group of such diverse commodities, handled and measured in so many different ways, that it is difficult to present the salient facts in a concise statement. There has been in recent years a very pronounced increase in the volume of interstate movement of fresh fruits and vegetables. It is evident that the consumption *per capita* of fruits and vegetables is steadily increasing, and also there is a tendency to expand production in areas where climatic and soil conditions are favourable and to co-operate in the organisation and development of agencies for the effective distribution and marketing of the products. This has resulted in better quality and longer marketing seasons for many of these commodities.

Forest Products.—In the United States, excluding Alaska, about 470,000,000 ac. of land are classed as forest, of which slightly less than 140,000,000 ac. are included in National forests. From this area, the timber crop is being harvested faster than it is being produced. The production of lumber in 1922 was only about two-thirds of what it was in 1910, 44,000 million ft. in 1910 and 31,000 million ft. in 1922, but rose to 37,000 million ft. in 1923. Another important forest product is pulpwood for paper of which the United States consumes annually nearly 6,000,000 cords, and of which two-thirds comes from domestic forests. While the production of lumber has decreased during the past 15 years, the production as well as the consumption of pulpwood has increased, the production by nearly 50% and the consumption by nearly 100%. The other important forest products include turpentine and resin. The annual output from 1910 to 1925 has been about 30,000,000 gal. of turpentine and 2,000,000 bbl. of resin.

Cotton.—The production of cotton (*q.v.*) is confined to the Southern states where the crop occupies ordinarily 35,000,000 ac. of land. During 1924 and 1925 the acreage has been substantially higher, reaching 46 million in 1925. The crop of the United States constitutes approximately half of the total world production, and the value of that part of the crop (about one half) exported from the United States has, until recently, equalled or exceeded the combined value of all other agricultural exports. Both in yield and price the fluctuations of this crop have been greater than those of any other important crop. The cotton plant is subject to injury from a number of diseases and insect pests. Probably the most serious of these is an insect known as the Mexican cotton boll weevil (*q.v.*). This pest invaded the United States from Mexico in 1892 and is now established over most of the cotton belt except for a narrow fringe on the north and broader areas to the west where its distribution is limited by climatic conditions. Since 1910 the production of cotton has been extended over a large part of northwest Texas and into irrigated sections of New Mexico, Arizona and California. The aggregate area of irrigated cotton is less than 5,000,000 ac., but conditions favour larger yields in the main belt.

There has been a continuing increase in the manufacture of cotton, most marked in the southeastern states. Formerly cotton manufacture was confined to the states of the northeast, and while the industry has continued to expand in that section, its growth in the south has been much more rapid. The increase in cotton manufacture in the United States has been more rapid than the increase in cotton production, with the result that a smaller proportion of the crop has been available for export. Another important development in relation to the cotton industry has been the better utilisation of the cotton seed. The crop yields two pounds of seed for each pound of fibre. This seed, when crushed, yields 40 gal. or more of oil per ton. The residue of meal and hulls is used as feed for livestock while the oil, after refining, yields edible fats that are widely used as human food.

Tobacco.—Tobacco is an important crop in several well-defined districts of the United States, in each of which a special type is produced. The aggregate acreage has varied in recent years from 1,000,000 to 2,000,000 ac. with a tendency toward an increase.

The crop is estimated as having a farm value of from $100,000,000 to $500,000,000.

Sugar.—Sugar is produced in the United States from sugar beets and cane. Cane production is confined to Louisiana where 200,000 to 300,000 ac. are devoted to the crop, yielding from 100,000 to 350,000 tons of sugar annually. The yield of sugar fluctuates from year to year, but there has been no significant trend of change in recent years. Sugar beets are grown extensively on irrigated lands in the western states and there are about 200,000 ac. in the states of Michigan, Wisconsin and Ohio devoted to the crop. In the western states, the aggregate area is approximately 500,000 acres. The acreage and production of sugar beets has doubled since 1910, the annual yield of sugar from this source is now about 1,000,000 tons. The total consumption of sugar in the United States has increased from 3,500,000 tons in 1910 to nearly 6,000,000 tons in 1925. The annual consumption *per capita* has increased from 80 lb. to more than 100 pounds.

Exports.—Of certain classes of commodities the United States produces more than it consumes. Although domestic requirements greatly exceed exports, domestic price levels are determined very largely by the prices obtainable for the exportable surpluses. The volume of the exports of the more important groups of agricultural commodities for the past 15 years is shown in Table I.

TABLE I. *Exports of Important Agricultural Commodities from the United States, 1910–25.*

Year	Cereals	Dairy Products	Meat and Products	Cotton
	Tons	Tons	Tons	Tons
Average, 1910–4	4,624,300	12,500	628,500	2,210,000
1915	14,147,000	51,000	807,000	2,201,000
1916	11,155,000	109,000	1,004,500	1,542,000
1917	10,375,000	176,000	1,003,500	1,544,000
1918	8,618,000	295,500	1,173,500	1,160,000
1919	12,566,000	390,500	1,729,000	1,381,500
1920	16,130,000	378,500	1,112,500	1,771,750
1921	15,220,000	142,500	907,500	1,405,750
1922	15,460,000	152,000	900,000	1,679,500
1923	11,795,000	89,000	1,010,500	1,313,250
1924	6,445,000	113,000	1,078,000	1,474,750
1925	10,290,000	98,500	819,000	2,109,750

This table shows that for the War period and since, the exports of foodstuffs greatly exceeded the average for the pre-War period. The exports of cotton have been lower during and since the War, but this is due in part at least to the smaller crops of the post-War period.

Production Efficiency.—This general review of the more important agricultural industries of the country appears to warrant the conclusion that farmers are steadily increasing the efficiency of production. During the past 15 years the population of the country has increased by nearly 20%. The indications are that domestic consumption of agricultural products *per capita* has also increased. The number of farms has remained constant, and while the acreage devoted to crop production has increased somewhat, the number of workers engaged in farming has not changed significantly. Hence it is apparent that the volume of production for each worker has increased. There are several factors that may have contributed to this result. Two of the more important appear to be agricultural education and the internal-combustion engine. Systematic education in agriculture began to be generally available toward the end of the last century. It has been rapidly improved and extended during the past 25 years.

In addition to the services of agricultural schools and colleges, farmers have had the service of a nation-wide system of advice and assistance in dealing with their production problems. This agricultural extension service was begun in a small way as early as 1904 to meet the exigency created in the cotton belt by the invasion of the cotton boll weevil. It was extended later into other sections and in 1913 was definitely established over the whole country. There can be no doubt that education and the application of science to agriculture has contributed greatly to the efficiency of production. The internal-combustion engine has come into very general use by farmers during the past 15 years. A great variety of stationary types have been utilised in doing the work of the farm. Automotive types have found a place in certain classes of field-work, and the automobile has come to be very extensively used both as a passenger vehicle and as a truck. The saving of time and the lightening of labour resulting from this new form of power is not easily measurable, but it is obvious that it has been a factor of great importance in changing the conditions of farming and of country life.

Economic Conditions.—During the past 15 years the business of farming in the United States has experienced a period of great prosperity, followed by a period of depression. During the period of agricultural expansion culminating in 1910, new lands were cheap, and farms increased in value as time went on, even if the profits from production were low. From 1910 to 1920 land prices advanced even more rapidly than formerly, so that new enterprises called for capital investments much higher than had previously been known. During the same period the conditions of credit for agriculture were greatly improved, so that the post-War period of readjustment beginning in 1920 found agriculture carrying an unprecedented burden of indebtedness for which it has been difficult to find interest payments and still more difficult to liquidate. A substantial improvement of credit conditions for agriculture was achieved in 1916 as a result of the Federal Farm Loan Act (*see* FEDERAL FARM LOAN ACT). Other credit facilities have been added, one of which is known as intermediate credit to provide capital for such agricultural operations as live-stock production that may require two or three years to complete.

Another system of credit has been based on warehouse receipts issued for standardised agricultural products such as grain and cotton. Such receipts are extensively used as collateral for short-time loans, which makes it possible for farmers either individually or co-operatively to meet seasonal production expenses without selling the product at harvest time if market conditions are not favourable. Agricultural co-operation has also made definite progress during the past 15 years. This has had on the one hand the advantage of more efficient and orderly marketing to the direct financial benefit of the co-operators, and on the other hand co-operators have learned something of market requirements, of the value of improved methods of production, and of the use of market grades and standards. In many instances these educational benefits have outweighed the direct financial benefits.

Science in Agriculture.—The problems of agriculture have been the subject of much scientific inquiry for a generation or more. Such inquiry has been liberally supported by the Federal Govt. and by the states, and effective work has been done by various independent agencies. The results have been usefully applied in very many different fields. Some of the more outstanding achievements have been made in connection with the control of serious plant and animal diseases. Methods of spraying orchard fruits and vines have been widely and effectively used to control or prevent injury from both insects and fungous parasites. A vaccine for hog cholera has been developed. Steady progress is being made in restricting bovine tuberculosis and Texas fever. These and many other diseases and pests have laid a heavy tax on farming that has been lightened by applying the results of scientific work.

The problems of soil fertility—among the first undertaken by agricultural scientists—engage attention. One of the forward steps in this field has been the recognition that acid soils are not unproductive with all crops, but are indeed necessary for the successful production of certain crops. Coincident with this, the character and causes of soil acidity and of soil alkalinity have become known. In the field of plant breeding great progress has been made, not only in the understanding and application of the laws of heredity but also in the introduction of breeding varieties suited to special conditions of soil or climate, and breeding for resistance to plant diseases. The utilisation by farmers of these results of scientific inquiry has been an important factor in increasing the efficiency of production. While it cannot be said

that farmers in the United States have been able as yet to produce yields per acre as high as the yields obtained in Europe, it can be claimed that the production per man engaged in farming is very much higher. The yield per acre appears to be steadily though slowly rising. The increase in efficiency per man has been more rapid, especially in recent years. This increase has been gained with steadily lessening manual labour, with more time for social enjoyments and with a continuing improvement of living conditions on the farms.

BIBLIOGRAPHY.—See *Fourteenth Census of the United States, 1920*, vol. V, VI, *Agriculture*. The Federal Dept. of Agriculture issues many statistical bulletins relating to crops, supplies and stocks of staple commodities. The most important of these are summarised in the *Year Book of the Department of Agriculture*. The *Statistical Abstract of the United States*, published annually, contains much data on agriculture, consumption estimates and prices. *The Financial Review*, published annually by the *Commercial and Financial Chronicle*, New York, contains useful information on crops. The Bureau of the Census also issued preliminary figures of the U.S. Census of Agriculture, 1925. Final figures had in July 1926 appeared only for Connecticut, Delaware, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and the District of Columbia. These contain interesting comparisons with former years. (C. S. S.*)

IV. POPULATION AND IMMIGRATION

Total Population.—In 1920 (Jan. 1) the population of the United States (excluding all outlying possessions) was 105,710,620, as compared with 91,972,266 in 1910 (April 15). The rate of increase between these two dates, 14·9%, was considerably less than in the preceding decades. Never before in a 10-year period had the rate of increase fallen below 20%. The decline was due to the large falling off of immigration in the last half of the decade, and in some slight degree to the epidemic of influenza in 1918, as well as to the casualties resulting from the World War. The population of the outlying possessions was 12,112,545, of which the Philippine Is. furnished more than 10,000,000. The total population of the United States with its outlying possessions in 1920, therefore, numbered 117,823,165. Excluding the outlying possessions, the total addition to the population in the decade 1910–20 was 13,738,354 as compared with nearly 16,000,000 in the previous decade. The estimated population of the continental United States in 1925 (July 1) was 113,493,720.

Territorial Divisions and Component States.—The accompanying Table I. shows the population by territorial divisions and component states, with changes between 1910 and 1920, with a final column of estimated population in 1925. (Figures for Florida, Massachusetts, Rhode Island and South Dakota, however, are based upon state censuses taken in 1925.)

There was no change between 1910 and 1920 in the relative rank of the territorial divisions, and only minor shiftings for most of the states, California rising from 12th to 8th place. More than one-half the increase in population was found in the north, and the rate of gain in this section was greater than in the south, but less than in the west.

Sex.—By sex the population in 1920 was divided as follows: males, 53,900,376; females, 51,810,244—104 males to 100 females. The excess of males is attributable in part to immigration, for in the foreign-born population the males greatly outnumber the females. In a few states the females are in excess of males *i.e.*, in Massachusetts 96·3 males to 100 females; in Rhode Island, 97. This is probably due to the inflow of female operatives to the textile factories. In some of the far-western states the proportion of males to females runs very high, as in Nevada, 148·4; Wyoming, 131·3; Arizona, 121·9. The mining industry accounts for these differences. The two sexes in these sections, however, are nearer in numbers than in 1910, when the ratio of males for the Mountain states was 128 to 100 females, while in 1920 it fell to 115·7. In the Pacific states the ratio dropped from 130 to 114, showing that these sections are rapidly approaching the standard forms of family life which obtain in the older portions of the country.

Negroes, Indians and Orientals.—The negro population in 1920 was nearly 10% of the total population, *i.e.*, 10,463,131 in a total of 105,710,620. For full details *see* NEGRO.

TABLE I. *Increase of Population*

	1920	1910	Increase	Increase %	1925 Estimated
New England					
Maine	768,014	742,371	25,643	3·5	782,541
New Hampshire	443,083	430,572	12,511	2·9	450,171
Vermont	352,428	355,956	−3,528	−1·0	352,428
Massachusetts	3,852,356	3,366,416	485,940	14·4	4,154,746
Rhode Island	604,397	542,610	61,787	11·4	679,260
Connecticut	1,380,631	1,114,756	265,875	23·9	1,531,255
	7,400,909	6,552,681	848,228	12·9	7,950,401
Middle Atlantic					
New York	10,385,227	9,113,614	1,271,613	14·0	11,105,625
New Jersey	3,155,900	2,537,167	618,733	24·4	3,506,428
Pennsylvania	8,720,017	7,665,111	1,054,906	13·8	9,317,647
	22,261,144	19,315,892	2,945,252	15·2	23,929,700
East North Central					
Ohio	5,759,394	4,767,121	992,273	20·8	6,321,539
Indiana	2,930,390	2,700,876	229,514	8·5	3,060,416
Illinois	6,485,280	5,638,591	846,689	15·0	6,964,950
Michigan	3,668,412	2,810,173	858,239	30·5	4,154,625
Wisconsin	2,632,067	2,333,860	298,207	12·8	2,801,008
	21,475,543	18,250,621	3,224,922	17·7	23,302,538
West North Central					
Minnesota	2,387,125	2,075,708	311,417	15·0	2,563,550
Iowa	2,404,021	2,224,771	179,250	8·1	2,505,569
Missouri	3,404,055	3,293,335	110,720	3·4	3,466,781
North Dakota	646,872	577,056	69,816	12·1	686,424
So. Dakota	636,547	583,888	52,659	9·0	681,560
Nebraska	1,296,372	1,192,214	104,158	8·7	1,355,371
Kansas	1,769,257	1,690,949	78,308	4·6	1,813,621
	12,544,249	11,637,921	906,328	7·8	13,072,876
So. Atlantic					
Delaware	223,003	202,322	20,681	10·2	234,720
Maryland	1,449,661	1,295,346	154,315	11·9	1,537,085
District of Columbia	437,571	331,069	106,502	32·2	497,906
Virginia	2,309,187	2,061,612	247,575	12·0	2,449,443
W. Virginia	1,463,701	1,221,119	242,582	19·9	1,601,130
N. Carolina	2,559,123	2,206,287	352,836	16·0	2,759,014
S. Carolina	1,683,724	1,515,400	168,324	11·1	1,779,084
Georgia	2,895,832	2,609,121	286,711	11·0	3,058,260
Florida	968,470	752,619	215,851	28·7	1,263,549
	13,990,272	12,194,895	1,795,377	14·7	15,180,191
East South Central					
Kentucky	2,416,630	2,289,905	126,725	5·5	2,488,423
Tennessee	2,337,885	2,184,789	153,096	7·0	2,424,616
Alabama	2,348,174	2,138,093	210,081	9·8	2,467,190
Mississippi	1,790,618	1,797,114	−6,496	−0·4	1,790,618
	8,893,307	8,409,901	483,406	5·7	9,170,847
West South Central					
Arkansas	1,752,204	1,574,449	177,755	11·3	1,852,905
Louisiana	1,798,509	1,656,388	142,121	8·6	1,879,024
Oklahoma	2,028,283	1,657,155	371,128	22·4	2,238,536
Texas	4,663,228	3,896,542	766,686	19·7	5,097,574
	10,242,224	8,784,534	1,457,690	16·6	11,068,039
Mountain					
Montana	548,889	376,053	172,836	46·0	646,806
Idaho	431,866	325,594	106,272	32·6	492,071
Wyoming	194,402	145,965	48,437	33·2	221,842
Colorado	939,629	799,024	140,605	17·6	1,019,286
New Mexico	360,350	327,301	33,049	10·1	379,074
Arizona	334,162	204,354	129,808	63·5	407,702
Utah	449,396	373,351	76,045	20·4	492,478
Nevada	77,407	81,875	4,468	−5·5	77,407
	3,336,101	2,633,517	702,584	26·7	3,736,666
Pacific					
Washington	1,356,621	1,141,990	214,631	18·8	1,478,214
Oregon	783,389	672,765	110,624	16·4	846,061
California	3,426,861	2,377,549	1,049,312	44·1	4,021,320
	5,566,871	4,192,304	1,374,567	32·8	6,345,595

The number of Indians declined from 265,683 in 1910 to 244,437 in 1920. This apparent decrease, however, is probably due to the fact that in 1910 persons with only slight traces of Indian blood were enumerated as Indians, and in 1920 were classified as whites. The Chinese also decreased in number, as might be expected from the policy of exclusion; in 1910 there were 71,531, and in 1920, 61,639. The number of Japanese, however, increased from 72,157 to 111,010, or 53·9%. About 30,000 of this increase is credited to California, and a little over 4,000 to the State of Washington.

Foreign-born.—The foreign-born white population, owing to the check in immigration resulting from the World War, increased but slightly, from 13,345,545 to 13,712,754, or 2·7% between 1910 and 1920, as against an increase of 30·7% between 1900 and 1910. The numerical increase in this group of the population, 367,209, was much smaller than in any preceding decade since 1850. This element increased between 1910 and 1920 in 20 states and the District of Columbia, and decreased in 28 states: in the previous decade there was a gain in every state except five. Arizona and Texas showed the largest rate of increase, 67% and 50% respectively, due to Mexican immigration. Table II. shows the foreign-born whites for the four states having over 1,000,000 of this element in 1920. In 1910 the foreign-born whites constituted 14·5% of the total population of the United States and in 1920, 13%. The nativity of the white population in 1920 is shown in Table III. Little over

TABLE II. *Foreign-born Whites*

State	1920	1910	1900	Per cent increase 1910–20	Per cent increase 1900–10
Illinois	1,206,951	1,202,560	964,635	0·2	24·7
Massachusetts	1,077,534	1,051,050	840,114	2·5	25·1
New York	2,786,112	2,729,272	1,889,523	2·0	44·4
Pennsylvania	1,387,534	1,438,719	982,543	−3·6	46·4

one-half of the total white population 55·3%, was native born with native-born parents. In New England only 30·8% were in this group; and in Massachusetts less than one-third, 31·9. According to the post-War map, the countries from which had come the largest numbers of foreign-born who were in the United States in 1920, were Germany, 1,686,108; Italy, 1,610,113; Russia, 1,410,495; Poland, 1,139,979; Canada, 1,124,925; Ireland, 1,037,234; England, 813,853; Sweden, 625,585; Austria, 575,627.

TABLE III. *Nativity of Whites, 1920*

	Number	Per Cent
Native parentage	58,421,957	55·3
Foreign parentage	15,694,539	14·8
Mixed parentage	6,991,665	6·6
Total native born	81,108,161	76·7
Foreign-born white	13,712,754	13·0
Total white	94,820,915	89·7
Negro	10,463,131	9·9
Other non-white races	426,574	0·4
Total population	105,710,620	100·0

The following figures show the total number of foreign-born whites in certain states, with the foreign country which had furnished the largest number in that state: California, 757,625 (Italy, 88,504); Illinois, 1,206,951 (Germany, 205,491); Massachusetts, 1,077,534 (Ireland, 183,171); Michigan, 726,635 (Canada, 164,502); Minnesota, 486,164 (Sweden, 112,117); New Jersey, 738,613 (Italy, 157,285); New York, 2,786,112 (Italy, 545,173); Ohio, 678,697 (Germany, 111,893); Pennsylvania, 1,387,850 (Italy, 222,764); Texas, 360,519 (Mexico, 249,652); Wisconsin, 460,128 (Germany, 151,250).

In connection with the problems of Americanisation the statistics of citizenship of the foreign born are of interest. In 1920, 12,686,393, or 89·4% of this element, were 21 years of age and over; 7,063,594 were men and 5,622,799 were women. Table IV. shows the number in 1920 naturalised, those who had taken out first papers, aliens, and those for whom no reports were obtained.

TABLE IV. *Naturalisations, 1920*

	Men		Women	
	Number	Per Cent	Number	Per Cent
Naturalised	3,322,104	47·8	2,899,601	52·0
First papers	1,120,833	16·1	77,755	1·4
Alien	2,253,691	30·9	2,226,672	40·0
No reports	366,966	5·2	376,775	6·6

In 1910, 45·6% of the men were naturalised, as compared with 47·8% in 1920, and only 8·6% had taken out first papers, as compared with 16·1% in 1920.

Increasing facilities in ocean transportation, and the higher wages received by immigrants, enabling them to travel, led to a constant stream of repatriation in the years following the War. In order to determine the net increase of population by immigration, it is necessary, therefore, to determine both arrivals and departures. Table V. compiled by the Bureau of Immigration, shows the changes for the 14 years 1910–24.

TABLE V. *Immigrants, in Thousands*

	Admitted			Departed			Added to population
	Immigrant	Non-immigrant	Total	Emigrant	Non-emigrant	Total	
1910	1,042	156	1,198	202	178	380	818
1911	878	152	1,030	296	222	518	512
1912	838	179	1,017	333	282	615	402
1913	1,198	229	1,427	308	304	612	815
1914	1,218	185	1,403	303	330	634	769
1915	327	107	434	204	180	384	50
1916	299	68	367	130	111	241	126
1917	295	67	363	66	80	146	216
1918	111	101	212	94	99	193	19
1919	141	96	237	123	93	216	21
1920	430	192	622	288	140	428	194
1921	805	173	978	248	178	426	552
1922	310	123	433	199	147	345	87
1923	523	150	673	81	119	201	473
1924	707	172	879	77	140	217	663

Since 1915 there has been a marked decline in immigration, due to the World War. In the five years 1910–4, the total number of immigrants was 5,174,000, and in the succeeding five years ending in 1919, only 1,173,000. In 1921 immigration increased to pre-War figures; declined in 1922 owing to industrial depression; but by 1923 again was tending upward.

Immigrants may be classified (*a*) as to race or people and (*b*) as to country of last residence. Table VI. shows immigration,

TABLE VI. *Immigrant Aliens, by Race*

Race or people	1924		1910	
	Number	Per cent of total	Number	Per cent of total
Croatian and Slovenian	4,137	0·6	39,562	4
Dutch and Flemish	7,840	1·1	13,012	1
English	93,939	13·3	53,498	5
French	48,632	6·9	21,107	2
German	95,627	13·5	71,380	7
Greek	5,252	0·7	39,135	4
Hebrew	49,989	7·1	84,260	8
Irish	42,364	6·0	38,382	4
Italian, North	11,576	1·6	30,780	3
Italian, South	47,633	6·7	192,673	19
Lithuanian	1,991	0·3	22,714	2
Magyar	7,446	1·1	27,302	3
Mexican	87,648	12·4	17,760	2
Polish	19,371	2·7	128,348	13
Portuguese	3,892	0·6	7,657	7
Ruthenian	2,356	0·3	27,907	3
Scandinavian	40,978	5·8	52,037	5
Scotch	61,327	8·7	24,612	2
Spanish	3,664	0·5	5,837	

by race, for the most important groups for the years 1910 and 1924. Table VII. shows immigration of countries for the years 1910 and 1923.

TABLE VII. *Immigrant Aliens, by Country*

Country of last residence	1924		1910	
	Number	Per cent of total	Number	Per cent of total
Austria	7,505	1·5	135,793	13
Hungary	5,806	·8	122,944	12
Germany	75,091	20·6	31,283	3
Greece	4,871	·6	25,888	2
Italy	56,246	8·0	215,537	21
Russia	12,649	1·8	186,792	18
England	24,466	3·5	46,706	5
Ireland	17,111	2·4	29,855	3
Norway	11,986	1·7	17,538	2
Portugal	2,769	·4	8,229	1
Sweden	18,310	2·6	23,745	2
Turkey in Europe	1,481	·2	18,405	2
Turkey in Asia	2,820	·4	15,212	1
British North America	200,690	28·4	56,555	5
Mexico	89,336	12·6	18,691	2

It will be observed that by 1924 there was a change in the racial composition of immigration as compared with 1910. Immigration from Italy and eastern European stocks fell off; from Austria, Hungary, Germany and Russia it practically stopped during the War, but beginning with 1921, the flow from Germany assumed greater proportion. Immigration from the northern border, of both English and French Canadians, and from Mexico greatly increased. Until the World War, Europe was the chief source of immigration to the United States, furnishing 90% of the total. The percentage coming from Europe fell, however, to 60% in 1915, 50% in 1916, 45% in 1917, 28% in 1918 and 17% in 1919. In 1920 it rose to 57% and in 1924 to 51%. The proportion of females among the immigrant aliens in 1924 was 44%, as compared with 33% in the years 1910–4. Such increase presumably makes for the stability of the immigrant population.

In 1917 a literacy test was imposed upon immigrants, exemptions being made in certain cases. As a result only 15,094 illiterate immigrants 16 years of age and over, or 4·4%, were admitted in 1920. During the years 1908–17, 1,617,000 illiterate immigrants 14 years of age and over were admitted. Undoubtedly the new restriction should show in the course of the decade 1920–30 a marked effect upon the degree of illiteracy in the United States. By the Immigration Act passed in 1921 and subsequent legislation, the number of immigrants admitted from any one country in the year July 1, 1921, to June 20 1922, was restricted to definite quotas of the persons of that nationality resident in the United States at an earlier period. Only 358,000 immigrants, were eligible for admittance during 1921–2. The United Kingdom was limited to 77,200; Germany to 68,000; Italy to 42,000; Russia to 34,200 and Poland to 25,800.

Urban and Rural Population.—The tendency of the population to concentrate in towns and cities continued unabated. In 1910 the percentage of the population living in urban territory (that is, in cities and other incorporated places of 2,500 inhabitants or more, and in towns of that size in Massachusetts, New Hampshire and Rhode Island) was 46·3%, and in 1920 it was 51·4.

Table VIII. shows the population of cities having 50,000 inhabitants or more in 1920 with comparison for 1910. In the final column estimates of population in 1925 of most of the cities, as made by the Bureau of the Census, are given.

The cities with increases of over 100% were Detroit, Mich., due to the development of the automobile industry; Akron, O., the home of several large rubber factories which manufacture tires for automobiles; Flint, Mich., also an automobile city; Tulsa, Okla., a centre of oil activity; Gary, Ind., a city recently built up by the U.S. Steel Corp.; Bethlehem, Pa., also a steel city; Knoxville, Tenn.; and Long Beach, California. With the exception of Bethlehem, no one of these cities is in the east.

TABLE VIII. *Cities with 50,000 Inhabitants or More*

Rank in 1920		1920	1910	Per-centage increase	1925 estimate
1	New York, N. Y.	5,620,048	4,766,883	17·9	..
2	Chicago, Ill.	2,701,705	2,185,283	23·6	2,995,239
3	Philadelphia, Pa.	1,823,779	1,549,008	17·7	1,979,364
4	Detroit, Mich.	993,678	465,766	113·3	1,242,044
5	Cleveland, O.	796,841	560,663	42·1	936,485
6	St. Louis, Mo.	772,897	687,029	12·5	821,543
7	Boston, Mass.	748,060	670,585	11·6	781,529
8	Baltimore, Md.	733,826	558,485	31·4	796,296
9	Pittsburgh, Pa.	588,343	533,905	10·2	631,563
10	Los Angeles, Cal.	576,673	319,198	80·7	..
11	Buffalo, N. Y.	506,775	423,715	19·6	538,016
12	San Francisco, Cal.	506,676	416,912	21·5	557,530
13	Milwaukee, Wis.	457,147	373,857	22·3	509,192
14	Washington, D. C.	437,571	331,069	32·2	497,906
15	Newark, N. J.	414,524	347,469	19·3	452,513
16	Cincinnati, O.	401,247	363,591	10·4	409,333
17	New Orleans, La.	387,219	339,075	14·2	414,493
18	Minneapolis, Minn.	380,582	301,408	26·3	425,435
19	Kansas City, Mo.	324,410	248,381	30·6	367,481
20	Seattle, Wash.	315,312	237,194	32·9	..
21	Indianapolis, Ind.	314,194	233,650	34·5	358,819
22	Jersey City, N. J.	298,103	267,779	11·3	315,280
23	Rochester, N. Y.	295,750	218,149	35·6	316,786
24	Portland, Ore.	258,288	207,214	24·6	282,383
25	Denver, Colo.	256,491	213,381	20·2	280,911
26	Toledo, O.	243,164	168,497	44·3	287,380
27	Providence, R. I.	237,595	224,326	5·9	267,918
28	Columbus, O.	237,031	181,511	30·6	279,836
29	Louisville, Ky.	234,891	223,928	4·9	259,259
30	St. Paul, Minn.	234,698	214,744	9·3	246,001
31	Oakland, Cal.	216,261	150,174	44·0	253,700
32	Akron, O.	208,435	69,067	201·8	..
33	Atlanta, Ga.	200,616	154,839	29·6	..
34	Omaha, Neb.	191,601	124,096	54·4	211,768
35	Worcester, Mass.	179,754	145,986	23·1	192,242
36	Birmingham, Ala.	178,806	132,685	34·8	205,670
37	Syracuse, N. Y.	171,717	137,249	25·1	182,003
38	Richmond, Va.	171,667	127,628	34·5	186,403
39	New Haven, Conn.	162,537	133,605	21·7	178,927
40	Memphis, Tenn.	162,351	131,105	23·8	174,533
41	San Antonio, Tex.	161,379	96,614	67·0	198,069
42	Dallas, Tex.	158,976	92,104	72·6	194,450
43	Dayton, Ohio.	152,559	116,577	30·9	172,942
44	Bridgeport, Conn.	143,555	102,054	40·7	..
45	Houston, Tex.	138,276	78,800	75·5	164,954
46	Hartford, Conn.	138,036	98,915	39·6	160,197
47	Scranton, Pa.	137,783	129,867	6·1	142,266
48	Grand Rapids, Mich.	137,634	112,571	22·3	153,698
49	Paterson, N. J.	135,875	125,600	8·2	141,695
50	Youngstown, O.	132,358	79,066	67·4	..
51	Springfield, Mass.	129,614	88,926	45·8	142,224
52	Des Moines, Ia.	126,468	86,368	46·4	..
53	New Bedford, Mass.	121,217	96,652	25·4	120,494
54	Fall River, Mass.	120,485	119,295	1·0	129,662
55	Trenton, N. J.	119,289	96,815	23·2	132,020
56	Nashville, Tenn.	118,342	110,364	7·2	136,220
57	Salt Lake City, Utah	118,110	92,777	27·3	130,948
58	Camden, N. J.	116,309	94,538	23·0	128,642
59	Norfolk, Va.	115,777	67,452	71·6	..
60	Albany, N. Y.	113,344	100,253	13·1	117,830
61	Lowell, Mass.	112,759	106,294	6·1	110,542
62	Wilmington, Del.	110,168	87,411	26·0	122,049
63	Cambridge, Mass.	109,694	104,839	4·6	120,053
64	Reading, Pa.	107,784	96,071	12·2	112,707
65	Fort Worth, Tex.	106,482	73,312	45·2	154,847
66	Spokane, Wash.	104,437	104,402	..	108,897
67	Kansas City, Kan.	101,177	82,331	22·9	..
68	Yonkers, N. Y.	100,176	79,803	25·5	113,647
69	Lynn, Mass.	99,148	89,336	11·0	103,147
70	Duluth, Minn.	98,917	78,466	26·1	110,502

TABLE VIII—*Continued*

Rank in 1920		1920	1910	Per-cent-age in-crease	1925 estimate
71	Tacoma, Wash.	96,965	83,743	15·8	104,455
72	Elizabeth, N. J.	95,783	73,409	30·5	..
73	Lawrence, Mass.	94,270	85,892	9·8	95,136
74	Utica, N. Y.	94,156	74,419	26·5	101,604
75	Erie, Pa.	93,372	66,525	40·4	..
76	Somerville, Mass.	93,091	77,236	20·5	99,206
77	Flint, Mich.	91,599	38,550	137·6	130,316
78	Jacksonville, Fla.	91,558	57,699	58·7	95,450
79	Waterbury, Conn.	91,715	73,141	25·4	..
80	Oklahoma City, Okla.	91,295	64,205	42·2	..
81	Schenectady, N. Y.	88,723	72,826	21·8	92,786
82	Canton, O.	87,091	50,217	73·4	106,260
83	Fort Wayne, Ind.	86,549	65,933	35·4	97,846
84	Evansville, Ind.	85,264	69,647	22·4	93,601
85	Savannah, Ga.	83,252	65,064	28·0	93,134
86	Manchester, N. H.	78,384	70,063	11·9	83,097
87	St. Joseph, Mo.	77,939	77,403	0·7	78,342
88	Knoxville, Tenn.	77,818	36,346	114·1	95,464
89	El Paso, Tex.	77,560	39,279	97·5	104,929
90	Bayonne, N. J.	76,754	55,545	38·2	88,767
91	Peoria, Ill.	76,121	66,950	13·7	81,564
92	Harrisburg, Pa.	75,917	64,186	18·3	83,522
93	San Diego, Cal.	74,683	39,578	88·7	106,047
94	Wilkesbarre, Pa.	73,833	67,105	10·0	77,644
95	Allentown, Pa.	73,502	51,913	41·6	92,151
96	Wichita, Kan.	72,217	52,450	37·7	..
97	Tulsa, Okla.	72,075	18,182	296·4	124,478
98	Troy, N. Y.	72,013	76,813	−6·2	72,223
99	Sioux City, Ia.	71,227	47,828	48·9	..
100	South Bend, Ind.	70,983	53,684	32·2	80,091
101	Portland, Me.	69,272	58,571	18·3	75,333
102	Hoboken, N. J.	68,166	70,324	−3·1	68,166
103	Charleston, S. C.	67,957	58,833	15·5	73,135
104	Johnstown, Pa.	67,327	55,482	21·3	71,475
105	Binghamton, N. Y.	66,800	48,443	37·9	71,915
106	East St. Louis, Ill.	66,767	58,547	14·0	71,423
107	Brockton, Mass.	66,254	56,878	16·5	65,731
108	Terre Haute, Ind.	66,083	58,157	13·6	71,071
109	Sacramento, Cal.	65,908	44,696	47·5	72,260
110	Rockford, Ill.	65,651	45,401	44·6	76,462
111	Little Rock, Ark.	65,142	45,941	41·8	74,216
112	Pawtucket, R. I.	64,248	51,622	24·5	69,760
113	Passaic, N. J.	63,841	54,773	16·6	68,979
114	Saginaw, Mich.	61,903	50,510	22·6	72,100
115	Springfield, O.	60,840	46,921	29·7	68,725
116	Mobile, Ala.	60,777	51,521	18·0	65,955
117	Altoona, Pa.	60,331	52,127	15·7	66,148
118	Holyoke, Mass.	60,203	57,730	4·3	60,892
119	New Britain, Conn.	59,316	43,916	35·1	68,039
120	Springfield, Ill.	59,183	51,678	14·5	63,923
121	Racine, Wis.	58,593	38,002	54·2	67,077
122	Chester, Pa.	58,030	38,537	50·6	68,507
123	Chattanooga, Tenn.	57,895	44,604	29·8	66,575
124	Lansing, Mich.	57,327	31,229	83·6	70,753
125	Covington, Ky.	57,121	53,270	7·2	58,309
126	Davenport, Ia.	56,727	43,028	31·8	..
127	Wheeling, W. Va.	56,208	41,641	35·0	..
128	Berkeley, Cal.	56,036	40,434	38·6	66,209
129	Long Beach, Cal.	55,593	17,809	212·2	91,182
130	Gary, Ind.	55,378	16,802	229·6	76,870
131	Lincoln, Neb.	54,948	43,973	25·0	60,941
132	Portsmouth, Va.	54,387	33,190	63·9	59,029
133	Haverhill, Mass.	53,884	44,115	22·1	49,084
134	Lancaster, Pa.	53,150	47,227	12·5	56,505
135	Macon, Ga.	52,995	−40·665	30·3	58,237
136	Augusta, Ga.	52,548	41,040	28·0	55,245
137	Tampa, Fla.	51,608	37,782	36·6	94,743
138	Roanoke, Va.	50,842	34,874	45·8	58,208
139	Niagara Falls, N.Y.	50,760	30,445	66·7	57,033
140	East Orange, N. J.	50,710	34,371	47·5	59,967
141	Atlantic City, N. J.	50,707	46,150	9·9	53,287
142	Bethlehem, Pa.	50,358	12,837	292·3	62,828
143	Huntington, W.Va.	50,177	31,161	61·0	63,485
144	Topeka, Kan.	50,022	43,684	14·5	55,411

Nearly one-fourth of the gain in the total population was due to the growth of the 12 largest cities, which in 1920 all had more than 500,000 inhabitants each. In 1910 there were only eight cities with a population of 500,000 or over, and in that year 12·5% or one-eighth of the total population lived in cities of this size; in 1920 the proportion was 15·5%. In 1910 there were 42 cities with a population between 100,000 and 500,000; in 1920 there were 56. (*See* URBANISATION.)

Occupations.—The proportion of the population engaged in gainful occupations was recorded as slightly less in 1920 than in 1910, declining from 41·5% to 39·4%. This decline was attributed to the forwarding of the census date from April 15 1910, to Jan. 1 1920, when a considerable number usually engaged in agricultural and building industries were idle. Table IX. classifies those engaged in industry according to the principal division of occupations.

TABLE IX. *Industrial Occupations*

Occupation	Number		Per Cent	
	1920	1910	1920	1910
Males:—				
Agriculture, forestry and animal husbandry	9,869,030	10,851,581	29·8	36·1
Extraction of minerals	1,087,359	964,075	3·3	3·2
Manufacturing and mechanical industries	10,888,183	8,808,161	32·9	29·3
Transportation	2,850,528	2,530,795	8·6	8·4
Trade	3,575,187	3,146,582	10·8	10·4
Public service (not elsewhere classified)	748,666	445,733	2·3	1·5
Professional service	1,127,391	959,470	3·4	3·2
Domestic and personal service	1,217,968	1,241,338	3·7	4·1
Clerical occupations	1,700,425	1,143,829	5·2	3·8
All occupations (male)	33,964,737	30,091,564	100·0	100·0
Females:—				
Agriculture, forestry and animal husbandry	1,084,128	1,807,501	12·7	22·4
Extraction of minerals	2,864	1,094	..	..
Manufacturing and mechanical industries	1,930,341	1,820,570	22·6	22·6
Transportation	213,054	106,625	2·5	1·3
Trade	667,792	468,088	7·8	5·8
Public service (not elsewhere classified)	21,794	13,558	0·2	0·2
Professional service	1,016,498	733,891	11·9	9·1
Domestic and personal service	2,186,924	2,531,221	25·6	31·3
Clerical occupations	1,426,116	593,224	16·7	7·3
All occupations (female)	8,549,511	8,075,772	100·0	100·0

Table IX. does not include all those engaged in economic services. Many children and wives work for their parents or husbands, and as technically they do not receive wages they are not recorded as engaged in gainful occupations, although in reality they contribute to the household economy. If these be included, approximately two-thirds of the population was engaged in some degree in creating wealth or in services which might be valued in economic terms. Nearly one-third of all the workers were engaged in agricultural and allied industries.

Education.—In 1922 there were 23,239,227 children enrolled in the public schools, constituting over 75% of the population from five to 18 years of age. There were 722,976 teachers in the public schools, or one to every 32 pupils. Of the teachers 16% were males. The total expenditure for education in elementary and secondary schools was $1,580,671,296, or about $68 per pupil. The above enrolment of pupils includes 2,229,000 attending public high schools. In addition there were 186,641 pupils in private high schools and academies. There were 350 public and private normal schools with an enrolment of 217,000. Universities, colleges and professional schools numbered 780 in 1922, having 67,649 students of preparatory grade, 415,806 of collegiate grade, 23,016 graduate students and 75,466 students in professional schools. Professional schools numbered 418, as follows: theology, 116, with 8,566 students; law, 110,

with 27,017 students; medicine, 74, with 16,747 students; dentistry, 43, with 11,773 students; pharmacy, 59, with 8,202 students; and veterinary medicine, 16, with 716 students. (*See* EDUCATION, *United States*.)

The statistics of illiteracy for 1920 showed a diminution compared with those for 1910. The Census Bureau classifies as illiterate any person 10 years of age or over who is unable to write in any language, regardless of ability to read. Illiterates in 1920 numbered 4,931,905 ,or 6% of the population at least 10 years of age, as compared with 7·7% in 1910. The proportion of illiteracy for the individual states in 1920 ranged from 1·1% in Iowa to 21·9% for Louisiana. Illiteracy is very marked in those states in which the coloured population or the foreign-born population is relatively large. There has been a marked decrease in illiteracy of negroes, declining from 44·5% in 1900 to 30·4% in 1910 and 22·9% in 1920. Of the native whites of native parentage only 2·5% in 1920 were illiterate.

Births and Deaths.—In 1915 the Census Bureau began the annual analysis and publication of birth statistics based upon data obtained from state registration records. In 1923 the birth registration area covered nearly three-fourths (72·2%) of the total population. Between 1915 and 1924 the birth-rate declined from 25·1 to 22·5 per 1,000. The ratio of male to female births since 1915 was practically constant; in 1915 it was 1,055 males to 1,000 females, and in 1921 1,057 to 1,000. The fecundity of foreign-born mothers was much greater than that of native mothers. For example, in Connecticut, in 1919, although the white married women of foreign birth, age 15 to 42, constituted only 46% of the total population of white married women of that age group, they gave birth to 57% of the children. In Massachusetts 49% of foreign-born mothers gave birth to 53% of the children; and in New York 43% of foreign-born mothers gave birth to 49% of the children. The first and second children formed 50% of all children born to native white mothers, while only 34% born to foreign-born mothers were first and second children.

The registration area for mortality statistics covers 90% of the population. Between 1900 and 1922 the death-rate varied from a minimum of 11·6 per 1,000 in 1921 to 18·1 per 1,000 in 1918. This latter high rate was due largely to a great influenza pandemic. The rate of infant mortality (the number of deaths of infants under one year of age per 1,000 born alive) for the registration area in 1923 was 81 for the white population; for the negro population 143; and for the total population, 86.

A fifth nation-wide compilation of statistics of marriage and divorce was made by the Bureau of Census, covering the year 1923. There were 1,224,373 marriages, or 11·1 per 1,000 of the population. In the northern states, the rate was lower, while in southern groups in some instances it exceeded 13. There were 165,226 divorces. The statistics were not analysed to show ratios of divorce to marriage, but only the ratios to population. For the whole country the ratio of divorces was 149 per 100,000 population. In New England the ratio was 104, Middle Atlantic States, 59, West South Central States (Arkansas, Louisiana, Texas and Oklahoma), 250, and Pacific States, 260. Of the divorces 32% were granted to the husband and 68% to the wife.

BIBLIOGRAPHY.—Relating to the *Fourteenth Census of the United States, 1920*, are the following volumes: I. *Population, Number and Distribution of Inhabitants;* II. *Population, General Report and Analytical Tables;* III. *Population, Composition and Characteristics by States;* IV. *Population, Occupations*. The data for the census of 1910 are graphically represented in the *Statistical Atlas of the United States 1914*. Important volumes on special topics have been recently published by the Bureau of the Census: *Negro Population 1790–1915* (1918); *Indian Population in the United States and Alaska, 1910* (1915); *Religious Bodies, 1916:* Part I., *Summary and General Tables* (1919); Part II., *Separate Denominations* (1919); *Insane and Feebleminded in Institutions 1910* (1914); *Benevolent Institutions, 1910* (1913); *Deaf Mutes in the United States, 1910* (1918); *Paupers in Almshouses, 1910* (1915); *Prisoners and Juvenile Delinquents, 1910* (1918); *Statistical Directory of State Institutions for Defective, Dependent and Delinquent Classes* (1919); *Increase of Population in the United States 1910–1920* (1922). The Bureau of the Census continues the annual compilation on Mortality Statistics, begun in 1900. As the registration area is constantly enlarged, these latter statistics are of increasing value. The most serviceable single source-book is the annual volume. *Statistical Abstract of the United States*, first issued in 1878, published by the Dept. of Commerce. This assembles data on area and population, including census returns, immigration and vital statistics. Most of the statistics are derived from official publications, but when they are wanting, reliance is placed upon private statistical agencies. (D. R. D.)

V. COMMUNICATIONS

Railways.—The development of United States railways from 1910 to 1924, in mileage, equipment, employees, public service and finance, may be summarised in a comparison of the significant statistical units. In miles of railway the total in 1910 was 240,831. In 1924 the total was 258,238. Practically all of the increase was in 1911 to 1914. In 1914 the total was 256,547. The additions since 1914 have been offset in substantial part by the miles of branch lines abandoned. In total track miles the increase was greater in degree—351,767 in 1910 and 415,027 in 1924. The ratio of total tracks to road miles was 1·46 in 1910 and 1·61 in 1924.

The number of locomotives was 60,019 in 1910 and 69,486 in 1924. The increase in number, however, does not fully indicate the increase in capacity. The average tractive power was 27,282 lb. in 1910 and 39,891 lb. in 1924. Passenger train cars increased in number from 47,179 to 57,451. The number of freight cars grew from 2,148,478 to 2,411,627, with an average capacity of 35·9 tons in 1910 and 44·3 tons in 1924.

The net capitalisation in 1910 was about 14·4 thousand million dollars, of which 44% was in capital stock and 54% in funded debt. In 1924 the net capitalisation was 18·2 thousand million, of which 40% was in capital stock and 60% in funded debt. As it was impracticable from 1914 to 1923 to finance through the sale of stock, nearly all of the increases in railway capitalisation were in funded debt. The net capitalisation per mile of road was $62,657 in 1910 and $75,332 in 1924. The total dividend payments actually decreased. In 1910 they were $405,771,416. In 1924, with an increase of 16% in total stock, they were $382,879,890. The average dividend rate on all stock in 1910 was 5%; in 1924 it was 4·12%.

The financial results of operation were as follows: operating revenues increased from 2,812 million dollars to 6,045 millions. Operating expenses advanced from 1,882 millions to 4,609 millions. Taxes grew from 98 millions to 347 millions, and the net railway operating income (the amount left to pay interest and other fixed charges and dividends) was 805 millions in 1910 and 984 millions in 1924. In other words, the increase of 115% in revenues was accompanied by increases of 145% in expenses and 254% in taxes, leaving an increase of but 12% in net income as the return on the 26% increase in total invested capital. These figures indicate that the net earning power of railways suffered substantial impairment during the 14-year period.

The transportation product may be measured in passengers and tons carried one mile. The passenger miles of 1910 were 32.3 millions; in 1924 they were 36.4 millions. Beginning with 1923 railway passenger traffic, notably in short-distance riders, has shown a tendency to decrease, principally because of motor-bus competition and the greater use of the automobile by individuals. The revenue ton-miles of 1910 were 255 thousanv millions; in 1924 they were 392 thousand millions. The effect of motor-truck competition for short hauls, while substantial in absolute figures, was not serious relatively, as such losses were small in comparison with the gains in other freight traffic. Expressed in averages which take account of increased road miles the passenger miles per mile of railway were 138,169 in 1910 and 153,618 in 1924. Ton-miles per mile of railway were 1,071,086 in 1910 and 1,518,556 in 1924.

The substantial increases in rates in 1918 and 1920 are reflected in the revenue averages. The average revenue per passenger mile in 1910 was 1·938 cents; in 1924 it was 2·985 cents. The average revenue per ton mile in 1910 was ·753 cents; in 1924 it was 1·132 cents. That these increases were not equal in degree to the higher operating costs is shown by the decline in net earnings.

The number of employees in 1910 was 1,669,420 and their compensation was $1,143,725,306, an average of $685 per employee. This average may not be entirely accurate as the 1910 method of counting employees was somewhat defective. In 1924 the number of employees was 1,751,362 and their compensation was $2,825,775,181, an average of $1,613 per employee. It will be noted that the increases of 13% in passenger miles and 54% in ton-miles were accomplished with but 5% increase in the number of employees but the aggregate compensation shows an increase of 147% and the average per employee was advanced 136%.

A striking indication of the gain in operating efficiency is shown in the relation between train miles and passenger miles and ton-miles. The increase of 13% in passenger miles was accomplished with but 5% increase in passenger train miles and the 54% increase in ton-miles was produced with actually less freight train miles. This performance was the result of an increase in the freight train load from 380 revenue tons in 1910 to 634 revenue tons in 1924. The heavier train load was made possible by locomotives of greater capacity, larger cars, stronger roadway structures and improved technique.

The 1887 Act to Regulate Commerce was intended primarily to correct abuse of power on the part of railway managers. The Interstate Commerce Commission, as a Federal agency acting for Congress, was given wide powers over rates, finance and accounting. While the Commission's early accomplishments were substantial the experience during the first 15 years demonstrated that the law was defective as the Commission was without sufficient power to effect all of the needed reforms.

The 1906 and 1910 amendments to the Act corrected certain outstanding deficiencies by giving the Commission power not only to find that a rate was unreasonable but also to prescribe the reasonable rate, and to suspend a rate proposed by a carrier. Broadly speaking, the Commission since 1910 has had complete control over interstate rates, and the tendency has been for that Federal body to supersede the state commissions in their regulation of intrastate rates. While formerly the burden of proof had been on the Commission to prove that a rate was unreasonable, the burden of proof of reasonableness was shifted to the carriers.

For a series of years prior to 1910 the tendency of rates had been downward. The steady growth in traffic and the improvements in facilities, equipment and operating methods, had enabled the carriers to absorb rising costs, reduce transportation charges and earn sufficient in net income to yield reasonable returns on capitalisation, finance extensions and improvements, and maintain the surplus essential to sound credit. From the beginning of the decade 1910–20, however, the greater costs of materials and the higher wage rates incident to changed economic conditions began adversely to effect net income, and the carriers attempted to prevent further losses by increasing rates. In 1910 the railways collectively appealed to the Commission for authority to advance freight rates, but the Commission in denying the application held that the anticipated increase in traffic and a higher degree of operating efficiency should enable the carriers to earn a fair return. In 1914, 1915 and 1917, with continuing impairment of net earnings, further efforts were made by the carriers to convince the Commission that advances in rates were justified. These efforts met with but partial success, as the authorised increases were small in extent and limited territorially.

Viewed in retrospect it appears that the Commission was unduly optimistic in assuming that the growth in traffic and greater economies in operation would avert the threatened impairment in railway net earning power and credit. The railway financial situation in 1915 was so serious that 42,000 mi. of railway, one-sixth of the total, were in the hands of receivers. Railway extensions practically ceased and additions and betterments to facilities and equipment were confined in the main to the few strong companies.

A substantial increase in traffic in 1916, as a result of War orders from the Allies, and the consequent increase in railway revenues, partially relieved the financial distress. In April 1917, the United States entered the War, and the demands for railway transportation were further increased. The additional load overtaxed railway facilities and serious congestion resulted in the late fall of that year. While that congestion was due in large measure to conflict in priority rights for movement of war materials, it may be attributed in greater part to the slowing up in railway development during the preceding decade when the carriers were endeavouring to convince the Commission that financial relief in advanced rates was essential to the continuation of adequate transportation service.

From Jan. 1 1918, until March 1 1920, the railways of the United States were operated for the Government by a Director-General of Railroads with almost unlimited powers to administer the railway as one unified system during the crisis. As rental for the railway properties the government agreed to pay yearly to each company a sum equal to its average annual net income during the three years ended June 30 1917, and to return the railways to their owners, within 21 months after the signing of treaties of peace, in physical condition equal to that when taken over by the government or to compensate the owners for undermaintenance.

Under unified operation and autocratic control by the Director-General the tangle of priority orders was overcome and the railways functioned effectively as a branch of the Government. The congestion was relieved early in 1918 and thereafter there was no delay to essential traffic—the movement of troops, military and naval supplies, and essential commodities. Civilian travel was discouraged and the movement of non-essential freight was curtailed. The Director-General was given hearty support both by employees and the general public. The passenger miles, including troop movements, and the ton-miles of 1918, with but minor additions to facilities and equipment, were greater than in any previous year.

Directly after the conclusion of the War an effort was made by those favourably inclined toward the nationalisation of railways to continue the experiment of Federal control indefinitely, but the proposal met with pronounced public disapproval. As an emergency measure for war purposes it was successful, even though costly, but as a permanent policy it had little support. The railways were returned to their owners on March 1 1920.

One of the first major acts of the Director-General was to grant substantial wage increases to employees. Subsequently during the period of Federal control other wage advances were made so that at the end of Federal control the average wages were approximately double those of 1917. Besides these advances important concessions in national standardised agreements were made to the labour organisations, and those organisations emerged from the War period with very much greater strength than before.

The Director-General's second act of major importance was in June 1918, when he arbitrarily advanced freight rates 25% and passenger rates about 20%. The rate increases, however, were not sufficient to overcome the higher wages and other increased operating costs and the government failed to earn the amounts paid as rentals. The deficit of 1918 was augmented in 1919, when there was a sharp recession in business and railway traffic. The total deficit from operation, plus the cost of administration and claims paid for undermaintenance and other causes, was in excess of $1,600,000,000, or over $2,000,000 per day. A large part of that deficit, however, could have been avoided if the Director-General had exercised his authority to order a second advance in rates in 1919. Such action would have been justified by higher costs but the Administration chose to incur a larger deficit rather than afford stimulus for further advances in commodity prices.

Inasmuch as the Director-General was concerned only with the results of operation as a whole, and was not interested in the individual units by themselves, competition was eliminated and there was a substantial degree of unification in joint use of facilities and equipment and much short-cutting in accounting and pooling of revenues and expenses. Traffic was routed over the lines which were best fitted to handle it, regardless of former traffic arrangements, and the right of shippers to designate

routing was suspended. All of these things added to the aggregate capacity of the unified system in the emergency and some of the expedients resulted in economies, but the elimination of competition was so distasteful to the public that practically all of the unification innovations were abandoned when private operation was resumed.

The legislation under which pre-War railway control was restored was known as the Transportation Act of 1920. It provided for a transition period of six months in which the government continued its War-time guarantee while the companies were reorganising and the Interstate Commerce Commission was revising rates to take account of higher operating costs.

The Transportation Act contained several important amendments to the Act to Regulate Commerce. Continuing and broadening all of the powers vested in the Commission by the original Act and its several amendments, it contained a new rule of rate-making. All previous laws, designed to protect the public, were essentially corrective and punitive; they provided no protection to the carriers against regulation which might be unduly injurious. The 1920 law, however, contained the mandate that in addition to the major duties of insuring reasonable rates, preventing undue discrimination in rates or service, and supervising operation, accounting and finance, the Commission should establish the rate scales as a whole, so that the carriers as a whole in large territorial groups, should be able, under honest and efficient operation, to earn "as nearly as may be" a fair return on the value of the properties as a whole in each group. The fair return for two years was set at a maximum of 6%, the Commission subsequently to use its discretion in defining the rate. In 1922 the Commission set it at 5¾%. This principle, however, was to apply to the railways as a whole in territorial groups. It did not apply to the carriers individually. Nor was it a guarantee either to the individual carrier or to the railways as a whole. As a matter of fact, even though the rates in Aug. 1920, were advanced from 25% to 40% with the purpose of bringing a 6% return on value, the decline in traffic in 1921 upset calculations and the return was but 2·9% on the carriers' book value, including materials and working cash. In 1922, the return was 3·6%; in 1923, 4·4%; in 1924, 4·3%; and about 4·9% in 1925. From the viewpoint of the carriers the rate-making mandate of the 1920 law has been disappointing. In no year since the law was enacted, up to and including 1925, did the return as a whole equal the 5¾% standard.

For the shortage under the fair return the carriers have no recourse, but another section of the law known as the "recapture" clause, requires the individual carriers who earn in excess of 6% on value to turn over one-half of the excess to the government for a revolving fund from which the Government may make loans to the weaker carriers. In 1924 and 1925 substantial sums were thus recaptured from the few prosperous roads which earned in excess of 6% on value, but the very much greater number of companies which earned less than the fair return were without remedy.

The principle of recapture was a temporary expedient to operate until a permanent remedy could be had in the principle of consolidation. The 1920 law recognised the fact that under competitive conditions a scale of rates which would yield a fair return to the group would give more than a fair return to the strong and less than a fair return to the weak carriers in that group. Rates on competitive traffic necessarily are uniform. To enable the Commission to establish such uniform rates so that all of the carriers would earn substantially the same rate of return, the law required the Commission to make a study and to formulate and publish a tentative plan, to be followed by a final plan, under which all railways would be consolidated into a small number of large systems of fairly equal financial strength and earning power. The Commission, however, was not given power to enforce its final recommendations. In defining the principles which should govern consolidation the law provided that competition should be continued as far as practicable, that existing routes and channels of traffic should be maintained as fully as possible and that the capitalisation of a new company should not exceed the combined value of its consolidated properties.

In Aug. 1921 the Commission published its tentative plan of groupings, and hearings were held throughout the following two years. There was much opposition to the plan both in principle and detail and practically nothing definite had been done up to June 1926, except the authorisation of a few voluntary combinations.

The frequent reference to value as a rate-making base calls for a word of explanation. The value of a railway property has always been a controversial subject because of the several cases of "stock watering" or fictitious inflation of capitalisation in earlier years. In 1913 the Valuation Act directed the Interstate Commerce Commission to make a physical inventory of each railway property and to ascertain its value for rate-making purposes. Three alternative bases were to be used: (*a*) original cost to date; (*b*) cost of reproduction new; and (*c*) cost of reproduction new less depreciation. The Commission has concentrated its work on the cost of reproduction new less depreciation, appraising land on the values of adjacent properties. In addition to land values, and the depreciated reproduction cost of every physical unit, the Commission was instructed to take into account "other values and elements of value, if any." Presumably these were meant to include such things as going value and an allowance for material, inventory and working cash.

Contrary to the expectations of the sponsors of the 1913 Act the valuations, as determined up to 1926, indicate very little "watered stock." On the contrary the indications are that when the work is completed in 1927 or 1928 the aggregate so found will likely exceed the book value and the capitalisation of the carriers. In the meantime the Commission, in exercising its authority over rates and in recapturing net income, has used tentative figures, and in fixing individual rates, such as those on agricultural products, has been influenced more by other economic factors than fair return on value. (W. J. C.)

Water Transport.—In 1916 the Bureau of Census made a study of transportation by water. According to this report the tonnage employed on the Great Lakes and the St. Lawrence river in 1916 was 2,737,491 tons, as compared with 2,392,863 tons in 1906, a gain of 14·4%. The freight carried was 125,384,000 tons, as against 75,610,000 tons in 1906, a gain of 65·8%. Of this, 73,000,000 tons was iron-ore, 30,000,000 tons coal and 6,000,000 tons grain. The freight handled by the Lakes fleet represented nearly one-half (48·6%) of the water-borne freight shipments reported for the United States as a whole in 1916, as against 42·6% in 1906. Tonnage on the Mississippi river and tributaries declined greatly, from 4,412,000 tons in 1906 to 1,621,000 tons in 1916. Vessels operating on canals declined both in number and in tonnage. In 1906 the number of such vessels was 3,140, with a tonnage of 259,491; in 1916 the number was 2,049, with a tonnage of 196,426. There has been a decline in the tonnage in the New York State canals. On the Erie Canal, the yearly average for the period 1906–10 was 2,206,595 tons; in 1920 it was 891,221 tons; and in 1923, 1,626,062 tons. The freight carried on the Sault Ste. Marie Canal, connecting lakes Superior and Huron, fluctuated during the decade 1910–9, between 53,477,000 tons in 1911 and 91,888,000 tons in 1916; in 1923 it was 91,380,000 tons. Commercial traffic through the Panama Canal has steadily increased since its opening in 1915. In 1924, 26,995,000 cargo tons were carried by 5,230 vessels.

Shipping.—Owing to the great activity in shipbuilding during the World War the tonnage of the American merchant marine showed a marked increase between 1910 and 1921 rising from 7,508,000 tons in 1910 to 18,282,000 tons in 1921; 1924 showed a slight decrease. Nearly one-seventh, or 2,693,000 tons in the latter year, was employed on the Great Lakes. The tonnage on western rivers continued to decline, being only 138,000 in 1923 but rose to 164,000 in 1924. Sailing vessels decreased both in number and tonnage, and steam vessels declined in number from 12,452 to 7,736, but increased in size. The average tonnage of a steam vessel in 1910 was 394 tons; and in 1923, 1,914 tons. During the five years, 1911–5, the tonnage of new steam vessels

built was 1,003,345 tons; in the five years, 1920–4, 6,714,678 tons, or more than six times as much. New construction reached its peak in 1920, showing 3,660,023 tons; in 1924 it was only 145,493 tons. American shipping is engaged in two distinct branches of trade: coastwise trade between domestic points, and foreign trade. The tonnage in foreign trade increased from 1,019,165 in 1913 to 11,077,398 in 1921, declining to 8,794,000 in 1924. Coasting tonnage which in 1913 amounted to 6,817,000 tons rose to 8,911,000 tons in 1924. It is estimated that the new tonnage, constructed under the emergency of the War, represented an expenditure of $3,000,000,000, a sum greater than the book value of all the world's merchant shipping in 1914, aggregating 49,000,000 tons.

A notable change has taken place in the nationality of shipping entering and clearing from American seaports. Until 1916 the tonnage of vessels sailing under foreign flags for many years was approximately three times as great as that under U.S. registry; in 1920 U.S. tonnage entered (32,119,103) slightly exceeded foreign tonnage (31,984,932). This supremacy was soon lost, the respective figures for 1924 being 29,628,000 and 38,664,000 tons. The total tonnage of vessels entering at all ports from foreign countries increased from 40,235,800 tons in 1910 to 68,292,000 tons in 1924, and the tonnage cleared, from 39,705,858 tons to 68,910,000 tons. The tonnage of British shipping entering at seaports of the United States averaged in the five-year period 1910–4, 17,900,596; in 1924 the tonnage was approximately the same, 17,628,290. German tonnage in the earlier period averaged 4,362,019; and in 1924, 1,338,706.

Mails, Telephone and Telegraph.—Postal statistics show a slight extension of post routes, exclusive of rural delivery routes, from 447,998 m. in 1910 to 467,896 m. in 1924; the number of city carriers from 28,715 to 43,829; the mileage of rural delivery service from 993,068 to 1,205,714; the number employed in railway mail service from 16,795 to 21,446; and the postal revenue from $224,000,000 to $573,000,000. The telephone was rapidly extended. In 1922 there were 37,265,958 m. of wire in this service, as compared with 20,248,326 m. in 1912. Of this mileage, 30,600,000 in 1922 and 15,100,000 in 1912 were in the Bell system. The number of daily exchange messages of the Bell system was 21·7 millions in 1910 and 36·8 millions in 1922; daily toll messages increased from 602,000 to 1,523,000. The number of employees of all systems in 1922 was 312,015. The telegraph systems have made but little extension in the past 20 years. In 1902 there were 237,990 m. of pole line, and 252,991 in 1922. The number of messages sent rose from 91.6 millions in 1902 to 181·5 millions in 1922; and the number of employees from 27,627 to 62,299. (*See* TELEGRAPH and TELEPHONE.)

The automobile became an important factor in terminal transportation. Motor-car registration increased fourteen times between 1913 and 1924, numbering (not allowing for duplicate registration) in the latter year 17,591,981. This represents a motor-car for approximately one-seventh of the population. (*See* MOTOR VEHICLES.)

BIBLIOGRAPHY.—Important volumes on special topics have been published by the Bureau of the Census, including *Street and Electric Railways 1912* (1915); *Telephones and Telegraphs 1912* (1915); *Transportation by Water 1916* (1920). The Interstate Commerce Commission issues an annual report, *Statistics of Railways*. Shipping statistics are published in the *Annual Report of the Commissioner of Navigation*. The annual volume, *Statistical Abstract of the United States*, published by the Dept. of Commerce, assembles data on internal communication and transportation, merchant marine and shipping. (D. R. D.)

UNITED STATES LITERATURE: *see* AMERICAN LITERATURE.

UNIVERSAL LANGUAGE (27.746).—The term International language (or IL) denotes a second, or auxiliary, language for international use, not a universal language to displace national tongues. As the world grows smaller, international travel, commerce, science, broadcasting, increasingly accentuate the necessity of some common tongue. Suggested solutions of the problem fall under three classes: (1) the revival of a dead language, (2) the internationalisation of a national language, (3) the creation of a language *ad hoc*.

Latin and Greek.—Latin was the IL of the Middle Ages. It still survives implicitly in the nomenclature of certain sciences, and in the liturgy of the Roman Church, but, as a committee of the British Association found, it is impossible to give the dead bones life. Even mediaeval Latin is inadequate to express current ideas of modern life. The great difficulty of Latin restricts its use to the cultured few, who least need an IL. If the pronunciation were settled, the grammar simplified, the vocabulary clarified and extended, it would be no longer Latin, and would please the Latinists least of all. The futility of refurbishing Latin for modern uses is demonstrated by the failure of such magazines as *Phoenix, Praeco Latinus, Vox Urbis, Iuventus*. No teaching methods will make the average working man into a fluent Latin speaker. If Latin is inadmissible, we can certainly rule out Greek, Sanscrit and other dead languages. Nor does a proposal to utilise hypothetical Aryan (*Lipskith*, 1919) seem more practical.

If a national language is to be universally recognised as international, which shall it be?

Modern Languages.—English is widely taught, its use is extending; it has a rich vocabulary, a great literature, a simple grammar. But its accentuation and pronunciation are difficult, its idioms drive the foreigner to despair, its spelling is chaotic. Even if agreement could be reached on phonetic spelling (and reformers are widely at variance), this would make written English more difficult for the average European, for whom the present spelling facilitates recognition of the words.

French is spoken by many educated Europeans, and still maintains a precarious hold in diplomacy. Its lucidity is proverbial, but its spelling, pronunciation and grammar are a stumbling block, and it is intensely national in character.

Spanish, though easier, shows divergence as between European and American forms. The widely spoken Russian and Chinese offer insuperable difficulties. Malay and the Pidgins are so much simplified as to be totally inadequate. In any case it would be impracticable for an international body to adopt any one national language. A proposal to officialise Spanish in the League of Nations evoked a similar request from the Italians. This solution is indeed not one solution, but many, mutually exclusive. The difficulties of any national language are too great. To force it on the world would tend to debase it and split it into dialects. Patriotism and national jealousies are in the way. Why should all other peoples sacrifice their national pride and prestige to suit the convenience of one?

THE VARIOUS PROPOSALS EXAMINED

Scientific Languages.—There remains the creation of a suitable language on scientific principles. Of some 200 such schemes the vast majority are mere projects only. They may be roughly divided into (*a*) *a priori* (philosophical, arbitrary), and (*b*) *a posteriori* (based on one or more existing languages).

Most early schemes were of the *a priori* type alluded to by Roget in his *Thesaurus*. Solresol based on the seven notes of the scale (1817), Lingualumina (1875), Blaia Zimondal (1884), Cabe aban (1887), Zahlensprache (1901), are more recent examples. Such schemes are based on a classification of ideas translated into words bearing no relation to any other language. Obviously they depend on the caprice of the inventor; though usable as codes they impose a great strain on the memory. One such scheme still advocated is Ro, invented in 1904 by the Rev. P. Foster. It has some vocabularies, a monthly sheet *Roia* and as literature the first chapter of St. John.

It is, however, now generally agreed that the IL must be *a posteriori*. Unlike previous schemes, most post-Esperanto schemes closely resemble Esperanto and one another. Consideration shows that an IL should be international, easy for all, neutral, euphonious, phonetic, flexible, unambiguous, logical, regular, adaptable and tested by long-continued practical use on a large scale.

Esperanto.—Esperanto, initiated in 1887 by Dr. L. L. Zamenhof (1859–1917) is the only language which possesses all these characteristics. It is neutral and international in its elements,

logical and regular in construction, and as euphonious as Italian and Spanish, for which it is often mistaken. The grammar can be grasped in half an hour; every rule is without exception, the spelling is phonetic and the dictionary small. Nevertheless, it has literary power, beauty, precision, flexibility and power of growth. In nearly 40 years of testing it has never been found wanting.

There are some 4,000 Esperanto books, original and translated, including the Bible; and the literature is rapidly growing; 95 magazines appear regularly. The League of Nations has published a favourable memorandum (compiled from government reports) on the teaching of Esperanto in the schools of the world. The Paris Chamber of Commerce and the London County Council teach Esperanto in their commercial schools; the London Chamber of Commerce examines in Esperanto. In 1925 the International Telegraphic Union officially recognised Esperanto as a "clear language." The British Association in 1919 appointed a committee on IL, which in 1924 definitely recommended Esperanto as its choice. Twenty-seven European Broadcasting Stations were giving regular Esperanto transmissions in 1925 and 16 International Esperanto Congresses have been held, attended by 4,000 members from all parts of the world.

Esperanto has long passed the stage of theory; it is in truth "the living language of a living people." Esperantists, finding the language adequate, concentrate their energies on the organisation of linguistic intercourse, and look to use for the elimination of possible flaws. On a foundation they regard as sound they are rearing a superstructure of technical vocabularies with the co-operation of expert committees. The majority of IL partisans and literature are Esperantist.

Ido.—In 1907 two Frenchmen, Messrs. Couturat and de Beaufront, produced a modification of Esperanto which they named simplified Esperanto. Owing to Esperantist protests, the "linguo internaciona" was renamed Ido (an Esperanto word meaning offspring). The title was still under discussion in 1925.

The Idists claim that Ido is Esperanto rendered more scientific and natural; it has abolished accented letters, correlatives, the compulsory accusative, the agreement of the adjective with the noun. The supposed chaos of Esperanto derivation has been regularised by Couturat's rule of reversibility.[1] The unchangeable fundamento of Esperanto has been replaced by the principle of infinite perfectibility. These changes, it is claimed, are so self evidently improvements, that the whole world must fall into line, and recognise Ido as the final solution of the problem.

The Esperantists energetically rejected the proposed changes as, though superficially attractive, in the main unacceptable, being based on misconceptions, introducing objectionable irregularities and complications, and destructive of the literary power and beauty of the language. In particular they opposed Couturat's principle of "reversibility" as *a priori*, arbitrary and contrary to linguistic practice and instinct. The "reforms" were supported by the authority of a 1907 "delegation," which the Esperantists ridicule.

Esperanto and Ido both admit all necessary international roots. The Esperantist Academy officialises new words, however, only after extended trial in literature. The Idists, occupied in perfecting their dictionary, have largely neglected literature. In this matter each may learn from the other.

The history of Ido has confirmed the faith of Esperantists, though it has driven some to ultra-conservatism. Ido at first changed with bewildering rapidity. It being impossible to propagate a language which changed in details every month, a temporary period of stability (to end in 1926) was eventually inaugurated, during which further changes were to be held in reserve. Notwithstanding this, the chief Idist grammarian, Dr. Max Talmey, advocates what he calls "Improved Ido" or "Ilo" or "Arulo" (Auxiliara Racionoza Universala Linguo), which is Ido considerably reformed. Time will show how far unity may be preserved by judicious yieldings in various directions.

Over 50 schemes have appeared of "reformed" Esperanto, "reformed" Ido or some compromise. It is easy for anyone with ambition and moderate intelligence to catch this *morbus linguificus*, and publish a slightly modified Esperanto, over his own name. None of these projects, however, has had any success.

Prof. R. de Saussure, believing that some minor features of Esperanto handicap propaganda, proposes to eliminate them while preserving the essential qualities of the language. From 1907 onwards a stream of experimental projects and literature has issued from his language laboratory—Antido I., Antido II., Lingvo Kosmopolita, Esperantido and finally, Nov-Esperanto (1925). His attitude of scientific detachment and research, however, has been widely misunderstood, and he remains a voice crying in the wilderness.

Volapük.—Volapük (*see* 28.178) was based 40% on English, but English arbitrarily altered almost out of recognition. Born in 1880 and at its height in 1888, it was practically dead in 1890. The grammar was wonderfully ingenious, but the vocabulary too arbitrary. Despite the protests of the inventor, the Volapük Academy decided to reform the language, but was immediately torn by dissensions. Spelin, Dil, Dilpok, Balla, Orba, Tal, Pankel and other stillborn schemes, corrected or exaggerated the defects of Volapük.

Neutral.—Mr. W. Rosenberger, a later director of the Academy, initiated reforms of Volapük which resulted in an entirely new language, Idiom Neutral (1898). The "Kadem bevüretik volapüka" became the "Akademi de Lingu Internasional." Neutral, and especially a later form, Reformed Neutral (1907), represented the extreme swing of the pendulum to the *a posteriori* side, being almost exclusively neo-Latin, to this end sacrificing logic, beauty and simplicity. Prof. H. Sweet, who in the *Encyclopædia Britannica* in 1911 (9.773) damned Esperanto with very faint praise, wrote "the most formidable rival of Esperanto is unquestionably Idiom Neutral." Nevertheless, Neutral died with Rosenberger in 1918.

Interlingua.—In 1908 the Akademi passed under the directorship of Prof. G. Peano, and is now the "Academia pro Interlingua." Following Henderson in Lingua (1888) and Latinesce (1901) and Rosa in Nov-Latin (1890), Prof. Peano in 1903 proposed a systematic simplification of Latin called Latino sine Flexione (afterwards Interlingua). He practically discards all grammar as unnecessary. Interlingua is attractive to the classical scholar; its appearance is not undignified. Lacking specific tense-forms, it seems more suited to mathematical or philosophical exposition than to a narrative, lyric or dramatic style. One variant of Interlingua is that by Aldo Lavagnini, who by grammatical additions has changed it through the various stages of Interlingue and Unilingue to Monario (1925). A magazine in Monario appeared in 1926.

Occidental.—Mr. E. de Wahl, after experimenting with many systems, finally produced Occidental, "comprehensible at first sight to 10,000,000 educated Europeans without preliminary study." To write or speak it is less easy than to read it, variety being dearly bought by the introduction of irregularities.

Other Schemes.—Josef Weisbart, an ex-Idist, brought out in 1909 a project Unial, which in 1912 became Europal, and in 1923 Medial. This also "non sukcessit." In 1925 appeared a new version, Europan. A magazine *Le Bon Europano* is announced for 1927. Europan claims to be a compromise between *latinitae* and *germanitae;* in other words, between Esperanto, Ido, Interlingua and Occidental. Details are still in the melting pot. Sidni Bond in 1912 published a rather vague scheme Omnez, superseded in 1913 by Domni (afterwards Optez). This also he has dropped, and is now at work on Meso.

Romanal is a project by Mr. A. Michaux, who nevertheless remains an active Esperantist. His aim is to show that an acceptable language may be constructed on a latin vocabulary like that of Courtonne (Neo-latine, 1885) derivation being based on Esperanto as opposed to Ido; in other words, a combination of

[1] In word-building Couturat demands reversibility or two-way derivation; *e.g.*, he holds that from a root like *Kron* "a crown," one must not form "to crown" by the simple addition of the infinitive inflexion; by starting from the infinitive and "subtracting" the suffix one should pass back to the idea of "coronation" and not "crown."

Interlingua vocabulary, Esperanto derivation and Micheaux grammar. Prof. A. L. Guérard apparently regards Romanal as near the ideal.

A non-partisan body, The International Auxiliary Language Association (525 West 120th street, New York City), was formed in 1923 to collect and distribute information, initiate experiments and awaken interest on all phases of the problem. This may lead to an authoritative decision by some competent international body or group of governments powerful enough to carry the world with it. Or, at worst, it may result merely in the creation of some new competing scheme.

Meantime it seems practical to sympathise with the Resolution passed by the World Congress of International Associations in Brussels, 1920:—

Recognising the ever-growing need for an auxiliary language, the Congress expresses the desire that every person who is convinced of such a necessity adhere to the important Esperanto movement, deferring all improvements which may be deemed necessary until the moment when the language has been officially adopted by the governments, and to regard other schemes as interesting branches of experimental research.

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UNIVERSE: ELECTROMAGNETIC-GRAVITATIONAL SCHEMES.—Einstein's theory of relativity (*q.v.*) unifies the mechanical properties of the world with the geometrical properties. The experimental methods by which we find out mechanical quantities (mass, momentum, stress, etc.) are not essentially different in nature from those by which we find out geometrical magnitudes (length and, for four-dimensional geometry, duration). Einstein's theory combines them all in one scheme so that the mechanical quantities are not extraneous things residing *in* space-time—they are characteristics of it. For example, mass and momentum are components of the curvature of space-time.

But in the original theory the electromagnetic field stands aloof—*in* space but not *of* space. The discrimination seems unnatural. We desire to find a single continuum—call it *space, aether, relation-structure*, what you will—such that all quantities ascertained by experiment shall be measures of intrinsic properties. There should be no discrimination between geometrical, mechanical and physical magnitudes, and no division into characteristics of the continuum and characteristics of "fields" disturbing the continuum. The Maxwellian electromagnetic field is described by a scalar potential Φ and a vector potential F, G, H. These are combined in a four-vector:

$$\kappa_\mu = (-F, -G, -H, \Phi) \qquad (1)$$

Riemannian geometry is completely described by 10 parameters $g_{\mu\nu}$ which have already received geometrical and mechanical interpretation, and our first problem is to find a more general geometry (or description of a continuum) requiring 14 parameters so as to leave room for the four parameters κ_μ.

This problem was solved in a brilliant paper by Weyl in 1918.[1] In Riemannian geometry it is assumed that the difference between two neighbouring points is something that can be given a unique measure, so that any distance can be compared unambiguously with any other distance. Weyl pointed out that a more general geometry is obtained if lengths in different directions *at the same point* can be compared but not lengths *at different points*. It can be urged that the idea of "comparison at a distance" ought really to be as repugnant to us as "action at a distance." In practice the comparison of a length in America with the standard metre at Paris is not a comparison at a distance; we can trace the intermediate steps by which the unit of length has been transferred by material conveyance or by triangulation to the place where the comparison is made. The assumption of Riemannian geometry is that the result does not depend on the intermediate steps—the route of transfer; this is an assumption, not an *a priori* necessity, and the experimental verification only extends to a limited degree of accuracy. Let us consider the effect of rejecting the assumption.

Instead of a single standard of unit length we now require a standard unit at every point of space-time because the unit cannot be transferred from place to place unambiguously. This (arbitrary) collection of standards will be called a *gauge-system.* If a material rod of length l is displaced from (x,y,z,t) to $(x+dx, y+dy, z+dz, t+dt)$ it will in general have a new length $l+dl$. It is meaningless to ask whether the change is due to a change in the rod or to a difference in the standard units at the two points. To the first order the most general expression for the proportionate change of length is

$$dl/l = \kappa_1\,dx+\kappa_2 dy+\kappa_3 dx+\kappa_4 dt = \kappa_\mu dx_\mu \qquad (2)$$

adopting the usual summation convention. Here the four κ's are characteristic of the metric in the neighbourhood of (x,y,z,t). We assume that these are the four extra parameters which we wanted, and accordingly identify them with the electromagnetic potential as in (1). Integrating over a finite path

$$\log\,(l_2/l_1) = \int_1^2 \frac{dl}{l} = \int_1^2 (-F dx - G dy - H dx + \Phi dt) \qquad (3)$$

The integral will be independent of the route between the points 1 and 2 if the integrand is a perfect differential; the condition for this is

$$-\partial F/\partial t - \partial\Phi/\partial x = 0,\quad \partial H/\partial y - \partial G/\partial z = 0,\ \text{etc.}$$

The left sides are the usual expressions for the components of electric and magnetic force. Hence the vanishing of the electromagnetic field is the condition that l_2/l_1 may be independent of the route, *i.e.*, the condition that comparison of lengths at different places may be unambiguous.

The arbitrary gauge-system is irrelevant to the actual phenomena just as an arbitrary co-ordinate system is. By a transformation of gauge a length l becomes λl, where λ is an arbitrary function of position. It easily follows from (2) that by this change we get new parameters $\kappa'_\mu = \kappa_\mu - \partial(\log\lambda)/\partial x_\mu$. The interesting point is that we can identify either κ'_μ or κ_μ with the electromagnetic potential; it is well known that the latter is indeterminate to the extent that the gradient of an arbitrary function can be added without altering the electric or magnetic force.

A really absolute property of the world should be invariant for transformations not only of the co-ordinates but also of the gauge; hence has arisen a study of gauge invariance and covariance. For example the Riemannian invariant of curvature G is in this generalised geometry replaced by $G - 6(\kappa^\alpha)_\alpha + 6\kappa_\alpha\kappa^\alpha$. Weyl has pointed out that there exists a simple set of completely invariant quantities in a world of four dimensions which have no parallel in a world of more or fewer dimensions.

Although this theory finds a place for the electromagnetic quantities in the geometry of the continuum, it is incomplete in that the most characteristic manifestations of electrical conditions are not predictable from their geometrical specification. There is an interaction between the electromagnetic and the mechanical quantities, appearing as the ponderomotive force exerted by an electromagnetic field on its own singularities (electric charges). Having removed the Riemannian restriction, we have now to impose some other restriction on our generalised geometry so that the $g_{\mu\nu}$ and κ_μ will interact according to the law of ponderomotive force. It has been sought to represent this restriction (or additional axiom of our geometry) in the form of a principle of least action. This part of the theory is not so satisfactory. Least action applied to 14 parameters gives 14 equations; we require only 10 equations to express the observed law of ponderomotive force; the remaining four give relations between the electric current and potential which are useless to us and have to be explained away as undetectable by observation. A more serious difficulty is that the only action invariants which lead to agreement with observation are artificial in appearance, as though nature had failed to display her usual artistry. Least action seems to fail here because it attempts to jump by a formal

[1] H. Weyl, *Berlin Sitzungsberichte*, p. 465 (1918).

device a territory comprising the problems of electron structure and quantum theory requiring other conceptions than those of field-physics. The value of the Hamiltonian method of variation of world-invariants has perhaps been misunderstood; its importance is that it follows the kind of dissection which we ourselves have made when we analyse the world into *things* existing in *space* and *time*. But that application has nothing to do with a governing law of the continuum.

A generalisation of Weyl's geometry has been proposed by Eddington.[1] In this theory lengths even at the same point are not initially comparable. The basal geometry is an affine (non-metrical) geometry supposed to be closely descriptive of the underlying relation-structure of the world; the conception of length is not introduced until later when things capable of measuring length have been found. The elementary relation in the world-structure is a four-vector called a *displacement* and it is postulated that there is a comparability of displacements sufficiently close together in the structure, so that we can pick out a displacement $A^\mu+dA^\mu$ at $x_\mu+dx_\mu$ which is in some sense "equivalent" to A^μ at x_μ. By following a chain of equivalent displacements completely round the boundary of an area $dS^{\mu\nu}$ we find the final displacement $A^\mu+\delta A^\mu$ associated with the initial displacement A^μ with respect to the area $dS^{\mu\nu}$. It is found that $\delta A^\epsilon=-\frac{1}{2}B^\epsilon{}_{\mu\nu\sigma}\delta A^\mu dS^{\nu\sigma}$ where $B_{\mu\nu\sigma}{}^\epsilon$ is a tensor—the generalised Riemann-Christoffel tensor—which can be taken as descriptive of the general interconnection of the world-structure. Contracting this tensor we have a tensor of the second rank analogous to the Einstein tensor ($G_{\mu\nu}$) but differing from it by having an antisymmetrical part $F_{\mu\nu}$ as well as a symmetrical part $R_{\mu\nu}$. Thus from the basal relation-structure we have extracted two tensors $R_{\mu\nu}$ and $F_{\mu\nu}$ with which to build a physical world of space, time and things.

Connected with the displacement dx_μ between two neighbouring points there is an invariant $ds^2=R_{\mu\nu}dx_\mu dx_\nu$; hence there is after all a unique measure associated with the separation of two points which may be called the *distance*. It will be seen that this is a deduction not an axiom of our geometry. If our experimental appliances are such as to get hold of this unique measure, then the geometry of space and time is strictly Riemannian as Einstein supposed. This is, of course, a partial reaction from the views described earlier in the article; Weyl's geometry is not an actual geometry of space and time, but his ideas are transplanted to a more fundamental domain and illuminate the study of the basal structure of the world. Weyl's own later views have moved in this direction. In his own words the extension of a material object is determined by *adjustment*, not by *persistence;* that is to say, the object does not try to connect its present dimensions with previous dimensions by a chain of equivalence; instead it takes up an extension in equilibrium with its present surroundings and therefore settled with respect to the invariants descriptive of the part of the world in which it is now situated.

In Einstein's theory $ds^2=g_{\mu\nu}dx_\mu dx_\nu$; hence, inserting a constant factor λ to allow for choice of units, $R_{\mu\nu}=\lambda g_{\mu\nu}$. As already stated $R_{\mu\nu}$ is a generalisation of Einstein's curvature-tensor $G_{\mu\nu}$; it contains additional terms supposed to represent the non-Maxwellian stresses in electrons, protons and quanta. Hence in empty space $R_{\mu\nu}$ reduces to $G_{\mu\nu}$, and we have immediately Einstein's law of gravitation:—

$$G_{\mu\nu}=\lambda g_{\mu\nu}$$

The antisymmetrical tensor $F_{\mu\nu}$ turns out to be the curl of a four-vector and can therefore suitably be identified with the electromagnetic force (which is the curl of κ_μ). In this theory geometrico-mechanical and electromagnetic quantities are completely unified provided that we look at the basal structure; if we do not look so deep we find a bifurcation of the properties of the world into symmetrical and antisymmetrical and a corresponding distinction of space and entities in space.

As in Weyl's theory the ponderomotive force of the electric field involves some additional law not comprised in the original geometrical axioms. Einstein[2] has sought to complete this affine theory by a suitable action-principle and his result probably represents the greatest advance yet made on these lines; but he himself is now of opinion that it is only formal and the true line of progress is not to be found that way. The fact is that, whilst these methods are adequate for field-physics, in the problem of the ponderomotive force field-physics impinges on atomic physics, for which a different order of conceptions seems necessary. The field theory has reached its limit and is awaiting the development of the quantum theory. (A. S. E.)

UNIVERSE, MODERN CONCEPTIONS OF THE.—For simplicity we begin by taking space of two dimensions only, that is, we consider processes taking place in a plane E, which is at rest. If we depict these processes by plotting t, the time, on an axis at right angles to the plane E, taken as horizontal, then the movement of a body proceeding uniformly in a straight line according to the law of inertia is represented by a straight line in the three-dimensional diagram; in particular vertical straight lines in this diagram represent the history of particles at rest. Such a line, the "graphic time-table" of a single particle, is called a world-line, after Minkowski; quite generally, on the world-line of a given particle lie all the space-time points which it occupies in the course of its history. On a t-constant plane drawn parallel to E through a given world-point P ("here and now") lie all points contemporary with P.

Such a plane separates the past and the future, which have their common frontier in this plane of the present. Only events belonging to the *future* half of the world can be influenced by P, while on the other hand what happens in P is subject only to actions localised in the *past* half of the world. Now according to the theory of relativity, the function of separating past and future in the causal sense is not attributed to the plane through P just

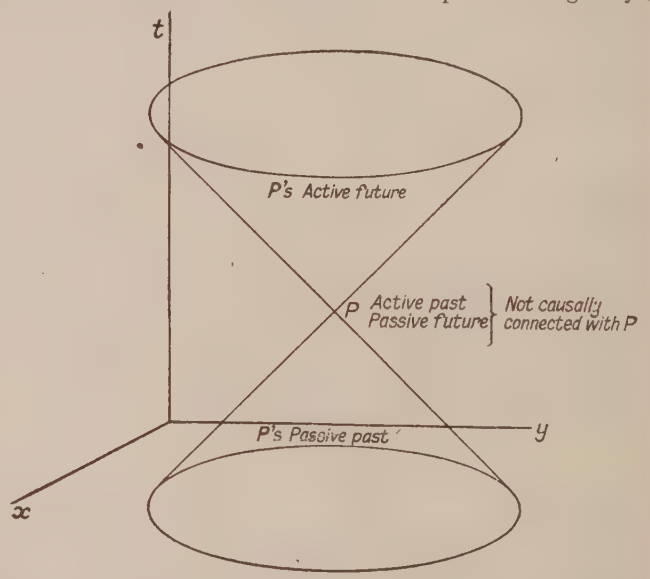

FIG. 1.

discussed but to the *light-cone* through P, that is, the cone on which lie all world-points which are traversed by a light signal originating in P. If in our graphical picture the scale is chosen so that the time interval of one second on the t-axis is as long as the length 300,000 km. in the E-plane, this light-cone is a right circular cone, of apex angle 90°, with its apex at P. If it is produced backwards it divides the world into three regions, the past, the future and the intermediate region, with which last P is not causally connected. (It may be noted that if the velocity of light be made infinite the cone becomes a double plane which separates the past and the future as considered above.)

Relativity and Recent Theories.—The causal structure of the world is given by light-cones radiating from all points which separate past and future: its inertial structure is known if the world-lines of the massive points moving without impressed forces, the so-called geodetics, are selected from all possible

[1] A. S. Eddington, *Proc. Roy. Soc.*, A, 99 p. 104 (1921).

[2] A. Einstein, *Berlin Sitzungsberichte*, pp. 32, 76, 137 (1923).

world-lines. According to Einstein's general theory of relativity, gravity and inertia are indissolubly connected in one unifying scheme, so that, for example, the motions of the planets follow geodetic world-lines. The causal and the inertial structure of the world is, on that theory, reciprocally connected with matter; on the other hand, before the theory was formulated this structure was considered as a fixed feature of the world, given *a priori*, governing matter, but not influenced by matter, as expressed in the drawing on the preceding page. We need not discuss how both together, constituting a field of measurement, determine the measurements made with rigid bodies and clocks.

Finally, the electromagnetic field has to be considered. The merging of this with the field of measurement into a single *world-geometry* has been the subject of recent theories of H. Weyl ("Gravitation und Elektricität," *Sitzungsberichte Berliner Akademie*, 465, 1918), of A. S. Eddington "A Generalisation of Weyl's Theory of the Electromagnetic and Gravitational Fields," *Proc. Roy. Soc.*, vol. 99, 1921); and of A. Einstein ("Zur allgemeinen Relativitätstheorie, *Sitzungsberichte Berliner Akademie*, p. 32, 1923; "Einheitliche Feldtheorie von Gravitation und Elektricität, *ibid.*, 414, 1925). The final success of these theories is still in question. In any case we distinguish between all this (which we call *field* or *ether*) and *matter*. G. Mie ("Grundlagen einer Theorie der Materie," *Annalen der Physik*, vol. 37, 39, 40, 1912 and 1913), has attempted to do away with this dualism, and to merge matter in the field. Even though he may have succeeded in finally destroying the old naïve representation of matter as a substance, yet the physics of matter is developing to-day along the lines of the quantum theory in quite another direction to that prescribed by the idea of a pure physics of the field.

Gravitational Problems.—Since Galileo—in contrast to Aristotle—physics has regarded the *infinite* space of Euclidean geometry as the theatre of material events. This assumption leads to serious paradoxes in astronomy. If the masses in the universe are distributed on a large scale uniformly, then the Newtonian law of gravitation leads to an infinitely great value of the gravitational potential at every point. We must on this assumption consider, not the nearest large masses—the earth, the moon, the sun—as predominating in their gravitational action on us, but the most distant masses. Further, the same reasoning would necessitate the heavens being infinitely bright. We can get over these difficulties by the contrasting picture of space as occupied by matter of perceptible density in a certain limited region only, the density decreasing, as we go out along r from this central region, more rapidly than $1/r$. This, however, is unsatisfactory as attributing a preference to certain parts of space. Further, Einstein has shown that such an island or cluster of stars must gradually become depopulated: every now and again so great a fraction of the total energy would unite in one star that this star would be slung off towards infinity on a hyperbolic path like a comet.

A way out of this dilemma is provided if we choose to modify the Newtonian laws of gravitation. (Attempts, based upon a fundamental idea of Lambert's, have also been made to overcome the difficulties by the assumption of a hierarchy of systems increasing without limit in order of magnitude. Recently C. V. L. Charlier has taken up this line [*Ark. für. Mat. Astr. och Fysik*, vol. 16, no. 22, 1922]). From the standpoint of the theory of action in proximity, it seems simplest to replace the equation for the gravitational potential Φ in empty Euclidean space with co-ordinates x, y and z, namely the equation

$$\Delta\Phi = \frac{\partial^2\Phi}{\partial x^2}+\frac{\partial^2\Phi}{\partial y^2}+\frac{\partial^2\Phi}{\partial z^2} = \sigma \qquad (1)$$

by the equation

$$\Delta\Phi-\epsilon^2\Phi = \sigma$$

where ϵ is an exceedingly small positive constant. The Newtonian potential satisfying equation (1),

$$\Phi = \frac{M}{r},$$

which decreases in inverse proportion to the distance r from the body producing the field, becomes

$$M\,\frac{e^{-\epsilon r}}{r}.$$

The factor $e^{-\epsilon r}$, decreasing exponentially with r, cuts out the action of very distant masses, and represents what we may term a kind of absorption of gravitation. On this assumption, the chief importance is assumed by stellar masses which are separated from us by distances of the order $R = \frac{1}{\epsilon}$, so that a slight lack of isotropy in the distribution of such stellar masses would lead to enormous accelerations.

Nature of Space.—Einstein applied the same ideas to his gravitational equations ("Kosmologische Betrachtungen zur allgemeinen Relativitätstheorie, *Sitzungsberichte Berliner Akademie*, p. 142, 1917) and reached the result that space is not infinite but closed. If we consider two dimensions only, space is not a plane, but of the nature of a spherical surface which runs into itself in all directions. The spherically closed space, without boundaries, yet finite, to which Einstein was led, is, of course, something quite different from the limited spherical universe of Aristotle. The distance R introduced above is the radius of this space, that is, the volume is of the order of magnitude R^3. In mathematical terminology, we term such differences between surfaces as cannot be abolished by a continuous deformation *topological* differences. Thus a plane differs topologically from a spherical surface, for a closed surface always remains a closed surface, however it be deformed, without tearing. The sphere, again, differs topologically from the tore, or anchor ring, although this is also closed. Three- and four-dimensional continua can also possess a variety of topological differences, just as can surfaces. The first and most important question in all speculations on the world as a whole is as to the topology of the space of our world. The generalised theory of relativity, by dispensing with Euclidean geometry, has left the door open for possibilities of every kind.

Phenomena of Inertia.—At every point of spherical space masses whose distance is of the order R, *i.e.*, the totality of cosmic masses, will produce an effect enormously greater than the gravitational action of the nearest star. This result, so baleful for the Newtonian theory, is just what Einstein wants: this enormous effect comes to light in the *phenomena of inertia*. By the theory of relativity gravitation is merely a slight fluctuation of the inertia field, which is on the whole homogeneous. This inertia field may be compared to a high table-land, on which in isolated localities, corresponding to the neighbourhood of stars, small hillocks arise. If c be the velocity of light, then

$$\frac{\phi}{c^2} = \frac{\mu}{r} \qquad \left(\mu = \frac{M}{c^2}\right)$$

which is a pure number, measures the magnitude of the local fluctuation in comparison to the strength of the homogeneous field. The magnitude μ, which is of the dimensions of a length, gives the gravitational radius, proportional to the mass, of the body producing the field; for the sun it is less than a mile. Newton's belief can be stated as follows: The plane in which Foucault's pendulum swings remains fixed in absolute space, and the fixed stars are apparently at rest in absolute space; hence the plane of the pendulum goes with the fixed stars, and rotates relatively to the earth. On the other hand, Einstein, in harmony with Mach, declares that this absolute space is a mere ghost, a superfluous intermediary; the actual enormous masses of the fixed stars of the cosmos really control the plane of the pendulum.

The conclusion that this conception demands a closed space can be reached in the following way: The laws of action in proximity for empty space summarised in equation (1) do not determine fully the Newtonian potential until we add the condition that the potential is in general at a level $\Phi=\sigma$, matter merely causing a departure from this value which becomes negligible at a great distance. The ether, and in particular the field of inertia, is in a determined state of rest so long as no matter is about, and

is slightly disturbed by the presence of matter. If, however, space is closed, the laws of action in proximity determine the potential uniquely, *i.e.*, the state of the ether is not so much modified by the matter as produced. Correspondingly Einstein found that a world without matter could not be reconciled with his cosmic equations—at any rate, if it were assumed to be "static." He found that the total world-mass must stand in a precise relation to its spatial extent: the gravitational radius of the world-mass must equal the geometrical radius, R, of the sphere of space. This result need not be ascribed to a pre-established harmony; the total mass which happens to be present in the world determines the cosmic constant $\epsilon=\frac{1}{R}$. Einstein further invoked the closed character of space to explain the remarkable fact that the velocities with which the stars are moving relatively to one another are so much smaller than the velocity of light which is the norm. He compared the stars in closed space to gas molecules shut up in a stationary vessel and interpreted the comparative quiet which reigns in the cosmos as the effect of a thermodynamic adjustment, that is, as a steady state of equilibrium which has gradually resulted from a probably much stormier past.

Main Difficulties.—Attractive as the Einstein cosmology appears at first sight it is open to many objections. A fundamental consequence of the theory of relativity is that matter alone cannot determine the course of events in the world, for of the three characteristics of matter—charge, mass and motion—the third disappears, since without reference to the field the conception of the motion of separate bodies relative to one another is as indefinite as that of absolute motion. Further, W. de Sitter has shown ("On Einstein's Theory of Gravitation, and its Astronomical Consequences," *Monthly Notices, Royal Astronomical Society, London*, vol. 77, 1917) that Einstein's equations can be reconciled with a world empty of mass. Admittedly such a world would not possess a static character, but it is more homogeneous than Einstein's world in so far as, in harmony with experience, all geodetic motions are of the same inner nature, and rest is not distinguished among them. Finally, there is no observational indication that, even adopting the largest scale for our measurement, the stars are uniformly distributed, and comparatively small departures from homogeneity would, on Einstein's scheme, lead to enormous forces. The present state of the stars is certainly nothing like a final statistical state. The small velocities of the stars are far more likely to be due to a common origin than to an adjustment.

To describe completely the homogeneous normal state of the universe, which is fundamental for cosmology, time must be added to space. We abstract two dimensions from space, so that the space-time continuum becomes a surface, and can be depicted by ordinary figures in two dimensions.

Elementary Cosmology.—The universe is represented by a vertical plane. The straight lines on it are the geodetics, the light cone from a point P is represented by two straight lines through P making an angle of 45° with the vertical. The electromagnetic field is zero. The stars are distributed in infinite dilution and are at rest, *i.e.*, their world-lines are all vertical straight lines.

Einstein's Cosmology.—The plane becomes a right circular cylinder, the axis of the cylinder having the direction of the vertical time axis. Geodetics are ascending spirals, cutting the vertical at a constant angle. The light cone from P is represented by the two spirals through P making an angle of 45° with the vertical. The electromagnetic field is zero. The world-lines of the stars are again vertical straight lines; the density of cosmic mass distribution is not infinitely small, but stands in a determined relation to the radius of the right section of the cylinder (*i.e.*, of world-space).

De Sitter's Cosmology.—The universe appears as a hyperboloid of one sheet. Geodetics are hyperbolae given by the intersection of the surface with planes drawn through the midpoint of the hyperboloid. The light-cone consists of the two straight-line generators through the origin. The electromagnetic field vanishes. The distribution of the stars is infinitely dilute.

Weyl's Hypothesis.—On Weyl's supplementary hypothesis the world-lines of the stars form a sheaf, which rises in a given direction from the infinitely distant past, and spreads out over the hyperboloid in the direction of the future, getting broader and broader. It is traced on the surface by all planes passing through a fixed position of the generator of the asymptotic cone.

In the first case, the universe has a single, coherent, infinitely distant border, while in the second and third cases, there are two borders, the infinitely distant past and the infinitely distant future: the universe stretches from eternity to eternity. This is the essence of the doctrine of closed spaces. The world-line of a permanent body, say an electron, will originate in the one border and proceed to the other border, whereas in the first case, no reasonable rule can be devised to forbid the world-line of a body returning into itself, or nearly into itself. This would lead to the most gruesome possibilities of ghostly doubles and meeting oneself. On the Einstein cylinder the light cone crosses itself infinitely often; thus an observer must see an infinite number of images of one and the same star. However, between the different states of the star to which these images correspond an aeon has passed, namely, the time which light takes to go once round the universe. The perception of what is now happening is haunted by the ghosts of events of very long ago.

De Sitter's hyperboloid unites the advantages of both the former schemes: the double border of past and future on the one hand and the light cone which does not cross itself on the other hand. In the cosmology of the first case there is no reason why the world-lines of the stars should be (nearly) parallel to one another; in the Einstein scheme this fact is referred to a statistical adjustment; by De Sitter's view, the "sheaf" arises from a common origin of the stars, from the postulate that the stars of our system have had from the beginning a causal connection with one another. (This postulate, by the way, is not satisfied by world-lines chosen at random.) They seem to radiate out from an arbitrarily chosen central star; their spectral lines should therefore be displaced towards the red end of the spectrum for an observer on the central star. Now the spiral nebulae, which are probably the most distant celestial objects, show, with few exceptions, a strong displacement of their spectral lines towards the red. If the cosmological interpretation of this fact is correct, the distance of the spiral nebulae is comparable with the radius of the universe, and we derive for it a value of about 10^{27} centimetres. On De Sitter's hypothesis the ether is only slightly disturbed from its state of rest by the presence of matter. The fact that the inertia compass and the star compass indicate almost exactly the same direction is not to be explained by the action of the stellar masses but by the powerful *supremacy of the ether* in the interaction between ether and matter.

It is, however, possible that the gravitational constant and, together with it, the inertial mass of a body is determined not alone by the nature of the body (its gravitational radius), but depends on the total mass which happens to be present in the universe. A circumstance which seems to favour the supposition is that the gravitational constant falls right outside the scheme of the other physical constants. The gravitational radius μ of the electron is more than 10^{45} times as small as the radius ρ (approximately 10^{-13} cm.) calculated from its charge and inertial mass. In some way or another this must depend upon the disproportion between electron and universe. The simplest hypothesis which we can make would be to suppose that the radius R of the universe is to the radius ρ of the electron as ρ is to μ. This does, as a matter of fact, lead to the same order of magnitude for R as is found by measurement for the distance of the spiral nebulae, and by the cosmological interpretation of the shift of their spectral lines.

K. Lanczos has still another hypothesis, that of a universe conceived to be in stationary rotation "Über eine stationäre Kosmologie im Sinne der Einsteinschen Gravitationstheorie," *Zeitschrift für Physik*, vol 21, 1924). No point at which the

theory can be checked by astronomical fact is reached. It is, however, important to keep constantly in mind the new kind of interpretation which the relativity theory has rendered possible. (*See* also RELATIVITY; TIME-SPACE.)

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UNIVERSITIES (*see* 27.748).—A striking feature of university development since 1910 is the increase in the number of universities. It is difficult to quote precise figures, because full information regarding the universities in the Union of the Soviet Republics, in China and in some of the Latin American countries is not available; there are also institutions, particularly in the United States of America, which are termed universities but do not perhaps entirely conform to the usual meaning of that word. The total number of universities all over the world, which was certainly not more than 370 in 1910, approached 450 in 1926; an increase of at least 21%.

Thirteen new universities have been founded in western Europe since 1910, most of them after the War.[1] In the so-called "new countries" of Central Europe, including the Baltic and Balkan states, 16 new universities have been established, almost all of them since the War;[2] many of the elder universities in these countries have been entirely reorganised. In Russia, White Russia and Ukraine several universities were inaugurated during the War, and a great many came into existence after the revolution. Some of the latter were soon closed. Instead of the 7 universities which existed in 1910 on the present territory of the Soviet republics, there are now about 20. The general increase in Europe is approximately from 143 to 186.

This development is not less remarkable on the other continents. Where many universities had come into existence during the 19th century only a few foundations are to be recorded since 1910, some of which were reorganisations of older institutions.[3] In Latin America at least ten new universities[4] have been created since that year. In South Africa, which had one university only in 1910, there are now four. India possessed only five universities in 1910 and has now 20, including two women's universities and the International University founded by Rabindranath Tagore. Two new Imperial Universities have been founded in Japan since 1910, so that the number in that country, including the private universities, now reaches 15. In China, where university life is still in formation, we find now at least 10 or 12 universities. Further foundations in other Asiatic countries, such as Palestine (the Jewish University of Jerusalem was inaugurated in 1925, the Catholic University, later) Persia, Siam, Australia (University of Perth, 1911), and even in Hawaii (1920) have also to be recorded.

[1] Lisbon, Porto and Reykjavik in 1911; Frankfort 1914, Murcia 1915; Hamburg and Köln 1919, Milan (Catholic) University 1921; Milan (Royal University) and Nimeguen 1923; Bari and Florence 1924.

[2] Debreczen in 1914; Lublin 1918; Abo-Turku (Swedish University), Bratislava (started as Hungarian University of Pozsonyi in 1914), Brno, Ljubljana, Poznān, Riga, Skoplje (Fac. of Philosophy only), Subotica (Fac. of Law only) and Wilno in 1919; Turku (Finnish University) 1920, Szeged 1921, Kaunas 1922, Pécs 1923, Salonika 1925.

[3] The Rice Institute at Houston (Texas) 1912, the University of Akron (Ohio) 1913, the Emory University at Atlanta (Ga.) 1915, the Catholic University of Montreal 1919, the Duke University at Durham (N. C.) 1925.

[4] The most important are the University of Rio de Janeiro and the "Universidad del Litoral" (of Argentina), both constituted in 1920.

Number of Students.—The considerable increase in the number of students in the great majority of the universities[5] is particularly striking in the United States. Columbia University, with 34,823 students (6,529 only in 1909–10), has now the largest enrolment of students in the world.[6] Paris, however, is first in regard to whole time students, of whom there were 21,455 in 1925. An extraordinary development is to be noted also in some universities of central Europe, like Athens (2,800 students in 1909–10, 8,512 in 1923–4), Belgrade (902 students in 1908–9, 7,500 in 1924), Bucarest (3,478 in 1909–10, 13,478 in 1924–5), Warsaw (1,263 in 1909–10, 9,419 in 1923–4).

In some universities the maximum number was reached in the years immediately after the World War, when thousands of students whose studies had been interrupted or postponed entered. In many cases, however, this increase continues even to-day, and is due both to the general increase of the population and to the increasingly democratic character both of knowledge and public life. In the faculties of law and medicine especially the rush of students is conspicuous. In many universities the increase in various departments of the faculties of arts and sciences is due to the development of university study among women. The very high and ever-growing percentage of women students, already the majority in some faculties of arts, is characteristic of contemporary university life. Since this movement started only in the first years of this century, it would be premature to make any statement about its consequences.

University Teachers.—The teaching staff has not increased in the same proportion, and must be regarded as inadequate when compared with the number of students.

Institutes.—University institutes, both for teaching and for research, have reached an extremely large number. Many universities possess more than 100 such institutions. This development is due to the adoption in almost all countries in modified forms, of the so-called "seminar" system, started in Germany during the 19th century, and to developments which found no place in the traditional university organisation; so new institutions, either connected with the old faculties or independent of them, were established.

A remarkable feature of university progress in the United States within recent years has been the enormous increase in endowments by private donors. An outstanding instance of this is afforded by Harvard University. In 1869 its endowment was $2,257,990. This increased to $22,716,700 in 1909. In 1919 it was approximately $48,000,000 and in 1926 had reached $70,000,000.

This increase in endowments is also paralleled as regards the number of teachers and students. In 1910 the total number of teachers in the universities and colleges was 24,667, and the students numbered 274,084. In 1925 the numbers were 56,279 and 726,124 respectively. The increase of women students being proportionately greater than that of men.

Specialised Institutes.—As to these institutions, two different methods have been followed. In most European countries there existed since the end of the 18th century many specialised institutions for higher education which, while independent of the universities, had obtained university rank. They were created mainly for the study of technical sciences, of agriculture, mining and forestry, of commerce, of fine arts and so on. In many cases the schools of education, of political science, of dentistry and veterinary medicine were independent establishments. The number of these institutions has already grown steadily. Since 1910 some 50 or 60 schools of this kind have been founded in Europe. In the more important centres of intellectual life, the number of independent higher schools surrounding the university has become very considerable. Paris attains undoubtedly the record with its more than 40 schools. In England, such

[5] There are notable exceptions, *e.g.*, in Germany, where the University of Berlin had 14,034 students in 1909—10 and 10,566 only in 1924.

[6] New York University, in the same city, had 4,036 students in 1909–10 and 20,760 in 1925–6; for Temple University, Philadelphia, the same figures are 5,033 and 10,020; the University of California in 1906–7 had 3,684 students and 11,197 in 1925–6.

schools or " colleges " are usually affiliated with the universities. In other countries, mainly in America, but also in Great Britain, the British dominions, and some of the new European countries (*e.g.*, Latvia, where the University of Riga has 11 faculties), all branches of higher education have been included in the curricula of the universities, which therefore possess faculties of engineering, applied science, veterinary medicine, agriculture, commerce, education, fine arts, music, etc. In some universities the number of faculties has doubled since the War.

Faculty Organisation.—In many universities of to-day there are faculties which are entirely different from the traditional ones. These again have been divided, owing to the developing needs of life and to the specialisation of science. Thus for theology, in some universities two or even three (*e.g.*, Warsaw) different theological faculties have been formed, to meet the requirements of various denominations. Economic and social sciences have been separated from law and have formed a new faculty (*e.g.*, Geneva). In some countries (*e.g.*, France) a faculty of pharmacy has been created separate from the faculties of medicine, thus following the practice which has prevailed in America for many years. The division of the traditional faculty of philosophy into faculties of letters (arts, humanities) and sciences (natural and physical sciences), which started very early in western Europe, has strongly influenced the other countries. Since the War many universities in central Europe, even in Germany, have adopted this system. In several cases a special faculty of mathematics has been instituted.

New Chairs.—In all faculties, old and new, many new Chairs have been established for subjects which 10 or 20 years ago either did not appear at all or appeared only exceptionally in university curricula. These new Chairs and subjects may be divided into three groups. In the first place, new branches of science have developed into individual subjects, *e.g.*, radiology, or have been recognised as independent sciences, *e.g.*, sociology, and therefore Chairs have been founded for their teaching. In the second place, the closer association of universities with practical life has necessitated the establishment of new Chairs for various branches of applied sciences, even for subjects like journalism and nursing. Finally, it has been realised that knowledge of foreign nations needs an intensive study not only of their languages but of their whole civilisation: history, literature, political institutions, economic conditions and so on. Therefore not only many new lecturers have been appointed for teaching languages, but chairs have been founded for the systematic and comprehensive teaching of what in Germany is called " Auslandskunde."

National Institutes.—Studies of this last order, which are particularly important for the future, are sometimes organised in special schools or institutes annexed to the faculties of letters and devoted to individual nations or groups of nations, as teaching and research institutes. In some cases these institutes, founded and maintained by the mother country, or even the mother university, have been placed in the country the knowledge of which was to be specially studied. This system was first adopted by France (the " Instituts français à l'étranger," first founded at Florence in 1908, exist now in some ten countries) and then followed by other nations like Great Britain, Spain, Hungary, etc.

Post-graduate and Research Work.—The measures taken for furthering research work, especially of post-graduates, are mainly of two different kinds. Frequently university " seminars " have been developed into research institutes grouping the students who wish to devote themselves to pure science. On the other hand, the system of fellowships which has been developed especially in the Anglo-Saxon countries offers to the students and post-graduates certain possibilities of continuing their research work.

Specialisation.—Despite these efforts for promoting research work in the universities, there is a serious and ever-growing danger for pure science. In the various specialised higher schools, and in the majority of the faculties, the studies tend to acquire a professional rather than a scientific character. Even in the faculties of arts and sciences the majority of the students mainly seek to pass the examinations required for various professions. The professors have to devote most of their time to teaching duties, to examinations, to administrative business, and consequently are handicapped in research work. The years between graduation and a professor's chair are particularly critical for young university men, a very small minority of whom are independent financially. Fellowships as well as institutes where they can find temporary posts, are insufficient in number in most countries. In both cases the pecuniary return is inadequate, when compared with the cost of living and with the advantages offered by other careers.

The League's Committee on Intellectual Co-operation (see below) at its very first session pointed out two of the deeper causes of this danger. It desires " to stimulate pure scientific work and to increase general learning, with a view to combating an excess of specialisation and professionalism." Specialisation is indispensable, but no subject can be studied satisfactorily in isolation from cognate problems. The student, instead of specialising hastily at the very beginning of his university work, should first obtain a certain amount of general culture. Professional utilitarianism induces the students to prefer those branches of science which lead to immediate practical application. While these sciences are not less important than others, their empiric study should be based upon more fundamental knowledge, and even these sciences cannot progress indefinitely without a simultaneous progress of theoretical investigations.

Effects of World War.—Still other, less general, reasons explain the very serious dangers observed in university life to-day. First of all are the consequences of the War. A whole generation of teachers and students was obliged to interrupt during four or more years its normal university work. The interruption of international exchanges isolated many countries or groups of countries. In the university libraries there are tremendous gaps which even now are far from being filled. Political problems have absorbed the thought of many thousands of intellectual workers, economic conditions have impoverished them and weakened their social position.

The first years after the War were not more favourable. After the conclusion of peace, between many countries a bad feeling remained which hindered intellectual relations of any kind; and it was (and sometimes still is) particularly strong in the universities. The delicate problem of national, religious and racial minorities has troubled university life in various places. In others, revolutions have simply destroyed it, at least for a certain number of years.

The economic situation after the War was still more unfortunate. The tendencies described above are explained, even justified, by the material needs of the moment. Exchange difficulties made it impossible to secure indispensable books and instruments, or to erect buildings to meet the needs of the new universities and of the enlarged old universities. Students and professors alike suffered misery in whole countries.

In spite of these dangers and obstacles, much has been achieved. There must be indeed in university life an extraordinary vitality which justifies the most ambitious hopes for the future. New intellectual forces have come into existence, and new forms of organisation have helped the universities to overcome the difficulties of the critical years, and will help them to continue their development in the future.

Nationalism.—During the whole 19th century, university life, which had been undoubtedly international in the middle ages and in the times of the Renaissance and the Reformation, became more and more closely connected with national development and national feeling. The World War and its consequences have rather strengthened this connection. In many territories which passed from one state to another the national character of the universities and higher schools changed with the political *régime*.[1] Many nations, especially in central and eastern Europe,

[1] The University of Strasbourg, German before the War, became French, the Russian Universities of Warsaw and Dorpat became respectively Polish and Estonian.

which before the War, owing to political conditions, had either no, or insufficient, universities of their own, have profited by their independence, creating universities as living symbols of their liberty and proofs of their intellectual progress or maturity. In all such cases university development has been directed by the national ideal.

National Co-operation.—In countries where the number of universities was large the necessity of promoting co-operation between the national universities began to be recognised more strongly. In 1910 the well-known "Office des Universités et écoles françaises" was founded in Paris. In 1912 the numerous universities of the British Empire held their first congress and decided to establish a common Universities Bureau, which started its activities during the War and a few years later organised the second Imperial Universities Congress. Similar offices came into existence in Switzerland, Italy, Belgium, Holland, etc. In the United States a similar *rôle* has been assumed by the various associations of universities, by the Institute of International Education in New York, and by the American University Union in Europe. These national organisations bring the universities of their own country into closer contact, and promote co-operation with the universities of other countries.

International Co-operation.—International university co-operation, which was almost entirely interrupted during the War, plays an extremely important *rôle* in the university life of to-day. Ambitious schemes have been proposed to organise it systematically. The project of an international university has been advanced on various sides. Up to now, this idea has been realised in a limited but perhaps more practical form by organising in various places international courses and summer schools, like those started in Brussels, Vienna, Geneva, The Hague (international law), Williamstown, Mass., etc.

Exchanges of Professors and Students.—International exchanges of professors and students have been recently facilitated by means of international conventions. General conventions of that kind being still impossible, such agreements have been concluded between one country and another (*e.g.*, between France and a great number of other European nations since the War; also between various Latin-American countries) and between one university and another in the United States. Lecturers or series of lectures given occasionally by travelling professors in foreign universities are more frequent than exchanges of teachers in the proper sense. A practice has grown up in the United States and Canada of professors "visiting" other universities by invitation for the purpose of delivering lectures. Exchanges of students and, in general, study abroad have been facilitated by progress toward the international recognition of the equivalence of studies and degrees. While no general conventions have been concluded for this purpose, various countries have published official lists of foreign degrees recognised by their national universities.

Conferences of universities of two different countries (France and Switzerland in 1919, England and Switzerland in 1922) mark progress in that direction. Students who are more and more interested in international affairs have developed international associations. The International Students' Confederation founded in 1919, is the most representative of these federations. The splendid results achieved by the European Student Relief Fund of the World's Student Christian Federation and the activity of the International University Federation for the League of Nations[1] should also be mentioned.

The League of Nations.—All these problems have been taken up by the League of Nations, and carefully studied, since 1922, by its committee on intellectual co-operation. The International University Information Office, established by the committee in 1923, is the nucleus of the International Institute of Intellectual Co-operation, offered to the league by the French Govt. and opened in Paris in Nov. 1925. The institute's special section for inter-university relations publishes a quarterly bulletin containing information on international university development.

[1] University women (post-graduates) joined in an International Federation which has devoted particular attention to the question of international fellowships; the Catholic students' associations have an international secretariat called "Pax Romana."

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UNIVERSITY EXTENSION.—The older type of university extramural work, called officially university extension at Oxford and London and university local lectures at Cambridge, has continued to advance since 1910. Even during the World War a large number of courses were delivered, and numbers of men and women, with extra burdens of work and anxiety, welcomed the relief of turning their thoughts to inspiring subjects.

I. THE WORK IN GREAT BRITAIN

The period has shown a remarkable development of university tutorial classes, begun by Oxford in 1908 and soon taken up by other universities. The system, like the older type, provides for lectures, discussion classes and paper work; but the membership is limited to a small number, formerly 32 and now 24, of students pledged to fulfil the conditions for three years. In 1910–1 the number of classes was 72 and students 1,829; in 1924–5 these had increased to 452 and 9,012 respectively.

The Cambridge Jubilee.—In 1923 a jubilee conference was held at Cambridge to celebrate the 50th year of the university local lectures, founded by Professor James Stuart in 1873. It was attended by representatives of most of the universities of the British Empire and of some American universities. The discussions ranged over the whole field of the teaching activities of universities outside their own walls.

Summer Meetings.—The summer meeting, which takes place at Oxford and Cambridge in alternate years, has been attended by several hundred students. The same universities, in addition to London, arrange summer courses for foreign students and for others. The tutorial classes summer school is now an important feature and is held annually at Oxford, Cambridge and other centres.

Royal Commission Report.—The Royal Commission on the ancient universities, which reported in 1922, urged that extramural instruction should be regarded "in all universities as an established and essential part of the normal work of a university." To this end they recommended "that a special inclusive grant of £6,000 a year be paid to Oxford and Cambridge Universities to enable them both to develop their extramural work and to assist in providing financial support for adult students" entering the university. A substantial part of the grant has been received, and both universities have formed new governing bodies on the lines recommended.

General Developments.—Other organisations are forming extramural boards, and one—University College, Nottingham—has appointed a professor of education, whose main duty is to organise and develop a department of extra-mural instruction. Consultation between different universities has become much more regular and systematic than it was.

The central joint advisory committee on tutorial classes, formed in 1909, was one of the first bodies to represent all the universities and university colleges in England and Wales. It also has direct representation of the joint committees, which manage the work in each case, and which include members nominated by the Workers' Educational Association. At the congresses of universities of the Empire, held in 1912 and 1921, a prominent place was given to teaching work outside the walls. The tutorial class movement has been specially successful in Australia, Canada and New Zealand.

Every university and university college in England and Wales is now conducting tutorial classes. Several are starting or restarting university extension work of the older type, a development which has been made possible by the issue, in Aug. 1924, of new regulations of the Board of Education providing for grants in aid.

Adult Students at the Universities.—One of the most promising developments is the plan, recommended by the Royal Commission, of bringing up to the university adult students who have gone

through a course of extramural instruction. At both Oxford and Cambridge a number of such students are now in residence for at least a year, and experience is already showing that, besides widening their own outlook, they contribute an element of great value to the undergraduate life of the place. All will return to their homes with powers of greater service to the community, and many will become valuable teachers in the adult education movement.

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(D. H. S. C.)

II. IN THE UNITED STATES

University Extension in the United States may readily be traced to the development in Great Britain of the idea of extending the influence and advantages of the universities of Oxford and Cambridge, which were serving only a small and select body of students. This movement whereby opportunities of university education were offered to the multitude was simply one phase of the general tendency to democratise education. It might well have found its origin in America, where the discrepancy between the cost of university education and the influence of universities upon the community was deeply felt.

The early form of university extension was that of the "lyceum" or short lecture course—not too profound, often illustrated, intended to entertain as well as instruct. Organisations were formed in certain cities the purpose of which was to maintain these cultural lecture courses. Soon the universities began to consider their obligation in this respect and departments of extension teaching were organised as part of the educational programme of important institutions of higher learning, particularly those located in urban centres. Although the short lecture course served a useful purpose, yet the lyceum as a means of education, with its difficulty of maintaining a balance between the serious and the entertaining, proved unsatisfactory. It became necessary to approximate much more closely the form of instruction followed in the established schools and offered to students in regular attendance. This implied, first, the transfer of university education to the homes of those who could not attend classes, and correspondence courses came into being. Again classes were organised in places within reach of the universities, and at hours convenient to wage earners.

The large universities of the West, the University of Chicago and the University of Wisconsin for example, built up great and important departments of correspondence study. In the East, however, the class system has prevailed, although some institutions use the lyceum and the home study system as supplementary to the classes held in the university halls and in extramural centres. This is notably true of Columbia University, New York City, which has built up a most elaborate system of adult education,—enrolling 16,500 students in 1925–6, in classes of University Extension and 4,000 students in home study. The original lyceum form is maintained in the Institute of Arts and Sciences. New York University and the college of the City of New York also have very large departments of University Extension and thus enroll many supplementary students.

There is a general feeling among certain universities and colleges of the country, particularly those in the East, that they have their own function to perform and that this would be jeopardised if they should supplement their classes by those intended for the irregular student. Thus, Princeton gives no indication of a desire to enter upon this work. Yale in like manner is cautious in its active interest in adult education. Harvard co-operates with Tufts College, Massachusetts Institute of Technology, Boston University and Wellesley College in offering courses of collegiate grade to qualified although not formally matriculated students. The state of Massachusetts has a well organised department of university education. There is no established policy in the universities as to credit for degrees for extension students. The Western universities credit freely their correspondence courses. Columbia gives credit for class instruction but not for home study. Harvard grants credit in co-operation with other institutions toward a special degree, that of A.A., associate in arts.

It is interesting to note that early in the 19th century Columbia College initiated a series of lectures open to the public on the payment of a small fee. This movement was premature. In 1889 Teachers College, of Columbia University, commenced certain elementary courses in science for teachers, and, in 1897 courses were given throughout the academic year and counted for a diploma. In 1910 Columbia University established the department of University Extension which has grown to such remarkable proportions. The reports of the National Extension Association should be consulted by the reader who desires to study the development in detail of this side of higher education.

(J. C. E.*)

UNTERMYER, SAMUEL (1858–), American lawyer, was born at Lynchburg, Va., March 2 1858. He was educated at the College of the City of New York and at the Columbia Law School (LL.B., 1876), was admitted to the bar in 1879, practising thereafter in New York City. He was counsel in many celebrated cases covering almost every phase of corporate, civil, criminal and international law. As counsel for H. Clay Pierce he prevented the Standard Oil Co., after its dissolution in 1910, from dominating the Water-Pierce Company. In the same year he effected the merger of the Utah Copper Co. with the Boston Consolidated and the Nevada Consolidated Cos., involving more than $100,000,000. In 1903 he undertook the first judicial exposure of "high finance" in connection with the failure of the U.S. Shipbuilding Co., organised as a consolidation of the larger shipbuilding companies in America. After this he conducted a number of similar exposures. In 1911 he delivered an address entitled, "Is There a Money Trust?" which led the following year to the so-called Pujo money trust investigation in which he appeared as counsel, by the committee on banking and currency of the Federal House of Representatives.

Mr. Untermyer for years urged such measures as the compulsory regulation of stock exchanges, reform of the criminal laws, the regulation of trusts and combinations and other economic legislation. He was counsel for many reorganisation committees, including those of the Seaboard Air Line, the Rock Island Railway, the Central Fuel Oil Co., and the Southern Iron and Steel Co. He took an active part in preparing the Federal Reserve Bank law, the Clayton bill, the Federal Trade Commission bill and other legislation curbing trusts. He was a delegate to the Democratic National Conventions in 1904, 1908 and 1912, and delegate-at-large for the State of New York in 1916. He was a strong supporter of President Wilson's administration. After America entered the World War he was adviser to the Treasury Dept. regarding the interpretation of the income tax and the excess profits tax laws. He was appointed by President Wilson to serve on the U.S. section of the International High Commission, which sat at Buenos Aires, in 1916, for the purpose of framing uniform laws for the Pan-American countries.

In 1920–1 he was counsel for the Lockwood Committee, appointed by the state Legislature to investigate an alleged conspiracy among the building trades of New York City. The charge was that labour leaders were using their power by extorting bribes for the prevention of strikes, by preventing independent bids and by forcing building awards to favourites. Many illegal acts were disclosed and numerous convictions secured. It was shown that in many of the building trades both manufacturers and dealers, often with the collusive aid of labour leaders, had organised to fix prices and prevent competition. Public opinion, especially in view of the housing shortage, reacted sharply to these revelations, and it was felt that Mr. Untermyer's work in this connection had been performed with admirable public spirit, energy and courage. Mr. Untermyer was an ardent believer in the Zionist movement and was president of the Keren Hayesod, the agency through which the movement was conducted in America.

URBANISATION.—The growth of cities has characterised the increase in the population of all countries. This urban tendency which has affected the whole social order of the modern world, continued almost unbroken until the World War. Since then, in the inevitable redistribution of population consequent upon a slowing down of industry, there has been a suggestion of a decrease in the movement both in Europe and America. The urban tendency is due to the promise of greater rewards for concentrated energy; to reduced areas for free colonising; to improved agricultural methods; to immigration; and to the tendency of foreign groups to concentrate in cities. (*See* also POPULATION.)

Distribution of Populations.—The extraordinary changes in population resulting from economic conditions have been statistically measured in the United States (see Table I), but in Europe enumerations have been detailed and systematic only in Great Britain and France. According to the most recent (available) censuses covering Europe (ranging from 1912–20) there were in that continent, exclusive of Russia, 291 cities having more than 50,000 inhabitants, representing approximately 20% of the total population. In the United States the corresponding percentage was 31.

The population of the world in 1926 was placed at 1,800 millions of which it is estimated that about 12% live in cities and in more or less urban territory whose population can definitely be established from late censuses; a more accurate percentage, namely 29% is to be found, however, by comparing the urban population with the total population of the countries in which they live. This estimate is complete, as it omits many of the densely populated cities of Asiatic countries, of Southern Europe, and of Russia, and—an important omission—the highly industrialised population of Germany. The largely rural character of other countries omitted, which have no official statistics of city growth, would however probably tend to offset the large urban figures for Germany.

The are no complete statistics showing the extent to which the population of the world has concentrated in urban districts, but data are available for some of the principal countries. In Table I. the urban population in proportion to the total is given for all the countries which have made this segregation.

TABLE I. *Distribution of Population in Groups of Cities Classified According to Size and in Rural Territory: 1900–20*

Class of Places	1920		1910		1900		Per cent of total population		
	Number of places	Population	Number of places	Population	Number of places	Population	1920	1910	1900
Total Population of the United States	..	105,710,620	..	91,972,266	..	75,994,575	100·0	100·0	100·0
Urban territory (inhabitants)	2,787	54,304,603	2,313	42,166,120	1,801	30,380,433	51·4	45·8	40·0
1,000,000 or more	3	10,145,532	3	8,501,174	3	6,429,474	9·6	9·2	8·5
500,000 to 1,000,000	9	6,223,769	5	3,010,667	3	1,645,087	5·9	3·3	2·2
250,000 to 500,000	13	4,540,838	11	3,949,839	9	2,861,296	4·3	4·3	3·8
100,000 to 250,000	43	6,519,187	31	4,840,458	23	3,272,490	6·2	5·3	4·3
50,000 to 100,000	76	5,265,747	59	4,178,915	40	2,709,338	5·0	4·5	3·6
25,000 to 50,000	143	5,075,041	119	4,026,045	82	2,800,627	4·8	4·4	3·7
10,000 to 25,000	459	6,942,742	367	5,524,434	280	4,338,250	6·6	6·0	5·7
5,000 to 10,000	721	4,997,794	612	4,254,856	468	3,220,766	4·7	4·6	4·2
2,500 to 5,000	1,320	4,593,953	1,106	3,879,732	893	3,103,105	4·3	4·2	4·0
Rural territory (inhabitants)	..	51,406,017	..	49,806,146	..	45,614,142	48·6	54·2	60·0
Incorporated places of less than 2,500	12,905	8,969,241	11,832	8,169,149	8,930	6,301,533	8·5	8·9	8·3
Other rural territory	..	42,436,776	..	41,636,997	..	39,312,609	40·1	45·3	51·7

Proportion of Urban to Total Population.—Urban communities tend to grow more quickly than rural districts. This, and the continuous formation of communities have led to an increase of the proportion of urban to the total population of most countries. Even if the rate of growth in urban and rural communities were equal, there would nevertheless be a constantly increasing proportion of urban population, provided the population of the country were increasing. Were there no movement from country to city, no disturbing effect from international migration, and no difference between urban and rural communities with respect to the natural increase from excess of births over deaths, there would still be, in a growing population, a constant passage of certain communities from the rural to the urban class. The smaller towns, maintaining a rate of growth uniform with that of the country as a whole, would one by one pass the limit fixed for the urban population, thus increasing the proportion of urban population. In Great Britain and the United States, for instance, this process is continually operating. Mutual protection and social intercourse have been largely supplanted by manufactures and trade as the principal factors controlling the growth of cities.

All the principal countries have taken a census of population since 1920, but uniform methods were not followed in determining the size of the places to be considered as urban communities. As a rule, the population reported for these places resided within the city limits, but in some cases the city limits give only an inadequate idea of the population grouped about the urban centre. In large cities there are suburban districts outside the city limits, which, from many standpoints, form part of the city. Many of the residents have their business or employment in the city and to some extent, persons living in the city are employed in the suburbs. This has led, in the latest census of England and Wales, to an inquiry as to place of work with reference to the place of residence.

United States.—As defined by the census, urban territory includes all incorporated places of 2,500 inhabitants or more, and in three New England states, all towns of that size; all other territory is classed as rural. The urbanisation of the population has been notable for the increase in the large cities. There are four cities in the United States that have a population of more than a million. China, Great Britain, Japan and India each has two cities of this class, and Argentina, Austria, Brazil, France, Germany, Russia and Turkey each has one city with more than a million inhabitants. In the United States there were only six cities in 1790 that had 8,000 or more inhabitants, and their population amounted to 131,472, forming 3·3% of the total population. At the census of 1920 there were 924 cities in this class, and they had 46,307,640 inhabitants, or 43·8% of the total. The census of 1920 was the first to show that more than half (51·4%) of the inhabitants resided in places having a population of 2,500 or more, the proportion having increased from 28·6% in 1880.

In many instances the population of the cities has been increased by the annexation of territory and the extension of the municipal boundaries so as to include suburban districts. The boundaries of some cities have been extended so as to entirely surround independent governmental districts. These districts being outside the corporate limits of the cities (although really within them), their population is not counted as part of the city. Highland Park and Hamtramck, Michigan, are densely populated communities, entirely surrounded by the city of Detroit, Mich., but their population is not included in the population of Detroit. A similar condition exists in Los Angeles, Cal., and in numerous other cities. (W. M. ST.)

TABLE II. *Total and Urban Population*

(This list comprises only countries which at recent censuses have segregated urban and rural population.)

Country	Census date	Population			Urban defined
		Aggregate	Urban		
			Number	Per cent	
Europe					
United Kingdom:					
England & Wales	1921	37,886,699	30,035,417	79·3	1,154 urban districts.
Scotland	1921	4,882,497	3,771,762	77·3	Places having 1,000 inhabitants or more.
Ireland	1911	4,390,219	1,470,595	33·5	Civic areas having 2,000 inhabitants or more.
Belgium	1920	7,402,276[1]	4,224,225	57·1	Places having 5,000 inhabitants or more.
Czechoslovakia	1921	13,595,816	5,884,576	43·3	Places having 2,000 inhabitants or more.
Denmark	1921	3,267,813	1,418,551	43·4	Cities and villages.
Finland	1920	3,364,807	543,046	16·1	Towns.
France	1921	39,209,518	18,205,492	46·4	Places having 2,000 inhabitants or more.
Netherlands, The	1920	6,865,314	6,327,928	92·2	Places having 2,000 inhabitants or more (not defined as urban).
Norway	1920	2,649,775	785,404	29·6	Towns.
Portugal	1920	6,032,991	1,050,500	17·4	Cities having 2,000 inhabitants or more (not defined as urban).
Serbs, Croats, and Slovenes, Kingdom of	1921	12,017,323	7,804,596	64·9	Places having 2,000 inhabitants or more (not defined as urban).
Sweden	1920	5,904,489	1,813,422	30·7	Thickly populated area; not absolutely defined.
Ukraine	1923	25,605,021[2]	5,087,595	19·9	Only places having 500 inhabitants or more enumerated.
America					
Continental United States	1920	105,710,620	54,304,603	51·4	Incorporated places having 2,500 inhabitants or more.
Alaska	1920	55,036	3,058	5·6	Incorporated places having 2,500 inhabitants or more.
Hawaii	1920	255,912	93,758	36·6	Incorporated places having 2,500 inhabitants or more.
Porto Rico	1920	1,299,809	283,934	21·8	Incorporated places having 2,500 inhabitants or more.
Canada	1921	8,788,483	4,352,773	49·5	Population residing in all cities, towns and incorporated villages.
Cuba	1919	2,889,004	1,290,955	44·7	Cities having 1,000 inhabitants or more.
Argentina	1914	7,885,237	4,525,500	57·4	Classified by local board.
Chile	1920	3,754,723	1,749,562	46·6	Cities, towns and villages having 1,000 inhabitants or more.
Guiana, British	1921	297,691	67,987	22·8	Towns.
Honduras, British	1921	45,317	22,524	49·7	The district town and other towns of the Colony.
Asia					
Ceylon	1921	4,504,549	580,953	12·9	Towns having special regulations regarding deaths.
Hongkong	1921	625,166	542,003	86·7	Approximately all population massed around Hongkong harbour.
India	1921	318,942,480	32,418,776	10·2	All towns.
Japan	1918	58,087,277	10,842,857	18·7	All large cities (smallest 23,996); not defined as urban.
Malays, British	1921	3,358,054	932,170	27·8	Towns having 1,000 inhabitants or more.
Africa					
Egypt	1917	12,718,255	1,854,100	14·6	Towns; not defined as urban (smallest 11,022).
Uganda Protectorate	1921	3,071,608	65,156	2·1	Towns having 500 inhabitants or more.
Union of South Africa, British	1921	6,928,580	1,735,685	25·1	Any localities possessing some form of urban local authority.
All others					
Australia	1921	5,436,794	3,370,316	62·0	Metropolitan areas and urban provincial districts.
Dominican Republic	1920	894,665	148,894	16·6	Not defined.
New Zealand	1921	1,284,873	626,633	48·8	Cities, boroughs or town districts having 1,000 inhabitants or more.

[1] Does not include population (60,179) of Eupen and Malmedy.
[2] Population estimate from 1925 *Statesmen's Year Book*.

URBAN TRANSPORTATION (*see* also TRAFFIC PROBLEMS).—Concurrently with the continuous growth of mechanically-operated industries, from their inception on a large scale following the application of steam as a source of power early in the 19th century, there has been in all industrial, as distinguished from agricultural, countries an increasingly marked drift of population to the cities. Of all the problems, whether old or new, created and intensified by this concentration of population in large cities, the most pressing is the furnishing of means of intra-urban transportation. This is especially the case in the large cities of Great Britain, Germany and the United States.

Types of Service.—Three types of transit services are now employed, the rapid transit railway, the street railway and the omnibus. On the rapid transit railways, both beneath and above the surface of streets which, in the largest cities of Europe and the United States, make possible long-distance high-speed intra-urban travel, the coal-burning steam locomotives have been replaced by electric motors (*see* RAILWAYS, ELECTRIFICATION OF) attached to individual cars in the trains, which latter, on the Interborough subways, New York, are composed of 10 cars with a capacity of 44 seated passengers each and many more standing during the hours of maximum traffic.

Rapid Transit Railways.—Railways of this character will be described as rapid transit railways regardless as to whether they are locally known as underground, subways, tubes or elevated, and in like manner surface railways or tramways will be termed street railways. The greatest mileage of rapid transit railways and the system carrying the heaviest traffic in one city is in New York, which in 1925 amounted to 224·71 m., composed of 100·26 m. of two tracks, 77·48 m. of three tracks and 46·97 m. of four tracks. The street railway is almost universally worked by the overhead electric trolley or the underground slot system, as in the London area. It is criticised on the grounds that it is nonflexible, occupies permanently a considerable part of the roadway, and is liable to working troubles which occasionally suspend traffic over a wide area.

Intensity of the Problem.—The intensity of the urban transportation problem and particularly the demand for high-speed long-distance service is greater in American than in European cities due, in part at least, to the greater activity of the people, to the higher average scale of wages enabling the population to pay for transportation service and to the fact that the cities themselves are in large part the product of modern industrial development.

The measure of the problem is given in the statistics of passengers carried by the several means of travel and for comparison London and New York, respectively the largest cities of Europe and America, are taken for the years 1905, 1915 and 1925, the totals being stated in millions.

Type	1905	1915	1925
LONDON			
Rapid transit	272	459	575
Street railways	478	852	979
Omnibuses	291	689	1,658
Total	1,041	2,000	3,212
Population	6·858	7·341	7·65
Rides, per head	152	272	420
NEW YORK			
Rapid transit	453	896	1,801
Street railways	683	919	1,057
Omnibuses	1	14	146
Total	1,137	1,829	3,004
Population	4·285	5·047	5·873
Rides, per head	265	362	511

While the total travel in the two cities has remained for 20 years substantially the same, the rides *per capita* in New York are greatly in excess of those in London, and the distribution among the several types is radically different.

London and New York.—In London all types of transportation show for each decade a substantial growth, but the greatest increase is in passengers carried by the omnibuses, whose traffic was more than doubled in the first 10 years and again doubled in the next 10. Thus is short-distance travel cared for with the minimum of operating and capital cost since a free right-of-way is provided in the public streets and no construction other than the vehicles is involved. In New York the greatest demand is for a rapid transit service, the burden of which doubled and redoubled during the past two periods of 10 years. The construction cost for the necessary long-distance high-speed facilities mount up to $10,000,000 per mile of four tracks exclusive of equipment. In both cities the rate of increase in the street railways is less in the second period than in the first, due largely to the fact that there has been no increase in new facilities of this type, but in New York there is shown a very rapid growth in omnibus service in connection with which new routes have been established and additional vehicles put in commission particularly since 1915. The differences illustrate the greater intensity of the American problem.

Some American Cities.—To extend the comparison the following figures give the corresponding data for three other American cities each typical of a distinct class: Philadelphia, one of the oldest American cities with a steady growth in population, served by all forms of urban transportation; Chicago, which in 100 years has risen from an insignificant hamlet to the second city in size in the United States and which has been equipped with rapid transit railways for some years; and Detroit, an exhibit of phenomenal development in the past 20 years but which is still dependent for its local transportation on surface means. The figures are given in millions.

Type	1905	1915	1925
PHILADELPHIA			
Rapid transit	..	42	89
Surface railways	382	474	585
Omnibuses	..	..	11
Total	382	516	685
Population	1·4	1·7	2
Rides, per head	273	303	346
CHICAGO			
Rapid transit	124	165	217
Surface railways	350	623	842
Omnibuses	..	..	58
Total	474	788	1·117
Population	1·9	2·4	3
Rides, per head	240	323	369
DETROIT			
Surface railways	88	240	358
Omnibuses	..	..	43
Total	88	240	401
Population	0·3	0·6	1·2
Rides, per head	231	400	323

The striking features of these statistics, which are fairly representative of American cities, are that the growth in rides is greater than the growth in population except in Detroit where population is advancing by great strides and faster than new transportation facilities have been provided, and that the relative increase in rides is greater according as the cities are greater—in short there is a cumulative result that produces the serious aspect of the new problem.

Taking the four cities in question, while the combined population in 1925 was 150% of what it was in 1905, the rides were 250%. If the ratio of growth be squared it will be seen that the increase in rides in 20 years was 1·11 times that of the square of the growth in population. In other words, if a city be doubled in number of inhabitants the burden of urban transportation will be increased fourfold. Taking the individual cases it will be seen that the ratio of rides to population increases with the size of the city. Thus the ratio between the increase of rides and the square of the increase of population is for Detroit 0·44; Philadelphia 0·9; Chicago 1·0; New York 1·4.

Another complication in urban transportation is the use of the motor-car, the expansion of which still further congests the streets and tends to prevent increasing surface transportation facilities by surface railways or omnibuses. This is particularly in evidence in America where on account of the low cost of certain cars they are freely used by all classes. The local registration in the two largest cities for 10 years was as follows:—

Type	1915	1920	1925
NEW YORK			
Passenger	59,850	152,036	365,894
Commercial	12,148	83,746	114,022
CHICAGO			
Passenger	36,419	86,709	290,956
Commercial	7,384	22,900	48,262

These figures, without parallel in other countries, are repeated proportionally in other American cities. In the United States there is one car for every six persons, while in Great Britain there is (1926) 1 for 57, in France 1 for 69 and in Germany 1 for 272. (*See* MOTOR VEHICLES.) (W.B.P.)

UROLOGY (*see* 27.797).—Recent progress in urology has been due largely to improvements in the cystoscope, advances in radiology, use of diathermy and close co-operation between urologists, bacteriologists, and bio-chemists. Endo-vesical instruments are now available from the simplest cystoscope, consisting of a telescope within an irrigating sheath, to complicated instruments with which lesions can be treated surgically under direct vision instead of by an open operation.

Similarly, advances in radiology have led to the detection of calculi hitherto regarded as transparent to the rays, and to stereoscopic radiograms indispensable for locating a suspicious shadow in the neighbourhood of the kidney or ureter. Pyelography also gives information concerning the size and shape of the renal pelvis and calices. A skiagram is taken after a fluid opaque to the X-rays (*e.g.*, sodium iodide or lipiodol) has been introduced into the renal pelvis by means of a ureteric catheter. It is of great value in diagnosing early dilation of the kidney, silent hydronephrosis, polycystic kidney, malformation of the pelvis and renal tumours encroaching on the pelvis; in localising shadows in the renal area such as calcified mesenteric glands and gall stones, and in differentiating between abdominal and renal tumours. By similar means, silhouettes of the bladder or male urethra can be obtained, though in the latter instance they are not indispensable, for the canal can be examined easily and thoroughly with a urethroscope.

Perirenal inflation with CO_2 was introduced by Carelli of Buenos Aires and in radiographs shows clearly alterations in shape, size and density, therefore being useful in such conditions as early hydronephrosis, polycystic kidneys, tuberculosis, tumours and stones not dense enough to show by ordinary radiography; but its greatest value lies in giving a clear and distinct radiogram of the suprarenal capsule.

Diathermy.—Diathermy (*see* ELECTRO-THERAPY) acts by virtue of the heat generated in the tissues by the resistance they offer to the passage of an electric current. For this purpose a very strong current must be used, deprived of its stimulating and electrolytic properties by alternations of not less than 500,000 per second.

The only sensation produced by a current of such high frequency is one of heat ranging, according to the strength of the current, from a pleasing warmth to a temperature high enough to char the tissues for a distance of about 1 cm. from the electrode. All degrees of diathermy are used for diseases of the genito-urinary system, the lower temperatures for testicular neuralgia and epididymo-orchitis, chronic urethritis and prostatitis, and benign enlargement of the prostate when a radical operation is inadvisable. Destructive diathermy is now the method of choice in the treatment of certain forms of papilloma of the bladder and urethra, and in the median bar type of prostatic obstruction. It has also been employed with moderate success for carcinoma of the prostate.

Use of Radium.—Radium (*q.v.*) has been used extensively for carcinoma of the prostate and bladder. It is applied in the form of needles and emanation tubes or seeds implanted directly into the growth, but has not yet emerged from the experimental stage. Caution is required in its use, for large doses produce great irritation and may be followed by excessive infiltrations of the bladder neck. Again, emanation tubes placed too close to the pouch of Douglas have caused peritonitis and death. In view of these disadvantages and the discouraging results they have encountered many urologists are now averse to using it at all.

Urinary Antiseptics.— Both mercurochrome and hexyl-resorcinol are powerful antiseptics, and though not "ideal" are valuable additions to the comparatively few powerful bactericides which can be administered with safety. Mercurochrome can be used either locally or intravenously. In cases of chronic cystitis, usually due to the colon bacillus, instillation of a watery solution (0·2–1·0%) sometimes has a remarkable effect. In pyogenic coccal infections the results are not so striking. In pyelitis, irrigation with mercurochrome is not so irritating as with silver nitrate. Instillations appear to be particularly valuable for chronic posterior urethritis, especially when complicated by prostatitis and vesiculitis. When given intravenously in doses of from 1 to 5 mg. per kg. of body weight results have been most encouraging, especially in acute coccal and bacillary infections of the genito-urinary tract associated with pyrexia. Chronic afebrile colon bacilluria, on the other hand, does not always respond so readily to this treatment. In rare cases, pronounced febrile and gastro-intestinal reactions follow the injection but these usually subside in 24 hours. The danger to the kidneys of such a powerful mercurial compound must never be overlooked, but Young (Baltimore) considers it may be used intravenously without fear of injury.

Hexyl-resorcinol $[C_6H_3(OH)_2C_6H_{13}]$ is a synthetic compound first described by Leonard. Possessing forty-five times the germicidal power of phenol, it conforms experimentally to the qualifications necessary for an ideal urinary antiseptic in that it is chemically stable, non-toxic, non-irritating to the urinary tract, has an antiseptic and bactericidal action in high dilution in urine of any reaction, and is eliminated in high percentage by the kidneys. On the other hand, it can only exert its germicidal properties on tissues with which the urine comes in contact, and therefore infections of the renal parenchyma and submucous tissues of the urinary tract are not affected by it. If taken on an empty stomach the drug may cause griping or catharsis. Infections due to pyogenic cocci appear to yield to the drug with remarkable rapidity. *B. coli* infections of the urinary mucosa with a low bacterial count can be cured with hexyl-resorcinol, but when the count is high and the sub-mucous tissues are infected, prolonged treatment combined with appropriate local treatment is necessary. When administered prophylactically two days before, and daily after operations on the bladder, the wounds remain healthy and healing is accelerated.

Tests of Renal Function.—Tests for estimating the function of one or both kidneys are now employed regularly. Though not conclusive, they are capable of giving a warning which should be heeded, particularly in operations on the urinary tract. Thus in prostatectomy they serve to determine a one- or two-stage operation, and since they have been adopted as a routine the mortality from uraemia has become almost negligible. The chief tests in use in England are: (1) The urea concentration test (Maclean and de Wesselow); (2) estimation of blood urea; (3) colour tests. The technique of applying these tests can be found in appropriate text-books.

The range of normality of the blood urea is so great that this test alone is of little value unless the urea retention is above 50 mg. per 100 cu.cm. of blood, but when combined with the urea concentration test it gives an excellent indication of the renal efficiency. In some clinics on the Continent great reliance is placed on the elimination of creatinin and chlorides as tests of renal efficiency. The dyes chiefly employed for colour tests are indigo-carmine and phenolsulphonephthalein. Indigo-carmine can be employed during a cystoscopy and gives a good indication of the function of one kidney without the use of a ureteric catheter (chromocystoscopy). A 0·4% solution injected either intravenously (5 c.c.) or intramuscularly (20 c.c.) should tinge the urine of a healthy kidney in five minutes. Phenolsulphonephthalein is excreted solely by the kidneys and so differs from indigo-carmine, which is only partly excreted by the kidneys. In America it is used almost exclusively, but in England it has not been popular owing to the somewhat elaborate technique required and to the difficulty, since the War, of obtaining a reliable preparation of the dye. The test is very reliable provided the pure compound is used.

The capacity or otherwise of a patient to resist the spread of sepsis to the upper urinary tract after an operation, such as prostatectomy, is a factor which may upset the calculations of both surgeon and bio-chemist. MacAdam and Shiskin have found that the *cholesterol content* of the blood gives a fair indication of the power of resistance. The average in a series of healthy adults under 50 years of age was found to be 0·16%. Above 50 years it ranges between 0·13% and 0·19%. Practical experience led these workers to conclude that in prostatic

obstruction a blood-cholesterol below 0·13% indicates such a lowered resistance to the spread of sepsis as to constitute a bad operative risk. Cases with a high blood-urea and a normal blood-cholesterol all recovered from a two-stage prostatectomy, but out of eight cases with a high blood-urea and a low blood-cholesterol all died save one.

The Kidney.—Dudgeon and others have pointed out that the combination of pus cells and a pure culture of staphylococcus albus in the urine of one kidney is almost pathognomonic of a stone in that kidney. With certain reservations all cases of renal calculus are now subjected to operation, for the stone, whether causing symptoms or not, slowly but surely injures the kidney and often determines a serious bacterial infection. Small stones are more dangerous than large ones, for they may lodge in the ureter and cause hydronephrosis, anuria and so on.

The problem of bilateral lithiasis is a difficult one, but on the whole urologists advocate operation on the healthiest kidney first, as there is always the possibility that nephrectomy may be necessary on the side which is more grossly affected. Pyelolithotomy is now performed in preference to nephrolithotomy whenever possible.

Decapsulation of the kidney for nephritis has been performed on many occasions with varying success, but is viewed with increasing favour. The benefit obtained is probably due to the mechanical relief of renal tension, and this certainly explains the immediate improvement following unilateral decapsulation in eclamptic uraemia. The indications for this operation are uraemia, anuria, oedema, excessive albuminuria and obstinate haematuria. Contra-indications are age, heart diseases and extensive cardiovascular changes.

Renal Tuberculosis.—Investigations by Braasch in the Mayo clinic have disproved the common opinion that renal tuberculosis is usually primarily unilateral. In seven out of 22 apparently unilateral cases, the urine from the supposed healthy kidney was proved to contain tubercle bacilli by animal inoculation, a fact which goes far to explain the comparatively heavy mortality in the first few years after nephrectomy. Continental writers estimate that in life the infection is bilateral in about 15% of cases, whereas in the post-mortem room it is as high as 65%. This fully bears out the experience that spontaneous cure is extremely rare and that the only rational treatment of unilateral tuberculosis is early nephrectomy. In bilateral infections, Ekehorn advocates and practises removal of that kidney which is found by inspection to be the most diseased, or which is thought to be the cause of pyrexia and distressing bladder symptoms. In 20 cases reported by him the results were good enough to justify the operation. The treatment of the tuberculous ureter is still under discussion, most workers considering that it heals naturally after the diseased kidney has been removed, while others advocate a primary nephro-ureterectomy to prevent infection of the lower urinary tract by the diseased ureter. All are now in favour of a post-operative course of tuberculin.

Movable Kidney.—Operations for nephroptosis are decreasing in number year by year, for surgeons have now realised that the condition is commonly associated with Glenard's disease and with such general symptoms as headache, gastric discomfort, neurasthenia and ptoses of various kinds, for which fixation of the kidney gives no relief whatever. Nephropexy is now reserved chiefly for cases of intermittent hydronephrosis, haematuria, casts and albuminurias, and for uncomplicated renal pain relieved absolutely by rest in the horizontal position.

Ureteral Calculus.—In the case of small stones impacted in the ureter most urologists favour removal by manipulative and other methods rather than by ureterolithotomy. The chief methods employed are: (i.) dilation of the ureter combined with instillation of sterile liquid paraffin, subcutaneous injection of atropine, and forced diuresis with Contrexéville water; (ii.) intra-ureteral instillation of 5 cu.cm. of a 2% solution of papaverine sulphate, selected for its analgesic and antispasmodic properties; (iii.) dilation of the ureter by diathermy, and (iv.) division of the ureteric meatus with scissors through a cystoscope.

Severe reactions after cystoscopic manipulations, and irregular stones greater than 1 cm. in diameter are indications for ureteto-lithotomy. The pelvic portion of the ureter is now always exposed extraperitoneally, either through a paramedian subumbilical incision or by Kidd's inguinal operation.

Transplantation of the Ureter.—The ureter may be implanted into another part of the bladder, either for stricture of its extramural portion or after partial cystectomy for growths involving the ureteric orifice. For inoperable bladder growths and for extrophy of the bladder, Coffey has devised a method of simultaneous transplantation of both ureters into the pelvic colon, which does not obstruct the ureters or disturb kidney function.

Bladder.—The bacteriology of cystitis and pyelocystitis has received much attention from bacteriologists. The most important recent communications on this subject are by Dudgeon, Wordley and Bawtree. These workers have isolated from different cases:—

(1) A special group of haemolytic bacilli, strongly resembling but not identical with the paratyphoid bacillus; (2) the colon bacillus; (3) Proteus.

Vesical Diverticula.—Improvements in the cystoscope have led to earlier recognition of diverticula. Swift Joly reviews the whole subject and discusses the relative value of the different operations. He also points out that accompanying prostatic or urethral obstruction should be treated at the same time whenever possible.

Papilloma.—These tumours are now treated by fulguration through a cystoscope whenever possible, and in many instances can be destroyed completely at one sitting and under local anaesthesia. When the papilloma is sessile and diathermy can only be applied to the surface nearest the cystoscope, several treatments at intervals of a week or ten days may be required, a portion of the growth being destroyed at each sitting. Subsequently a cystoscopic examination should be made at intervals of three to six months for at least three years, so that fresh growths can be kept in check. Open operation by the suprapubic route is reserved for large growths, especially if sessile and for those involving the ureteric orifice. In some cases the tumour can be destroyed by diathermy with a large electrode, in others a partial cystectomy, with or without transplantation of the ureter, is necessary. Attention has been called to the danger of "graft-recurrences" in the abdominal wall after removal of papillomata by the suprapubic route, and Maybury and Dyke have reported a case in which three successive implants grew in the abdominal wall. The primary vesical growth was benign but the recurrent implants became progressively malignant. Carcinoma should be excised whenever possible, for as yet the results of treatment with imbedded radium is disappointing and uncertain. In the flat ulcerating form of carcinoma, peculiar to the aged, a fair measure of comfort and relief can be obtained from deep X-ray therapy.

The Prostate.—For chronic inflammatory lesions of the prostate and seminal vesicles diathermy is valuable and acts, not only on the gland itself, but also on the arthritic and other complications so frequently associated with gonorrheal prostatitis and vesiculitis. In cases of enlarged prostate where operation is impossible owing to age, cardiovascular changes, advanced renal disease, etc., a fair measure of relief can be obtained by medical diathermy or by deep X-ray therapy. In all other cases prostatectomy is undoubtedly the correct procedure. The type of enlargement most suitable for operation is that due to chronic lobular prostatitis with pronounced adenomata; the second type, chronic interstitial prostatitis or fibrous prostate, presents many difficulties to the operator but should be removed whenever possible, as it causes a severer degree of obstruction and consequent impairment of the renal function than the adenomatous variety. Before deciding on an operation the chemical tests of renal efficiency should be carried out, for the type of operation selected will depend almost entirely on these tests. Careful preliminary treatment, often lasting several weeks, is nearly as important as the operation itself.

After much discussion, the majority of urologists have decided in favour of the suprapubic operation in one or two stages. The two-stage operation has reduced the mortality from uraemia to a negligible quantity and is indicated in all cases with renal deficiency, severe cystitis, retention, or four or more ounces of residual urine. The Thomson-Walker operation is undoubtedly an improvement on the somewhat crude but remarkably effective operation practised by Freyer. It takes longer but eliminates the risk of post-operative stricture. The perineal operation, performed almost exclusively by Young of Baltimore, is in England reserved for carcinoma and for the fibrous type of prostate. Here the advantages of control of haemorrhage and perfect drainage are outweighed by the dangers of pelvic cellulitis, perineal fistula and incontinence of urine.

Prostatic Bars.—In about 25% of patients with symptoms of prostatic obstruction but without palpable enlargement of the prostate, a careful cystoscopic examination reveals the presence of a ridge of hypertrophied tissue, either on the posterior lip of the prostate overhanging the internal meatus, or projecting upwards from the floor of the prostatic urethra and constituting the so-called median bar. For the relief of this type of obstruction H. Young invented his well-known punch, later improved by Kenneth Walker, by adapting it for diathermy. (*See* ELECTROTHERAPY.)

Carcinoma.—Hitherto, treatment of prostatic carcinoma by radium has been so unsatisfactory that many surgeons have ceased to use it. Diathermy has been more or less successful in conferring relief, but the results can hardly be described as brilliant. Whenever possible, Young's perineal resection appears to be the most satisfactory procedure; failing this, excellent results have been sometimes obtained from deep X-ray therapy.

The Testis.—Steinach of Vienna performed vasoligation in *senile* rats with a view to increasing the internal secretion of their testes and thereby stimulating their failing energies. For two to four weeks after bilateral division of the vas between ligatures no appreciable change was noticeable. The rats then began to show a return of sexual excitement and vigour, in some instances equalling that of young males. This was followed in rapid succession by a return of pugnacity, increase in muscular energy and a copious growth of fur. The change lasted for about six months, when the animal gradually lost his youthful appearance and powers and became senile again, eventually dying within a few weeks of the onset of the change. Steinach found that the operation induced degeneration of the seminal epithelium (later followed by regeneration) and an increase in the interstitial tissue. In man the operation has been attended by very variable results. The greatest successes appear to have occurred in cases of premature old age; when performed for impotence alone it is not so satisfactory, and is quite useless if the testis be already atrophied. Some cases of arteriosclerosis have been greatly benefited by it.

Testicular Grafts (*see* REJUVENATION).—Grafts from lower animals have been employed for many years with more or less similar results, viz., improvement shortly after implantation, followed by atrophy and absorption of the graft, and a return on the part of the patient to the original condition. Voronoff in 1920 used testes of anthropoid apes and found that they survived for three years or longer, and that the initial improvement in the patient's condition was maintained. Kenneth Walker has on several occasions employed a healthy human ectopic testis. He concludes that the life of a hetero-graft is not longer than two years, that absorption of the graft does not necessarily imply a return of the patient to his former condition, and that permanent improvement is probably due to increased growth in other endocrine tissues stimulated into activity by the graft.

Tuberculous Epididymitis.—When this disease is advanced castration is indicated, but when it is localised to the globus major or minor epididymectomy is now regarded as the correct procedure. The full extent of the disease must always be determined with care.

The Urethra.—The great improvement in urethroscopes has simplified the diagnosis and treatment of urethral conditions. With the Joly type of posterior urethroscope, diathermy can be applied where formerly a serious cutting operation was necessary. There is now an increasing tendency to revert to former methods and to treat stricture of the urethra by gradual dilatation with metal sounds or gum elastic bougies, urethrotomy being reserved for resilient and cartilaginous strictures and those complicated by fistulae. If contraction recurs after internal urethrotomy many surgeons advocate excision of the stricture and axial anastomosis. When a large amount of cicatricial tissue has been excised, the gap has been successfully bridged in one case by implantation of the patient's appendix, and in another by a child's prepuce fashioned into a canal around a catheter.

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URUGUAY (*see* 27.805).—The smallest of the South American republics, has an area of 72,180 square miles. Uruguay broke off diplomatic relations with Germany in Oct. 1917 after a Government decree had been published defining the country's attitude towards the American powers which had preceded it into the War. The estimated population on Dec. 31 1925 was 1,758,334, an increase of 68·6% since the last census in 1908. The population of Montevideo, the capital, on June 30 1925, according to the Municipal Statistical office, was 381,228. Cities with a population of 30,000 or more were Paysandú, Salto and Mercedes. The average density of population increased from 12·9 per sq. m. in 1908 to 24·4 in 1925, the latter being greater than that of any other South American country.

I. POLITICAL HISTORY

The administration of President Claudio Williman (1907–11) marked a definite period of progress and stabilisation. Since no serious armed attempt was made to overthrow the Government its efforts were largely concentrated on educational progress and internal development. The first child-labour legislation was adopted, the death penalty abolished, and a model penitentiary and a tuberculosis sanatorium were established.

The social and educational progress of the country continued during the second administration of José Batlle y Ordóñez (1911–5), who succeeded Williman. Hours of labour were regulated, a National Insurance Bank was established and experts were brought from the United States and Europe to advance education, particularly industrial and agricultural. The first South American International Conference of Agricultural Defence was held at Montevideo on May 2 1913, and 200,000 gold pesos (1 peso=$1.03) annually was appropriated for free seeds for farmers. A law of July 12 1911 set aside 100,000 pesos for the encouragement of immigration.

In May 1910, ratifications of the boundary treaty concluded in Oct. 1909 were exchanged between Uruguay and Brazil; this settled several minor but long-pending questions. A subsequent treaty of May 7 1913, since carried out, provided for delimiting and marking the boundary. Brazil ceded to Uruguay "the waters and navigation" of Lake Mirim and the Jaguarão river, and the contracting parties agreed not to fortify their new frontiers. Uruguay continued to prosper under her next President, Feliciano Vieira (1915–9), who surrounded himself with able advisers of the young and progressive group which continued to dominate

Uruguayan affairs. Most of them had studied or travelled abroad. Baltasar Brum, Vieira's successor in the presidency, had been Minister of Foreign Affairs in the latter part of Vieira's administration, when the growing pro-Ally sympathies of Uruguay were crystallised by the entry of the United States into the World War. Although no military or naval aid was sent to the Allies, Uruguay's sympathies continued with them until the end of the War. On Nov. 9 1917, the eight German merchant vessels in Montevideo harbour were seized by the Uruguayan Government. A credit of 15,000,000 pesos (approximately £3,000,000 at normal exchange) was advanced to England by the Uruguayan Govt. at 5%, to be used for the purchase of supplies in Uruguay.

In 1916 a constitutional convention met to discuss a new constitution to replace that of 1830. The convention concluded its task in Oct. 1917, and the new constitution came into effect on March 1 1919. The most important change in it was the definite separation of Church and State. The Roman Catholic Church, though no longer recognised as the state religion, was given control of those places of worship wholly or partly constructed by funds from the national treasury. Members of the clergy were eligible for election as representatives or senators. Decentralisation of the formerly strongly centralised Federal Govt. was brought about by the installation of popularly elected assemblies and autonomous councils of administration to regulate the local affairs of the departments, with control over the municipalities. The chief of police in each department, paid by the national treasury, was made subordinate to, and appointed or dismissed by the President of the Republic. The executive power was divided between the President (elected by the direct vote for four years) and an administrative board composed of nine members elected by a popular vote for a six-year term, one-third of its members retiring every two years. The President was to co-operate with this board, which directs the affairs of the departments of Finance, Public Instruction and Public Works, the President controlling those of the Interior, Foreign Relations, War and Marine. Minority representation was protected by a system of plural voting, and woman suffrage provided for, subject to acceptance by a two-thirds majority of each chamber of the legislature. The General Assembly, composed of two Houses, was charged with the interpretation of the constitution and the election of justices of the Supreme Court. Uruguay spends more money on education than on her combined army and navy under this new and liberal constitution.

Uruguay's youngest President, Baltasar Brum, took office on March 1 1919, and surrounded himself with an able and progressive Cabinet. Uruguay ratified the Treaty of Versailles in 1919, and also concluded obligatory arbitration treaties with Great Britain and Italy in that year. A system of old-age pensions was introduced in 1919, and a total of 20,000 pensions had been granted by 1925. José Serrato, an engineer of Italian descent, became President on March 1 1923. In 1922 Uruguay became a non-permanent member of the Council of the League of Nations.

Education.—Primary education is compulsory. In 1923 there were 1,045 Government schools with 120,583 children in attendance. Private schools in 1922 were 186 with 20,168 pupils. Evening courses for adults were attended by 6,678. The Agronomical Institute of the University of Montevideo, which was opened in Sept. 1906, was developed into a National Agricultural College, modelled on the best European and United States institutions. Vocational training was given gratuitously to 185 pupils in the school of arts and trades supported by the Government. The University of Montevideo had a student body of 1,615 in 1922.

II. FINANCIAL AND ECONOMIC HISTORY

The public debt of Uruguay was 129,774,119 pesos in 1900 and 176,693,631 pesos in 1924, a small relative increase. The budget estimates for 1924–5 were, revenue 45,182,207 pesos and expenditure 45,120,052 pesos. It was decided to prolong the budget of 1924–5 for the whole of the period 1925–6, with the estimated expenditure altered to 47,199,900 pesos. Revenue for 1923–4 was 44,963,678 pesos and expenditure 43,033,998 pesos. Customs receipts in 1924 were 14,573,890 pesos.

Production and Trade.—Agricultural development has favoured the increase of small holdings and of peasant proprietors. The number of rural holdings in 1908 was 48,874, in 1916 there were 57,974. The cattle census of 1924 gave the number of meat cattle as 8,431,613, as against 7,802,442 in 1916. The wool-clip 1923–4 yielded 49,500,000 kilos of wool, the number of sheep being estimated at 14,443,341. The meat-packing industry has developed rapidly, and in 1912 a large and up-to-date packing and freezing plant was established at Montevideo. In 1920 Uruguay had two freezing plants, 13 salting plants, three canning and three tongue-preserving factories, as well as a large factory for liquid meat extract.

Extensive manganese deposits were discovered in 1924. The accompanying table, given in thousands of gold pesos, contains the latest available statistics of foreign commerce:—

Countries	Imports		Exports	
	1924	1923	1924	1923
Great Britain	11,398	11,592	24,253	25,536
United States	14,917	10,340	7,103	14,911
Germany	6,613	5,166	17,731	12,530
Argentina	6,211	5,460	11,384	6,007
France	3,516	2,378	13,791	10,429
Brazil	5,295	4,927	6,135	1,802

Communications.—Through rail communication between Montevideo and Rio de Janeiro was completed in 1911 by the connection of various railways in Southern Brazil. Work has been expedited on the San Carlos-Rocha line, and it is proposed to construct a direct line from Montevideo to the free port of Colonia. In 1921 there were 1,625 m. of railway open for traffic in Uruguay.

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UTAH (*see* 27.813), a State of the United States. Owing to increase in industry in the years 1910–25, the urban population of Utah increased more rapidly than the rural. The population in 1925 was estimated at 485,530, as compared with 449,396 in 1920.

Political History.—Political divisions are no longer on religious lines. Utah was Republican between 1910 and 1925 except in 1916, when both the electoral vote and state officers were Democratic; and in 1924, when the national and state officers elected were Republican, but the governor was a Democrat. The governors from 1909 to 1925 were William Spry (Rep.), 1909–17; Simon Bamberger (Dem.), 1917–21; Charles R. Mabey (Rep.), 1921–5; George Dern (Dem.), 1925–

Section 3 of article 10 was amended, Nov. 8 1910, to provide that funds from the state tax for high schools be apportioned among cities and school districts according to attendance at high schools. Section 4 of article 13 was amended to provide that after Jan. 1 1919 metalliferous mines and mining claims be assessed at $5 per ac., and in addition thereto at a value based on some multiple or sub-multiple of net annual proceeds. All other mineral deposits, including coal, are assessed at full value, as are also machinery and surface improvements. Article 22 was amended to prohibit, after Jan. 1 1919, the manufacture and sale of intoxicating liquor containing in excess of one-half of 1% of alcohol.

Education.—The state tax furnishes approximately $25 per annum for each child of school age. The total expenditure for elementary and high schools in 1923–4 was $9,882,768.47, making $71.79 for each child of school age. In 1925 there were 139,457 children of school age in the state, 93% of whom were enrolled in public schools. Of this number, 23,379 were enrolled in the high schools. Attendance at high school in 1924 was double the attendance in 1918.

Irrigation.—An important irrigation enterprise, the Strawberry project, begun in 1906, has been completed. By means of a tunnel 4 m. long through the Wasatch mountains, water is brought from a drainage basin on the east side of the mountains into the Utah valley, 45 m. away. The reservoir in Strawberry valley, covering 8,100 ac., 7,600 ft. above sea-level, has a capacity of 280,000 ac. ft., of which only 75,000 are to be used annually until the project is enlarged. The state's irrigated acreage in 1919 was 722,772; in 1924, 1,371,651. The Great Salt Lake Basin project, under construction in 1925, is designed to double the irrigated area in the northern valleys of the state.

Agriculture.—Important acts in the interests of agriculture were passed by the legislature of 1921. Several separate boards and commissions were consolidated and placed in a department of agriculture composed of seven members with an executive officer, called the commissioner of agriculture. In 1929 there were 25,622 farms, with an acreage of 5,050,410, of which 1,716,380 ac. were improved land. The chief products in 1924 were:—

	Quantity	Value
Wheat	4,413,000 bu.	$ 5,737,000
Corn	728,000 bu.	1,056,000
Oats	3,080,000 bu.	2,156,000
Barley	936,000 bu.	807,000
Rye	99,000 bu.	106,000
Hay	1,631,000 tons	19,246,000
Alfalfa seed	350,000 bu.	3,430,000
Potatoes	2,184,000 bu.	1,616,000
Sugar beets	568,000 tons	4,703,000

Livestock on Jan. 1 1925 were estimated at 2,246,000 sheep, 385,000 beef cattle, 101,000 dairy cows, 97,000 swine and 122,000 horses and mules. The wool clip in 1925 was estimated at 16,000,000 lb.

Minerals.—During the period 1910–25 the development of all the mineral resources of Utah proceeded rapidly. There are 13,130 sq. m. of workable coal land in the state. At the end of 1923 approximately 80,000,000 tons had been mined. It was estimated in 1925 that only ·05 of 1% of the total available supply had been taken out. In 1924 Utah was the leading metal mining state. Mining supplies 85% of the freight traffic originating within the state. The mines, mills and smelting afford employment to over 18,000 men, and the wages bill is about $30,000,000. The chief mineral products in 1924 were: Silver 17,000,000 oz., copper 242,700,000 lb., lead 241,425,000 lb.

Industries.—The chief industries of the state in 1920 were meat-packing, creameries and condenseries, canneries, flour and cereals, candy, salt, metal and sheet iron, cement and lime. By 1925 there had been important additions, including two large establishments manufacturing radio sets and appliances; a concern manufacturing car wheels; and two iron and steel industries; $4,000,000 of capital was added to the flour-mill business. In 1924 the manufacture of pig iron had been undertaken by the Columbia Iron and Steel Corporation, with a capital of $20,000,000. This corporation has coal mines at Columbia, Utah, iron mines at Iron Springs and blast furnaces at Ironton, about 30 m. from Salt Lake City. The blast furnaces are capable of producing 400 tons of pig iron per day, which requires 800 tons of iron ore and 400 tons of coke, and to make the necessary coke 800 tons of coal are required, the daily output from the coke ovens being 11,000,000 cu. ft. of gas, 100,000 gal. of coal tar, 2,000 gal. of benzol and 18 tons of ammonium sulphate. The number of employees reported in the classified industries by the industrial commission was 58,464 in 1925. The railway and highway systems radiate from Salt Lake City. The total length of main line railway was 2,207 m. in 1923, and a network of excellent highways connect the principal towns with the capital. (G. E. F.)

UTICA, N.Y., U.S.A. (*see* 27.820), increased 26·5% in population in the decade after 1910, reaching 94,156 in 1920, of whom 23,291 were foreign-born; and 101,604 in 1925, according to the state census (local estimate, 110,000). The area was more than doubled, increasing from 9·2 sq. m. in 1910 to about 24 in 1924. The varied products manufactured within the widening city limits were valued at $31,199,000 in 1909; $77,746,000 in 1919; $76,060,528 in 1923. Utica is served by the New York State Barge canal, opened in 1918. The abandoned bed of the Erie canal was utilised for a water conduit, and a roadway was built over it (1921). Hydroelectric power, generated at Trenton Falls, is available, and the proposed super-power development for the eastern states contemplates Utica as one of the load centres and distributing points. By 1925 zoning ordinances had been adopted; a soldiers' and sailors' memorial hospital had been added to the buildings of the state Masonic Home; and the park system had been expanded until it contained about 700 acres.

UZBEGISTAN.—A Soviet republic in Central Asia. It comprises districts formerly known as Bokhara and Ferghana and also including a part of former Turkestan. (*See* TURKESTAN.)

VACCINE THERAPY.—This consists in the introduction into the body of a suitable vaccine, in order to stimulate the tissue cells to elaborate a sufficiency of specific antibodies to resist the subsequent invasion of a particular micro-organism; or in the case of an already infected individual to prevent the further multiplication and diffusion of the invading bacterium—in other words, to establish a condition of active immunity.

To Edward Jenner belongs the credit of exploiting the use of an attenuated virus for the production of an active immunity to smallpox, and originally the term " vaccine " was restricted to the virus of smallpox as altered by its passage through the bovine species, in which it gives rise to cow-pox or vaccinia. Pasteur then applied the principle to the prophylaxis of bacterial infections and Almroth Wright expanded it to embrace not only the prevention but also the treatment of microbial disease. Consequently, the word " vaccine " now includes suspensions of bacterial cells and emulsions of bacterial protoplasm, which when introduced into the human economy result in the formation of specific antibodies.

In either case the plan adopted was to inject successive quantities of bacterial protoplasm derived from artificial cultures of the particular micro-organism under study. In the initial stages of the process these cultures are usually modified by some physical agent, such as heat, in order to attenuate or destroy the virulence of the microbe. For instance, Pasteur vaccinated sheep with cultures of the anthrax bacillus which had been attenuated by growth at a temperature (41° C) some degrees above the optimum, to protect them against the natural disease splenic fever; and Wright used cultures of *B. typhosus*, killed by heating to 60° C. for the protection of British soldiers in India against typhoid fever.

The success that attended this work of Wright, sufficiently notable in the later stages of the Boer War, reached its culmination during the World War, when first typhoid, and subsequently paratyphoid, fevers were eliminated from the British Army by the use of appropriate vaccines, and in consequence prophylactic vaccination against these diseases has established its position in preventive medicine.

Attempts have naturally been made in the direction of prophylaxis against many other infective diseases by the use of special vaccines, as, for example, cholera; plague; dysentery; cerebro-spinal fever; tuberculosis; pneumonia; influenza and the common "cold"; but although considerable success has been attained, the results have not presented the uniformity of those achieved in the prevention of typhoid and para-typhoid fever. At the same time, it must be conceded that it is a difficult matter to arrange " mass " experiments in which the numbers of inoculated and uninoculated or " control " individuals are sufficiently large to permit of the application of statistical methods in the evaluation of the results obtained, particularly in view of the very brief " incubation " period of many of these diseases. This difficulty becomes even greater when vaccines are employed in the treatment of individuals already incapacitated by bacterial infections, for here each case must be judged as a separate entity and accessory means of treatment, to say nothing of the long arm of coincidence, are factors which cannot be ignored when attempting to form a just estimate of the value of vaccine therapy. In the opinion, however, of those who have devoted themselves to the study and application of this type of medication no reasonable doubt exists as to the importance of what may be termed specific therapy—despite the acknowledged imperfections of the vaccines in use.

Types of Vaccines.—Vaccines belong to one of two main types—" stock " or heterogenous—that is to say prepared from a cultivation of the required species of microbe which has already been isolated from an infected individual and after identification stored in the laboratory; and " autogenous," prepared from the actual organism isolated from the particular patient under treatment. Obviously " stock " vaccines must of necessity be utilised in the attempt to immunise the normal individual prior to exposure to infection by the corresponding microbe. Stock vaccines also possess a distinct value in therapeutic medicine particularly in the case of certain chronic infections such as tuberculosis, but since bacteria exhibit so many biological variations presumably due to the operation of environmental factors, the employment of a number of different " strains " of the same species, thereby rendering the " stock " vaccine " polyvalent," for this purpose is advocated (*see* also SERUM THERAPY). In the treatment of acute diseases, however, " autogenous " vaccines are immeasurably superior even to polyvalent stock vaccines. When the serum containing the specific immune antibody for a particular strain of micro-organism is available it may be combined with that germ during the process of manufacture and a " sensitised " vaccine—either stock or autogenous, as the case may be—results.

Detoxicated Vaccine.—Another variety of vaccine, in which the bacterial protoplasm has been so modified as to remove its toxicity, as well as its infectivity, is known as " detoxicated." Pasteur's anthrax cultures incubated at an unsuitable temperature, and Raw's tubercle cultures grown for a long period of years upon artificial culture media, were detoxicated in this sense by purely biological methods. Recent workers have attempted to effect the same object by treating the bacterial protoplasm with either mineral acids or alkalis. These chemical methods, however, profoundly change the protoplasm of the organism, and the injection of the resulting vaccines into the animal economy is not as a rule followed by the production of any large amount of the " specific " antibodies as at present recognised. That detoxicated vaccines of this type do subserve a useful purpose is beyond question, however, although the mechanism which is here brought into action is probably closely allied to that of protein shock (*see* IMMUNITY).

Mode of Preparation.—All the above varieties of vaccines are prepared on very similar lines. The selected organism is cultivated usually on a solid substratum, under optimum conditions for that particular period which will give the maximum development, and the resulting growth is emulsified in normal saline solution. In the preparation of sensitised vaccines the appropriate anti-serum is added to the emulsion and the mixture is allowed to stand at 0° C. for a period of about 12 hours. Next, the amount of bacterial protoplasm held in suspension per unit volume (1 c.c.) is measured, and several methods are available for the purpose. Undoubtedly the most accurate method involves drying and weighing the mass of bacteria, but this is a lengthy process, and often the time factor is of paramount importance where therapeutic vaccines are concerned. For this reason the plating methods ordinarily employed for the estimation of the number of bacteria suspended in fluids, such as water, are rarely resorted to, and other more rapid methods have been utilised. Thus Sir Almroth Wright mixed equal volumes of the bacterial emulsion and blood from a normal individual, and by means of microscopical films estimated the ratio existing between the red cells and the bodies of the bacteria in the mixture. This ratio having been ascertained, a simple calculation determines the number of bacteria in the unit volume, since the number of erythrocytes normally present in man is a remarkably constant factor (amounting to 5,000 million per cubic centimetre). Again, the bacteria may be counted by means of the ordinary haemocytometer, or the estimation may be made by comparing the suspension of bacteria with standard tubes containing opaque fluids corresponding to definite numbers of various organisms per cubic centimetre.

In most instances the microbes contained in the emulsion are now altered by heat coagulation (by suspension in a water bath adjusted to the thermal death point of the particular organism) by autolysis, or by lysis due to the action of chemicals such as

sodium fluoride or carbolic acid, so that their infectivity is destroyed; in the case of sensitised vaccines the microbes may, at the discretion of the bacteriologist, be left in the living state and unaltered—save for their combination with the corresponding antibody. In the chemically detoxicated vaccines the solution of the bacterial protoplasm is effected at this stage by the addition of the requisite acid or alkali, and the vegetable protein is further purified by repeated precipitation and solution.

Finally, the emulsion, is adjusted to some pre-determined standard by dilution or concentration, a small quantity of a preservative, such as tricresol or phenol, is added and the finished product stored in suitable receptacles.

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VACUUM TUBES (*see* 27.834).—The beauty and the interest of the phenomena attending the passage of electricity through gases at low pressures have engaged the attention of physicists for a generation, and a rich harvest of discoveries of the greatest importance has resulted. The discovery of the electron by J. J. Thomson and of the proton by Rutherford have given us the basis of the modern theory of electricity and of the structure of the atom (*q.v.*). The study of the electric discharge tube has further given us, or materially advanced, the X-ray tube, the wireless valve, the electric lamp, the cathode-ray oscillograph, the vacuum flask, mercury vapour and neon lamps, etc. Moreover the requirements of vacuum tube workers have led to the most profound improvements in the methods and technique of producing high vacua, more particularly during the present century.

Vacuum Pumps.—The various types of high-vacuum pumps are mostly designed to operate after a preliminary exhaustion to a few millimetres of mercury by a "backing" pump. For this purpose a water-jet pump is sometimes suitable although a piston or rotary oil pump is generally to be preferred. Some types of rotary oil pump are capable of pressures as low as $\frac{1}{1000}$ mm. mercury and are rapid in action. It is important to protect them from water vapour.

The Töpler and Sprengel pumps are now little used on account of their slowness of action. This remark applies also to the earlier types of rotary mercury pumps. Dewar's discovery in 1904 of the absorbent properties of coconut charcoal when immersed in liquid air was a conspicuous advance. The process is very rapid for certain gases and is capable of affording extreme vacua, but the necessity for liquid air restricts its general utility.

The molecular pump of Gaede followed in 1913. Holweck has brought out a new design. This depends for its action on the fact that in confined spaces at low pressures the collisions of a molecule with the boundary walls are much more frequent than with other molecules. If one of the walls is in rapid motion it follows that the molecules tend to take up the direction of this motion. The principle takes practical shape in the form of a grooved cylinder revolving at high speed within a cylindrical casing, the clearance being about $\frac{1}{10}$ mm. or less. The pump is capable of the highest vacua, but is expensive and is occasionally attended by mechanical troubles inherent to the design.

Gaede and Langmuir Pumps.—But the method which has displaced almost all others for most purposes is that underlying Gaede's mercury-vapour diffusion pump (1915), of which Langmuir's condensation pump (1916) may be regarded as an independently developed and valuable modification. A variety of types are now available constructed of glass, silica or steel. In all these a blast of mercury vapour, arranged to entrain molecules of the gas to be pumped, is directed tangentially across a water-cooled surface. The energy of the "reflected" mercury molecules is too small and non-directive to interfere with the direct blast. The gas is accordingly passed on to the backing pump and the mercury vapour is condensed and used again. The highest vacua (10^{-6} mm. or less) are attainable under suitable conditions, gases and vapours being pumped equally well. The speed of pumping of some types is very high. Backing pressures range from a few millimeters to $\frac{1}{100}$ mm. of mercury, depending on the type.

It should be added that, if full advantage is to be taken of the high speed of mercury-vapour pumps, wide-bore (about 1 in. diameter) connecting tubes should be used throughout and the backing pump should be fully capable of keeping pace. A practical convenience with such pumps is the provision of an adjustable air leak (*e.g.*, by a needle valve) for maintaining a suitably high pressure in the discharge tube. If the presence of mercury-vapour in the vacuum tube is objectionable, a trap of liquid air or metallic potassium should be interposed.

In the manufacture of electric lamps and wireless valves the final stages of evacuation are effected by making use of the "cleaning up" properties of red phosphorus, magnesium, etc. The material is deposited on the filament or adjacent supports, and when vapourised by heating results in the reduction of the pressure to a low limit. If it is desired to maintain permanently the highest vacuum in a sealed vacuum tube, it is essential to heat the tube and its enclosures to as high a temperature as possible while the exhaustion is proceeding.

Electric Discharge in Vacuum Tubes.—The potential difference required to excite an electric discharge in a vacuum tube depends greatly on the conditions, *e.g.*, the nature and pressure of the residual gas, the size and shape of the tube, the size shape, material and disposition of the electrodes. If the cathode can be heated and if it is coated with one of the alkaline earths, the exciting voltage may be only 50 volts or less at suitable pressures. This is owing to the elimination of the cathode-fall of potential.

If the electrodes are both cold, it is necessary to apply much higher voltages—some hundreds or thousands, such as are yielded by an induction coil or, preferably, some source of constant high potential. The phenomena presented are very varied and of a complexity which has even now been only partly cleared up. Though negative ions may play some part, the current passing through the tube is, in general, carried almost entirely by electrons and positive ions. Their interdependence and essentially different nature lead to the existence of space charges within the tube and surface charges on the walls, which markedly influence the type of discharge.

Pressure Effects.—If the pressure is relatively high—say 10 mm. of mercury—the discharge consists of a collection of sinuous and irregular luminous streamers. At lower pressures—say 1 mm. to $\frac{1}{10}$ mm. of mercury—the tube normally shows the following appearances: (*a*) the anode glow—a thin film of light over the surface of the anode; (b) the cathode glow—a thin film of light over the surface of the cathode, bounding which is the non-luminous Crookes dark-space, beyond which again is a second cathode glow bounded in turn by the ill-defined and somewhat transient Faraday dark-space; (*c*) the positive column, sometimes continuous, sometimes striated, occupying the main body of the tube and extending from the anode glow to the Faraday dark-space.

It has been shown that the value of the axial electric field is not at all uniform along the tube, but varies widely as we pass from one electrode to the other. At the anode there is a fall of potential, the extent of which depends only on the current and the nature of the residual gas and not on the nature of the anode. The anode fall appears to be due to an accumulation of electrons near the anode.

Cathode Fall.—It is at the cathode that the electrons or cathode rays originate by positive ray bombardment. Schuster, Wehnelt and others showed long ago that an obstacle placed in the Crookes dark-space cast a shadow both ways, as the approaching positive rays and the resulting electrons were simultaneously cut off. The electric field at the boundary of the dark-

space is small but increases linearly with distance from the dark-space boundary until it reaches a high value at a point very close to the cathode where it drops suddenly. The speed of the cathode rays normally corresponds with but little loss to the potential difference between the cathode and the boundary of the dark-space—the so-called "cathode fall." The cathode fall depends on the nature and pressure of the gas, the nature and area of the cathode, and on the current density.

The curiously sharp luminous boundary of the dark-space runs parallel to that of the cathode and is supposed to represent a region of ionisation by the cathode rays, together with recombination resulting in luminosity. It is inferred that, in general, there is a positive space-charge in the dark-space, while very close to the cathode is a negative space-charge due to the production of electrons by positive ray bombardment. The first cathode glow yields a line spectrum and Stark has shown that it shows the Doppler effect by reason of the rapid motion of the luminous particles towards the cathode.

The width of the Crookes dark-space is normally somewhat larger than the mean free path of an electron through the gas. The width depends on the current density and on the gas pressure, it increases as the pressure falls (F. W. Aston, *Proc. Roy. Soc.*, London, 1911) and is frequently used as a measure of the vacuum prevailing.

The positive column may present a uniform column of light or it may be striated, depending on the conditions. The distance between the striations increases as the pressure of the gas is reduced and the diameter of the tube is increased. The electric field in the positive column is fairly small, the conductivity being high. If the positive column is uniform the field is uniform; when the positive column is striated the field is periodic, being greater in the bright parts of the striation than in the dark. The field is very small in the Faraday dark-space, as in the adjacent cathode glow. In the case of the continuous positive column the luminosity is believed due to ionisation and subsequent recombination, produced by a stream of electrons which owe their ionising speed to space and surface charges in the tube. The striations are regarded as due to the insertion, so to speak, of a number of Faraday dark-spaces. The phenomena of the positive column are complicated and appear to be intermittent even with a steady exciting potential, pulses of positive ions and electrons being apparently ejected from the electrodes in opposite directions with different velocities. Whiddington (*Proc. Camb. Phil. Soc.*, 1924) has shown that periodic flashes of luminosity move from anode to cathode with a speed and frequency which increase as the gas pressure is reduced. These flashes do not show the Doppler effect.

With higher rarefactions—say $\frac{1}{10}$ to $\frac{1}{100}$ mm.—the positive and negative glows lose shape and luminosity, and the Crookes dark-space grows at the expense of all else. As its boundaries reach the walls they begin to fluoresce with an appearance well known to users of gas X-ray tubes. The exhaustion may ultimately be pressed until it becomes impossible for a discharge to pass in a tube with cold electrodes.

It was with a suitably designed discharge tube that J. J. Thomson first demonstrated the existence of electrons. By using a perforated cathode and allowing the positive rays to stream through, J. J. Thomson and later Aston made measurements of the masses of these positively charged atoms of gas and obtained results which have thrown striking light on the question of the isotopes (*q.v.*) of a considerable number of elements. Incidentally, the positive rays are responsible for two well-known effects with discharge tubes—the pulverisation and "sputtering" of the cathode, and the bombardment and disintegration of the glass walls round the cathode.

In the case of Coolidge X-ray tubes and wireless valves the vacuum is so high that the positive rays play no effective part and the discharge phenomena are considerably simplified. Further, if a Leyden jar discharge is employed for a vacuum tube in which an appreciable amount of gas still remains, the discharge passes as a uniform continuous column stretching from anode to cathode without interruption.

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VAIDA-VOEVOD, ALEXANDRE (1871–), Rumanian statesman, was born at Olpret (Transylvania) in 1871. He studied medicine in Vienna and practised for many years at Karlsbad (Karlovy Vary). At the age of 28 he joined the National Rumanian party of Transylvania and from 1906–18 sat in the Hungarian Parliament at Budapest, where he waged a permanent fight in defence of the Rumanians in Transylvania. On the collapse of the Central Powers in the autumn of 1918, Dr. Vaida-Voevod was instructed by the newly formed "Rumanian national committee," to voice their claims in the Hungarian Parliament. Invoking the right of self-determination he denied the right of the Hungarian Govt. to speak in the name of the Rumanians of Transylvania and claimed that the latter should have their own representative at the Peace Conference. Soon after, the Rumanian national committee took administrative control of Transylvania and delegated Dr. Vaida-Voevod to represent the Rumanians of Transylvania and the Banat at the Peace Conference in Paris.

In 1919 Dr. Vaida-Voevod was appointed Prime Minister and Minister for Foreign Affairs of Rumania and in the latter capacity went to Paris and London early in the following year to negotiate with the French and British Governments the recognition of the union of Bessarabia with Rumania. This he succeeded in doing in March 1920 when the rights of Rumania over Bessarabia were recognised by the Supreme Economic Council, and afterwards ratified by the Treaty of London Oct. 28 1920. Dr. Vaida-Voevod resigned in the same year and afterwards sat in Parliament as one of the leaders of the National Rumanian party.

VAIL, THEODORE NEWTON (1845–1920), American capitalist, was born in Carroll co., O., July 16 1845. Educated at the Morristown Academy, N.J., for two years he studied medicine. Meanwhile he had become interested in telegraphy. In 1868 he became station agent and telegraph operator on the Union Pacific at Pine Bluffs, Wyoming. Then he was appointed clerk in the railway mail service, and his efficiency led to his being made in 1873 assistant superintendent of railway mail service, rising in 1875 to general superintendent. In 1878 he was made general manager of the American Bell Telephone Company. In 1885 he resigned and was elected president of the newly organised American Telephone and Telegraph Co., which in 1900 acquired the American Bell Telephone Company. In 1887 because of ill-health Vail retired.

During a visit to South America he studied traction problems, and in 1896 installed an electric railway system in Buenos Aires, and later introduced telephone systems in many South American cities. In 1907 he was again induced to accept the presidency of the American Telephone and Telegraph Company. When this company in 1910 bought control of the Western Union Telegraph Co., Vail was made president of the latter also, and introduced many changes, including "night letters" at reduced rates. When in 1914, as the result of a threatened suit by the Government, the Western Union was again segregated, Vail remained president of his old company. After the taking over of the wires in Aug. 1918, by the Government as a War measure, he was appointed advisor by the postmaster-general. When the wires were returned in 1919 to private ownership he was elected chairman of the board of directors of the American Telephone and Telegraph Company. He died in Baltimore April 16 1920. See A. B. Paine, *In One Man's Life* (1921).

VALPARAISO, Chile (*see* 27.865) has a population of about 185,000. Its modernisation may be said to date from the earthquakes of 1906–7. From ashes and débris streets were widened and paved, better business structures gradually arose and modern sewerage provided a cleaner city. A striking feature of the newer Valparaiso is the increased height of the buildings, many being five or more stories. Harbour improvements, begun

in 1912, represent an outlay of several million pounds. The great depth of the water retards progress, but two breakwaters, building outward from opposite shores of the bay, have attained sufficient length to protect shipping. Eventually 220 ac. of water space will offer protection. In 1923 vessels began to dock at modern piers; a mile of semi-circular stone seawall, scores of new warehouses, modern cargo-handling machinery serve annual imports of 700,000 and exports of 400,000 tons.

The city's civic improvements are striking and beautiful. The Chilean Naval Academy buildings and fine residences are located on heights overlooking the bay. Improved roads connect the upper and lower city. There are numerous passenger elevators. The suburban resort, Viña del Mar, is noted for its splendid buildings, amusements, flowers and society. A railway 117 m. to Santiago, electrified in 1924–5, relieves port congestion. From Valparaiso good highways are gradually extending inland and to the capital. All classes of motor cars are multiplying. Public utilities, advertising and homes are using electricity to an increasing degree. Valparaiso province has about 600 manufacturing enterprises. Factories in or near the city are producing railway cars, clothing, furniture, wagons, shoes, soaps, perfumes and other classes of goods formerly imported.

VÁMBÉRY, ARMIN (1832–1913), Hungarian orientalist and traveller (*see* 27.876), died at Budapest Sept. 15 1913.

VANCOUVER, British Columbia (*see* 27.883), the fourth city of Canada and its chief Pacific port, had an estimated population of 230,000 in 1923 (the suburbs of North and South Vancouver and Point Grey included). The population of Vancouver proper was 117,217, including about 10,000 Orientals, in 1921. The increasing Oriental trade and the shipping of wheat to Europe by way of the Panama Canal have revolutionised the status of the port in recent years. In 1912 there were no shipments of grain or flour, but in 1924 53,240,500 bu. of wheat passed through the harbour. In 1912, 9,382 vessels entered, and in 1922 16,641 with a larger tonnage than that of Montreal in the same year. The wheat storage capacity of the port is now very large, and the whole crop of Alberta can be handled. The export trade is particularly active when the Great Lake ports are closed by ice. Trade is increasing rapidly also in other directions, especially in the export of lumber.

Harbour improvements include two large piers, one built by the Canadian Pacific Railway and one by the harbour commissioners, which increase the capacity of the port for coastal shipping by 35%. Twenty-four sea-going vessels can now be berthed at once, and further works are in hand. The port is a terminus of the Canadian Pacific and Canadian National railway systems and of over 50 steamship lines. Industrial development is also proceeding rapidly, especially on Granville Island, a large block of reclaimed land near the business district. South Vancouver is a separate municipality, mainly industrial, with a population of 32,182 in 1924. North Vancouver, on the north shore of Burrard inlet, nearly two miles from the centre of the city, had a population of 13,200 in 1921, and a bridge to connect it with Vancouver proper was in course of construction in 1924. Point Grey, with a population of 22,000, is a growing residential suburb to the south and west of Vancouver. The permanent buildings for the University of British Columbia, which has absorbed the British Columbia branch of McGill University were begun at Point Grey in 1921. Stanley Park, an area of virgin forest, is now the property of the Dominion.

VANDERVELDE, EMILE (1866–) Belgian statesman, was born Jan. 25 1866 at Ixelles near Brussels. He studied law at Brussels University and in 1885 took his doctorate in social science. In the following year he joined the Belgian Labour party and soon became its acknowledged leader. He first entered Parliament in 1894 as socialist member for the Charleroi constituency, but after 1900 was returned continuously by Brussels. In the Chamber he achieved both influence and prestige and played a prominent part in the struggle to attain universal suffrage, a struggle which resulted in more than one national general strike. On the outbreak of the War, Vandervelde devoted himself to the problems of national defence, the liberation of his invaded country, and in Aug. 1914 was summoned to join the Government as minister of state, later becoming member of the Cabinet. At the time of the peace negotiations and the signing of the Versailles Treaty, he used his influence to obtain the insertion of labour clauses, relating especially to the eight-hour day. As minister of justice in the "Liberal-Catholic-Socialist" Cabinet formed after the War, Vandervelde effected great humanitarian and scientific reforms in the prison system. After the important successes achieved by the Labour Party at the general elections of 1925 he entered the "Socialist-Catholic Coalition" Cabinet as minister for foreign affairs and played an important part in negotiating the Locarno Pact in 1925, which he signed on behalf of Belgium.

Considered by some to be the most powerful socialist orator in the French language since the death of Jaurès, Vandervelde has played a very conspicuous rôle in all the international socialist congresses since the beginning of the present century. His speeches in the congresses of Amsterdam (1904), Stuttgart (1907), Copenhagen (1910) and the Berlin international conference of 1922 were epoch making. In 1922 he went to Moscow to defend before the Soviet tribunal the "Revolutionary Socialists" threatened with capital punishment by the Bolshevik authorities, and managed to save their lives. He was for many years president of the international socialist bureau, and it was due to his interest in the education of the working classes that the "artistic section" of the Brussels "house of the people" was formed in 1891. In 1924 Vandervelde was made professor of political economy at the University of Brussels. He wrote for this *Encyclopædia* part of the article on Belgium and was elected a member of the Belgian academy of moral and political sciences.

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(J. Lo.)

VAN DYKE, HENRY (1852–), American writer, was born at Germantown, Pa., Nov. 10 1852. He studied at the Brooklyn Polytechnic Institute, Princeton University (M.A., 1876), the Princeton theological school and the University of Berlin. In 1879 he entered the Presbyterian ministry, being pastor at Newport, R. I., and from 1883 to 1900 pastor of the Brick Presbyterian Church, New York City. In this capacity his preaching gave him a national reputation. From 1900 he was professor of English literature at Princeton. During 1902–3 he was moderator of the Presbyterian Church in the United States. In 1908 he was appointed American lecturer at the Sorbonne and in 1913 was appointed, by President Wilson, minister to Holland and Luxembourg, but resigned in 1917 to enter the U.S. Navy as Lt.-Commander, Chaplains' Corps.

His books, both prose and in verse, give him a high place in modern American literature. Among his best works are his "outdoor essays," especially *Little Rivers* (1895) and *Fisherman's Luck* (1899). His other publications include *The Reality of Religion* (1884); *Days Off* (1907); *The House of Rimmon* (1908); *Out-of-doors in the Holy Land* (1908); *Collected Poems* (1911); *The Unknown Quantity* (1912); *Fighting for Peace* (1917); *The Valley of Vision* (1919); *Camp-Fires and Guide-Posts* (1921); *Half-Told Tales* (1925).

VAN HORNE, SIR WILLIAM CORNELIUS (1843–1915), Canadian financier (*see* 27.894), died at Montreal Sept. 11 1915.

VAN'T HOFF, JACOBUS HENDRICUS (1852–1911), Dutch chemist and physicist (*see* 27.896), died at Steglitz, near Berlin, March 1 1911.

VAPORISATION: *see* HEAT.

VARIABLE TRANSMISSION GEARS.—This article is concerned only with variable transmission of power, and not merely variable speed transmission, otherwise it would have to include the consideration of a multitude of appliances such as speed indicators, integrators and many kinds of calculating machines.

Power transmission gears may be divided into two classes (1) that in which there is a step by step change and (2) that in which

the change is gradually effected and an infinite range of velocity ratio is possible.

Step by step variable gears are familiar to all who have passed through an engineer's workshop, in which lathes, drilling machines and other tools operated by stepped belt pulleys or trains of wheels of different size, these devices being employed to effect variable transmission. A familiar example on the roads is the motor-car, in which with very rare exceptions the change of speed is effected by means of a gear box containing a number of different sized pairs of tooth wheels, arranged so that a change of speed can be effected at will by operating a gear lever. On the other hand infinitely variable transmission is less familiar and until comparatively recent times had no particular application except for very light powers. The increasing employment of infinitely variable transmission is due to the fact that the electric motor, steam turbine, but most of all the internal-combustion engine (*q.v.*) have for many purposes superseded the steam engine. One feature of the greatest value in the steam engine is its flexibility, the inferiority in this direction of other kinds of motive power being very marked. Hence there have been continual attempts to find either by frictional, electric, hydraulic or other means some form of infinitely variable transmission.

A case where variable transmission would constitute a vital factor is the heavy locomotive, and here up to the present no effective variable transmission has been devised which can replace the flexibility of the steam locomotive, although there are enormous tracts of country where water is scarce, which the internal-combustion locomotive might open up to civilisation.

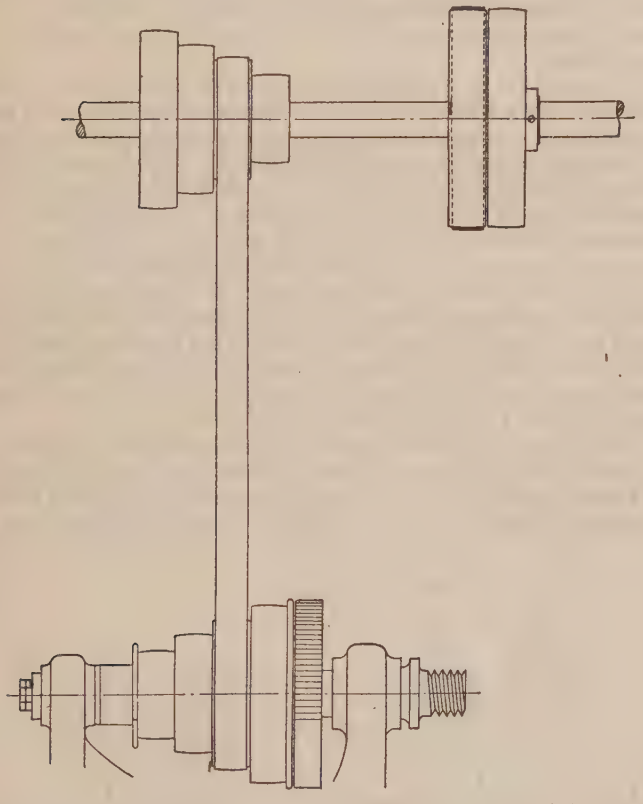

FIG. 1.—Diagram showing the step pulley system of frictional gear for an ordinary lathe.

Probably more inventive effort has been employed in finding some form of infinitely variable transmission for motor-cars than for any other purpose, but step by step mechanism with all its obvious disadvantages still holds the field, being up to the present superior in the two vital points of weight and cost.

Before proceeding to describe various types of variable transmission it must be understood that it is quite possible to vary the speed of transmission by a slipping clutch and claims are often put forward for such a clutch as effecting infinitely variable transmission. This, however, is not correct, being only a case of variation in speed by a direct loss of energy and not true variable transmission. The true test of variable transmission is as to whether it fulfils, at any rate approximately, what is called the Law of Work that "what is lost in force is gained in speed" and vice versa. Thus, for instance, apart from the unavoidable loss of efficiency due to friction either with a train of wheels or a combination of belt pulleys, these obey the law of work and overcome a greater resistance by a corresponding reduction of speed. On the other hand, if a lesser resistance is to be overcome the rate of operation can be proportionately increased by suitable alteration of the train of wheels employed.

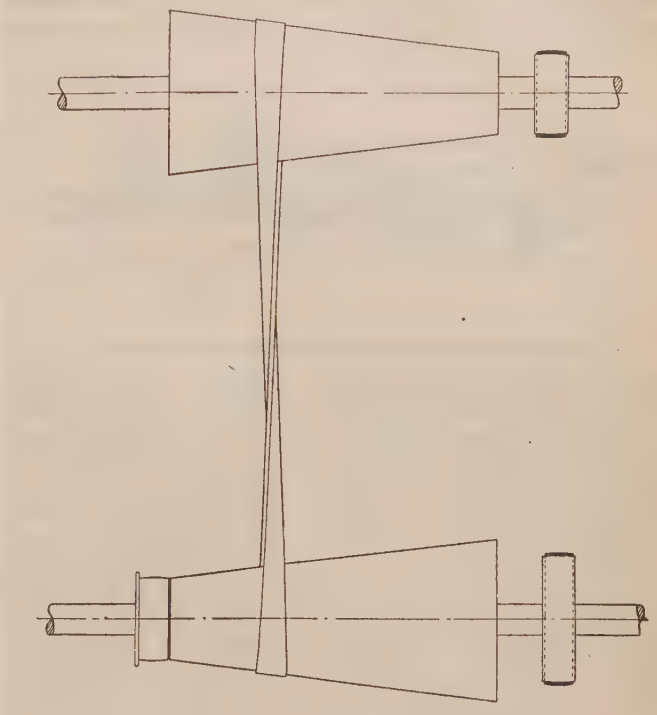

FIG. 2.—Diagram showing an infinitely variable transmission by pulleys.

Classification of Methods.—In order to understand the different types of variable transmission they may be classified under the

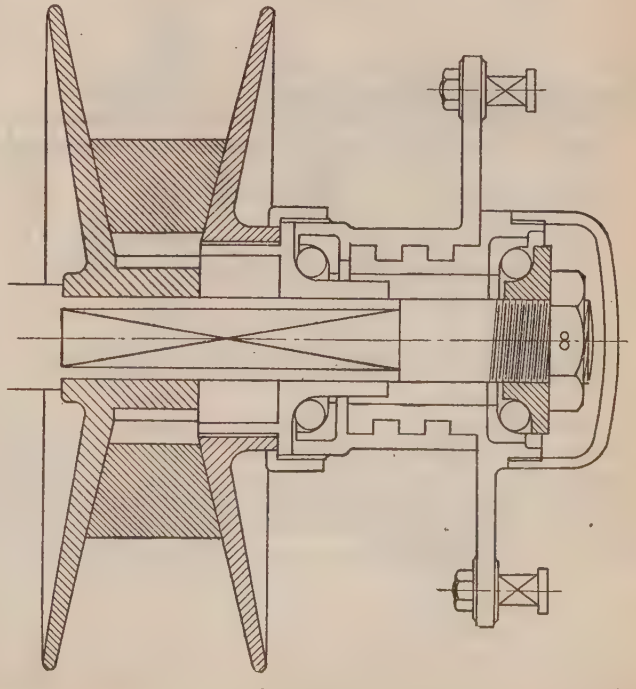

FIG. 3.—Modern form of variable transmission, as applied to motor-bicycles.

following heads: Frictional, Mechanical, Pneumatic, Electric and Hydraulic.

Frictional.—Fig. 1 shows the step pulley system for the ordinary lathe, the lower series operating in the headstock of the lathe, and the upper on the driving shaft. As the belt is shifted from left to right off and on the different pulleys the speed of the lathe can be increased; or when from right to left the opposite

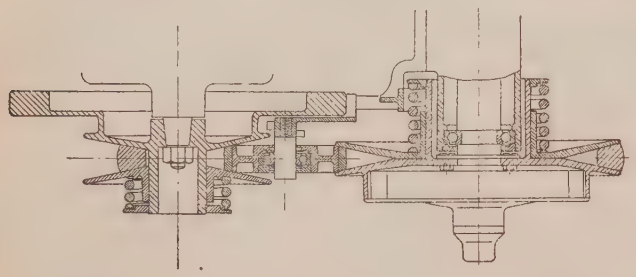

FIG. 4.—Cross section of pair of expanding pulleys.

effect is obtained. Corresponding to step by step movement, fig. 2 shows an infinitely variable transmission by pulleys which forms part of the cotton spinning device of Houldsworth invented just a century ago. Here the variation of speed between the driving and driven pulleys is obtained by shifting the belt to and fro along drums of nearly conical form. Fig. 3 shows a modern form of variable transmission as applied very successfully to motor bicycles. Here the pulley is of a "V" shape, shown in cross section, and having driving and driven pulleys both capable of expansion and contraction. This expansion or contraction is effected by shifting in one direction or another the conical movable side of the pulley. The closer the sides come together the greater will be the effective diameter of the pulley. This device is given in greater detail in fig. 4 which figure shows the pair of pulleys in cross section. In the latter diagram it will be seen that powerful springs ensure that the driving belt shall be gripped on both pulleys, an idle wheel running between two pulleys in order to accurately secure the correct location of the conical surface.

A development is now taking place of this type of variable transmission for larger powers. Fig. 5 shows how the variation of the distance apart of the conical sides of a driving and driven pulley is effected when much power has to be transmitted. The hand wheel (*a*) operates a combination of worm and worm wheel (*b*) so as to turn to other worms (c_1c_2) and thereby move levers,

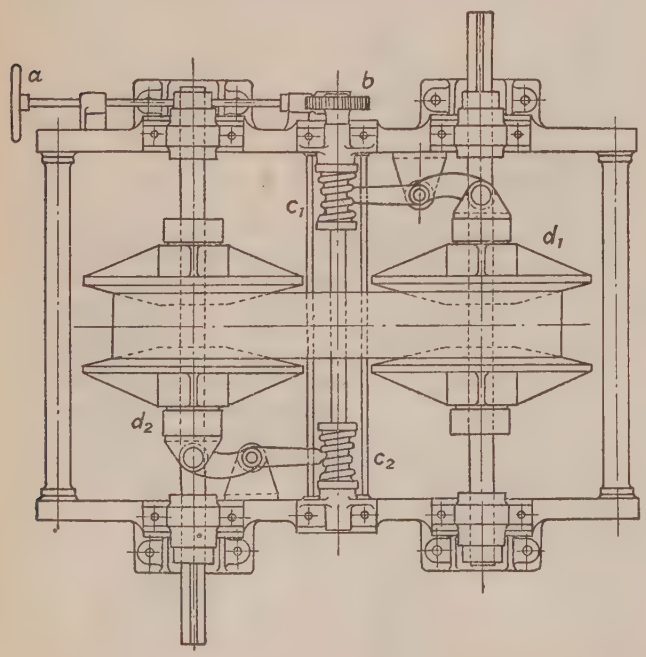

FIG. 5.—Diagram showing how the variation of the distance apart of the conical sides of a driving and driven pulley is effected when much power has to be transmitted.

which respectively operate the movable cheeks (d_1d_2) of the conical pulleys either inwards or outwards. Probably the oldest type of infinitely variable gear is that shown in fig. 6, in which a friction roller is moved edgeways to and fro on the disk or circular flat plate *p*. If, as in a certain type of motor-car, *r* is the

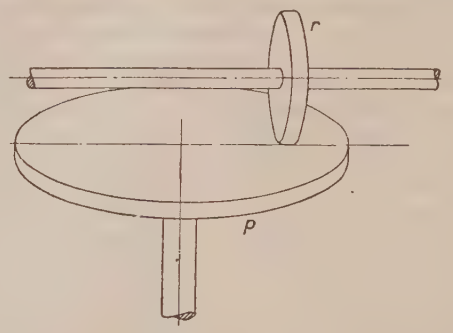

FIG. 6.—Infinitely variable gear in which a friction roller is moved edgeways to and fro on a disk.

driver, the speed of the driven disk *p* is least when *r* is nearest the edge, and the greatest driving force is then obtained. On the other hand, when *r* has approached towards the centre of the disk *p* the greatest speed is obtained with corresponding reduction of driving force. The power transmitted with this gear is however comparatively small as it depends entirely on frictional contact of the surfaces and the wear of the frictional surfaces is considerable.

A novel type of variable friction gear was exhibited at the London Power Exhibition in 1885, operating a sackhoist. This transmission, although not of much practical importance, has certain interesting features, and although not used for power purposes has been largely employed as a spherical integrator. The principle of operation is the movement of a sphere which in the above case was a steel ball. This sphere was supported in a frame by four friction rollers, the frame being pivoted on a vertical axis. In contact with the sphere, in a horizontal plane, were the driving and driven rollers, the axes of which were at right angles to each other. By swivelling the frame the relative velocities of driving and driven wheels could be altered between any required velocity ratios; a discussion of the theory being given in *Phil. Trans. Roy. Soc.*, Part II. 1885.

Mechanical.—Variable transmission of mechanical kind can be said to be practically confined to the employment of trains of toothed wheels. The most familiar case of all is that of a lathe headstock shown in fig. 7, in which by coupling up the largest

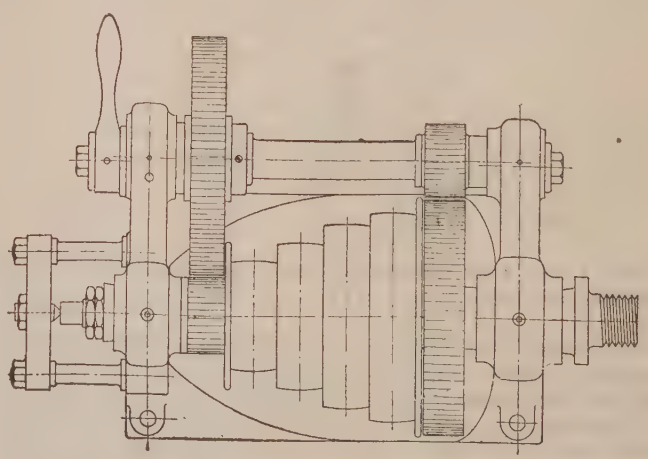

FIG. 7.—Variable transmission as used in a lathe headstock.

step pulley to the spur wheel to the spindle of the headstock a direct drive is obtained from the speed pulleys. If this coupling is released and by means of a handle shown in the figure the back axle is approached to the main spindle so as to bring into engagement the two pairs of tooth wheels, the driving now takes place through the pinion driven by the step cone pulley

through the axle shaft, and back to the lay spindle. Increase of driving force is thus obtained which in the present example is nine times as great as by the direct drive.

Fig. 8 shows the clutch type of motor car change speed gear box, in which the engagement of different ratios of spur wheels and pinions is obtained by sliding the teeth sideways into mesh with each other. This is called the "clash" engagement. In

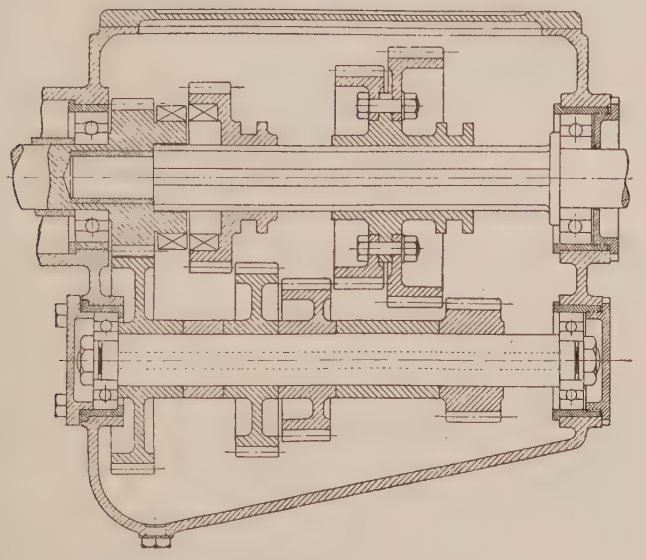

FIG. 8.—Clutch type of motor car change speed gear box.

this diagram the whole transmission is shown out of gear. In another type of gear box no such sideway sliding takes place, the teeth of the respective wheels being always in mesh with each other. Change of gear is effected by sliding the different jaw clutches into engagement with each other.

For many years inventors have aspired to produce an infinitely variable mechanical transmission on the principle of ratchet motion, in which by altering the positions of the fulcrum of a lever operating a driving pawl, relative variation of force and speed is obtained without any variation in the driving effort. One form of this gear of extremely interesting character is a French invention by de Lavaud which operated quite effectively on a small motor car. More attention, however, has been attracted by the torque converter of Constantinesco. The latter is a ratchet gear, but has practically no resemblance to the gear of de Lavaud and appears to introduce an entirely new mechanical principle, in which as the velocity of the motor increases the inertia effect of a weight changes the position of the fulcrum of the lever and causes an impulsive effort to be given to what is called the secondary shaft by the movement of what is called the primary shaft. Although this gear has been applied both to a motor car and to a locomotive, as well as to other purposes with remarkable results, it can scarcely be said at present to be beyond the experimental stage, the difficulty of the invention being to find an effective friction ratchet, or as the inventor calls it, a "mechanical valve," which will satisfy all the conditions of practice.

Pneumatic.—Many attempts have been made to introduce pneumatic variable transmission since 1900 by Dunlop, Lenz, Lebach and others. The best account of these pneumatic devices as applied on a large scale to locomotives was given in *La Revue Générale des Chemins de Fer*, May 1923, by Brillé. Up to the present these devices, though extremely interesting and ingenious, have not proved efficient in practice.

Electrical.—Various inventors have suggested continuously variable electric change speed gear. As already explained a mere reduction of effort by interposed resistance is not a true variable transmission, and all the most important examples of real variable electric transmission as on electric railways, is of essentially a step by step nature. Locomotive systems such as Crochat's mine locomotive, the loco-tractor of Moyse, those of Westinghouse, of Sultzer Diesel and Dewa are on the same fundamental principle as the Tilling-Stevens electric transmission, namely, production of electrical current by a dynamo from an internal-combustion engine and the operation by an electric motor of some form of gearing to turn the wheels. In the electric railways there is no variable transmission apart from the driving motor itself, and as far as the writer is aware there are no cases on a large scale of an internal-combustion motor operating directly through self-contained electrical variable gear.

Hydraulic.—The last form of transmission, and in its development the most recent, is hydraulic transmission. A beautiful device by Hastie was described as long ago as 1881 in the 9th Edition of *The Encyclopædia Britannica*, in an article on Hydromechanics. By means of two springs the stroke of the crank *can be altered*, when the crank pin slides in *a groove*.

When the effort is great the springs are compressed and the stroke is increased correspondingly, enabling a constant hydraulic pressure to overcome a variable resistance. This resistance may vary within wide limits, with the corresponding economy in the matter of the fluid employed. In the foregoing case the working fluid was water supplied by a high-pressure hydraulic main on the principle first introduced by Armstrong. Modern hydraulic variable gear in which oil is the working fluid has been brought into extensive operation chiefly to enable electrical power to overcome very variable resistance without unduly causing a rise in the ampères transmitted. The principle of operation is exactly identical with the generation of electrical current by a dynamo, which current is transformed into mechanical effort by an electrical motor. In the case of hydraulic transmission, however, a variable stroke pump is employed to produce a flow of incompressible fluid, generally oil, which operates in a hydraulic motor. Thus it is only necessary to effect a change in the stroke of the pump when any required hydraulic pressure can be obtained without unduly increasing the driving effort on the pump.

Hydraulic variable gear has been employed for a great variety of purposes such as cranes, lifts, winches, tipping wagons, rail cars, gun mountings, planing and broaching machines, swing bridges, etc. The chief types of these gears may be distinguished as parallel and radial. Fig. 9 shows a section of the Janney-Williams gear (either pump or motor) which is an example of the former type, and it will be seen that the variation in effort is attained by varying the angle of what is known as the swash

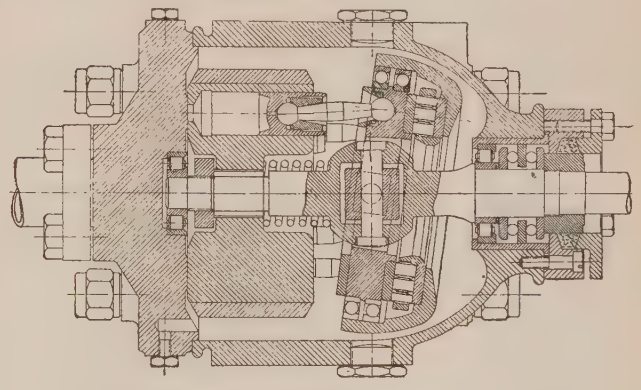

FIG. 9.—Section of the Janney-Williams hydraulic variable gear.

plate, with the result of altering the stroke of the pistons. As the stroke is reduced the working pressure can be increased; thus when the stroke is very small a very great pressure can be produced and consequently great resistance can be overcome. The necessary valve action is obtained by causing the opening at the inner end of the cylinders to pass alternately in succession supply and exhaust ports.

Fig. 10 shows the operation of one radial type pump. The cylinder body revolves about a fixed axis which forms a cylindrical valve. As the cylindrical body revolves, the working fluid is alternately admitted from and exhausted into the two ports *a* and *p* respectively. The fluid comes in under no pressure from the

port *a* and is driven out under any required pressure from the port *p* along the shaft. In order to obtain any required variation of pressure the frame to which the connecting rod ends are attached is made to pivot about the fixed centre *c* by a rod attached

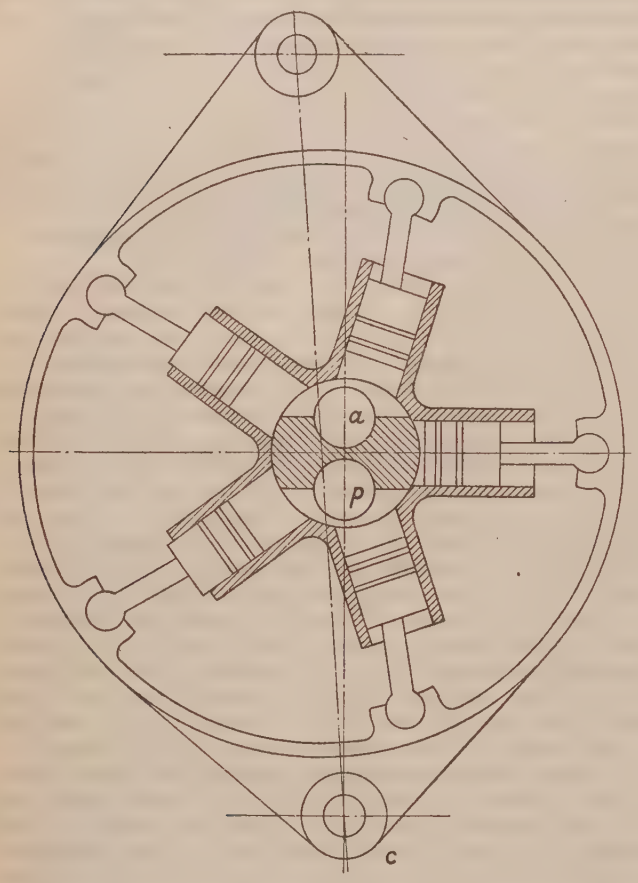

FIG. 10.—Diagram showing the operation of one radial type pump.

to the upper end of the frame. In the middle position there is obviously no stroke, and when the neutral position is passed the direction of flow is reversed.

Two views of another type of radial stroke pump are shown in fig. 11 (Hele-Shaw Pump), the left-hand view being in half section, the lower portion of which shows *ff* a revolving case

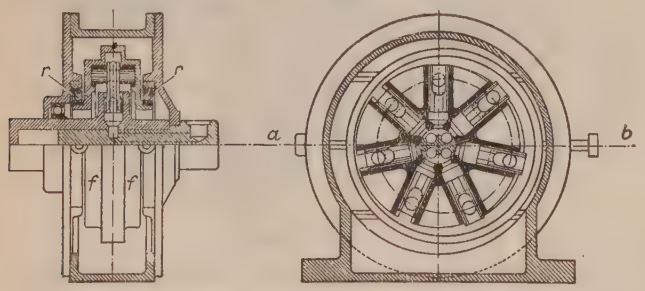

FIG. 11.—Two views of the Hele-Shaw radial stroke pump.

called the "floating ring." The sectional portion in the view shows that this floating ring is carried on ball races *r* and *r*, their object being to reduce the frictional wear of the rollers or slippers by allowing the floating ring to rotate freely with the cylinder body, in which the pistons are carried. If the floating ring is moved bodily along guides on the line *a-b* (shown in the other view) the stroke of the pistons and the fluid pressure can be varied as required, just as in the previous example. The action of the fixed cylindrical valve is exactly the same as in fig. 10, the employment of the four cylindrical passages in the shaft instead of two being simply a matter of design.

While the floating ring is found to give almost indefinite life to the pump there was a characteristic hum or noise which was after years of research traced to the same deformation that produces the sound in a bell. The latest form of radial variable stroke radial pump, while employing the same type of cylindrical valve is found, when properly designed, to be almost silent. The floating ring is dispensed with, variation of stroke being obtained by allowing the pistons, which work inwardly instead of outwardly, to be operated by the equivalent of a crank in the form of a live ring mounted with roller bearings on a compound eccentric. The compound eccentric consists of two parts of equal eccentricity, the stroke varying mechanism being arranged to effect rotation of these two parts in opposite directions with the result that the resultant eccentricity may be varied at will from zero to maximum in either direction. This gear was fully described in *Engineering*, Oct. 16 1925.

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VARIETY THEATRE (*see* MUSIC HALLS, 19.87).—The history of the European variety theatre since 1911 is a regrettable chronicle of the gradual decline of an old and hitherto extremely popular form of entertainment, and its waning hold upon the imagination and support of the public at large. In the quarter of a century preceding the War the variety stage generally had evolved to a position of paramount importance in the entertainment world. It touched the zenith of its popularity in the first decade of the 20th century since when it has retreated from popular favour with markedly greater rapidity than it had previously advanced.

The reasons for this decline are manifold. In the first place and to the most superficial observation, it is clear that the principal requisites of successful variety entertainment, that is, performers of exceptional ability endowed with magnetic personalities, have not been produced during the present century in sufficient numbers to maintain the music hall as a whole in its former pre-eminence. In the case of the British industry, for example, the great artists of the earlier generation, who delighted the public from end to end of Great Britain and whose names were household words throughout the Empire, have not been replaced in any sense by the younger generation. The death in the early years of this century of Dan Leno, the greatest, probably, of all entertainers in this particular field was an irreparable loss and in its way marked the beginning of the end of the era of variety. Leno possessed in the greatest measure that personal histrionic art which, while it inspired laughter, touched also often so nearly on tears.

The Art of Personal Exploitation.—The art of the music hall is essentially the art of personal exploitation. It differs from its sister art of the theatre in that the variety artist has to create his own mood almost without the aid of any intermediary. He is directly face to face with his audience and, broadly considered, his principal effects are those of personality accompanied, of course, by technique. But, primarily, it is the individuality of the performer rather than his choice of material which determines his success or failure. Leno, like all the finest artists of the music hall, such as the French clown Grock, relied but little upon his material. But his self-exploitation was entertaining and apparently illimitable. Leno stands, and will probably stand for all time, as the personification of the British music hall at its best and most successful. Marie Lloyd, who died in 1923, was another artist whose popularity was only equalled by her remarkable abilities. She, like Leno, was unsparing of her gifts and like him, too, she had at command that authoritative persuasion of an audience which is so rare a gift but which is always essential to the highest achievement of the histrion.

Another supreme product of the British music hall was Albert Chevalier whose Cockney characterisations expressed the London of his time as directly, as intelligibly and as sympathetically as

Yvette Guilbert expressed the Paris of the '90's. Chevalier possessed a remarkable gift for assuming character as well as for exploiting his own characteristics. His art therefore partook, more than did that of many other leading music hall performers, of the "legitimate" drama. Among the great impersonators one who has left the variety stage the loser for her retirement is Vesta Tilley, who, in her own field of male impersonation, stands unapproached. All these artists, with many others who have died or retired and others who still appear, were the direct product of a régime very different from that obtaining in the present world of vaudeville. To understand how such a great number of performers could have appeared in one generation, it is necessary to glance back at the evolution and conditions of the theatre which produced them.

Origins of the British Music Hall.—The British music hall, like its continental similars, derives primarily from the smoking concert or "free-and-easy" of early Victorian times. To these informal concerts, usually associated in the first instance with licensed premises, came a number of amateurs or semi-professional entertainers who plied their trade of amusement in a more or less haphazard way. That is to say, the majority were not in the true sense of the word professionals at the outset. Those who merited popular appreciation naturally became assets of the managements concerned and gradually attained professional status owing to the continuous demands upon their services. From such humble beginnings was the great British music hall industry developed. The next phase followed naturally from the first. The "free-and-easy" established itself as the small music hall, giving regular nightly or twice-nightly performances, and by the middle of the 19th century numerous music halls were carrying on a prosperous trade.

The artists of this régime were in direct contact with their audience. They had to establish themselves as entertainers or step down to give place to others more capable. But the decentralised control of the early music halls (and this is true of the continental houses as well as the British) meant that each proprietor sought for talent suited to his own particular public. It was therefore possible for an individual artist to familiarise himself with a more or less specialised audience. If he succeeded he might move on to wider conquests. But he had ampler opportunities than does the variety performer of to-day of testing his personality, his talent and his material and in winnowing the chaff from the grain.

The managements, too, were in a more direct relationship to their immediate public than are the directorates of the big syndicates who nowadays control practically the whole world of variety. Thus a more intimate personal relationship, so vital to successful showmanship, was a feature of the earlier variety world and thus were brought to fruition the talents of the great race of music hall performers.

Syndicates and the Decline of Variety.—When once these artists had created a prosperous industry, however, a system of managerial exploitation very different from this personal direction began to evolve. During the early years of this century vast syndicates "cornered" variety. The inevitable sequel to this amalgamation and centralisation of control was reckless speculation in the leading personalities. "Star" salaries beyond the most avaricious dreams of the old performers began to be the order of the day. Artists of any standing were given long-date contracts at long prices. The few big syndicates rivalled one another in luring under their management all established artists. But that very lack of personal management, so evident in the syndicate system, was destined to affect disastrously the prosperity of the industry which the syndicates monopolised. For syndicate control has notably failed to encourage and advance the art of the emergent performer and in the course of a very few years the race of the giants was without succession. With a decreasing number of powerfully attractive personalities, the music hall began to languish.

The internationalisation, or rather denationalisation, of the music hall has further depreciated its attractiveness, especially in so far as European countries are concerned. America with its cosmopolitan public and with its very considerable proportion of Jewish theatrical patrons is in a somewhat different position. In Great Britain, France, Germany and Austria, however, there is no doubt that the music hall since 1910 has suffered from the decrease in the embodiment of national character and characteristics on the various vaudeville stages. This is another aspect of the changed conditions of financial control which has led to a measure of international exchanges of talent comparatively unknown in former years. In the British music hall, for example, artists like Sir Harry Lauder, J. W. Rickaby, George Robey, George Formby, Harry Weldon, Nellie Wallace, Lottie Collins, Louie Freear and many others characterised or caricatured a person, a district or a race easily recognisable and intimately observable by the public. They made the art of the music hall as familiar almost as the very households of the public. The cosmopolitanisation of variety has produced nothing to replace this attractive homeliness.

Revival of Vaudeville in France.—The character song is the backbone of the best and most successful of music hall entertainments and, while the dearth of this is perhaps more than anything else responsible for the waning attraction of present-day vaudeville, it is to be noted that in France a most significant revival of the typically national lyric, suitably set to music, has sponsored a very definite revival of popular esteem of variety. French vaudeville is indeed recovering rapidly its hold on the public. Like the British "free-and-easy" the French café-concert was almost wiped out. Fortunately, however, extinction was not complete and the recent success of the great Parisian music halls, Olympia and the new Empire, have profited by their encouragement of French music hall singers. The *chanson* has again become a part of French national life. This revival was in part assisted by the encouragement of several of the favourite artists of an earlier generation to reappear on the music hall stage. Some of these *chansonniers* and the songs thus resurrected, renewed their former success in surprising fashion. Mayol and Yvette Guilbert, returning once more to the scenes of their former triumphs, are outstanding examples of this. Their performances have encouraged a number of new lyrists, composers and singers to develop their art to the advantage of the music hall industry as a whole. Aristide Bruant, the inimitable ballad singer of the Montmartre of other days, not long before his death in 1925 returned to delight the Parisian public and added a notable quota to the revival to neglected songs of the boulevard.

The French Press has been of great assistance to the new growth of interest in the music hall. Whereas in England the music hall, although tolerated and occasionally patronised by distinguished theatrical journalists, has never been taken seriously as a department of theatrical art, in France informed criticism and helpful publicity have been a feature of modern Parisian and provincial journalism. Another factor which has undoubtedly furthered the cause of French vaudeville has been the establishment in Paris of permanent circuses. These have created a desire for, and developed the talent of "dumb acts."

It is true that a tentative effort was made to re-introduce several of the once famous personalities of the music halls to the London public. Arthur Roberts, Charles Coborn and others were persuaded to appear in their former successes, being billed as "veterans of variety." But the British impresarios concerned in this venture seemed more concerned to show these masters to the public as oddities or freaks of entertainment and to indicate to the audience the strange tastes of the preceding generation than, following the example of their French colleagues, to revitalise the most important province of the art of the music hall, the characteristic song.

Syndicate control led also to great changes in the atmosphere of the entertainment houses. Vast palaces replaced the simple halls of other days and thus decreased the intimacy of contact between the stage and the public, thus requiring a broadening of the illusional effects of individual artists, whose very audibility indeed became menaced by the increasing size of the halls in which they were called upon to perform. The material or "numbers" used by artists have been disastrously "commercialised"

in like manner under the new system. Formerly any artist had virtual monopoly of his "business," "patter," "props" or songs. Now these are freely used by almost all comers who care to pay the fee for the performing rights. There is thus little encouragement to the individual artist to obtain or to the composers to provide first-rate exclusive material. Syndication has indeed reacted throughout most unfavourably upon the artistic appeal of vaudeville.

The Bane of "Refinement."—In response to sundry puritanical attacks on popular entertainment the refinement of the music hall began with this century. Artistically it may be said to have commenced with the appearance of Albert Chevalier. This great creator of Cockney types was, however, in no way responsible for the development of the so-called refining influence which robbed the music hall of its happiest and healthiest attributes and led to the transplantation to its stage of the worst elements of the concert-room and drama-house. Inferior musical turns, poor sketches performed by merely adequate "legitimate" artists were among the phenomena of attempted refinement, which actually only resulted in debasing the music hall as a whole.

The introduction of eminent dramatic artists in feeble one-act plays has done nothing to reflect credit on either the artists or the managements concerned. For it must be noted that the advent of artists with great reputations from other spheres of the entertainment world, whether dramatic or musical, has almost invariably been considered an act of condescension. This is generally unfavourable to the efficiency of variety because the technique of the music hall is a technique of its own, requiring immediate *rapport* between audience and player and a much more direct liaison between stage and audience than does the ordinary or concert performance. This technique is difficult to acquire and the only theatrical artists who have continued to hold the interest of the music hall public have been those who, like Chevalier, adapted, broadened and sharpened the dramatic technique to suit the needs of their new environment. The names of notable theatrical artists on the bills of the variety theatres have often proved a false promise, since the work which they have contributed has very seldom been up to the standard required. The introduction of big names unbacked by the "goods" has undoubtedly done definite harm to the industry. This is another aspect of the refinement of the music halls which must be in large measure ascribed to the introduction on the managerial side of amateur showmen, recruited from the ranks of accountants, lawyers and other professional men associated with the controlling syndicates, who have taken the place of the individual proprietors of other days.

Thus the decline of the British music hall has been brought about, and whereas French cabaret is continually providing new blood to revivify the French music hall no such revival is noticeable in Great Britain. For British cabaret seems content to avail itself of cosmopolitan and mostly American artists whose material is largely negroid or Semitic of inspiration and certainly reflects little or nothing of the characteristics of the various British folk-traditions. In Germany and Russia the divorce between the music hall and cabaret is almost complete, the Middle European music hall comprising almost entirely "dumb acts." Not only have theatrical illusion, strong character and robust comedy been driven out as a result of alleged respectability, but the characteristic costumes of the acrobats have given place to shirt and trousers or to the even more incongruous evening dress, and in other respects the old professional glamour has been almost abolished.

Officious interference which, with the consent of the syndicated directorship, thus made itself felt inside the music hall was also busy outside. The sale of intoxicating liquors, formerly an integral part of a variety entertainment, was soon limited to the bars and eventually the London County Council, the most important licensing authority, whose example was naturally followed by similar bodies in other districts, prohibited the sale of intoxicating liquors in all variety houses. Only towards the end of 1925 was this harassing, inconsistent and unfair regulation removed after sustained agitation carried on during a number of years by the entertainment proprietors immediately affected and backed by a considerable body of public opinion.

Other Adverse Influences.—The above must be considered the principal factors contributory to the decline in popularity of the music hall. But social changes have also had their effect. The World War provided a vast influx of prosperity to most types of entertainment. Concentrations of troops near the large towns, the passage of innumerable colonial and foreign migrants and the general desire to escape for a few hours from the stern realities of existence by the aid of entertainment, led to the expenditure at the box offices of a great deal of money which otherwise would never have found its way thither. But War-time vicissitudes undoubtedly reduced the artistic level of variety. A large number of entertainers were drawn to the colours, many gave their lives on the various European fronts and the careers of many more were harshly interrupted.

The later post-War years, which have witnessed a continuation of the pre-War decline of variety, have witnessed a very definite revival of the drama proper and of musical comedy. These have usurped to some extent not only the popularity but even the premises which were formerly devoted to vaudeville entertainment. This is distinctly seen in London where the Hippodrome is a more recent convert to the successful American type of musical comedy, which seems destined to oust the formerly popular Viennese type of operetta. The London Pavilion is now most successfully devoted to spectacular revue of the more cultivated type and the Palladium frequently houses revue productions of a more democratic style. The Empire, formerly a famous and much frequented variety theatre, has recently been the home of film and musical productions, even of "straight" drama. Innumerable provincial houses have likewise succumbed to the superior attraction of revue and cinema.

A remarkable exception to the general enfeeblement of vaudeville is the London Coliseum which, under the direction of Sir Oswald Stoll, has achieved a leading rôle in the entertainment world of London. This house, however, cannot be considered as a typical modern music hall. It is indeed a law unto itself, the individual product of discerning and novel showmanship. While its performances consist largely of variety turns, these are frequently reinforced by novel features. The frequent appearance at this house of items from the repertory of the Diaghilev Ballet, Comédie Française, productions by specialised dramatic troupes (*Sumurun* by a German company, the Scottish National Players, etc.) have added to the reputation of this unique and popular place of amusement.

Considerable developments of transport, excursion and holiday facilities both by rail and road, have naturally reacted upon theatrical entertainment. The great increase of athletic opportunities has caused sport to draw its quota from indoor amusements. The rapid growth of the cinema as a popular relaxation was probably the most serious rival of vaudeville in the years immediately preceding the War. But present-day tendencies seem to suggest that the cinema has touched the zenith of its popularity and the fact that many of the big film houses are interpolating variety acts into their programme (this is especially the case in America) has led those interested in the welfare of the variety artists to claim that the future of vaudeville may well lie in the direction of a considerable co-operation between this and the motion-picture industry.

Rise of Revue.—In spite of the enormous developments of the cinema during the period which we are considering, it is probable that the most serious rival of the music hall at the present time is revue. Attempts had been made before the War to promote entertainments in some way similar to the performances which have achieved conspicuous success on the Continent, either in intimate form, as the Capucines or Palais Royal (where *scènes d'actualité* were the principal items) or in spectacular style as at the larger music halls, Folies Bergère or Casino de Paris. Revue had long been a favourite pastime of the continental theatre-goer. It was, however, not until 1914 that revue as an art-form caught the imagination of the British public to any

considerable extent. With C. B. Cochran's production of *Odds and Ends* at the Ambassadors' Theatre, revue may be said to have been launched on its successful career in this country. This entertainment and its immediate successors were in the nature of *revues intimes*, but the first experiments proved emphatically successful and so much to the liking of the public that numerous other impresarios rapidly adopted this type of entertainment and proceeded to exploit it both in the London area and throughout the country.

Revue evolved from the intimate to the spectacular with astonishing celerity. It is probable that the emotions of War-time were in a measure responsible for the immediate and ready acceptance granted to this new type of entertainment. However this may be, revue certainly displaced both the legitimate drama and the older type of variety entertainment to a great extent in the various amusement resorts in Great Britain. Unfortunately the apparent ease of production and the elasticity of the revue-form led to its abuse by a number of inexperienced or incompetent managers. But revue at its best as an intermediate form between drama and the typical music hall bill has certainly recommended itself to a large and discerning body of theatre-goers. The ideal revue is no mere haphazard collection of numbers, no mere *pot-pourri* of music hall turns, dramatic sketches, dances and so on. Its ingredients need the most careful mixing. It must develop in as orderly a manner as a symphony, and the laws of revue composition, although unwritten, are as exacting as those of a pictorial design. In the past few years some of the purest gems of theatrical art have been seen in revue productions. Many scenic artists, actors, dancers and technicians of the theatre have developed their talents in this field and not a few others have found here a means for fuller self-expression than they have discovered in any other department of the theatre.

(C. B. C.)

The Variety Theatre in the United States

Beginnings.—As in England and on the continent, variety was one of the very early forms of theatrical entertainment in the New World. During the last decade of the 18th century, in most of the larger cities, resident theatrical companies presented alternately legitimate production, generally farces and comedies, and variety programmes. Company members and guest stars visited from one city to another, augmenting these local stock companies. In the last few years of the 18th century and the first of the 19th, variety became permanently dissociated from dramatic and operatic production, of which until then it had been an interlude or added attraction, and there began the policy of assembling complete programmes of music hall turns and specialty artists of varied talents.

At the beginning, variety was a theatrical stepchild. The halls in which variety had its birth in America were miserable enough, hardly better than stables. Frequently they were on the second storey, over stores, in rooms originally intended for dance halls. Such "theatres" generally eventuated casually, instigated largely by dance hall patrons who conceived the notion that they could jig, or sing. A brisk trade in refreshments augmented the rather informal entertainment. To facilitate this, patrons sat at tables. Sawdust or sand besprinkled the floor. Later variety theatres often had a museum adjoining, in which an exhibition of freaks, human and otherwise, served to amuse and attract the overflow.

The Period of Barnum and Tony Pastor.—By 1830 variety was an established and flourishing theatrical enterprise. Phineas T. Barnum, the great circus man, was early attracted to this form of entertainment. In 1835 in a hall on Chatham Street, New York City, his variety endeavours began with the exhibition of Joice Heth, later supplemented with Signor Vivallia, juggler and equilibrist of the Cinquevalli order. Adding several other attractions, he took this show on tour the following year, playing in a tent around the east and south, a forerunner of his circus activities. Back again in 1841, he continued variety for a short time in Vauxhalls Gardens, New York City.

Following Barnum there were numerous adventurers in variety. Between the days of his initial show in 1835 and the opening of Hoym's theatre in 1858, the first playhouse built expressly for variety, every one of New York's sixteen theatres was at one time or another given over to variety. But it was not until after the Civil War that variety acquired any firm foothold among American theatricals. In 1866 Tony Pastor, famous New York showman, took over the Hoym Theatre which he held for nine years.

The period was rich in personalities, in artists not excelled among stars of modern vaudeville. Many who later made their mark in legitimate drama were seen singly and in pairs in "acts" at Tony Pastor's, at Niblo's Gardens, at the Eagle theatre. Such supreme entertainers as Harrigan and Hart; Weber and Fields, whose low buffoonery was infinite artistry; the Four Cohans; Flo and May Irwin; Nat C. Goodwin, Jr.; the glorious blonde Lillian Russell; Montgomery and Stone; Hallen and Hart; Pat Rooney; Evans and Hoey; Maggie Kline; and Tony himself, were a few of the lights of those days.

Many of the prime successes in American variety were teams. Whereas the ballad and the popular song were the mainstay of European variety, the comedy sketch, generally enacted by two or more, was the *piece de resistance* upon American programmes. Often whole families appeared in such acts, as the Four Cohans, the Four Mortons, the Lauri Family and the Vokes Family.

Vaudeville.—Just when the word "vaudeville" began to be used in this country is not recorded. A program for Vauxhalls Gardens for August 1 1842 uses the word, and Tony Pastor employed it several times in 1877. In following years other managers took it up. But until the '80's it had no particular significance; it was merely a change from the overworked word "variety." Vaudeville as something to be distinguished from variety, as a revised and refined edition of the latter, came into being in 1882, conceived by a Boston showman, B. F. Keith, whose name has gone down in American theatrical annals as the father of modern vaudeville. He was an ex-circus man who started on his own as proprietor of a small dime museum and variety show in a meagre store building in the heart of Boston. His emporium differed from other variety houses in one particular feature—it was uniquely clean. In 1885 he was joined by Edward F. Albee, his eventual partner and successor, and present head of the Keith-Albee vaudeville circuit. Together they fought for Keith's dream of putting variety on a par with the legitimate theatre, a dream never quite attained but admirably approached.

In 1887 Messrs. Keith and Albee presented the first variety sketch with a legitimate star as principal. The star was Francesca Redding, a popular actress of the day. The success of that venture opened the way for a long parade of legitimate stars across the vaudeville stage. E. F. Albee enticed such dramatic celebrities as Maurice Barrymore, David Warfield, Ezra Kendall, Eben Plympton. An event of 1897 was the presentation of Clara Morris, then at the height of her legitimate career, in vaudeville at Keith's Union Square, New York. Her appearance moved one New York critic to write: "Vaudeville just now seems to be the goal of dramatic aspiration. We may yet see the day when the Divine Sarah will take it. But I can't help saying that I think not." Despite his thoughts, a few years later Bernhardt became one of the highest salaried and most popular headliners to tour the Keith Circuit. Edna Goodrich, Loie Fuller, Marie Tempest, Lily Langtry, Mrs. Leslie Carter and Phyllis Neilson Terry were a few more of the celebrities to grace the spotlight of American vaudeville. Concert and opera stars, legitimate actors and actresses no longer spurn vaudeville engagements; rather it has become the logical answer to a lull in their ordinary activities.

Public demands have made it necessary to augment motion pictures with vaudeville. This condition has resulted in several screen and variety mergers and a policy of presenting both forms of amusement at the majority of vaudeville houses. This idea seems destined, by force of popular demand, to rule, with exceptions only in the larger cities, in all variety houses, thereby combining two extremely popular theatrical factors on one programme.

(M. A. L.)

VASSAR COLLEGE (*see* 27.946d).—During the period 1910–25 the endowment of Vassar College grew from about $1,500,000 to $7,000,000 with 900 ac. in campus and farm. Student enrolment, formerly limited to 1,000, was increased to 1,150. The college has always maintained a full roster, admitting new students whenever vacancies occur. Some of the new students each year are admitted in order of application, provided they pass the entrance examination; but about one-third of the entering class is admitted on competitive examination. Plans call for enrolment exclusively by competitive examination after 1928. The funds available for student aid in one form or another amounted in 1926 to over $450,000. The physical equipment of the college, exclusive of faculty residences, includes 30 buildings, seven of them dormitories, a library containing 132,000 catalogued books and a farm of 675 ac., with vegetable gardens and a model dairy.

Student self-government is in effective operation, the students themselves assuming responsibility for most of the regulations governing attendance and conduct, for the management of the Students' Building and a Club House conducted for the maids; also for all extra curriculum activities, including the providing of various money-making occupations for self-supporting students. The price for rooms and board is the same for every student. The rooms are selected by lot. There are no sororities or other clubs to which membership is not absolutely open. No fee may be charged for admission to any campus building. All these facts help to maintain the democratic spirit of which the college is justly proud.

The increased endowment mentioned includes $3,000,000 pledged in 1921–2 for the increasing of teachers' salaries. The college in 1925 received a gift of $550,000 by Mrs. John W. Blodgett, of Grand Rapids, Mich., for the erection and endowment of a laboratory of "euthenics," a term comprising the sciences which contribute most directly to physical efficiency. This development is in keeping with the wishes of Matthew Vassar, founder of the college, to the effect that the curriculum should provide, in addition to other studies, those related to the fullest development of the primary interests of women in relation to parenthood and the family. (B. J.*)

VATICAN: *see* PAPACY.

VAUGHAN WILLIAMS, RALPH (1872–), British musical composer, was born at Down Ampney, Glos., Oct. 12 1872. He early determined on the pursuit of music, but his development as a composer was slow. At Trinity College, Cambridge, where he became Mus. Bac. in 1894, and at the Royal College of Music, where he studied with Parry and Stanford, his work made little mark. He seemed singularly lacking in the power of clear self-expression. The revival of English folk-song, however, in which he became absorbed, unlocked his latent creative powers. *The Norfolk Rhapsodies* for orchestra (founded on folktunes), and the symphonic impression *In the Fen Country*, on original themes of folk-song character, show his development. Other types of distinctively national music, notably the Tudor Church composers and Purcell, strengthened his technical resources and helped to determine his own style in the direction of vigorous melodic outline, the free use of model scales, an unflinching contrapuntal texture and a high-handed attitude towards harmony. Among poets, Walt Whitman specially attracted him, and his setting of *Toward the Unknown Region*, for chorus and orchestra (Leeds Festival, 1907), made its impression through the unaffected and sincere aspiration of the music and its close contact with the poem. *A Sea Symphony* for soprano and baritone soli, choir and orchestra (Leeds Festival, 1910), with the words selected from several poems of Whitman, was the crowning achievement of this period. *A London Symphony* for orchestra only (produced at the Queen's Hall, London, 1914) is a vividly imaginative piece in which poetry is discovered in such common places of London life as the noise of traffic and the street urchin playing a mouth-organ.

During the World War he served in the R.A.M.C. and later gained a commission as a gunner. Afterwards he took up his music where he had left it. *A Pastoral Symphony for Orchestra* (Royal Philharmonic Society, 1922) might be described as the deep breath of content which a man draws on recovering the wholesome sanity of the English country. A *Mass in G Minor* (Westminster Cathedral, 1923) is one of the noblest pieces of pure church music since Byrd's setting of the liturgical text for five voices. A choral work called an oratorio, *Sancta Civitas* (Oxford, 1926), shows the composer dwelling in a phase of mystic thought which he had already touched on in the scene for the stage from *The Pilgrim's Progress*, called *The Shepherd of the Delectable Mountains*. The ballad opera, *Hugh the Drover* (words by Harold Child), belongs to the earlier period when folklore and folk-songs were the primary inspiration of his work. As musical director of the English Folk Dance Society Vaughan Williams carried on the work which Cecil Sharp initiated. He also became conductor of the London Bach Choir and professor of composition at the Royal College of Music.

VAZOFF, IVAN (1850–1921), Bulgarian poet and novelist, was born at Sopot. In common with the founders of Bulgarian literature, Rakovsky, Karaveloff and Boteff, he was first inspired by the sufferings of his countrymen before the liberation. His *Trials of Bulgaria* describes the nation's struggle for freedom. A bard of the people, Vazoff's style is simple and unaffected; his *Epic Poem to the Forgotten*, celebrating the great deeds and sacrifices of the Bulgarian people, thrilled the nation, as also *Under the Thunder of Victory* (1914), *Songs of Macedonia* (1916) and *New Echo* (1917). Vazoff's most inspired poems and novels of a descriptive character are those relating to the Bulgarian countryside and village life. He died at Sofia Sept. 22 1921.

His chief novels are: *Under the Yoke* (Eng. trans. 1894); *Svetoslav Terter* (1907), *Hadji Ahil* and *Kazalarskata Tsaritza;* and his dramas include: *Borislav* (1910) and *Towards the Abyss.*

VEBLEN, THORSTEIN B. (1857–), American author and teacher, was born July 30 1857. He was educated at Carleton College, where he took the A.B. degree in 1880, and did post-graduate work at Johns Hopkins, Yale and Cornell Universities. He was appointed reader in political economy at the University of Chicago in 1893, becoming successively instructor and assistant professor. He was associate professor of economics at Stanford University, 1906–9, lecturer in economics at the University of Missouri in 1911–7, and lecturer in the New School for Social Research, New York City, 1918. He made contributions to the theory of economics, especially as modified by current business practices.

Among his works are *The Theory of the Leisure Class* (1899); *The Theory of Business Enterprise* (1904); *The Instinct of Workmanship* (1914); *Imperial Germany and the Industrial Revolution* (1915); *An Enquiry into the Nature of Peace and the Terms of Its Perpetuation* (1917); *The Higher Learning in America* (1918); *Vested Interests and the State of the Industrial Arts* (1919); *The Engineers and the Price System* (1921); *Absentee Ownership and Business Enterprise in Recent Times* (1923).

VEDDER, ELIHU (1836–1923), American artist (*see* 27.964), died at Rome Jan. 29 1923. His book, *Doubt and Other Things*, was published a few days before his death.

VEJDOVSKÝ, FRANTIŠEK (1849–), Czech zoologist, studied in Prague, Trieste and Naples and specialised in zoology, comparative anatomy and embryology. In 1877 he qualified as a lecturer at the Prague technical institute by a work entitled *Monographie der Enchytraeiden* (1879), and in 1879 was appointed professor at the Charles University in Prague. Of his numerous works the most noteworthy are those dealing with the problem of the ripening, fertilisation, segmentation and cleavage of ovum cells, on which he became widely known as an authority. In addition to numerous articles in periodicals his most important works are: *Die Süsswasserschwämme Böhmens* (1883); *Neue Untersuchungen über die Reifung und Befruchtung* (1907). Prof. Vejdovský received many academic distinctions and was made a corresponding member of numerous native and foreign biological and zoological societies.

VENEREAL DISEASE.—The period from 1910–25 has been marked by the commencement of a campaign which has developed into a world-war against venereal diseases. In this work Great Britain has taken a prominent part but the campaign has also been carried on in other parts of the world.

In 1913 a royal commission under the chairmanship of Lord Sydenham was set up to inquire into " the prevalence of venereal diseases in the United Kingdom, their effects on the health of the community, and the means by which those effects can be alleviated or prevented." The royal commission reported in 1916, and their recommendations were immediately acted upon by the Local Government Board of England and Wales (now the Ministry of Health), and the public measures for combating venereal diseases in England and Wales are now as mentioned below, while in Scotland and Ireland the campaign is being conducted on the same principles.

Legislative Action.—1. By an Act of Parliament passed in 1917 the treatment of patients for venereal disease by others than registered medical practitioners and the sale without the prescription of a registered medical practitioner or the advertisement to the lay public of remedies for the treatment or prevention of venereal diseases are forbidden.

2. There are 193 centres chiefly in voluntary hospitals for the treatment, free of charge, of persons suffering from venereal disease.

3. Fourteen hostels exist for the care and treatment of females who are infected, and would, unless helped by shelter, become professional prostitutes.

4. Seven institutions are specially for the care of pregnant females who are infected.

5. Treatment of venereal disease is also provided in poor law institutions.

6. Arsenobenzol (salvarsan) compounds are given free of charge to medical practitioners qualified to administer these remedies.

7. Specimens from persons suspected to be suffering from venereal disease can be examined free of charge in 73 laboratories which have been approved for the purpose.

8. The work of educating the public in the dangers of venereal diseases and the importance of early and continued treatment is carried out by the British Social Hygiene Council (formerly the National Council for Combating Venereal Diseases), which receives from the Government a grant in aid of its expenses. Propagandist work is also undertaken by the county councils and county borough councils, either directly or in conjunction with the British Social Hygiene Council.

The arrangements for establishment of free treatment facilities for distribution of arsenobenzol compounds and for laboratory examinations are under the control of county councils and county borough councils, which receive from the Government 75% of their approved expenditure on this account.

Results Obtained.—Some idea of the results obtained may be gathered by comparing the returns of cases seen for the first time in 1920, when the numbers were highest, with those seen for the first time in 1924, as presented hereunder:—

Year	Syphilis	Soft Chancre	Gonorrhoea	Non-ven.	Total
1920	42,805	2,442	40,284	19,654	105,185
1924	22,010	1,098	31,272	18,842	73,222

The table discloses a substantial reduction in the number of cases of syphilis, and the figures indicate that the incidence of syphilis in the community has declined considerably. Similar results have been reported by other countries which have set up venereal-disease schemes on the principle of treating the infected. The attendance at the centres in 1920 was 1,488,514 and in 1924 had increased to 1,645,415.

Gonorrhoea.—No outstanding remedy has been discovered analogous to that of arsenobenzol in syphilis, but, particularly since 1914, improvements in detail have made the diagnosis and cure of gonorrhoea more certain. In diagnosis, improvements in methods of cultivating the gonococcus on artificial media have placed the surgeon on firmer ground when determining the question of cure. In treatment the practice of administering vaccines to raise the patient's resistance has become much more common. In complications of gonorrhoea, such as gonorrhoeal rheumatism and iritis, what is known as protein-shock therapy has proved useful.

The remedies employed in this form of treatment are quite varied; for example, colloidal silver or anti-typhoid vaccine injected into a vein; milk or turpentine injected into the muscles. They have the immediate effect of raising the patient's temperature and by the next day there is usually a definite improvement in the symptoms.

Another form of treatment which has been in use by a few for a number of years but is only now becoming more general is diathermy (*see* ELECTRO THERAPY). The principle of its use in gonorrhoea and its complications is that the gonococcus is very sensitive to heat, being killed at temperatures which are supported with comparative ease by human tissues.

Good results have been obtained in gonorrhoea of females by this method, but undoubtedly its most pleasing effects are in epididymitis and in gonorrhoeal rheumatism in men. In gonorrhoeal rheumatism and iritis the reservoir from which the joints and eyes are continually being infected is commonly in the prostate and the seminal vesicles, both situated at the base of the bladder. The current is applied by means of an electrode placed in the rectum and is increased in strength until the patient feels the part becoming uncomfortably hot.

Soft Chancre or Chancroid.—The figures showing the new cases which have been seen at treatment centres indicate that chancroid is not now very prevalent in Great Britain. The treatment is now more conservative than formerly. The chancroid is viewed as possibly harbouring also the germs of syphilis, and with the object of avoiding any action which may prejudice the microscopical search for the more severe disease, the surgeon withholds for as long as possible the application of antiseptics.

When a bubo forms in the groin, a comparatively rare event under modern practice, it is more usual now to attempt to secure resolution by protein-shock therapy (*see* GONORRHOEA) and by aspiration of the abscess followed by injection into the abscess cavity of some drug which will lead to the destruction of the germs.

Syphilis.—Improvements in methods of detecting the germ of the disease, *Spirochaeta pallida*, under the microscope, viz., by dark-ground illumination, have made it possible to diagnose the disease very rapidly on the day it makes its first appearance.

The Wassermann, or the Bordet-Wassermann, test has been modified considerably in its details and is generally more delicate than formerly.

In 1918 Sachs and Georgi published the details of a new test which, either in its original or a modified form is now being practised very extensively. It depends on the fact that, if a suitably diluted extract of heart muscle, with some cholesterol, is incubated at 37° C. for a number of hours with the blood serum of a syphilitic person, small flocculi appear in the previously clear or very slightly turbid mixture. In Great Britain, Dreyer and Ward have devised a test which depends on the same principles but is much more precise in technique and expresses the strength of the reaction numerically. In the U.S.A., Kahn has produced a modification which is extremely easy to carry out. So far these flocculation tests have not reached the degree of perfection which would justify their substitution for the Wassermann test, but often they give positive results when the original gives negative and vice versa, so that they supplement usefully the Wassermann test. The examination of the fluid in the spinal canal is now carried out much more frequently than formerly, and a patient is not regarded as cured unless all tests of this cerebro-spinal fluid have given negative results. As to all these tests it must be emphasised that negative reactions to all of them do not prove the absence of syphilis. It is therefore customary to pursue the treatment far beyond the stage of the first negative reactions.

Great strides have been made in treatment since 1910 when Ehrlich introduced dioxy-diamino-arsenobenzol dihydrochloride, commonly known as " 606 " or salvarsan, as a remedy for syphilis. The effect of a single dose of this remedy is usually to cause the spirochaetes to disappear from the discharge of syphilitic sores in 24 hours and syphilitic lesions heal with a rapidity which was a source of great wonder to those who had toiled in the treatment of syphilis with the help of only mercury and preparations of iodine.

The original preparation has largely been supplanted by a compound introduced by Ehrlich in 1912 under the name of neosalvarsan or " 914," which is much more convenient to use and less disturbing to the patient than was the original preparation. These advantages are somewhat offset by a lower therapeutic activity of the newer preparation. Combinations of arsenobenzol with silver and with zinc are also used. The manufacture of arsenobenzol preparations spread during the War into the hands of a number of firms each of which has attached to the same chemical compounds trade names of their own to an extent which may be somewhat bewildering to the uninitiated.

Every arsenobenzol compound is made in batches each of which receives a distinctive mark and must pass a certain test of toxicity and of therapeutic activity before it can be issued to the public. The testing in Great Britain is carried out by the Medical Research Council. Experience has shown that, although the

arsenobenzol preparations act very promptly, a number of injections in successive courses must be administered to secure eradication of syphilis and that it is advisable to supplement them by administering another metallic compound.

Arsenobenzol will not penetrate into the nerve tissue of the brain, and this limitation has led to the introduction of an arsenical preparation of another order, viz.: tryparsamide or n-phenyl glycine-amido-p-arsonic acid into the therapy of locomotor ataxy and general paresis. The results show generally that tryparsamide is valuable for this purpose.

In 1920 Sazerac and Levaditi showed that tartro-bismuthate of potassium and sodium is more powerful than mercury in destroying the spirochaetes of syphilis, and a large number of bismuth preparations have been placed on the market since it was found that it is the metal rather than the compound which matters in the therapeutic action. Generally it can be said that bismuth injections effect more towards the cure of syphilis than do mercurial and that preparations of bismuth can be used which cause less discomfort than do any mercurial.

Bismuth is useless for the cure of syphilis if given by the mouth and its injection into veins is practised very little on account of its greater toxicity when administered by this route. Bismuth is generally considered to be an adjuvant rather than a substitute for arsenobenzol treatment. It is retained in the tissues for long after a series of injections has been given, and it thus prolongs the anti-syphilitic effect after all the arsenobenzol has been excreted.

The powerful effect of the arsenobenzol and bismuth compounds on the germ of syphilis has led to a number of experiments to determine whether or not they prevent the development of syphilis after inoculation.

There is strong evidence to the effect that a few arsenobenzol injections given after contamination with syphilitic virus does protect against the disease. Kolle has produced experimental evidence tending to show that the injection of bismuth carbonate protects against infection resulting from inoculation with syphilitic virus so long as the compound remains in the muscles. Rabbits treated thus proved resistant to inoculation with syphilitic material for as long as 109 days after injection of the bismuth.

The disadvantage of injections as a method of preventing syphilis after venereal risk led Levaditi to try an arsenical compound called stovarsol or acetyl-oxyamino-phenyl arsenic acid, which is administered by the mouth. There is good evidence that the ingestion of stovarsol in suitable doses prevents infection, but considerably more work on the subject will be necessary before stovarsol can safely be given to the public as a prophylactic against syphilis.

Treatment of General Paralysis of the Insane.—A great advance has been made in the treatment of a form of syphilis which is acknowledged to be the most incurable of all, namely general paralysis of the insane. This disease is one which has almost always ended fatally, defying the most intensive treatment by anti-syphilitic remedies. Its course is marked by remissions of varying length, during which the patient may appear to have recovered. It has been known for a century or more that an intercurrent infection accompanied by fever often results in a long remission, and this knowledge has led Wagner von Jauregg and his colleagues in Vienna since 1887 to inoculate patients with a variety of substances designed to make their temperatures rise. The best of all the agents has proved to be the parasite of benign tertian malaria and since its introduction in 1919 the method has been tested all over the world. The results have been very encouraging. The inoculation is by injection of malarial blood or by the bites of infected mosquitoes, and eight to twelve attacks of fever are allowed before quinine is given.

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(L. W. H.*).

VENEZUELA (*see* 27.988).—A republic on the north coast of South America. Its area is 398,594 sq. m. and the estimated population on Jan. 1 1925 was 2,563,334. The population of Caracas, the capital, in 1920 was 92,212; Maracaibo, 46,706; Valencia, 29,466. Venezuela acquired membership in the League of Nations in 1920.

Venezuela's constitution of 1922 declared that the republic was composed of 20 states, 2 territories, a Federal district and certain islands in the sea of the Antilles. It provided that the Federal district was to be organised by a special law and should be composed of the city of Caracas with the neighbouring parishes as well as the department of Vargas. It is further stipulated that the territories of Amazonas and Delta-Amacuro, which were to be organised by a special law, might become states when they fulfilled certain conditions, as when they had at least as many inhabitants as the quota required by the constitution for the election of one deputy to Congress.

I. POLITICAL HISTORY

Constitution.—On May 18 1914 a Congress of Deputies from the Venezuelan states adopted a new constitution for their union. That constitution declared that the Venezuelan states reciprocally recognised their autonomy and equality, and that they retained all sovereignty not delegated to the central Govt. by the constitution. The states agreed to promulgate constitutions that would harmonise with the fundamental law, and agreed to see that the national constitution, laws and orders were obeyed. Early in June assemblies at the capitals of the respective states ratified the new form of government, which came into force on June 13 1914. This constitution conferred male suffrage on all citizens 21 years of age or over. Foreigners who took part in political controversies (*contiendas*) could be arrested, confined or expelled by order of the president. Executive power was vested in a president and a Cabinet of ministers appointed by him. The president was to be elected for a seven-year term by vote of Congress. Among the extensive powers vested in the chief executive were the following: to administer the Federal district and the two Federal territories; to issue decrees and regulations for the better execution of the laws; to negotiate loans as provided by Congress; to grant certificates of naturalisation; to appoint national officials whose appointment was not otherwise provided for; to convoke an extraordinary session of Congress; to declare war when authorised by Congress; to negotiate treaties with foreign nations; and to proclaim martial law throughout the republic.

Legislative authority was granted to a Congress composed of a Senate and a Chamber of Deputies. The Senate was to be composed of two Senators from each State chosen by its Legislative Assembly for three years. The Chamber of Deputies was to be composed of members chosen from every State and from the Federal district by popular vote for three years at the ratio of one deputy to every 35,000 inhabitants. Congress was to meet annually on April 19 at the capital for a session of 70 days. Judicial authority was vested in a Supreme Court designated the *Corte Federal y de Casación* and in other tribunals established by law. The Federal Supreme Court was to be composed of seven judges who were to be elected by Congress for a term of seven years. Clauses defining the powers of this court provided that it should take cognizance of accusations against the president and other high officials. It was given jurisdiction over cases involving claims against the nation, cases relating to foreign diplomatic agents in Venezuela, cases arising from contracts made by the president and cases involving conflicts between laws or decrees, State or Federal. These provisions were retained in the constitution of 1922.

Events from 1908.—When in Nov. 1908 President Castro left Venezuela to visit Europe, the first vice-president, Juan Vicente Gómez was given the presidential power. In decrees of Nov. 23 1908 Gómez appointed a general secretary and confirmed the existing Cabinet appointments. On May 3 1909 he issued a decree announcing that he was exercising the powers of president of Venezuela, and after suppressing opposition to his

rule, he was acclaimed President Dec. 19 1909. Under the constitution of 1909, on Aug. 27 1910 Congress elected Gómez constitutional President for four years. In June and July 1911 Venezuela celebrated the centenary of her declaration of independence. During the rule of Gómez diplomatic relations with foreign nations that had been ruptured were resumed, and Venezuela undertook to pay those obligations to foreign nations upon which payments had lapsed. Upon an attempt of ex-President Castro to regain power, President Gómez issued a proclamation on Aug. 3 1913 announcing that he was leaving the capital to undertake a campaign for the restoration of public order. On Aug. 4 he delegated his authority to José Gil Fortoul, president of the council of government. On Jan. 1 1914 he re-entered Caracas at the head of his army and reassumed the powers of President.

According to the constitution the term of office of President Gómez ended on April 19 1914. Upon that day a Congress of Deputies from the Venezuelan states adopted a provisional constitutional statute for the Union, which declared that all laws not inconsistent therewith should remain in force. It further provided that this Congress should elect a commander-in-chief of the national army at the same time that it elected a provisional president of the republic. Congress was also to frame a new pact of union for Venezuela, which should be submitted to the assemblies of the states for approval. The period of provisional rule should last until the new constitution had been ratified by the states and until the constitutional functionaries had taken their posts. On the same day Congress elected Victorino Márquez Bustillos, who had been Minister of War and the Navy, provisional President, and by a decree of the same day Bustillos appointed his ministers of state. Congress elected General Gómez commander-in-chief of the national army.

On May 3 1915 the Congress chosen under the constitution of 1914 unanimously elected Gen. Gómez President of the republic for the term ending April 19 1922, but the president-elect did not assume the presidency. The provisional president continued to exercise authority while General Gómez remained commander-in-chief of the army with the title president-elect of the republic. In May 1922 Gen. Juan Vicente Gómez was unanimously re-elected President of Venezuela. On June 19 a new constitution was promulgated which made some slight but important changes in the constitution of 1914. Articles 137 and 138 of that fundamental law, which stipulated that the provisional president and the vice-presidents of the republic should hold their offices until the new magistrates were inaugurated and that the commander of the national army should exercise his functions until the inauguration of the constitutional president, were omitted from the constitution of 1922. This constitution further provided that in case the president should be permanently disabled, he should be succeeded by the ranking vice-president. On June 24 following, General Gómez relieved Márquez Bustillos of the nominal authority which the latter had exercised since 1914, and assumed the powers of president for the term terminating in 1929. On July 1 1923 the president's brother, Gen. Juan C. Gómez, first vice-president of the republic, was murdered in Miraflores Palace. In Oct. 1923 the Venezuelan Minister of Foreign Affairs declared that Mexico had severed diplomatic relations with his country alleging that Venezuela had expelled a Mexican theatrical company. In April 1924 the Congress of Venezuela assembled at Caracas.

Boundary Disputes.—The boundary dispute between Colombia and Venezuela, which had been submitted to the arbitration of the Swiss Federal Council, was decided in March 1922 in favour of the Colombian contention; namely, that she was entitled to take possession of such portions of the territory in dispute as had been adjudged to her in accordance with the decision of the King of Spain in 1891. This award also decided that both Colombia and Venezuela might proceed to occupy sections of territory bounded by natural frontiers which had been adjudged to them by the action of mixed commissions. The boundary line through the contested territory, so far as it had not been definitely settled, was subsequently determined by Swiss experts who employed aeroplanes and cameras to map out the unexplored areas involved.

Defence.—In 1912 Venezuela purchased a small vessel from the United States, which was made the flagship of the navy. In 1925 the Venezuelan Navy was composed of three gunboats and a training ship with a personnel of a few hundred men. The standing army was composed of some 9,000 infantry, artillery and cavalry. In addition there was a reserve estimated to consist of about 100,000 men. By a law published in June 1919 military service was made compulsory for all adult male citizens with certain exceptions. Service in the army or navy for two years in peace-time and during war at the president's pleasure was made compulsory with relegation to the reserve until the age of 45. A decree of April 17 1920 provided for a military aviation school at Maracay.

Education.—According to the law of 1921 primary education is free and compulsory between 7 and 14 years. Secondary education comprises two courses; one of general study occupying four years, and one of professional study occupying two years. Normal training is furnished by two institutions at Caracas. Among the special schools are schools of commerce and modern languages at the capital and other important cities, besides two schools of industrial arts and trades. Higher education is afforded by the Central University of Venezuela at Caracas where instruction is given in medical science, political science, ecclesiastical science, mathematics and physical science. There was a similar institution, the University of the Andes, at Mérida. Physical education is compulsory in all schools up to the age of 21. According to the report of the Minister of Public Instruction for 1925, the attendance at educational institutions of Venezuela for 1924 was as follows: Primary schools, 352,337; secondary schools, 9,203; normal schools, 3,664; special schools, 14,762; higher institutions, 4,304; making a total of 384,270. Expenditure on education for 1924–5 was 4,648,345 bolivares.

II. FINANCIAL AND ECONOMIC HISTORY

Finance.—Since 1909 the financial condition of Venezuela has steadily improved. The new law concerning public credit which came into force on June 15 1923, introduced reforms in the administration of Venezuela's finances. Among other provisions it stipulated that certificates of the internal national consolidated debt which were received by the Treasury should be burned. The following details of the public debt of Venezuela in bolivares as outstanding on Dec. 31 1923, are taken from the report of the Minister of Finance for 1924:—

External debt:	
National three per cent diplomatic debt	9,169,490·26
Three per cent diplomatic debt of 1905	58,948,145
Total	68,117,635.26
Internal debt:	
National internal three per cent consolidated debt	42,647,277·93
Three per cent inscribed debt	2,098,652·50
Total	44,745,930·43

The total indebtedness of the Venezuelan Govt. on Dec. 31 1923 thus amounted to 112,863,565·69. The budget for 1924–5 estimated expenditure at 63,354,500 bolivares. Over one-fourth of this amount was allotted to the Ministry of Finance and Public Credit, one-fifth was assigned to the Ministry of War and the Navy, while more than one-sixth was given to the Ministry of the interior. In the budget the receipts of that year were estimated at 66,167,000 bolivares, an increase of 3,322,000 over those for 1923–4. In his message to Congress on April 25 1925 President Gómez stated that the total national debt had been reduced to 99,445,723 bolivares by Jan. 1 1925, and that on Dec. 31 1924 there was in the treasury a surplus of 64,692,080.46 bolivares. The bolivar was relatively stable during the World War. The exchange value of the U.S. dollar measured in bolivares at different dates was as follows: July 1914, 5·30; April 1917, 5·14; April 1918, 4·32; Jan. 1919, 4·25; Dec. 1919, 5·16; Feb. 1920, 5·18; Sept. 1923, 5·43; Jan. 1924, 5·25; and Oct. 1924, 5·18. On Dec. 31 1923 there were in circulation in Venezuela 35,129,695 bolivares of bank-notes, while the gold reserve aggregated 55,149,749. Of the paper currency 25,293,340 bolivares was supplied by the *Banco de Venezuela*. A shortage of silver in the circulating media has been met under the provisions of a law of 1918 by the minting of new silver coins.

Industry and Commerce.—Agriculture and cotton raising were the chief sources of national wealth, and for 1924 the Venezuelan oil-fields showed a successful yield; in 1924 petroleum production was 1,330,912 metric tons. Exports of coffee had risen from 52,088,000 kilos in 1922 to 38,436,000 during the first six months of 1924. According to official reports, the total foreign trade of Venezuela in 1923 amounted to 309,396,512 bolivares (1 bolivar = $.19295). The imports aggregated 152,692,315 while the exports came to 156,704,197 bolivares. The countries furnishing the largest amounts of the imports were in order: United States, Great Britain, Germany, France, the Netherlands, Spain and Italy, while the countries taking the largest amounts of exports were the Netherlands, United States,

Spain, France, Great Britain and Germany. In 1923 the chief exports were valued as follows in bolivares: coffee, 68,945,726; petroleum, 27,321,920; cacao, 23,817,102; sugar, 5,359,128; balata, 4,084,588; hides, 3,515,550; cattle, 1,901,455; gold, 1,300,000; asphalt, 1,332,940; heron plumes, 1,017,735; and pearls, 740,880.

Communications.—In 1924 thirteen railways of importance were operating in Venezuela. The total length was 645 m., and the construction of new, short lines was contemplated. The construction, improvement and repair of Venezuelan roads continued to receive much attention from the Government. Decrees have been issued providing especially for the construction of a Great Western Highway to connect Caracas with the Colombian border near Cristóbal, and for the construction of a Great Eastern Highway to connect Caracas with Venezuelan Guiana. Wireless communication with Trinidad is maintained through the Caracas station, which has been improved. Communication with Puerto Rico has been maintained through the Maiquetia station. The Puerto Cabello and Maracaibo stations have ceased operations.

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(W. S. Ro.)

VENICE, Italy (*see* 27.995), had a population of 171,615 in 1921. An exact reproduction of the famous campanile, which collapsed in 1902, was finished in 1912; and the Loggetta dei Cavalieri, which was crushed in its fall, has also been repaired. The city suffered from aerial bombardments in the World War; 620 bombs were dropped, but the damage to its famous buildings and monuments, though considerable, was less than had been feared. The church of Santa Maria Formosa was practically destroyed, but has been restored. The bronze horses of St. Mark's were removed to Rome for safety. After the War various pictures were returned to the Academia by Austria. In 1920 the Procuratie Nuove, which was first the home of the procurators of St. Mark's and then a Napoleonic palace, was given to Venice by the Italian royal family, and now houses the civic museum of art and history. In 1925 the foundation stone of a votive temple was laid on the Lido by the Venetian patriarch in fulfilment of a vow made in 1917 that if the city was saved from falling into the hands of the enemy a church would be built in honour of the Virgin. A brick from St. Peter's and a piece of rock from the Grotto at Lourdes have been incorporated in the foundations.

Improvements to the Port.—In 1917 plans were made for a new port for Venice on the mainland, south of the railway line to Padua; in 1922 the canal of approach was opened by King Victor Emmanuel, and named in his honour, and in 1924 the construction of the main works was begun. The port, when finished, will cover twice the area of Venice itself, and will consist of parallel moles 3,000 ft. long with docks of 600 to 800 ft. between. Two moles will be built at first, with isolated jetties on the canal for oil ships. With the existing docks in Venice this will give the port a capacity of 10,000,000 to 12,000,000 tons a year. It is hoped that the industrial area, which is being built behind the docks, will create a considerable volume of trade. Behind the industrial area again a garden suburb to house 30,000 is being brought into existence by the municipality. Special customs facilities have been granted for the encouragement of trade in the new port, which, it is thought, will in no way spoil the beauty of Venice.

VENISELOS, ELEUTHERIOS (1864–), Greek statesman, was born in Crete Aug. 23 1864 of a family which had emigrated from Greece in 1770. Having been educated in the schools of Syra and Athens and having taken a degree in the University of Athens at the age of 23, the future statesman practised law in Crete. But following his father's example and like most members of his profession in the Near East, he soon became a politician, and in the insurrection of 1889 was compelled to flee from the island. After his return and the re-establishment of tranquillity, Veniselos was elected a member of the Cretan Assembly, and in 1897 came into prominence as one of the leaders of the Cretan uprising; it was he who received the British, French and Italian admirals when they came to negotiate a settlement between the insurgents and the Turks early in Feb. of that year.

In Dec. 1898 Prince George of Greece landed in Crete as the High Commissioner of the Great Powers, and a few months later Veniselos became head of the Island Executive. But he soon found himself at variance with the Prince's autocracy, and in 1904 a complete rupture occurred. Subsequently the Venizelists were defeated at the polls, but the Cretan leader organised a revolt, which greatly increased the unpopularity of the High Commissioner among a people whom he was misruling. In Sept. 1906 the Prince left the island, his place being taken by M. Alex. Zaimis, who was appointed not by the Powers, but by the King of Greece. From that time until 1909 Veniselos was sometimes Chief of the Cretan Govt. and sometimes Leader of the Opposition. But whilst the Cretans often came into sharp conflict with the Protecting Powers, Veniselos's wisdom and moderation were responsible for the generally friendly relations which existed, and his far-sightedness, particularly after the departure of M. Zaimis in Oct. 1908, and during the crisis of 1909, facilitated the union of Crete with Greece, which ultimately took place as a result of the first Balkan War.

In 1909 the military league headed a bloodless revolution against political corruption and court favouritism in Greece and invited Veniselos to come to Athens. He persuaded King George and the League that the best way out of a dangerous situation would be the revision of the Constitution by a National Assembly. Elections were held in Aug. 1910, and Veniselos, who had remained technically a Greek citizen during his Cretan political life, took his seat at Athens for the first time. The Chamber having been opened in Sept., a month later Veniselos became Prime Minister. Indeed, such was his power at this time that, although faced by parliamentary difficulties, he was in a position to have brought about the expulsion of the royal family and the establishment of any régime which he thought desirable.

But the Cretan statesman was bent upon reforms by pacific means, and realising that a fundamental change would be contrary to the interests of the country, he loyally decided to work with the King and his successors. The Constitution was successfully revised in 1911, reforms in the public services were introduced, and the reorganisation of the army and of the navy were respectively placed in the hands of French and British Missions. In the spring of 1912 Veniselos was returned to power as the leader of an overwhelming majority in an ordinary Chamber which then replaced the Revisionary Assembly. By that time, too, the Prime Minister was busily occupied with the formation of the Balkan League, and on May 29 1912 the Greco-Bulgarian Treaty was signed. Other Greek statesmen had worked for a like object, and the circumstances may have been more favourable than heretofore, but it is certain that the Balkan League would never have come into being except for Veniselos's foresight in accepting the necessity for taking Greece into an alliance which had already been made between Bulgaria and Serbia.

Whilst the Balkan Wars and Veniselos's diplomacy led to an unexpected Hellenic expansion, the assassination of King George at Salonika on March 18 1913 removed a man who had always been in favour of moderation, and placed upon the throne his son Constantine, who had not forgiven, and who never really forgave, Veniselos for his attitude towards Prince George in Crete. When the World War broke out, therefore, the position of Greece was greatly complicated by the facts that she was bound to Serbia by a Treaty signed in the summer of 1913; that from the first Veniselos was an ardent supporter of the Allied cause; and that the King was in sympathy with the Central Powers. Before the entry of Turkey into the War, Veniselos openly favoured Hellenic assistance for the Entente in case of that entry, and early in 1915 the Prime Minister advocated concessions to Bulgaria, Greek support for Serbia, and Greek co-operation at the Dardanelles in exchange for the promise of important future compensations in Western Asia Minor. But,

though he appears originally to have approved of the idea, the King vetoed Veniselos' decision to accept this offer, and he was forced to resign, though he possessed a strong majority in the Chamber. In the election which followed in June the Veniselist party secured the return of 190 deputies out of a total of 316, of which the Chamber was then composed.

In spite of this, and with the excuse of the King's illness, Veniselos was not recalled to power until after the meeting of the Chamber in Aug. and by that time the situation had become seriously modified. The entry of Italy into the War, helpful as it was, complicated the position of Greece, the attack upon the Dardanelles had proved a failure, and developments in the Balkans were reacting seriously against the Allied cause. Serbia managed more or less to hold her own during the first year of the War, but now a fresh Austrian invasion was imminent, and Bulgaria, whose support the Allies had failed to gain, was preparing to throw in her lot with the Central Powers. In equity, if not in actual law, the entry of Bulgaria brought into operation the Greco-Serbian Treaty of 1913 and necessitated the support of Serbia by Greece. Bulgaria mobilised on Sept. 19 1915, and a few days later Veniselos had an audience with the King, at which His Majesty reluctantly consented to a Greek mobilisation and to a Greek request that the Allies should furnish an army of 150,000 men to take the place of the contingent which ought to have been supplied by Serbia under the Treaty.

Immediately after the original Allied landing at Salonika on Oct. 1 Veniselos secured a vote of confidence during an historic and stormy meeting of the Chamber, when he declared that if in aiding Serbia Greece was brought into contact with Germany she would act as her honour demanded. In spite of a formal protest against the Allied passage through Hellenic territory, this speech led to the second dismissal of Veniselos and to the open and final rupture between that statesman and the King, who, it would seem, always intended to withdraw his consent to an Hellenic entry into the War. Zaimis, the new Prime Minister, maintained his position for a month as a result of the patriotism of Veniselos, his friend from Cretan times, but, with the accession of Skouloudis to power, on Nov. 6 the Chamber was dissolved and a new election ordered for Dec. 19. As a protest against what was the King's infringement of the spirit, if not the letter, of the Constitution, Veniselos called upon his party to abstain from the polls, and therefore, whilst M. Gounaris secured an overwhelming majority for his policy of neutrality, the fact that M. Veniselos was able to prevent a large proportion of the voters from taking any part in the election proved the then existing strength of his party.

Veniselos spent that winter and spring (1915–6) in endeavouring to compel the King to change his point of view. But the surrender of Eastern Macedonia to the Bulgarians in the summer of 1916 and the delay in the success of the Allied Campaign at Salonika had strengthened the position of Constantine, and on Sept. 25 1916 Veniselos, together with his principal supporters, sailed for Crete, whence he sent out proclamations calling upon all true patriots to flock to the Standard of the Entente. Proceeding thence to Salonika, early in Oct., he founded a Provisional Govt., which was recognised about two months later by Great Britain and France, though not by Italy. A call for volunteers was responded to by the inhabitants of those parts of Greece not in Constantinist hands, and thousands of volunteers were soon gathered at Salonika, but the Royalist Govt. countered this and other developments by causing a solemn anathema to be pronounced against Veniselos by the Archbishop of Athens.

After the dethronement and enforced departure of King Constantine, Veniselos returned to Athens on June 26 1917, and took over the Government of the whole country. The June 15 Chamber was convoked, a general mobilisation was ordered, and Greece formally entered the theatre of hostilities upon the Allied side. But the removal of the King, the successes of the Central Powers, particularly in the Balkans, and an increased Greek desire for neutrality, backed up by German propaganda, were responsible for a great diminution of the Prime Minister's popularity. Thus, whereas the entry of Greece into the War materially favoured the Allied position at Salonika, and whereas Hellenic contingents co-operated in that area, the officers and functionaries whom it was necessary to retire on account of their political views formed a dangerous element in an opposition which became ever more and more active.

Between the Armistice of Nov. 1918 and his fall two years later, Veniselos and his colleagues, who represented Greece at the Peace Conference, were almost continuously absent in Paris and in London and, during this period, it appeared that the widespread influence of the Premier would secure for his country a success to which even her most ardent admirers had never even aspired. About the end of April 1919 the Greeks were permitted, or encouraged, to land at Smyrna; a year later the Conference of San Remo promised large areas to Greece, and the Treaty of Sèvres (Aug. 10 1920) coupled with the earlier Treaty of Neuilly (Nov. 27 1919) seemed destined to promote that country from a position of secondary Balkan importance to one of international significance. During this period, too, the Hellenic representative won such admiration and played so brilliant a part that he became a leading figure in the counsels of the Allies. Nevertheless, at a moment when his triumph appeared to be complete, and when he might have been expected to be a greater hero at home than abroad, an attempt was made upon his life at a Paris station (Aug. 1920), and three months later (Nov. 14) he received a crushing defeat at the hands of the Greek electorate for whom he had worked so hard.

Opinions have been, and are, widely divided as to the reasons for Veniselos's political downfall. It has been attributed to the unpopularity of the war in Asia Minor and to the consequent continued mobilisation, and it has been ascribed to a determination on the part of the people to regain what they called their liberty. Each of these factors played its part, but the decision was influenced primarily not by the foreign but by the broader aspects of the home situation. Thus the facts that Veniselos had been maintained at Salonika, that he was brought back to Athens in 1917, and that he was kept in power there largely by foreign support, were resented by the people. Moreover the re-assembly and particularly the prolongation of the Chamber of 1915, the maintenance of martial law, the bad administration carried on by the subordinates of the Premier while he was abroad, and the formation of and injustices practised by the " Corps de la Sûreté " were responsible for widespread ill-feeling. Furthermore, the continued absence of the Premier and the unreliable information then supplied to him caused him to lose touch with the electoral atmosphere, and gave him a confidence which was entirely unjustified. And, lastly, there was the popularity of Constantine, gained in the Balkan Wars and greatly increased by his enforced departure from Athens in 1917. This was always a matter of fundamental significance, but after the unexpected death of the young King Alexander, as a result of a monkey's bite, immediately before the election, the dynastic question, open mention of which had previously been prohibited, was brought into the forefront of the political struggle and, in what then became the direct issue between Constantine and Veniselos, the King won an overwhelming victory.

From the arrival of the King in Athens on Dec. 20 1920, until his final abdication and second departure on Sept. 30 1922, Veniselos took no official part in Greek affairs, though he continued to use his international influence in order to endeavour to mitigate the results of the Asiatic disaster, the seeds of which he had sown by his own policy. After the revolution (Sept. 1922), however, Veniselos for a time undertook the representation of Greece in Western Europe, and in that capacity he voiced the interests of his country during the long-drawn-out Conference of Lausanne which culminated in the peace signed with Turkey on July 24 1923. In the following Dec., when the publication of that document and various other events had aggravated the existing internal dissension and when the election (Dec. 16) had again given his party a majority, Veniselos was persuaded to return to Athens, where he arrived on Jan. 4 1924. King George was already then on leave of absence, Veniselos was Prime Minister from Jan. 11 till Feb. 4, when he resigned on the advice

of his physician, and a great struggle centred around the future constitutional system. Veniselos favoured a Republic, should a plebiscite support its establishment, and about a fortnight after his departure from Athens on March 10, this alternative was declared to have been adopted by the Chamber, which secured a mandate for its policy at a plebiscite held on April 13.

Veniselos, who spent the greater part of his leisure from 1921–6 in France, was left a widower with two sons (Kyriakos b. 1893 and Sophocles b. 1895) in 1895. On Sept. 15 1921 he married Miss Helena Schilizzi, heiress of a Greek Chiot family established in England.

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(H. C. Wo.)

VENTILATING: *see* HEATING AND VENTILATING.

VERDUN, BATTLES OF.—The invader of France coming from the east is confronted by a series of ridges between the Moselle and Paris. The second of these ridges is formed by the historic escarpment 400 metres in height, above the Meuse and called the Heights of the Meuse. Here is placed the fortress of Verdun, one of the main barriers on the road to Paris. The reduction of this position was one of the main aims of the Germans, especially after their failure to break through in the early months of the War. The following account of their efforts is presented in four sections, entitled respectively: I. Verdun before 1916; II. The First Battle, Feb. 1916; III. The Second Phase, March–Sept. 1916; and IV. Verdun Set Free.

I. VERDUN BEFORE 1916

In order that the strategic importance of Verdun may be duly appreciated, its position in the general French defensive scheme must be briefly described.

History of the Fortress.—After the war of 1870 Gen. Séré de Rivière, who was entrusted with the task of organising the frontier defences, constructed a protective curtain stretching from Verdun on the north to Toul on the south. Fortresses guarded the routes between these two places. The forts at Génicourt and Troyon covered the bridges of Dieuc and Lacroix. The battery at Paroches dominated the pass at Spada. The fort at the camp of the Romans dominated the road to St. Mihiel. Further south the forts at Liouville, Gironville and Jouy linked up with Toul. On this rampart of the Heights of the Meuse Verdun formed the northern muzzle, opposite the fortified camp at Metz some 40 m. away. The railway from Paris to Metz passes within the precincts of the fortress by the Tavannes tunnel. The fortress was planned so as to form the principal line of resistance towards the north—on a cross ridge on which were the forts of Froide Terre, Douaumont, and Hardaumont. On the east, on a line following the crest of the cliffs, were the forts of Vaux, la Laufée and Moulainville. The line then turned south on a cross ridge, the ridge of Rozellier, east of the Meuse along the Dugny and Landrecourt ridges on the west. The line then closed on the west and north on the ridges of the left bank by the forts Regret, Sartelles, Choisel and Bois-Bourrus. A second line of defence on the right bank, behind the first, was flanked by the fortifications at Belleville, Saint Michel, Souville and Belrupt. The core of the position consisted of an old fortified enclosure of Vauban's time and a citadel dating back to Henry II. Galleries hewn out of the rocky foundation of the citadel, with workshops, bakeries, stores of food, water pumps and barracks formed a subterranean city safe against bombardment.

Verdun in 1914.—At the beginning of the War the fortress was an independent command. After the battle of the Frontiers the III. Army in retreat based its right upon it and, pivoting round it, finally faced west on the Crown Prince's flank. The latter then sought to turn it by a southerly move along the valley of the Ornain, but on the morning of Sept. 13 1914 was obliged to retreat by the defeat of the German armies before Paris. The French lines were then established 10 km. north of Verdun and the point was quiet for nearly 18 months. At the southeast of Verdun where the Heights of the Meuse slope east to the plain of Woëvre, a stiff but indecisive fight took place in the spring of 1915 for the observatory of Les Eparges. French and Germans remained face to face along the crest. Further south, in the area of St. Mihiel, by a surprise attack on Sept. 20 1914 the Bavarians penetrated to the camp of the Romans and gained a foothold on the left bank of the Meuse in the barracks of Chauvoncourt. The French III. Army on one side and the I. Army on the other, checked the Bavarian success by operating on their flanks. The Bavarians stabilised their position in the woods of Chevaliers and Mouilly and to the south in the woods of Ailly. The German lines remained huddled up opposite St. Mihiel. West of Verdun the Crown Prince attempted to reach the Argonne in the direction of Varennes and forced the French lines back to the edge of Boureuilles and Vauquois. The Verdun-Boureuilles line had the grave defect of exposing the main supply line for Verdun to enemy fire from Aubréville.

Status of the Fortress Changed.—The autonomy of the great fortresses was cancelled on Aug. 5 1915 in order to make their garrisons and equipment available for the armies in the field. Dunkirk, Verdun and Belfort, the three great fortresses on the area of battle, became fortified regions linked up with the armies. The fortified region of Verdun (R.F.V.) was placed under Gen. Herr, who ranked as an army commander. His headquarters were at Dugny. The R.F.V. was at first part of the group of Armies of the East, but on Feb. 1 1916 was attached to the group of Armies of the Centre—then commanded by Gen. Langle de Cary whose headquarters were at Avize. On Feb. 10 1916 Gen. Herr had available seven divisions with one in reserve, and two territorial brigades. On the left hand, the 29th and 67th Div. formed the Bozelais group. On the right bank the XXX. Corps, with two divisions (72nd and 51st) was on the heights. The 14th Div. with the territorial brigades was to the east in the plain of Woëvre. The II. Corps was in support from Fromezey to Paroches. The 37th and 48th Divs. formed the reserve. These dispositions were laid down by the Instructions of Aug. 9 1915. They were entirely defensive in nature and sought to secure the front between the Army of Humbert on the left and the Army of Roques on the right.

Germany Selects Verdun for Attack.—About Christmas 1915 Gen. von Falkenhayn submitted to the German Emperor a report setting forth the views of the German Staff as to the campaign of 1916. The report urged that France had reached the limits of exhaustion. Russia was powerless, Serbia destroyed, Italy deceived, though all were sustained by the will of Britain who was fighting against Germany as she had fought against Napoleon. Unfortunately it was not easy to reach Britain effectively either in her distant possessions by operations which could never be decisive, or on her own soil, or on the Continent. In Flanders, no attack could be made before the middle of spring. The ground was too difficult. Between Arras and the Somme—on Allenby's front—an offensive would take 30 divisions. Germany could gather only 26 divisions, to be used all together, and this would expose dangerous points on the front. It was impossible to attack Britain directly. She would be defeated if the Allied armies on the Continent were broken.

Where, then, was this to be done. Defeat of Italy would have little effect on England. Operations against Russia could not begin till April and then only towards the Ukraine where communications were lacking and a flank would be exposed to Rumania. The only possible line of attack was against France. It was not necessary to attack or break through in force, which would be costly and stood condemned in the light of the recent failure in Champagne. Behind, but close to, the French front were positions of such importance that they would have to be held to the last man. Operations on a limited scale would not involve very large forces and Germany had reserves enough to meet all emergencies. This reasoning led to the battle of Verdun.

The German Command sought to force the French to accept battle under conditions of forced defence—conditions which the art of war shows are fatal to the defender.

The two objectives which realised Falkenhayn's conditions were Belfort and Verdun. The capture of Belfort involved the evacuation by the French of Upper Alsace. Verdun, however, was important for three reasons. From Verdun the French could launch an attack, similar to that contemplated by the Germans, upon the German communications. "Verdun," said Falkenhayn's report, "is the strongest starting point for any attempt by the enemy to threaten the whole German front in France and Belgium with relatively small forces." The French lines were but 12 m. from the German communications. Throughout the War German headquarters dreaded an Allied attack starting from Verdun, and with justice since it was from Verdun that Marshal Foch hurled the great American attack on Sept. 25 1918 (*see* VICTORY, ADVANCE TO).

French Preparations.—An attack on Verdun had been foreseen by the French side. Col. Driant, Deputy for Nancy, who commanded a group of chasseurs in the fortified region of Verdun, at the Bois de Caures, wrote to the Minister for War that the decisive blow would be struck on the line Verdun-Nancy. The defensive organisation of Verdun was very incomplete. It could hardly be otherwise. Gen. Herr, by the instructions of Aug. 9 had to link up the III. Army in Argonne with the I. Army in the Woëvre. That involved the revision of the defensive system of the fortress from a circular scheme to one of a series of parallel and successive lines. But the Supreme Command, disturbed by the thrust of the Germans in the Argonne, also ordered Gen. Herr to prepare a defensive position on the left bank in case Verdun had to be abandoned. Gen. Herr could not manage this double programme with his resources and of four positions suggested on the right bank, only the first existed at the end of Jan. 1916.

On Dec. 3 Col. Driant was in Paris and communicated his views to his colleagues on the Commission of the Army. Gen. Pedoya, President of the Commission, passed the warning to Gen. Gallieni, the Minister for War, who wrote on Dec. 16 to Marshal Joffre inquiring whether all along the front a defensive system of at least two lines had been planned and carried out with such constructional features as were necessary in support. On the 18th Joffre replied somewhat confusedly and stated that the improvement of the double line system already existing along the whole front had been ordered on Oct. 22, that the organisation of the fortified areas in the rear of the armies had also been ordered, and that this combination of defensive measures was in process of completion and at a number of points had been completed. He ended thus: "I consider there is no justification for the fears you express in the name of the Government in your despatch of the 16th of December." He complained that the criticisms had not reached him in the proper official manner and offered to resign.

Gallieni replied on the 22nd that the Government hoped that the works still to be completed would be carried out with all

speed and care and that the Government had full confidence in the Commander-in-Chief. In order to conceal its plans about Verdun the German High Command arranged to carry out preliminary measures at several points on the front. The French Staff was for long in doubt whether the attack would come in Artois or in Champagne. But from Jan. 1916 French airmen reported enemy preparations on the Verdun front. On Jan. 16 Gen. Herr collected all this information in a formal report and asked for a division to reinforce him. This was sent to him. On the 19th Gen. Castelnau, as Inspector General, visited the front. In his letter of the 26th to Gen. Herr, summing up the results of his visit he stated that the first line was in accord with requirements. He ordered the construction of strong points for the reserves and of closed redoubts with counterscarp. The second line was to be strengthened and the defensive works carried to the counterscarp.

II. THE FIRST BATTLE

On Feb. 8 1916 it was discovered that the Germans had brought a mass of manoeuvre to the neighbourhood of Verdun. A deserter disclosed the presence of the III. Corps and the VIII. Res. Corps. On the 11th an intelligence officer reported a concentration of troops on the right bank of the Meuse, which included the XV. Corps and heavy artillery. The French Command at once took precautions. On Feb. 13 three divisions of the VII. Corps (14th, 37th and 48th) were moved to Souilly a march south of Verdun, followed on the 16th by two divisions of the XX. Corps. On the 20th the Commander-in-Chief, who had inspected this front on the 19th, ordered the I. Army to place the 16th Div. at Gen. Herr's disposition, thus completing the XX. Corps. Between Feb. 10 and 20, 85 heavy guns were added to the equipment of the Verdun Frontier Region, the scene of the future battle. It thus had 388 field guns and 244 heavy guns.

French Supply Problems.—Transport questions arose. Ordinarily two standard gauge railways serve Verdun. The southern line had been cut by the enemy. The western line would be, and was, cut as soon as operations started. A departmental railway, the Meusien line, and a road from Bar-le-Duc still remained. To maintain supplies for an engagement in which 15 or 20 divisions are engaged, the daily requirements are 2,000 tons of munitions, 100 tons of supplies and material for each division, say 2,000 tons, and from 15,000 to 20,000 men. The Meusien Railway at best carried 800 tons daily. On the 19th Capt. Doumenc, commanding the M.T. service, undertook to carry 2,000 tons and 12,000 men daily in lorries provided that the M.T. service had sole control over the roads. Motor traffic was organised on the 20th on railway lines. From the 29th, 3,000, later 3,500, lorries passed in an endless stream along this little road only seven yards wide. 6,000 vehicles passed a given point in 24 hours, an average frequency of one vehicle every 14 seconds. At times the traffic rose to one vehicle every five seconds. In the language of the War this road was known as the "Sacred Way" (La Voie Sacrée).

German Dispositions.—Verdun was confronted by the German V. Army—part of the command of the Crown Prince, who directed the offensive. The Germans had 26 divisions available on the Western Front. A third of these were kept as a general reserve; 17 to 18 divisions were therefore available for the Verdun attack. The German Command allotted nine divisions to the first attack, which started from the right bank. East of the Meuse was the VII. Res. Corps (one division in line, one in support); then the XVIII. Corps and the III. Corps in echelon of divisions. Further east the XV. Corps was held in the plain of the Woëvre, ready on the breach of the French front to hurl itself on the French flank. The 113th Div., completing the assault troops, was in support. This mass of manoeuvre had been embodied in the Crown Prince's Army command and to make way for it, room was made between the V. Res. Corps and the VI. Res. Corps. The duty of the latter, on the left bank of the Meuse, was to attack the French when broken on the right bank and to bar their retreat. Thus it was engaged only on March 6.

On Feb. 21 1916 at 7:15 A.M. the Germans commenced bombardment on a front of 25 m. from the Bois d'Avocourt to Étain. It was of unheard of intensity. Heavy shell were used in vast quantities, not a shell was smaller than 150 or 210 millimetres. The woods were full of guns which fired ceaselessly with measured regularity. Observers from the air ceased to mark batteries on the map. The woods to them were masses of clouds pierced by flashes of lightning. Soon the French squadrons were chased from the sky. The enemy had mastery of the air as of the artillery duel.

The Attack Opens.—About 4:45 P.M. the first infantry attack was launched. Commandant Vouvard remarks that "It is probable that there were strong reconnoitring parties to test the efficacy of the artillery preparations and to seize trenches which had been destroyed. Beyond doubt that first day the Germans sought to put their infantry in an advantageous position and to get into line for the battle of the next day, by making it pass even the unequal intervals separating the lines." As a fact, the Germans, to effect a surprise, had not dug parallels from which to issue and moved from their lines at distances from the French lines which varied from 600 to 1,100 metres. Gillet describes their new tactics thus: "Each troop had a specific task, with an objective of limited breadth and depth. Before taking hold of it, a wave of scouts was sent forward to test the destruction by the artillery fire. If the destruction were not thorough the scouts retired and further artillery preparation was organised. The attack took place in waves about 80 metres apart. First came a line of pioneers and men with bombs. Then came the main body in single file. Then followed a reserve section carrying up ammunition, tools, sandbags, and filling up gaps in the first wave. A second line followed in the same order, passing through the first line, supporting it if checked and renewing the assault on their own initiative. The attack should now proceed by encircling movements, utilising cover and passing along ravines. Thus the centres of resistance would fall one by one. Shell fire would support the advance continually. On no account should troops attempt to overcome resistance which has not been broken by artillery fire. Units when held up must wait for fresh artillery action."

Early German Successes.—The French line rested on the village of Brabant, then on the Bois de Consenvoye, Bois d'Haumont, Bois de Caures, Bois de Ville and on Herbebois. A little in the rear the Bois de La Wavrille (southeast of the Bois de Ville) and the village of Beaumont had been strengthened with redoubts. On the extreme right the line rested on the village of Ornes. Before the German attack, what remained of the French trenches was filled with defenders. At Herbebois the Germans captured the first lines but were stopped in front of the supporting trenches. The Bois de Caures was lost but its northern part was retaken during the night. The loss of the Bois d'Haumont was a serious matter. A French counter-attack on the 22nd at 6 A.M. failed. The line had been pierced.

The Germans made good use, on the 22nd, of the advantage gained at the Bois d'Haumont. The village of Haumont was destroyed by shell fire and at 5:00 P.M. was attacked by three columns. The main redoubt, built of concrete, collapsed and buried 80 men. The remaining defenders were hunted from the cellars by bombs and liquid fire but rallied at Samogneux. Bois de Ville was lost. Bois de Caures was then enveloped on the right and left and Col. Driant decided to withdraw his chasseurs to Beaumont. He was the last to leave the wood and was then killed. On the 23rd the village of Samogneux was overwhelmed by shells and set on fire but the garrison held on till night fell. On the extreme left the village of Brabant outflanked by the German advance became untenable and was evacuated. On the right Wavrille and Herbebois were lost and the front passed along the northern edges of Bois des Fossés and La Chaume.

In three days the Germans had captured the first of the French positions. Each side was reinforced on the 24th. A fresh regiment from the V. Res. Corps was sent to each of the German corps. The corps on the right which, having gained the greatest success, thereby became as it were a pivotal wing, also

received a battalion of chasseurs. On the French side the two divisions in line from the 21st were relieved from the left by a division of the VII. Corps, on the right by two brigades from the XX. Corps. These troops, thrown at night into doubtful positions in the open country, were immediately destroyed. The 24th was the most critical day of the whole battle. On their right, where the Germans sought to move out from Samogneux, they were nailed down by the French artillery on the left bank. But they started a fresh attack immediately eastwards and captured all the line Beaumont, Bois des Fossés, Bois des Caurières. Further they penetrated towards Douaumont along the ravine of the Vauche.

The second French position was lost in one day. In the evening the situation was so grave that Gen. Langle de Cary, commanding the Centre group of Armies, ordered the II. Corps, then closely engaged in the Woëvre, to fall back on the Heights of the Meuse. This movement was carried out during the night. That same evening (24th) Gen. Joffre handed over the operations before Verdun to a fresh army, the II., commanded by Gen. Pétain, who after the Battle of Champagne had been resting at Noailles. The X. Army, on relief by the British Army, was placed in the general reserve.

New French Dispositions.—The initial task of the army under instructions of Feb. 25 at 9:00 A.M. was to gather together the troops of the Verdun area on the left bank and to prevent the Germans from crossing the Meuse. But on the 24th at midnight Gen. Castelnau set out for Verdun armed with full powers from the Commander-in-Chief. He halted at Avize, headquarters of Gen. de Langle de Cary, whence at 5:45 A.M. on the 25th he telephoned to Gen. Herr to order him to hold at all costs the line on the right bank facing north between the Meuse and Douaumont and, facing east, on the Heights of the Meuse. At 7:00 A.M. Gen. Castelnau reached Dugny, the headquarters of Gen. Herr. Gen. Pétain went on the morning of the 25th to Chantilly and thence to Dugny, which he reached in the evening. He took charge of the battle on the 25th at midnight.

During the 25th, on the French left, the Germans advanced 1,500 metres south of Samogneux up to the mill of Cotelettes. Further east they captured Bezonvaux. A party of Brandenburgers crept up to the fort of Douaumont, found it empty and took possession of it. Gen. de Bonneval, commanding the 37th Div. on the French left on the Talon and the Poivre Hills was afraid of being surrounded and ordered retreat on the Belleville Hills. This order was only partially carried out. The Zouaves held their position on the west of the Poivre. On the other hand while the 37th Div. retreated, the 39th Div. of the XX. Corps, going up into the line, passed it and covered the line Bras-Haudiomont.

On the 26th Gen. Pétain, at his headquarters at Souilly, reorganised the battle plan. He drew a sharp line—Bras-Douaumont—which he entrusted to the XX. Corps. He divided the area into four sections: (1) under Duchesne in the Woëvre, (2) under Balfourier from the Woëvre to Douaumont, (3) under Guillaumat astride the Meuse, and (4) under Bazelaire on the left bank. The artillery as it arrived was divided between these four commands. On Feb. 21 it consisted of 388 field guns and 244 heavy guns. In a few weeks there were 1,100 field guns, 225 guns of calibres from 80 to 105 mm. and 590 heavy guns. Many fresh battery positions were created and linked up by telephone. The French regained the mastery of the air. The 59th Div. was set to build two defensive positions chosen on the 27th and redoubled on March 2 by two intermediate lines. Bridges were built across Meuse. Three thousand territorials repaired and widened the Sacred Way.

French Resistance Stiffens.—Reinforcements arrived. The I. Corps was at Souilly on the 25th and the XIII. Corps at Revigny. The XXI. Corps followed it two days later. The XIV. Corps detrained on the 20th and the III. Corps on the 29th. Between the 26th and the 29th the Germans hurled violent attacks against Douaumont, using 500,000 men. On the east they reached the position of Hardaumont and attacked Bois de la Caillette. They stopped, exhausted, on the 29th. It was the first lull for eight days. Gen. Castelnau deemed the situation firmly held (Calée) and returned to Chantilly.

III. THE SECOND PHASE

The Germans failed to gain an immediate decision at Verdun. They soon realised that the British Army was about to attack them on the Somme. At the beginning of April they had to reinforce their front on the Ancre by a division. For four months they kept the battle of Verdun going with furious tenacity in order to disorganise the attack prepared by the Allies in Picardy. For the French Staff the problem was to hold on at Verdun without ceasing to prepare for the Somme, to exhaust the enemy as much as possible in advance and to wear him out for the attack on the Somme.

Front of Attack Extended.—The principal episodes of that struggle were the capture on March 4 of Douaumont after a violent attack on the 2nd. The French entrenched themselves 200 metres south. On March 6, as Gen. Pétain had expected and feared from the beginning, the Germans extended the action to the left bank. The attack was made by two corps, the VI. Res. and the X. Res., the latter taken from the General Reserve. On the 6th they captured the Hill de l'Oie and on the 10th Bois de Cumières. They were thus enabled to attack one of the pillars of the main line of defence, the Mort Homme. On the 14th they captured the lower crest of that double hill. The higher crest, Peak 295, could be held by neither side and was No Man's Land.

The second pillar of the French line, further to the west, and known as Hill 304, was attacked on March 20 by the 11th Bavarian Div. which took the Bois d'Avocourt but could not issue thence. While extending his attack on his right, the Crown Prince also developed it on his left. On March 8 the III. Corps with the 113th Div. and two regiments of the XV. Corps attacked on the line Douaumont-Hardaumont. The works at Hardaumont were taken. Next day the attack was developed further. On the west the VII. Res. Corps attacked the Côte du Poivre while the 21st Div. advanced on the ravines and crests between the Côte du Poivre and Douaumont. On the east the V. Res. Corps attacked the village and fort of Vaux but met with a bloody reverse, renewed on the 16th and 18th.

The Germans brought up fresh troops and the battle began again on March 28 on the left bank. It ended on April 8 by the French losing all that remained of their former front line. The new front passed thereafter by the redoubt at Avocourt, the first slopes of Hill 304, the southern reverse of the Mort Homme and the north of Cumières. On the right bank on March 31 the Germans captured the village of Vaux, which had held out till then, and on April 2 took the lake behind the village. Then on April 9 the Crown Prince attacked on both banks on a scale not known since the first attacks in February. On the left bank alone, 11 regiments were involved. The results were insignificant. On the morrow Gen. Pétain wrote in his orders of the day "the 9th April was a glorious day for our Armies . . .Courage. *Nous les aurons.*"

French Counter-Attacks.—On April 20 the French counter-attacked on the left bank in order to clear the Mort Homme. The 40th Div. continued the struggle till May 3. The eastern front became practically what it was before the German attack of April 9. But on May 3 the Germans renewed the offensive by an attack on Hill 304. On the 8th they captured Bois Camard, west of the Hill. On the 13th and 16th they attempted without success to advance from this position. They then organised a new attack on the 18th with a fresh corps, the XVIII. Res. Corps and two divisions of the XVIII. and added on the 22nd the 22nd. Res. Division. This violent battle ended on the 24th with the capture of Cumières. As the Germans had no reserves available the tired units could not be relieved and on the 26th they lost a portion of the trenches they had won. On the right bank in front of Douaumont, where on the 22nd the French made a vigorous counter-attack on the I. Bavarian Corps destined for the left bank. They held Douaumont but their attacks on the left bank were checked.

There had been changes in the command. On April 2 the right bank section had been placed under the orders of Gen. Nivelle, the left bank under Gen. Berthelot. At the end of April Gen. Pétain was called to command the Armies of the Centre and handed the II. Army to Gen. Nivelle. The Germans, too, from March had divided the field of battle into two sections, Gen. von Mudra commanding on the right bank, Gen. von Gallwitz on the left bank. In April Gen. von Mudra was replaced by Gen. von Lochow. In July Gen. von François relieved von Gallwitz. The Allies' preparations on the Somme took definite shape. Before all things the Germans had to prevent the French from taking part in these operations. For this a new success in the Meuse was necessary.

Germans Capture Thiaumont and Fleury.—The main French line of defence on the right bank was the Côte de Froide Terre—Fleury—Fort de Souville. On the right this position was covered by the fort of Vaux, on the left by the crest of Thiaumont. It was first necessary to capture Vaux and Thiaumont. On June 1 these two positions were attacked. Vaux was taken on the 9th. Thiaumont farm, taken by the Germans on the 1st, was recaptured by the French on the 2nd, who lost it again on the 9th. German attacks on the Thiaumont outworks behind the farm failed completely. They succeeded in establishing themselves on the west and opposite side in the ravine of La-Dame. At the same time battle was resumed on the left bank. Between May 29 and 31 the Germans took Cumières but tried vainly to move out of Bois Camard against Hill 304. On the 15th the French resumed the offensive and recaptured a kilometre of trenches on Mort Homme.

Time pressed more and more. On June 4 Gen. Brusilov started a wide offensive in Volhynia. In his announcement of the Russian victories of June 13 to the troops, Gen. Joffre said: "Soldiers of Verdun, to your heroic resistance we owe these victories. From your resistance will spring the victories we are soon to win." In these conditions the Germans attacked the line Froide Terre-Souville on June 21 in the grand style, with 19 regiments. On the west the Bavarian Corps took the fortified post of Thiaumont but was checked in front of the fort at Froide Terre. In the centre the Alpine Corps captured Fleury. On the west the 103rd Div. took the first line of trenches in front of Souville but failed before the second line. So serious was the situation for the French that on June 23 Gen. Pétain commanding the Armies of the Centre warned Gen. Joffre and suggested moving to the left bank if the enemy reached the counterscarps. Joffre's answer on the 27th was a peremptory order to hold on to the right bank.

The Turn of the Tide.—Meanwhile the preliminaries of the great Franco-British offensive on the Somme started on June 24 and the actual battle began on July 1. On July 11 the Germans made yet another attack on Verdun—from Vaux to Souville with 12 regiments. It crumpled up on the slopes of Souville the principal objective. On Aug. 1 another attack with eight divisions also failed. On Aug. 3 the French retook Thiaumont and Fleury on Aug. 4. The Germans regained Thiaumont on the 8th. Throughout the whole month there was local fighting. The last German attack on Sept. 3 also failed. The battle of Verdun, properly called, had come to an end. From Feb. 21 to June 15 the Army at Verdun had seen 66 divisions on its front. Up to July 1 the Germans had used up 43½ divisions. It is true that they maintained them on the ground by depots situated a march behind the front and left them fighting till worn out. The French artillery fired 10,300,000 rounds with the field artillery, 1,200,000 rounds of medium calibre and 600,000 rounds of large calibre.

IV. VERDUN SET FREE

On Sept. 13 M. Poincaré handed to Verdun the cross of the Legion of Honour and Allied decorations. The ceremony took place in the casemates of the citadel. From that moment began a new phase, that of the liberation of Verdun. To a large extent the glory of this feat belongs to Gen. Mangin. He it was who led the attack on Douaumont on May 22. Called from the battlefield of Verdun on June 22 he was placed in command of Group D, which then stretched from the Meuse to Fleury and was progressively enlarged right up to the cliffs of the Meuse.

On Sept. 17 in a report to Nivelle he set forth reasons for abandoning operations in detail and for seeking to free Verdun by a plan on broad lines.

Relief Offensive Opened.—The first scheme, approved by Nivelle on Sept. 21, dealt only with an advance up to 300 metres north of the farm of Thiaumont. The scheme of the 24th went further and included the fort of Douaumont as far as possible. A third scheme, that of Oct. 9, covered the capture of the fort of Douaumont and perhaps that of the fort of Vaux. A formidable artillery preparation with 650 guns started on Oct. 21. The assault was delivered on Oct. 24 at 11:40 A.M. by three divisions, the 38th on the left, 133rd in the centre, and 74th on the right. The first waves marched under a rolling fire which progressed according to a set time-table, so that the infantry were as it seemed fastened to a wall of steel. By night Douaumont was taken with 6,000 prisoners. The division on the right had not reached the fort of Vaux which was evacuated by the Germans on Nov. 2, the day before the date fixed for attack by the 63rd Division.

The Fortress Liberated.—In order to exploit this success to the full Gen. Mangin was obliged to restore his ammunition reserves by continued economy. He intended to attack again on Dec. 5 over a front of 10 m. in order to retake at one blow the whole of the former second French line which had been lost on Feb. 24. Artillery preparation started on Nov. 29 with 750 guns. Bad weather intervened. The Germans had been warned and the value of a surprise was lost. In order to upset the plans of the French the Germans made a violent attack on Dec. 6 and captured Hill 304. Fine weather returned on the 9th and Nivelle recommenced the artillery preparation. It was a keen struggle—the Germans replying vigorously. In the air, too, battle was set. On the 15th at 10 A.M. the attack was made. The German barrage started two minutes too late. The attack had started, four divisions—126th, 38th, 37th and 133rd—being in line. By night they had retaken the whole of Poivre Hill. The line was in front of Hill 378, stopped 20 metres south of the farm at Chambrettes, then turned south across Bois d'Hardaumont and la Vauche up to the outwork at Bezonvaux. The French captured and destroyed 115 guns and took 9,000 prisoners. This, known as the battle of Louvemont, was completed on the 18th by the recapture of Chambrettes with a total of 11,387 prisoners. It was the end of the battle of Verdun. On the evening of Dec. 15 Nivelle took over the command of the Armies of the North. Mangin went to the VI. Army. The II. Army was entrusted to Gen. Guillaumat and reduced from 25 to 15 divisions. The spring passed in organising the area conquered and in making preparations for the final battle.

The Final Battle.—In the summer of 1917 Pétain formulated plans for a series of limited offensives for the purposes of raising the spirit of the army and decided on an operation on the northern front of Verdun on both banks having as objectives, Mort Homme on the left and Samogneux and Beaumont on the right. From these positions the line would link up with Bezonvaux through Bois le Chaume and Bois des Caurières. The Germans, however, anticipated the French by making an attack on the left bank on June 28 which was followed by fighting right up to Aug. 3. The attack planned by Pétain was delivered on Aug. 20 after six days' heavy artillery preparation. The XIII. and XVI. Army Corps attacked on the left bank, the XV. and XXII. on the right bank, 16 divisions in all being engaged. Mort Homme was captured on the 20th, Hill 304 on the 24th. On the right bank Hill 344 was taken on the 20th, Samogneux on the 21st. More than 10,000 prisoners were taken. Beaumont alone remained in German hands. This was the final battle of Verdun.

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VERDY DU VERNOIS, JULIUS VON (1832–1910), German general and military writer (*see* 27.1019), died at Stockholm Sept. 30 1910.

VERGA, GIOVANNI (1840–1922), Italian novelist (*see* 27.1021), died in Rome Jan. 27 1922. *Cos'e il Re* (short stories) was published in 1922, and two of his works were translated into English by D. H. Lawrence: *Mastro-don Gesualdo* (New York, 1923), and *Little Novels of Sicily* (Oxford, 1925).

BIBLIOGRAPHY.—Laura Gropallo, *Autori italiani d'oggi—Giovanni Verga, etc.* (1903); L. Russo, *Giovanni Verga* (1920); C. A. Levi, *Autori drammatici italiani, G. Verga, etc.* (1922); N. Scalia, *Giovanni Verga* (1922).

VERHAEREN, EMILE (1855–1916), Belgian poet (*see* 27.1023), greatly increased his reputation during the last years of his life, mainly owing to the publication of his chief work *Toute la Flandre*, which he wrote from 1904–12 and which includes six series of poems dealing with the memories of his boyhood, *Les tendresses premières;* the Belgian coast, *La Guirlande des dunes;* various episodes of Flemish history, *Les héros;* life in the small towns, *Les villes à Pignons;* and the Flemish countryside, *Les plaines* and *Les blés mouvants*. The comparison between this great work and the first volume of verse published by the poet in 1883, on a similar subject *Les Flamandes*, shows the full development of his technique and of his genius. In 1911, Verhaeren published *Les heures du soir*, a series of intimate poems dedicated to his wife, completing two previous series published in 1905, *Les heures de l'après-midi*, and in 1896, *Les heures claires*. His tragedy, *Hélène de Sparte*, was produced in Paris in 1912. During the World War, the poet wrote *Les ailes rouges de la guerre* (1916), which contains an ode to Rupert Brooke, and two short volumes of prose, *La belgique sanglante* (1915) and *Parmi les cendres* (1916). He died on Nov. 27 1916, a victim of a railway accident in Rouen station. Selections of Verhaeren's poems have been translated into English by Jethro Bithell and by Alma Strettell. An English version of his *Love Poems* has been published by F. S. Flint, and the plays have been translated by Arthur Symons, Osman Edwards, F. S. Flint and Jethro Bithell.

VERMONT (*see* 27.1025).—The population of the State was 352,428 in 1920, as compared with 355,956 in 1910, a loss of 3,528, or 1%. As in many other States, there were losses in the rural districts and gains in industrial towns and cities. In 1910, 27·8% of the total population lived in villages and cities of 2,500 and over, and in 1920, 31·2%. Native whites of native parentage constituted 64·7% of the population. Foreign born whites constituted 12·6% of the population. Of the foreign born whites, 31·8% were French Canadians, and, including all Canadians, the percentage was 55·8. The following are the cities and towns having a population of 9,000 or over and the percentage of increase or decrease for the decade:—

	1920	1910	Percentage inc. or dec.
Burlington	22,779	20,468	+11·3
Rutland	14,954	13,546	+10·4
Barre	10,008	10,734	-6·8
Bennington	9,982	8,698	+14·8

Agriculture.—Vermont is pre-eminently a dairy state and its principal crops are hay and forage grown for cattle. The number of farms in 1920 was 29,075, and in 1910, 32,709, a decrease of 3,634, or 11·1%. Improved land increased from 1,633,965 ac. in 1910 to 1,691,595 in 1920, a gain of 3·5%. The value of all farm property in 1920 was $222,736,620, an increase of 53·2% over the 1910 total of $145,399,728. The average value per farm was $7,661 in 1920, a gain of 72·4 over 1910. The average Vermont farm area, 145·7 ac. is the largest of any State east of the Mississippi river. On Jan. 1 there were 377,000 milch cows, 83,000 other cattle, 73,000 horses, 48,000 sheep and 50,000 swine. Much milk and cream is shipped daily on special trains to the New York and Boston markets. In 1925 practically half the milk and cream supply of Boston came from Vermont dairies and quite a good proportion of that consumed in New York City. Vermont's ratio of dairy cows *per capita* (1·19) is the highest of any State. Only three States surpass Vermont in percentage of pure bred cattle.

The value of Vermont crops as reported by the census of 1920 was $47,999,600, and of this total the value of hay and forage was $29,581,464. In round numbers there were produced cereal crops worth $5,000,000, chiefly corn and oats; vegetables valued at $7,000,000, of which white potatoes were valued at $5,000,000; maple sugar and syrup, worth $3,500,000; and fruits worth $2,000,000. The total value of all Vermont's agricultural output crops, dairy products, poultry, eggs, maple sugar and syrup, meat products and forest products of farms, was $89,757,053. Crop reports of the U.S. Dept. of Agriculture for 1924 showed that Vermont led all other States in average yield of bushels of corn per ac. (47 bushels). In 1924 the production was: oats, 2,888,000 bu.; maize, 3,901,000 bu.; wheat, 21,000 bu.; barley, 279,000 bu.; potatoes, 3,340,000 bushels. Vermont produces more maple sugar and syrup than any other State, according to crop reports of the U.S. Dept. of Agriculture (1925).

Manufacturing.—Vermont leads all other States in the production of marble and granite and ranks second in its output of slate and talc. Owing to its large supply of hard and soft woods, it contains many woodworking establishments. It contains the largest plants in the United States producing scales, pipe organs and reed organs, screen windows, portable ovens and brush fibre. In 1921 there were 1,101 manufacturing establishments; 2,931 salaried employees, receiving a total of $6,433,000; 25,767 wage earners, receiving a total of $28,068,000. Raw material to the value of $63,688,000 was used; and the output amounted to $113,904,000—a decrease of 32% on that of 1919.

There are large plants in Springfield and Windsor making machine tools, and Springfield contains a large factory for utilising reworked wool. Bellows Falls contains large paper mills; Burlington and Brattleboro manufacture cotton goods on a large scale, and Winooski contains a large woollen factory. Bennington is noted for the manufacture of knit underwear. Readsboro contains a large plant manufacturing school furniture. Package dyes, butter colour, children's washable play clothes, refrigerators and boxes are made in large quantities in Burlington. Rutland manufactures silos, maple sugar utensils and marble- and granite-working machinery. Brattleboro produces chairs and overalls in large quantities. Barton produces piano actions; Orleans, piano sounding-boards. Montpelier manufactures sawmill machinery and clothes pins. St. Albans contains a large factory manufacturing summer clothing. Bristol contains a large burial-casket factory. In Hyde Park is a very large plant dealing in green calf skins.

History.—During the administration of Gov. Fletcher, the State constitution was amended, changing the date of the biennial State elections from Sept. to Nov. and the time of the convening of the legislature from Oct. to January. The power of the governor was strengthened by requiring a two-thirds instead of a majority vote for overriding the veto. The power of commuting sentences was taken from the legislature. In 1915 a workman's compensation law was enacted. Beginning in 1912 a series of Acts was passed leading to the establishment of a State system for the care of dependent, neglected and delinquent children. An important step was taken in 1917 in co-ordinating the work of State departments, commissions and boards, and it was carried still farther in 1923. A direct primary law was passed in 1915 with a referendum clause attached. The result of the referendum was a small majority in favour of the law. A presidential primary Act was repealed in 1921. The educational laws were revised in 1915 and in 1923 greater control in the management of school affairs was given to municipalities.

Following the ratification of the amendment to the national constitution granting the right of suffrage to women, the State constitution was amended along similar lines, and in 1921 a law was enacted giving women the right to hold office.

Vermont has been Republican in State and national politics since the organisation of the party. The recent governors have been: John A. Mead, 1910–2; Allen M. Fletcher, 1912–5; Charles W. Gates, 1915–7; Horace F. Graham, 1917–9; Percival W. Clement, 1919–21; James Hartness, 1921–3; Redfield Proctor, 1923–5; Franklin S. Billings, 1925– . (W. H. Cr.)

VERRALL, ARTHUR WOOLLGAR (1851–1912), British scholar, was born at Brighton Feb. 5 1851. Educated at Wellington and Trinity College, Cambridge, he graduated in 1873, becoming fellow and tutor of his college. He published editions of many classical plays, especially the *Medea* (1881), *Agamemnon* (1899) and *Choephoroe* (1893). In 1895 appeared *Euripides the Rationalist*, followed in 1905 and 1910 by editions of most of Euripides' plays. He was an original critic, and a frequent contributor to *The Classical Review* and other journals. In Feb. 1911 he was appointed to fill the new King Edward VII. professorship of literature at Cambridge, which had been endowed by Sir Harold Harmsworth, later Viscount Rothermere. He died at Cambridge June 18 1912.

VERSAILLES, TREATY OF.—The German Treaty was signed on June 28 1919, and came into force by exchange of ratifications on Jan. 10 1920. It was intended originally that it should be only one part of a general and inclusive treaty, comprising settlement with Austrians, Hungarians, Bulgars and Turks, as well as Germans. In such case it would have been strictly comparable to the Treaty of Vienna in 1815, which was, in fact, an "omnibus treaty." But the delays in dealing with these peoples, particularly Hungarians and Turks, not only separated the German Treaty from the others, but caused it to be the first to be signed and the first to come into force, just as it was the first in importance. It is also an important fact that, in the end, all the Principal Allied Powers (except the United States) recognised the Wilsonian principles and maintained that they had been applied in the German Treaty. No state, except the United States, recognised or attempted to apply the Wilsonian principles to the Austrian, Hungarian, Bulgarian or Turkish treaties.

I. NEGOTIATIONS BEFORE THE ARMISTICE

It is important, therefore, at the outset to understand the implications of the correspondence conducted between the German Govt. and President Wilson during Oct. and Nov. 1918, when the former was asking for peace. The governing document of the series is the reply of President Wilson to the German Govt. of Nov. 5, which embodied the result of the decisions of the principal Allied and Associated Governments as a whole (*i.e.*, France, Great Britain, Italy and the United States).

In that document they offered to make peace on the basis of President Wilson's speech of Jan. 8 1918, which embodied the "Fourteen Points"[1] (excluding only point 2 relating to the freedom of the seas). In addition, they promised to make peace by "the principles of settlement embodied in his subsequent addresses," *i.e.*, speeches up to Nov. 5 1918. They added to this a definition of what was meant by President Wilson's statement, (Jan. 8 1918):—

> That the invaded territories must be restored, as well as evacuated and freed, and the Allied Governments feel that no doubt ought to be allowed as to what that provision implies. By it they understand that compensation will be made by Germany for all damage done to the civilian population of the Allies and their property by the aggression of Germany by land, by sea and from the air.

So we may say that the Allies offered to make peace on the general basis of President Wilson's speeches in 1918, *minus* his point about "freedom of the seas," and *plus* a definition of loss and damage. The Germans sent no reply to this offer in writing, but in fact accepted it by communicating with Marshal Foch and asking for an armistice. The Germans never denied that they were bound by the Wilsonian principles, and the Principal Allies explicitly admitted their binding force in their *reply* to Germany of June 16.[2] So there was no difference between Allies and Enemies as to the binding character of the Wilson principles in the German Treaty, though they differed greatly in the end as to their interpretation. The course of the negotiations is related in the article Peace Conference, and all that can be done here is to indicate the character of the treaty itself and its apparent meaning as deduced from its clauses. It is at once the

[1] For the text *see* Fourteen Points.

[2] Text of the *Reply* in Misc. 4, 1919, Cmd. 2883 (H.M. Stationery Office).

largest and the most complicated of modern treaties, and the best way to analyse it would seem to be to take its 15 parts separately.

II. ANALYSIS OF THE TREATY

Part I. The Covenant.—Part I. deals with the Covenant of the League of Nations (*see* COVENANT). It may be here remarked that the Covenant unites all its members in a league guaranteeing their territorial independence and integrity. The entrance of Germany into the League was deprecated at the time by some of the Allies and only became a certainty after the signature of the agreements of Locarno on Dec. 1 1925, and their ratification in 1926. The most important powers granted to the League are the supervision of Mandated Territories (art. 22), whereby the future government of the German colonies, after having been assigned to various mandatory Powers, is subject to supervision by the Permanent Mandates' Commission. This is appointed by the League, and it inspects the annual reports of the mandatory Powers on the territory committed to their charge.

Similarly, the racial and religious Minorities' Treaties have been placed under the guardianship of the League, but their supervision here, though real, is not so effective as over territories under the mandates. Ultimately the supervision of disarmament, as provided in the German Treaty, is to fall into the hands of the League, and this has finally been accomplished by the dissolution of the inter-Allied naval and military commissions and their supersession by the League at the end of 1925. The international control of health and disease is provided for in article 25 and has been actually much extended since. Article 23 provides for international co-operation in labour questions (see below, Part XIII.).

The most binding obligation of the League is found in articles 12–16, by which members bind themselves not to go to war in disregard of its covenants until three months of arbitration or inquiry by the council have elapsed. It is provided under article 8 that the League shall formulate plans for reduction of national armaments, and it will take the lead in the disarmament conference about to meet in 1926.

The actual machinery, through which the League functions, consists at the outset of a council of nine, of whom five must be France, Great Britain, Italy, Japan and the United States. As the latter declined to accede, five out of the original nine seats were left to be filled by smaller states, whose representatives are elected by the Assembly of the League. The Assembly consists of representatives of all member states, and is an annual international Parliament. Two institutions connected with, but actually separated from the League are the Permanent Court of International Justice (provided for under art. 14), and the International Labour Office and annual conference (art. 23–4). The League also, as will be described below, is the governor of two important pieces of territory, the Saar basin and the free city of Danzig.

Parts II. and III. Territorial Dispositions. (*a*) *Western Frontiers.*—Germany lost territory in the south, north and east as a result of the War, whilst other arrangements tended to weaken her influence beyond her own borders. Belgium, for example, ceased by article 31 to be a neutralised state, and has since entered into a military alliance with France. She has also acquired by cession from Germany the frontier districts of Moresnet, Eupen and Malmedy (art. 32–4); Luxembourg similarly ceases to be a neutralised state (art. 40–1), and has since entered into an economic union with Belgium. By articles 42–4 the whole left bank of the Rhine and the right bank to the west of a line drawn 50 km. to the east of the Rhine, has been demilitarised forever. Fortifications are to be dismantled there, and no permanent works for manoeuvre or mobilisation are to be permitted.

By articles 45–50 the Saar basin forms an area under the control of an international commission and of the League, and its coal-mines are ceded to France. At the end of 15 years a plebiscite will be taken, whereby the inhabitants will vote as to their preference (*a*) for the existing international régime, (*b*) for union with France, (*c*) for union with Germany. Finally, and most important of all, by articles 51–79, Alsace and Lorraine are ceded by Germany to France. The latter thus gains nearly 2,000,000 inhabitants, great strategic advantages, and over three-fourths of the German-produced iron with other valuable minerals.

(*b*) *Northern Frontier.*—Toward the north Germany consented (art. 115) to demolish the fortifications of Heligoland and to demilitarise it, but she retains its territorial sovereignty. She has lost the northern part of Schleswig to Denmark. By articles 109–14 it was provided that there should be a plebiscite in two zones. Of these, the northern voted for incorporation with Denmark and the southern, or Flensburg, zone elected for Germany. Denmark thus received that plebiscite which Bismarck had promised her but which he never gave (Art. III., Treaty of Nikolsburg July 26 1866).

(*c*) *Eastern Frontier.*—By articles 87–93 it was provided that there should be a plebiscite in Upper Silesia. This has resulted (1921) in a decision in which the southern half of the area—including valuable mines—passed to Poland, the upper half returning to Germany. Two other such plebiscites were provided for in East Prussia in the Allenstein and Marienwerder districts respectively, both of which went in favour of Germany. By the boundaries as drawn, a large part of the Posen and Bromberg area goes to the new Polish Republic. In addition, a Polish corridor is run to the sea between East Prussia and Brandenburg ending in the free city of Danzig. The latter is administered by the League but its foreign relations are controlled by Poland. Finally, the city and hinterland of Memel, ceded to the Principal Allies in the treaty, was handed over to Lithuania in 1924. About 3,500,000 former inhabitants of Germany are ceded to Poland or Lithuania in the east, of which rather less than one-third are German. Altogether, the total number of inhabitants ceded to the various Powers under the German Treaty falls not far short of 6,000,000. And this loss is probably a good deal less serious than the economic injury suffered by Germany in the loss of most of her iron and other minerals.

Part IV. German Rights and Interests outside Germany.—By articles 119–27, Germany ceded all her oversea colonies to the Principal Allied Powers. She thus lost in Africa the Cameroons (divided between France and the British Empire as mandatories); Togoland (to Great Britain as mandatory); Southwest Africa(to the Union of South Africa as mandatory); East Africa (to Great Britain and to Belgium as mandatories). These territories included some 18,000 Germans and between 12,000,000 and 13,000,000 natives. In the Pacific she lost the Marshall Isles (ceded to Japan as mandatory); Samoa (to New Zealand as mandatory); New Guinea (to Australia as mandatory); Nauru Island (to the British Empire as mandatory). She also renounced outright to Japan (art. 156–8) the peninsula of Shantung, a province Japan returned to China in 1921. In addition to all these cessions of territory, Germany lost all her state property, movable and immovable, in her colonies. She was further obliged to cancel all her valuable treaty rights, capitulations and concessions with countries like China, Liberia, Siam, Egypt and Morocco. An absolutely clean sweep was made of her transmarine possessions, properties, powers and rights. By article 438 even the property and stations of German missionaries are to be handed over to trustees, and the individual missionaries controlled or expelled from the mandated territories, at the will of the mandatory. The course of time will show how far the general disabilities inflicted on German oversea undertakings will cripple the transmarine state enterprise of Germany in future, and hamper her private traders and steamship lines, as well as her missionaries.

Part V. Military, Naval and Air Clauses.—The aim of these clauses was similar in all cases, to destroy the existing German fortifications and the *matériel* of war, and to maintain Germany permanently in an absolutely weak and crippled condition, so far as armaments went. The maximum of the German Army in future was to be 100,000 men, with stores of ammunition, guns, etc., in strict proportion. Beyond this figure all existing munitions, etc., were to be surrendered and destroyed and munition

manufacture henceforth restricted. Germany consented to abolish conscription and to adopt a system of long-period voluntary enlistment of at least 12 years for the men, and of 25 for the officers. Military training outside the army was forbidden, and the existence of a large general staff prohibited.

The naval clauses were almost equally drastic, and the German fleet was henceforth restricted to six battleships of the "Deutschland" type, six light cruisers, 12 destroyers, 12 torpedo boats (art. 181), in short, to a flotilla for coast defence, with the important proviso that submarines were absolutely forbidden. No new ships above 10,000 tons are to be built for replacement purposes. A voluntary long-period recruitment for the navy, on the lines of that of the army was provided. A complete demolition of naval works and fortifications within 50 km. of the coast was insisted on. The air clauses (art. 198–202) were the most drastic of all, for they absolutely prohibited naval or military air forces, and arranged for the total destruction of all military or naval air *matériel*. Inter-Allied commissions of control were provided for all these arms of the service, and their work was finally concluded in 1925. But the German armaments are still subject to supervision and inspection by the League.

Part VI. Prisoners of War and Graves.—This section is common to all the treaties and provides for the return of prisoners of war and for the upkeep and maintenance of graves. It calls for no special remark.

Part VII. Penalties.—This is the most disputable of all parts of the German Treaty, as it is the only one that has remained wholly a dead letter. It provides (art. 227) for the trial of William II. "formerly German Emperor, for a supreme offence against international morality and the sanctity of treaties." An international tribunal of five, with one member nominated by each of the Principal Allies, was to try this high-placed offender. The statement of the procedure to be adopted, and of the punishment to be inflicted, was judiciously vague. The project never came to anything because the Netherlands Govt., in whose territory the ex-Kaiser had taken refuge, refused to surrender him in accordance with the Allied request.

Articles 228–30 provided for the punishment before military tribunals of the allies of Germans "accused of having committed acts in violation of the laws and customs of war." Eventually a list of over 100 such criminals was drawn up, and their extradition demanded from Germany. Finally, about a dozen of them were tried in Germany itself by Germans and, though only a few were convicted, the Allied Governments decided to drop the matter, for extradition was impossible without fighting. In 1925 Field-Marshal Hindenburg, himself a "war criminal," was elected President of the Republic without any formal Allied protest.

Part VIII. Reparation.—This is among the most celebrated and important of the sections of the Treaty, and it was affected more than any other by outside and popular influences. The payments demanded were called "reparation" rather than indemnity, in deference to the principles of President Wilson, but it is hard to see how more money could have been demanded under any name. "The reparation chapter," as it is called, opens with the famous article 231, which is here given in full:—

> The Allied and Associated Governments affirm and Germany accepts the responsibility of Germany and her allies for causing all the loss and damage to which the Allied and Associated Governments and their nationals have been subjected as a consequence of the War imposed upon them by the aggression of Germany and her allies.

Standing by itself, this article might be construed to mean no more than that Germany is rendered liable to pay by a *pro forma* admission of her guilt. But the *reply* of the Allies to Germany of June 16 must be considered an authoritative interpretation of their views. They admitted in it the binding character of the Wilsonian principles and interpreted the treaty as a whole, and therefore article 231 in particular, as fixing the War guilt on Germany. Article 232 defined (in connection with an annex) the categories of loss and damage under which Germany was liable. Among these was included pensions to civilians. This seems clearly contrary to the definition given in the memo. of Nov. 5 1918, which has been quoted above. It would appear from the doubtful manner in which this question is handled in the covering letter and *reply* of June 16 that the Allies themselves were uneasy upon this point, and most impartial observers would now agree that this uneasiness was justified.

The remainder of Part VIII. is concerned with the ways and means of paying reparation, and a body, known as the Reparation Commission, was set up with very extensive powers. It appears that Mr. Lloyd George intended these powers to be used for the purpose of greatly reducing the ultimate liabilities of Germany, but the absence of the United States from the commission and the French influence upon it, together with English popular opinion, defeated this idea. The later course of reparation cannot detain us here, but the original proposals were greatly modified in execution. Mr. Keynes estimated at the time that about £2,000,000,000 was all that could be got out of Germany, and it is pretty certain that £3,000,000,000, or at most £4,000,000,000, represented the utmost they could have paid. The institution of the Dawes Scheme in 1924 put an end to the original reparation clauses and to the Reparation Commission.

The payments in kind provided for in article 236, and in various annexes, were based on sounder ground. They included, among other things, "the ton for ton, and class for class" replacement of Allied merchant shipping by German vessels. Great Britain benefited most under this head; France most by deliveries of coal and coal derivatives; Belgium by livestock.

Part IX. The Financial Clauses.—This section is largely technical, dealing with order of priority, with the meeting of special debts from special assets, currency questions, etc. It is closely connected with the "Reparation Chapter."

Part X. Economic Clauses.—The first section of this consists of articles 264–75, which deals with commercial relations, shipping and unfair competition, commercial treaties, etc. Much was attempted at the conference in the way of promoting internationalisation of rivers and canals and transport. It was even proposed to make raw materials free of tariffs throughout the world. But in the end the only practical gain was that the Allied Powers secured a "most favoured nation treatment" from Germany for five years, and adjusted various commercial treaties for this purpose.

Sections III.–VIII. (articles 296–311) provide for the regulation of enemy property, debts, contracts, etc. In the liquidation of German property in foreign countries the principle was adopted of giving the Allies power to confiscate the private property of German individuals in an allied country, and of crediting the sums obtained to the amount paid as reparation by the German National Government. In other words, the private property of German individuals held anywhere abroad was as liable to confiscation for reparation purposes, as if it had been German state property confiscated in a ceded colony. The German *Observations* to the Allies seem to admit that German private property held abroad could not be expected to escape altogether.

The Allies, in their *reply* of June 17, pointed out that they had had, as a result of the War, to take over foreign investments from their nationals, thus infringing on their private rights. They added: "the time has arrived when Germany must do what she has forced her opponents to do." It is quite true that, though private property was invariably respected in former wars, the advance of socialistic ideas and the conditions of modern warfare cause difficulty in applying strictly the doctrine of total immunity of private property. None the less, it appears that the demands of the Allies in this particular went much too far, as is evidenced by the fact that the powers thus given to the Allies have been exercised *in toto* nowhere except in France, that they have been only partially applied in Great Britain, and that they have been abandoned altogether in some countries, *e.g.*, the Union of South Africa. Anyhow it constitutes a dangerous precedent for the future. It is notable as being one of the very few parts of the treaty with which "The Big Four" did not interfere.

Part XI. Aerial Navigation.—This merely arranges for full liberty of passage and facilities for Allied airships flying over Germany up till Jan. 1 1923.

Part XII. Ports, Waterways and Railways.—This is an important section, though a highly technical one. The aim was to secure international control over rivers which flowed through more than one country. This was a very extraordinary development from the doctrine laid down as to international rivers at Vienna in 1815. It was, however, affected by the desire to provide access to the sea for countries like Switzerland and Czechoslovakia. These were land-locked, though they are the source of rivers which end in the sea. International commissions were set up to control the Rhine,

Oder, Elbe, Niemen and Danube. The result is that Germany is in a minority in the control of three rivers regarded as typically German, the Rhine, Oder and Elbe. The Kiel canal is in effect internationalised to give freedom of access to all vessels of whatever country in peace and in war but, subject to this condition, is under German administration. Access to the sea is secured by providing free zones for Czechoslovakia in the harbours of Hamburg and Stettin. As regards international transport by rail, the clauses were mostly of a temporary nature; and were subsequently more defined by an international transport conference held at Barcelona in 1921 under the auspices of the League.

Part XIII. Labour.—This section marks the beginning of an attempt to build up an elaborate fabric of international Labour machinery, to provide for periodic international discussion, and to arrange for the representation both of employers and of working men. Three of the most distinguished of Labour representatives took part in its construction, Samuel Gompers of the United States, George N. Barnes of Great Britain, and Albert Thomas of France, the last-named becoming the permanent head of the International Labour Office. This is established at Geneva side by side, but not identical, with the League Secretariat. It is, in fact, the instrument set up to carry out article 23*a* of the Covenant by which the members undertook " to endeavour to secure and maintain fair and humane conditions for men, women and children, both in their own countries and in all countries to which their commercial and industrial relations extend." Though an integral part of the League, its character and organs are autonomous, which is not the case with the machinery set up to deal with health and transit questions. In the allocation of its finance the League has control, but not over the organs, of international Labour. The Labour office is controlled by the governing body of 24 persons, of whom 12 represent Governments; six are elected by employers' delegates to the conference and six by workers' delegates to the conference.

The general conference, or Labour Parliament, which has to meet once every year, consists of over 200 members, and is constituted as follows: Every member of the League is entitled to four representatives, of whom the state government nominates two, while a third is elected by the employers and a fourth by the workers of the state concerned. The conference has met annually, but has met with grave difficulties in the application of universal rules and standards. It is largely due to the conference, however, that the hours of labour in the West have been recognised as 48 per week, while most Eastern countries have been induced to adopt a 60-hour week standard, which represents a great advance upon anything previously done in this direction. The care with which questions of injury to workers, *e.g.*, lead poisoning, are investigated and the publicity given to the deliberations is, however, a matter of the greatest importance (*see* INTERNATIONAL LABOUR OFFICE).

Part XIV. Guarantees.—Provision was made in the military clauses (*see* above) for the demilitarisation of the left bank of the Rhine. But a military occupation of Allied troops is also provided for. By article 428 the whole of this area, together with bridgeheads across the Rhine, is to be occupied for 15 years from the coming into force of the treaty (Jan. 10 1920). But it is provided in article 429 that there shall be a successive Allied evacuation of the three zones and bridgeheads into which the area is divided. That of Cologne is to be evacuated in five years, that of Coblenz in 10 and of Mainz in 15. These evacuations are not, however, to take place unless Germany faithfully carries out the provisions of the treaty as a whole. The Cologne evacuation was delayed from Jan. to Dec. 1925 on this account.

But the meaning of articles 429 and 430 appears to be that the Allies are only permitted to continue occupation if German conduct proves unsatisfactory. There does not seem any justification under the treaty for the action taken by the Allies as a whole, including Great Britain, in 1921, when areas in Germany beyond the bridgeheads were occupied. Still less would there appear to be any justification for the occupation of the German district of the Ruhr by the French and Belgians in Jan. 1923. This was not approved of at the time by the British Govt., and was subsequently declared by them to be in their opinion illegal in a note to the French Govt. (Aug. 1923). As a guarantee for the settlement of the Eastern frontier of Germany, as fixed at the peace, article 433 abrogates the Brest-Litovsk treaties between Germany and Soviet Russia and binds all German troops to evacuate territory beyond their new frontier.

Part XV. Miscellaneous Provisions.—This consists of a number of miscellaneous and technical matters which were accidentally omitted elsewhere. In so far as they are of any importance they are mentioned in connection with their appropriate subject above.

III. SUMMARY

The German Treaty appears, when its various items are assembled together, to have been crushing and severe to a high degree. This result was partly due to the fact that the separate parts of the treaty were worked out by the different committees, and its cumulative effect not recognised when they were assembled together. It is due, however, more particularly to the fact that popular pressure was very great both on President Wilson, Mr. Lloyd George and M. Clemenceau not to make a lenient peace. Indeed, the scheme prepared by Mr. Lloyd George on March 25 (published as Cmd. 1614) shows sufficiently what his ideas were. And he only modified them when he received on April 8 the famous " round-robin " telegram of 370 M.P.'s, whereupon he abandoned his ideas of leniency.

At the beginning of June he again showed a tendency to moderation, but by this time President Wilson had made up his mind and all efforts were useless. M. Clemenceau was considered by some French organs not to have sufficiently supported the interests of France, and he could hardly have been more moderate, even had he so desired. The representatives of the British Dominions were generally in favour of severity, with the conspicuous exceptions of Generals Botha and Smuts, who strongly urged moderation. The chief defects of the peace, the procedure against the Kaiser and the War criminals and the inclusion of pensions to civilians in reparation, must be considered concessions to popular feeling rather than due to the deliberate judgment of the peace negotiators. The first two have been abandoned and the last greatly modified. The territorial concessions were carefully considered and may, with some effort, be brought within the bounds of " the Fourteen Points " and of the Wilsonian principles. As regards permanent maintenance of the new frontiers, the British Govt. has guaranteed these in the West by the Locarno Treaty, but they are evidently not prepared to give any special guarantees for the existing Eastern frontiers of Germany, though France has promised to support Poland and Czechoslovakia against Germany, if need arise.

The " guarantees " section of the Peace Treaty was carried out by the evacuation of the Cologne area and by the tacit abandonment of policies like the invasion and occupation of the Ruhr. The Property section of the treaty has been, in great part, modified or abandoned. No great diplomatic instrument has ever been so speedily modified, revised or altered, whether by tacit consent or by deliberate design. Two parts of the treaty alone have expanded and developed, the institutions set up by the international Labour organisation and by the League. President Wilson is known to have thought that other parts of the treaty were, to a large extent, temporary but that the League would be permanent and eventually prove the corrective and solvent of such difficulties as other sections had created. His prediction is now in a fair way to become verified.

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VERWEY, ALBERT (1865–), Dutch man of letters, was one of the leading figures of the revival of Dutch literature, called " The movement of 1880." He helped to found and from 1884–9 was one of the editors of the *Nieuwe Gids;* from 1894–1904 of the *Tweemaandelijksch Tijdschrift* and *De XXe Eeuw*, and from 1905–19 of *De Beweging*. In 1924 Verwey was appointed professor of Dutch literature in the university of Leyden. His anthology with commentaries of *Nederlandsche Dichters behalve Vondel* (1893, etc.) and his essay on *Potgieter* and his circle *Het Testament van Potgieter* (1908) are works of lasting value. Verwey, who held an honorary doctor's degree from the

University of Geroningen, translated into Dutch Shelley's *A Defence of Poetry* and Sidney's *An Apology for Poetry* (1891). In 1885 he issued an article on *The Sonnet and the Sonnets of Shakespeare*. See M. Uyldert, *Albert Verwey* (1908).

VESNIĆ, MILENKO (1862–1921), Serbian diplomatist, was born as a Turkish subject in what was then the Sanjak of Novi Pazar, but made his way to Belgrade, where he was educated. After studying law he took his doctorate in Munich. He entered the Serbian diplomatic service in 1891, but soon left it to edit the Serbian law journal and became professor of international law at the High School (soon to become the university) of Belgrade. In 1893 he entered Parliament and was for a short time Minister of Education in the Gruijić Cabinet. In 1899 he and other Radical leaders were charged with complicity in the attempt on King Milan's life, and though entirely innocent, he was sentenced to two years' imprisonment. After a year he was pardoned, resumed his professorship, and in 1901 became Minister in Rome. In 1904 he was appointed Minister in Paris, a post which he held, with short intervals of political work, until his death. He was one of the delegates sent by King Peter to negotiate the peace of London in 1913, and in 1919 was delegate of the new Yugoslav State at the Peace Conference. In 1920 Vesnić, who remained a staunch though level-headed Radical, was selected to fill the office of premier and remained in office for 12 months with a coalition cabinet. He died on May 15 1921.

VETERINARY SCIENCE (*see* 28.2).—There is no single cause to which the rapid development of veterinary science since 1910 can be attributed. Powerful influences have been at work, such as increasing national appreciation of the importance of agriculture as a whole, and recognition of the facts that animal husbandry forms one of the greatest divisions of agriculture, and that disease is intercommunicable between other animals and man.

Public Health Service.—The evolution of a public health service has been the means of allocating to animal disease an important position in schemes of preventive medicine. The indebtedness of veterinary science to some of the pioneers in public health is indeed great. The bearing which the animal food products, especially milk and meat, have upon the welfare of man has, during this period, become fully appreciated. In some countries, as North and South America and South Africa, animal by-products have become an extremely valuable national asset. In South America it is commonly said that when dealing with an animal body " nothing is lost but the breath."

The purity of meat and milk supplies has assumed a considerable importance. Inspection, carrying with it a guarantee of purity, has proceeded very rapidly in some countries. For example, in meat inspection alone Germany employed 1,180 qualified veterinary surgeons before the World War. In U.S.A. 800 were employed, and in the French Department of the Seine alone 67 were exclusively thus engaged in 1913. At this time the number engaged in Britain in the whole public health service, meat inspection included, was under 50.

In 1914 an investigation was made into the annual output of qualified veterinary surgeons in several countries in proportion to the population, with the following result: Denmark, 1 in 133,000; Germany, 1 in 210,000; France, 1 in 300,000; Sweden 1 in 275,000 (making provision for 1 in 183,000); United Kingdom 1 in 500,000.[1]

In 1921 Dr. Gerald Leighton, chief inspector (foods) for Scotland, instituted a searching enquiry into the question of meat inspection in Scotland. As a direct result, Scotland has secured by law a complete and uniform system of meat inspection in which it is definitely laid down that the only persons who are entitled to act as inspectors of meat with the power of passing judgment are: the medical officer of health (M.O.H.) of the district; a veterinary surgeon; a person who, not being the M.O.H. or a veterinary surgeon, has had not less than seven years' practical experience of the subject and has received a special certificate from the Board of Health. It was thus left to a medical colleague to secure this clear definition of the veterinary surgeon in relation to this important work.

[1] J. Share Jones, *Higher Agricultural Education in Wales.*

University Developments.—The rise of animal husbandry, animal industry and zootechny as divisions of veterinary science in countries such as North and South America, Switzerland and Rumania, led to the establishment of chairs in the universities of the countries mentioned, so that " in view of the constantly increasing importance of the production and conservation of food and clothing for mankind, especial consideration will be given to problems in breeds and breeding, feeds and feeding, care, management, exhibition, marketing and utilisation of all classes of livestock and their products " (University of the State of New York, 1920).

The isolation of one particular branch of education is now generally condemned. In those countries which were the pioneers in veterinary education there still exist huge veterinary institutions. But where a new veterinary institution has been established within recent years it has usually been founded in a university centre and as an integral part of the university. At present the movement towards the universities has become general. It is recognised that to be in the university as part of a national scheme gives education stability. In the United States, where veterinary schools of various kinds were very numerous, every school, with two exceptions, outside the universities or state colleges collapsed during the War. The utilisation of existing endowments in the universities for the advancement of veterinary education has proved of immense benefit, expecially in such subjects as physiology, where complete departments with endowments already existed.

The universities have recognised veterinary science by granting veterinary degrees, which in some countries entitle the holders to practise, *e.g.*, South Africa, Australia, Brazil and Japan. In other countries, as in England, the degrees are simply evidences of academic achievement and are not licences to practise. Although degrees of B.Sc., in which certain veterinary subjects could be taken, were already granted by the universities of London and Edinburgh, the University of Liverpool was the first British university to grant a full veterinary degree. This university has instituted degrees of bachelor, master and doctor of veterinary science (B.V.Sc., M.V.Sc. and D.V.Sc.).

Research Institutes.—Under the auspices of the Development Commissioners and their advisory committees, research institutes have been founded at London and Cambridge in England, and in Scotland, for the Animal Diseases Research Association. Scores of thousands of pounds have been disbursed, and in 1925 the commissioners enlarged their field of support by making a grant of £15,000 on a pound for pound basis to the University of Liverpool to provide more adequate buildings and equipment for teaching and research in the purely veterinary subjects of the university veterinary school, which is the only intramural school in a British university providing a full course of instruction for a veterinary qualification. The commissioners state that they " were impressed by the opportunities available at Liverpool for the scientific training of veterinary students . . ., that an increase in the supply of highly trained veterinary practitioners and research workers should justify itself by a diminution in the national losses from animal diseases, and that Liverpool could specially meet the needs of students from western English counties and from Wales." Sir A. D. Hall and Sir Thomas Middleton took a leading part in this movement.

Outbreaks of Diseases.—Foot-and-mouth disease has appeared periodically in Britain since 1910 and has been very prevalent on the European continent. The rapid spread of the disease in Britain during 1922–3–4 created consternation. The most severe outbreak in the history of the United States occurred in 1914–5. The cost to eliminate the disease was $9,000,000, and 172,000 animals were affected. In 1914 Britain experienced the highest number of outbreaks of swine fever since 1896. In 1903 England was free from rabies and continued free until Sept. 1918. Between this date and 1922, 304 cases were reported. Western Europe was free from rinderpest from 1870 until 1920, when the disease was introduced into Belgium by zebus from America. The eradication of glanders in Britain was slowly but surely progressing until the year 1917. In 1918, however, 34

outbreaks were reported; but since that year the number of outbreaks again diminished, the figures in each successive year being 25, 15, 11, 4, 9, 3. On April 1 1923 it was decided to allow the importation of Canadian cattle into Britain. The decision of the royal commission was that Canadian cattle were free from foot-and-mouth disease, pleuro-pneumonia and cattle plague.

During the World War " horrible epizootics were disseminated throughout Russia by marching and retreating armies . . . Anthrax, glanders, rinderpest, contagious pleuro-pneumonia of cattle, foot-and-mouth disease, hog cholera, swine erysipelas, rabies, mange—each of them contributed to the disappearance of the comparatively dense animal population of Russia " (Podgaez). The result was that in 1922 Russia had slightly over one-third the number of horses it had in 1914, one-third the number of cattle, half the number of sheep and a quarter the number of pigs. In Sept. 1924 contagious bovine pleuro-pneumonia appeared in Japan, being imported with cattle from China. In 1925 the disease broke out again in Osaka and spread rapidly to the five neighbouring prefectures.

Research.—Strenuous efforts have been made to bring about a closer relationship between the workers in human and veterinary medicine. In Great Britain the Royal Society of Medicine has instituted a section for comparative medicine. The outstanding result achieved is the universal recognition of the bearing disease in the lower animals has upon disease in man. This is evident in most of the important researches of the period.

At the ninth international veterinary congress held at the Hague it was resolved: 1. That swine plague and hog cholera are different diseases. 2. That an active serum against foot-and-mouth disease is possible. 3. That the presence of negri bodies is the best diagnostic of rabies.

Amongst researches carried on over a prolonged period the following are deserving of mention: McFadyean and Stockman (England) on abortion in cattle; Buxton, Brown, Tocher and others (Scotland) on grass disease (they claimed to have demonstrated that grass disease in horses in Scotland was botulism); Jensen (Copenhagen) on bradsot; Gaiger (Scotland) on lamb dysentery; Thieler (South Africa) on protozoan diseases; Watson (Canada) on dourine (he utilised the complement-fixation method of diagnosis, through which it is claimed that the disease will be eliminated in a few years); Lignières (Brazil) on Pasteurelloses; Vallée (Paris) on foot-and-mouth disease; Magnusson (Sweden) on joint ills; Hall (U.S.A.) on the treatment of hookworms by carbon tetrachloride (which has since been applied to more than 12,000 human cases in the Fiji Islands with success). In 1909 Nuttall and Hadwen reported the successful use of trypan blue in canine piroplasmosis and later suggested its use in piroplasmosis of cattle.

Bruce and others concluded in 1910 that cattle may act as reservoirs of the virus of sleeping sickness. The final report of the Royal Commission on Tuberculosis (1911) claimed: (1) that there were three types of tubercle bacilli, (2) that animals and man can be reciprocally infected, (3) that a considerable amount of tuberculosis in children must be ascribed to milk infection, (4) that milk may be infective when there is no evidence, even on post-mortem examination, of tuberculosis of the udder. The intimate relationship existing between the disease in man and in animals is thus clearly established. At this time Siegel (Germany) claimed to have found the causal organism (a coccus) of foot-and-mouth disease; and McGowan (Edinburgh) and Ferry (Detroit) individually to have found the causal organism of canine distemper. The work of Twort and Ingram on the diagnosis of Johne's disease in 1912 was an outstanding merit. Leptospiral jaundice was recognised in dogs probably for the first time by Courmont and Durand in 1917. A special committee was formed to investigate grass disease in 1918. In the following year the South African Govt's. select committee recognised the dipping scheme introduced by Watkins-Pitchford as an effective antidote for East Coast fever.

In 1922 Mellanby issued important results of his work on rickets in puppies carried out for the Medical Research Committee (London). In the same year *The Field* inaugurated a fund to assist research in canine distemper, and the Animal Diseases Research Association of Scotland received official recognition. The claim of Dahmen and Frosch (Berlin) to have discovered in 1924 the virus of foot-and-mouth disease has not been recognised. Interesting work on leptospiral jaundice was done in England by Okell, Dalling and Pugh in 1925.

At the congress on the prevention of tuberculosis in London 1925, Professor Mölgaard, of the Royal Veterinary College, Copenhagen, gave an account of his experiments on animals leading to his discovery of the treatment of tuberculosis with sanocrysin, and Professor Faber, of Copenhagen University, gave the results of the application of Mölgaard's method to a number of his human patients.

Remarkable progress has been made in veterinary science in Japan, and *The Journal of the Japanese Society of Veterinary Science*, edited by Drs. J. Muto and N. Nitta, is an excellent specimen of a first-class scientific journal. The three reports of K. Muto, director of the army veterinary school, Tōkyō, on the " Toxic Action of Carbon Disulphide "; Konno's work on the diseases found in young chicks in the Nagoya region and commonly called " kufun " or " ohri " in which he isolated the anaerogenic strain of *B. pullorum*, one of the causal agents of bacillary white diarrhoea of young chicks in Europe and America; the " Resistance of Erythrocytes of Healthy Domestic Animals," by Kohanawa and Kadono, of the Veterinary Institute, Hokkaido Imperial University, Sapporo; Ono's work at the laboratory of the animal quarantine station, Yokohama, on contagious bovine pleuro-pneumonia; and the work of Kohanawa and Ogura on cattle diseases in the Sapporo district indicate a breadth of view as well as high scientific capacity.

Progress in Surgery.—Considerable progress has been made in veterinary surgery. With the general adoption of anaesthetics, major operations are now widely practised. The operation on the laryngeal ventricle in the treatment of roaring, originally performed by the brothers Gunther, was reintroduced by Williams of Cornell and subsequently practised and popularised by many operators on thousands of cases with, it is claimed, a considerable measure of success. The most comprehensive work on roaring as a result of researches in the Argentine appeared in Spanish published at Buenos Aires. Imrie has done much to confirm the contention of Macqueen during the previous decade, that the abdominal cavity of the horse may be entered surgically almost with impunity, and Pugh has made an interesting contribution to thoracic surgery in the ox. In 1914 the first English work published on surgical anatomy of the horse was completed by Share Jones.

Veterinary Science in War.—In 1910 the strength of the British Army veterinary service was 160 officers and 218 others, or a total of 378. In 1917 there were over 1,200 officers and over 20,000 N.C.O.'s and men. Sixty-two men were killed in action and 358 died. Of the officers, 46 were killed in action or died of wounds or disease. Over 70 veterinary hospitals were established with accommodation for more than 100,000 animals. Much of the capital cost of hospitals in France was defrayed by the R.S.P.C.A. Most of the work in connection with the sale of horse-flesh for food was supervised by veterinary surgeons, and the funds thus realised were utilised to reduce the cost of the veterinary services in France.

During 1917 over 1,000,000 horses were on the strength at one time on all fronts, and of them 436,000 were in France. The average daily number of sick horses in that year rose to 110,000. The total dead wastage from Aug. 1914 to Nov. 1918 from all causes was over 500,000, of which 269,000 were in France. The weekly wastage in France was nearly 2% of the total strength. The total admissions to hospital in all theatres was 2,526,549, and of these 78% returned to duty. The mortality was worst in 1917, when the number lost was 145,475. The mortality in mules was only half of that in horses. During the War, the total number of camels admitted to hospital has been stated to exceed 60,000. One camel hospital averaged 1,103 camels daily, and the percentage discharged for duty was eight.

Cases of poll evil and quittor were common in horses and mules. It is stated that in one group of French hospitals 627 cases of quittor were dealt with in one day. Roarers were also numerous, and it is claimed that 80% were successfully treated. Specific ophthalmia appeared in 1916, and the number of cases rose to 1·4% of the strength. A point of great interest and importance is that glanders was not prevalent. This is due to the thorough manner in which the mallein test was applied. Mallein was ultimately produced at Aldershot at 2d. a dose.

In 1918 the corps was raised to the status of a Royal Corps. In 1917 Rainey claimed that the total wastage (from death, destruction, missing and casting) of horses and mules of the British forces at home and abroad during the year ending Dec. 1916 was 13% of the total. In peace time (1912) it was 14·8%, while the average annual mortality during the South African War, when there was no Army veterinary corps, was 55%. The names of Generals Sir Robert Pringle, Sir Frederick Smith, Sir Layton Blenkinsop and

Sir John Moore will be permanently associated with this extraordinary development.

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VICTOR EMMANUEL III. (1869–), King of Italy (*see* 28.28). When in 1915 Italy declared war on Austria, the King at once went to the war zone, remaining there until the Armistice, appointing his uncle Ferdinand, Duke of Genoa, regent of the kingdom to act in his stead. At the front he lived in a most unassuming manner at the "Villa Italia," near Udine, and after Caporetto near Padua, constantly visiting the trenches and the most exposed positions, as well as the military hospitals, and leading to a very large extent the life of the soldiers. His example was of great value as an encouragement, and he fully lived up to the tradition of his house that it has never known fear. He took the keenest interest in everything concerning the welfare of the men; but although nominally commander-in-chief he never interfered with the conduct of operations nor in the matter of appointments, and he allowed himself no more leave than was accorded to other combatants.

After Caporetto he multiplied his activities a thousandfold, and his proclamation of Nov. 19 1917 sounded like a trumpet call to the whole people. "As neither My House nor My People, one in spirit, have ever wavered in the face of danger, so even now we look adversity in the face without flinching. . . . Citizens and soldiers, be a single Army! All cowardice is treachery, all discord is treachery, all recrimination is treachery." After the Armistice King Victor Emmanuel returned to Rome on Nov. 14 1918, and had a triumphal reception. He visited Paris and the French front with the Crown Prince, and subsequently London.

At the time of the Fascist March on Rome (Oct. 28–30 1922), the Prime Minister, Sig. Facta, intended to proclaim martial law throughout Italy, and had actually prepared the decree and communicated it to the prefects and the Press; but the King, with that intuition that has never failed him on critical occasions, realised that its application would mean civil war, and refused to sign it and insisted on its immediate withdrawal. After the occupation of the capital the Fascist squadre before returning home marched past the Quirinal and paid homage to the King. The advent of the Fascist Govt. undoubtedly strengthened the prestige of the Crown, which the troubles of 1919–22 had seriously shaken. On May 26 1924 the King, accompanied by the Queen, the Crown Prince and Princess Mafalda, arrived in London to return the State visit to Rome of King George and Queen Mary. On June 7 he visited Madrid for a similar reason. In June 1925 the 25th year of his reign was celebrated throughout Italy with the greatest solemnity.

After the birth of his son and heir, Umberto, Prince of Piedmont (Sept. 15 1904), the King's family was increased by two more daughters, Giovanna, born Nov. 13 1907, and Maria, born Dec. 26 1914. His eldest daughter, Princess Yolanda, was married on April 9 1923 to Captain Count Giorgio Calvi of Bergolo, and his second on Sept. 23 1925 to Prince Philip of Hessen. A keen scholar, and especially interested in numismatics, in 1910 and 1913 he published six volumes of his monumental work on the coins of Italy, the *Corpus nummorum italicorum*. After the War he made over to the nation a large number of royal residences in various parts of Italy, a heritage of the days when Italy was divided into a number of separate states, each with one or more royal or ducal palaces and villas. Among the most famous of these are the Pitti Palace in Florence, the villas of Castello, La Petraia and Poggio a Cajano in the neighbourhood of that city, the royal palaces of Milan, Venice, Genoa, Naples, the villa of Capodimonte near Naples and the "Neapolitan Versailles" at Caserta. Some of these buildings were turned into hospitals and homes for War victims, and others into museums. (L. V.*)

VICTORIA (*see* 28.37), a State of the Australian Commonwealth. Area 87,884 sq. miles. Its population increased from 1,339,102 in 1911 to 1,670,852 in 1925. Victoria is the most Conservative of the States of the Commonwealth, and up to the end of 1925 had had only one Labour Govt., which was appointed in June 1924 and defeated six months later. The farming interests (Country party) are well represented, and in the Coalition Govt. (Nationalists and Country party) which came into power in Nov. 1924, a representative of the Country party, Mr. J. Allan, was elected Premier. State-aided immigration was re-established in 1908 and a vigorous policy of close settlement adopted.

Irrigation and Production.—The Water Act 1905 practically nationalised every river and watercourse within the State, and between 1905 and 1925 over £13,000,000 was expended in works of irrigation and water supply. The area artificially supplied with water for domestic and stock use in 1923 was 13,440,000 ac. and the land under irrigation culture, chiefly along the valleys of the Goulburn and Murray rivers, was over 300,000 acres. After 1918, good progress was made in intensive fruit-growing at Mildura on the Murray. The total area under crops in 1924 was 4,682,144 ac., of which 2,705,323 ac. was under wheat. In the same year 86,888,000 lb. of butter was produced.

Minerals and Manufactures.—Deposits of brown coal and lignite of immense extent occur in various districts. In 1918 a commission was appointed by the Government to work the brown coal deposits at Morwell, to be utilised for the generation of electricity to serve Melbourne and other towns. The first generator was brought into operation in 1924 and is serving Melbourne. The manufacture of briquettes on a commercial scale is being undertaken. The State also operates the black coal deposits at Wonthaggi; the output of this field in 1923 was 418,394 tons, the total production for the State being 476,823 tons. The total value of the manufacturing output in 1924 was £113,921,000, of which factories connected with food and drink accounted for £33,760,000, and clothing and textile factories for £23,617,000. Great progress has been made in the manufacture of woollen goods, and in 1924 there were 27 woollen and tweed factories, the output being valued at £3,561,980. Melbourne, the capital, had a population of 885,700 on Dec. 31 1924. It is the second port in the Commonwealth. Of the other important towns, Ballarat and Bendigo owe their rise to the gold rush, and are now prosperous agricultural centres. Geelong is the next port to Melbourne and is also the centre of the woollen industry. (*See* AUSTRALIA.)

VICTORY, ADVANCE TO.—By the end of July 1918 the German offensive on the Marne and in Champagne, which had been intended by their high command to be decisive, had been brilliantly repulsed by an Allied counter-blow which had forced the enemy to evacuate the greater part of the ground gained and had almost cleared the Allied lateral railway communications from Paris eastwards. In the meantime, the British front about Amiens had not been idle. During May and June, the Australian Corps in Gen. Rawlinson's IV. Army had by constant raids and

minor operations obtained an almost complete moral mastery over the enemy, and had done much to encourage the harassed troops on other parts of the front. The following article describes the Allied advance, which began early in July 1918 and ended with the Armistice. It has been divided into six sections, namely: I. Battle of Amiens; II. Battle of Bapaume-Peronne; III. The Breaking of the Hindenburg Line; IV. Battle of Meuse-Argonne; V. The Offensive in Flanders; VI. The French Armies.

I. THE BATTLE OF AMIENS

Towards the end of June, Rawlinson decided that an operation on rather a larger scale than the Australians had so far carried out had every chance of meeting with success. On July 4, six Australian battalions, working in close co-operation with some 60 tanks, together with four companies of the American 33rd Div., which was attached to the IV. Army for training, attacked on a front of nearly $3\frac{1}{2}$ m., and with consummate ease and only small losses captured the ridge running from Villers-Bretonneux down to the Somme at Hamel. This operation gave greater depth and valuable positions for observation to the British line, while at the same time it denied to the enemy important observation over much of the Somme valley. It also showed that the German infantry was no longer the determined foe that it had been in 1916 and 1917, and that the enemy's defences were not formidable. The real significance of the operation was its evidence that on the IV. Army front a well organised attack, supported by tanks well trained beforehand to co-operate with infantry, would have every prospect of breaking through the enemy's defences, given the element of surprise.

On July 17 Rawlinson, to whose initiative the opening of the decisive Allied offensive was chiefly due, submitted proposals to Haig for an attack by the IV. Army on a front of approximately 16 m. from Moreuil to Morlancourt. The plan was at once approved by Haig, who, in response to a request from Gen. Foch that the British should take the offensive on the Lys front with a view to recovering the important position on Kemmel Hill, recommended that the venue for the British offensive should be changed to the Amiens front. To this proposal Foch assented with the modification that the French I. Army (Debeney) should attack on the southern portion of the front between Moreuil and the River Luce (about $3\frac{1}{2}$ m.) shoulder to shoulder with the British IV. Army, both armies operating under the direct orders of the British commander-in-chief.

On July 28 Foch issued his orders. "The object of the operation," he said, "is to disengage Amiens and the Amiens-Paris railway, as well as to beat and push back the enemy between the Somme and the Avre. The offensive, covered on the north by the Somme, is to push forward as far as possible in the direction of Roye." The Amiens-Roye road was fixed as the dividing line between French and British, and Aug. 10 was to be the day of attack. This date was subsequently advanced to Aug. 8.

Preparations for the British Attack.—On July 26 orders were received that the preparations, which Rawlinson had already begun in anticipation of sanction being given to his proposed operation, were to be pressed forward with all speed. The essence of the whole plan was secrecy. Unless the existing conditions both as regards the state of the hostile defences and the absence of reserves could be maintained, success could not be guaranteed, and in consequence it was not until July 31 that divisional commanders even were told the true story of the operations, a false but adequate reason having been given for the preparations.

Allied Forces.—On Aug. 1 the strength of the IV. Army was seven divisions, one cavalry division, three tank battalions (about 110 tanks), 11 squadrons R.A.F. and 1,000 guns and howitzers. By zero hour on Aug. 8, this force had been increased to 13 divisions, three cavalry divisions, 12 tank battalions (about 456 tanks), 17 squadrons R.A.F., and over 2,000 guns and howitzers, of which 672 were "heavies." In addition, one division, retained in the hands of the commander-in-chief, was brought into the area, while two others arrived on the day of the battle. The cavalry, about 96 whippet tanks and part of the artillery were moved by road, the remainder being brought up in some 290 special trains, 230 for personnel and guns and 60 for ammunition and material.

As the Canadian Corps, at the time in reserve near Arras, had not been involved in the desperate fighting earlier in the year, it was realised that wherever it was identified in the line by the enemy an early offensive would certainly be expected. The first problem, therefore, was to camouflage its move and to keep its presence secret up to the last possible moment. With this object a few Canadian units were moved into the line near Kemmel, whilst the remainder moved down to the Amiens front, though it was not allowed to take over its part of the front line until just before zero hour on Aug. 8. The task also of introducing and registering a very large number of guns without detection was no easy matter. All movements of artillery units and the formation of ammunition dumps had to be done at night. A strictly limited number of guns only were allowed to fire daily, nothing above the normal number of rounds being permitted.

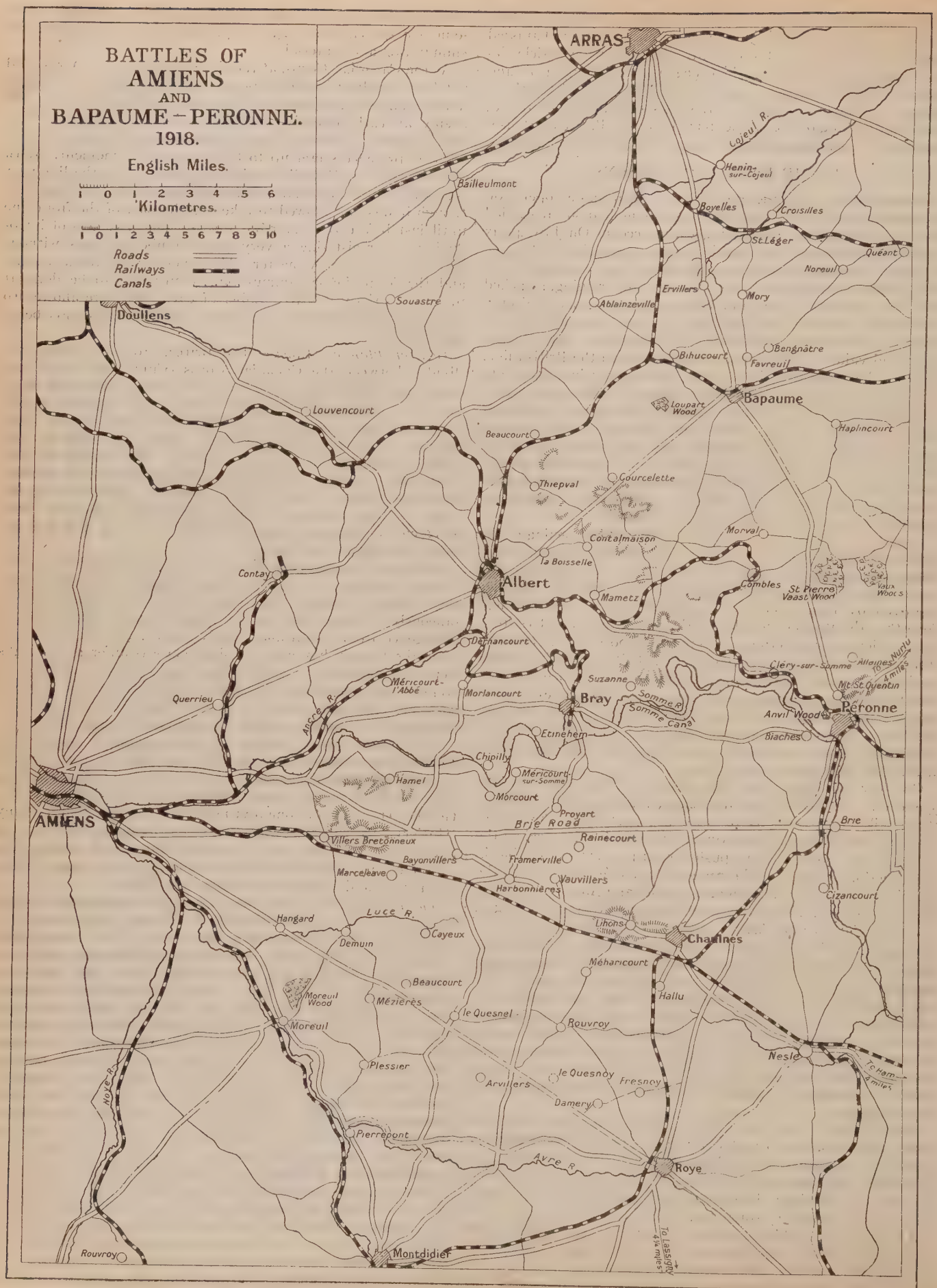
General Plan of Attack.—The British front of attack was divided between the Canadian Corps (Currie, four divisions) from the Amiens-Roye road to the Amiens-Chaulnes Rly., 7,500 yd.; the Australian Corps (Monash, five divisions) thence to the Somme, 7,500 yd.; and the III. Corps (Butler, four divisions) thence to the river Ancre, 5,000 yd.; while to each corps a proportion of tanks was allotted. The task of the III. Corps was to form a defensive flank north of the Somme, whilst the French I. Army would carry out a similar task on the right of the Canadians. Three successive objectives were assigned at distances respectively of 2–$2\frac{1}{2}$, 3–5 and 6–8 m. from the original starting line.

Owing to the ample provision of tanks and the weakness of the enemy's defences a preliminary bombardment was unnecessary, the artillery, infantry and tank action commencing simultaneously at zero hour, up to which moment there was no divergence from the ordinary daily routine of trench warfare. With the French, however, the situation was different, as tanks were not available to assist them; and Debeney decided to bombard the enemy's defences for 40 min. prior to the infantry advance. The zero hour, 4.20 A.M., of the IV. Army advance synchronised with the opening of the French bombardment.

The hostile forces believed to be available to oppose the British were six divisions in first line with eight in reserve of the German II. Army (Marwitz), while in front of the attacking corps of the French I. Army were the two left divisions of the German II. Army and one division of the German XVIII. Army (Hutier). By the morning of Aug. 8 all preparations for the battle were complete, and the Allied forces, all unsuspected by the enemy, were about to enter upon the first stage of their continuous and victorious march to the Rhine.

The British Attack, Aug. 8.—At 4.20 A.M. (approximately one hour before sunrise) Rawlinson's IV. Army, under cover of a powerful barrage, debouched to the assault. Thick ground mist veiled the advance from the eyes of the Germans, who were completely surprised and overwhelmed with little resistance along nearly the whole front. The Canadian Corps attacked with three divisions in line, the 3rd, 1st and 2nd in order from the right. The Canadian 3rd Div., making light of the difficult task of debouching from a narrow bridgehead on the south bank of the River Luce, captured Hangard and Demuin, and by noon had carried its front forward to the second objective, between Mézières and Cayeux. The 3rd Cav. Div. then went through, followed by the Canadian 4th Div., but, after taking Beaucourt, was held up by machine-gun fire. The infantry on coming up succeeded in pushing forward, though they were unable that day to capture le Quesnel, the final objective.

The Canadian 1st Div. in the centre reached the first objective by 6.20 A.M.; but the Canadian 2nd Div. on its left only attained it an hour and a half later, having met with strong opposition at Marcelcave. At 8.20 A.M. the advance was resumed, the German machine-gunners putting up considerable resistance against the Canadian 2nd Division. The 1st Cav. Div. now sent forward


BATTLES OF
AMIENS
AND
BAPAUME – PERONNE.
1918.
English Miles.
1 0 1 2 3 4 5 6
Kilometres.
1 0 1 2 3 4 5 6 7 8 9 10
Roads
Railways
Canals
ARRAS
Cojeul R.
Henin-sur-Cojeul
Bailleulmont
Boyelles
Croisilles
St. Léger
Queant
Noreuil
Ervillers
Mory
Souastre
Ablainzeville
Doullens
Bihucourt
Bengnâtre
Favreuil
Bapaume
Loupart Wood
Louvencourt
Beaucourt
Haplincourt
Thiepval
Courcelette
Contalmaison
Morval
la Boisselle
Albert
Combles
St. Pierre Vaast Wood
Vaux Wood
Contay
Mametz
Dernancourt
Méricourt-l'Abbé
Morlancourt
Suzanne
Bray
Somme R.
Somme Canal
Clery-sur-Somme
Allaines
To Nurlu 4 miles
Mt. St. Quentin
Péronne
Querrieu
Ancre R.
Anvil Wood
Etinehem
Biaches
Chipilly
Méricourt-sur-Somme
Hamel
Morcourt
Proyart
Brie Road
Brie
AMIENS
Villers Bretonneux
Rainecourt
Bayonvillers
Framerville
Marcelcave
Vauvillers
Harbonnières
Cizancourt
Hangard
Luce R.
Lihons
Chaulnes
Cayeux
Demuin
Méharicourt
Beaucourt
Hallu
Moreuil Wood
Mézières
le Quesnel
Moreuil
Rouvroy
Nesle
To Ham 5 miles
Plessier
le Quesnoy
Fresnoy
Arvillers
Damery
Noye R.
Pierrepont
Avre R.
Roye
To Lassigny 4¼ miles
Rouvroy
Montdidier

two brigades, one of which passed through the Canadian 2nd Div. and drove far into hostile territory, attaining the final objective in conjunction with the infantry, which followed up, clearing the ground in rear of the cavalry. By the end of the day's fighting the Canadian Corps had, with the exception already noted on the extreme right, carried out its appointed task, and captured over 5,000 prisoners and 161 guns.

Progress in the Centre.—The Australian Corps in the centre of the British attack had their 2nd and 3rd Divs. in the front line with the 5th and 4th in support, the 1st Div. being in reserve. The leading line, assisted effectively by the tanks, reached the first objective with little opposition. The 5th and 4th Divs. then continued the advance, pushing on beyond Bayonvillers and Morcourt, and occupied the second objective by about 10.30 A.M., when a brigade of the 1st Cav. Div. passed through towards Harbonnières and armoured cars raced forward down the Brie road, penetrating far into the enemy's back areas. Behind them, the Australians, throwing back their left to face the enemy on the north bank of the Somme, pushed forward their centre and right to the final objective just west of Vauvillers and Proyart, where they found the cavalry held up. During the day the Australians took nearly 8,000 prisoners and 173 guns.

North of the Somme the III. Corps had not met with the same measure of success. The plan had been disarranged by a local German attack near Morlancourt on Aug. 6, which forced back a part of the Allied line some 800 yards. In addition the terrain was not so suitable for tank manoeuvres as south of the river. The attack opened with the 58th, 18th and 12th Divs. from right to left. After the first objective had been gained, the further advance broke down against the resistance of the enemy holding the Chipilly spur, while further north the enemy counter-attacked and drove back the advanced attacking troops. Nevertheless, the III. Corps captured during the day nearly 2,400 prisoners and 40 guns.

The results of this most successful day's battle were the complete defeat and rout of 11 German divisions, a gain of ground to an average depth of six to seven miles on a front of eight miles, the capture of over 16,000 prisoners, 373 guns, several thousand machine-guns and quantities of ammunition and stores. Most important of all, the battle destroyed the last hope of German victory. "It was," says Ludendorff, "the black day of the German Army in the War. . . To continue would be a gamble. The War would have to be ended."

The French Attack, Aug. 8.—At 4:20 A.M., simultaneous with the British assault, the French bombardment of the enemy's position on the commanding ground in the angle between the rivers Avre and Luce opened, and at 5:05 A.M. the French infantry debouched to the attack. For this operation Debeney allotted three divisions of the XXXI. Corps, of which one division was given the task of capturing Moreuil. Despite a stubborn defence, the enemy was gradually driven back and Moreuil wood taken. This feature was of great importance, as its capture secured the flank of the British advance. At 9 A.M. the IX. Corps crossed the Avre, south of Moreuil, and extended the front of attack, which by the end of the day's fighting reached the general line Plessier-Fresnoy (excl.). Although the French attack did not quite reach its final objective for the day, its main task of securing the British flank was carried out, while some 3,000 prisoners and many guns were captured. The result also enabled General Fayolles, commanding the French reserve group of armies, to carry out his plan of extending the battle front further to the south on Aug. 9.

Continuation of British Advance, Aug. 9–11.—It was decided by Rawlinson that the IV. Army should on Aug. 9 continue its advance to the line Roye-Chaulnes-Bray-Dernancourt. The main attack was entrusted to the Canadian Corps which was to push southeast to the line Roye-Hallu, whilst the Australian Corps was to secure its left between the latter place and Méricourt, and the III. Corps to advance to Etinehem and form a defensive flank north of the Somme.

Early in the morning the Canadians captured the village of Le Quesnel, thus completing the capture of all the objectives allotted to the main British attack for the 8th. During the day, assisted by cavalry, they advanced the line an average of five miles and halted for the night on a general line east of Rouvroy and Méharicourt. To the north the Australians reached Lihons Hill and captured Framerville after stubborn fighting. The III. Corps, north of the Somme, cleared the Chipilly spur and occupied Morlancourt. During the day six German divisions reinforced the front from neighbouring armies. On Aug. 10 and 11 the advance continued against ever stiffening resistance and hostile counter-attacks, eventually reaching the general line Le Quesnoy-Lihons-Raincourt, whilst north of the river the Etinehem spur was completely cleared.

Pause in the Advance.—It was now clear that to push the offensive further would lead to disproportionate loss with little corresponding gain. The enemy had reformed his front, shattered on the 8th, by fresh troops from other portions of the line, and had settled down on the edge of the area devastated in the Somme battles of 1916, where a maze of old trenches, wire and shell holes rendered defence easy and rapid advance impracticable. Rawlinson had engaged all his 13 divisions, units were tired and in need of a breathing space. He therefore decided to allow his troops a few days' rest while preparing for a renewal of the attack on Aug. 15. Units in the line were relieved and tired infantry and cavalry withdrawn into reserve.

French Operations, Aug. 9–11.—On Aug. 9, Debeney made an encircling attack, southeast and northeast with his X. and XXXV. Corps, his objective being Montdidier. The operation was completely successful, and though the garrison of the town managed to slip out the town was occupied and the rearguard captured on the morning of Aug. 10. In the meantime the XXXI. Corps to the north reached the line Pierrepont-Arvillers. By the night of the 11th it gained the western outskirts of Roye. On Aug. 10 Fayolles brought in the French III. Army (Humbert) on the right. Attacking on the front Courcelles-Gournay in the direction of Lassigny, it made an advance of an average depth of three to four miles. Next day the front was extended still further southwards, but, owing to the enemy's resistance becoming stronger, progress was thenceforward slow.

British Operations, Aug. 12–21.—Owing to the difficulty of reorganising the front of attack and of bringing up the guns, the attack arranged for Aug. 15 did not materialise and up to the 21st only local actions took place on the IV. Army front. British attacks alternated with hostile counter-attacks, the line after hard fighting reaching Damery-Lihons-Proyart-Dernancourt. On Aug. 17, Haig decided to transfer temporarily the centre of gravity of the British offensive to the III. and I. Army areas. The Canadian Corps was taken out of the line and the French I. Army took over the British front as far north as Lihons. During the period Aug. 8–21 the IV. Army had forced back the Germans to a depth of 12 m., had defeated or engaged with its own 13 divisions no less than 27 of the enemy's, had taken over 23,000 prisoners and 400 guns and had killed and wounded more than an equivalent number, at a cost to itself of some 27,000 casualties.

French Operations, Aug. 12–21.—During this period the French I. Army, which remained under Haig's command until the 16th, continued its advance in touch with the British right, while the French III. Army, whose advance was assisted by the French X. Army's attack east of the Oise, after a hard and determined defence succeeded in occupying Lassigny on Aug. 21. In the 12 days' fighting Humbert's army of seven divisions had driven eight hostile divisions from their strong vantage ground and had taken 5,000 prisoners and 100 guns.

General Results of the Battle.—The course and results of the fortnight's fighting may be summed up as follows: The three Allied Armies (British IV., French I. and III.), with 32 divisions, had attacked and defeated the German II. and XVIII. Armies of 42 divisions. The Allies had advanced to a depth of 6–13 m. on a front of 47 m. taking 40,000 prisoners and 600 guns. Most important of all, the Allied lateral communications between Paris and the north had been cleared, and a wide breach had been made in the German front, susceptible, as events were

to show, of being rapidly widened to either flank by further Allied attacks. A shattering blow had been dealt to the morale of the German Army and their high command, from the effects of which neither was destined to recover. The battle of Amiens was the first page in the story of the Allied victory of 1918.

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II. THE BATTLE OF BAPAUME–PÉRONNE

On Aug. 10 at the moment when Rawlinson's IV. Army was carrying all before it, Foch issued a directive to Haig in which it was enjoined that " enterprises by the British III. Army in the general direction of Bapaume and Péronne should be prepared as soon as possible." At the time the front of Byng's III. Army was held as follows: V. Corps (Shute, with three divisions) from the left of the IV. Army just north of Albert to Beaucourt, IV. Corps (Harper, with five divisions) thence as far as opposite Ablainzeville, VI. Corps (Haldane, with four divisions) thence to the army boundary south of Arras. Preparations were at once put in hand, the operations being timed to begin on Aug. 21, by which date the rapid advance of the IV. Army had been checked on the western edge of the old Somme battlefields of 1916.

Attack by III. Army.—On Aug. 21 a preliminary operation was carried out by the IV. and VI. Corps together with the left division of the V. Corps, in order to get within striking distance of the enemy's main defensive position along the Arras-Albert railway. This attack, which was entirely successful and resulted in the capture of some 2,000 prisoners, enabled Byng to spend the 22nd in bringing up his guns preparatory to the main attack on the 23rd, on which date a general advance on the whole army front, together with that portion of the IV. Army which was north of the Somme, was timed to take place.

On the 23rd, Byng attacked on a front of 16 m. from just north of Albert to the Cojeul. Though stubborn resistance was encountered, considerable progress was made, the objective being reached all along the line. The IV. Corps, in the centre, pushed forward to Bihucourt and Loupart Wood, while the VI. Corps captured Ervillers and established itself east of the Arras-Bapaume road in the vicinity of Boyelles. On the right the V. Corps, in conjunction with the III. Corps (IV. Army), pushed out its right and established itself on the hills overlooking the town of Albert just west of La Boisselle. During the day 5,000 prisoners and a number of guns were taken.

The advance was continued on the 24th and 25th, by the evening of which the IV. Corps had pushed forward as far as the line Favreuil-Mory, thus threatening the enemy's line of retreat from Bapaume. To the south the V. Corps, after capturing the Thiepval stronghold on the 24th, attained a general line west of Contalmaison and Courcelette. On the left the VI. Corps occupied St. Léger and Henin-sur-Cojeul but was held up in front of Croisilles.

IV. Army Operations.—The operations of the III. Army were closely supported by the IV. Army troops north of the Somme. On the 22nd, the III. Corps and left Australian Div. attacked on a front of 7,000 yd., reaching all its objectives to a depth of from 2,000 to 3,000 yards. In the afternoon a strong counter-attack developed against the III. Corps right division and much of the ground won earlier in the day was lost. During the next three days the advance continued in conjunction with the III. Army, and on the evening of the 25th the front had reached a general line along the high ground west of Suzanne-Mametz. South of the Somme the Australian Corps on the 23rd advanced up to the edge of the old Somme battlefield, capturing 3,000 prisoners and 23 guns.

British Advance Continued.—As a result of the critical situation caused by these operations, the German Higher Command ordered Von Boehm, commanding the group of armies between the Ancre and the Aisne to fall back to the general line Quéant-east of Bapaume-Péronne-Ham. This movement was carried out on the 26th and 27th.

On the 26th the V. Corps made a rapid advance, whilst the IV. Corps continued to swing round to the northeast of Bapaume, occupying Beugnâtre. On the evening of the 25th, the XVII. Corps (Ferguson) relieved the VI. and undertook the difficult task of dispossessing the enemy of his strong position in the vicinity of Croisilles. During the next week a stubborn defence was shown all along the front, which by the evening of Sept. 2 had reached the enemy's position on the line Morval-Haplincourt-Noreuil. During the 13 days' fighting the 14 divisions of the III. Army had engaged 23 hostile divisions, had taken from them 11,000 prisoners and many guns and had driven them back a depth of 8–13 m. on a front of 20 m., besides inflicting heavy losses in killed and wounded.

On the IV. Army front north of the Somme, the III. Corps together with the 3rd. Aus. Div. continued the advance in touch with the III. Army. South of the Somme the advance had been rapid, and on the evening of the 29th the river had been reached between Cizaucourt and Biaches, whence the line continued northwards to Combles. In view of the small prospect of success afforded by an attempt to force the strongly held river line south of Peronne, Rawlinson decided that the next operation must be a strong advance by the centre and left towards Nurlu in order to turn the river line. Before that could be done, however, the key to it, the dominating height of Mont St. Quentin, which commanded all the country to the north and west including all the river passages by which it could be approached, had to be captured.

Capture of Mont St. Quentin.—Although the operation which resulted in its capture by the Australians extended over only a few miles of front, they were of such importance to the general advance and so brilliantly executed that a description will be given in rather greater detail. On the 30th, a bridge head on the north bank of the river near Cléry was seized and by 4 A.M. on the 31st, the 5th Bde. (2nd Aus. Div.) had crossed over and by 7 A.M. had captured Mt. St. Quentin village, the right being held up in front of Anvil Wood. Shortly afterwards, a strong counter-attack developed and drove the British line back to the road on the southwest side of the village. As a result of the day's fighting the 5th Bde. of some 1,200 rifles had penetrated to a depth of 2,000 yd. and though reduced to only 600 rifles had held out on a wide front of 4,000 yd. against repeated and desperate counter-blows.

Next morning the 6th Bde. which had crossed the river the evening before, passed through the 5th Bde. and after a short bombardment stormed the village and wood and established itself on the height. Meanwhile the 14th Bde. (5th Aus. Div.) also passed through south of the 6th Bde. and brushing aside all opposition entered and occupied Péronne, only a small portion of the suburbs on the northeast remaining in the enemy's hands. Next day, the Australians occupied Allaines and the III. Corps St. Pierre Vaast and Vaux Woods. The line of the Somme had been turned, due, as a detailed account would show, to the brilliant initiative of every commander from the Army Commander to the section leader and to the magnificent fighting qualities of the Australian soldier. Between Aug. 22 and Sept. 2 the IV. Army of 9 divisions had engaged 23 of the enemy's divisions and taken 23,000 prisoners and many guns.

Results of the Battle.—Byng and Rawlinson's armies totalling together 23 divisions had defeated 46 German divisions. On a front of 28 m. they had advanced to a depth of 6 to 13 m., capturing 34,250 prisoners and 270 guns. The whole area of the Somme battlefields, which had cost the British five months of bitter fighting in 1916, had been reconquered in less than a fortnight; more than half the ground gained by the German spring advance had been recovered, the only good natural line of defence west of the Hindenburg system had been broken, and the shifting of the moral and material balance, in favour of the British and against the Germans, had become patent to the world.

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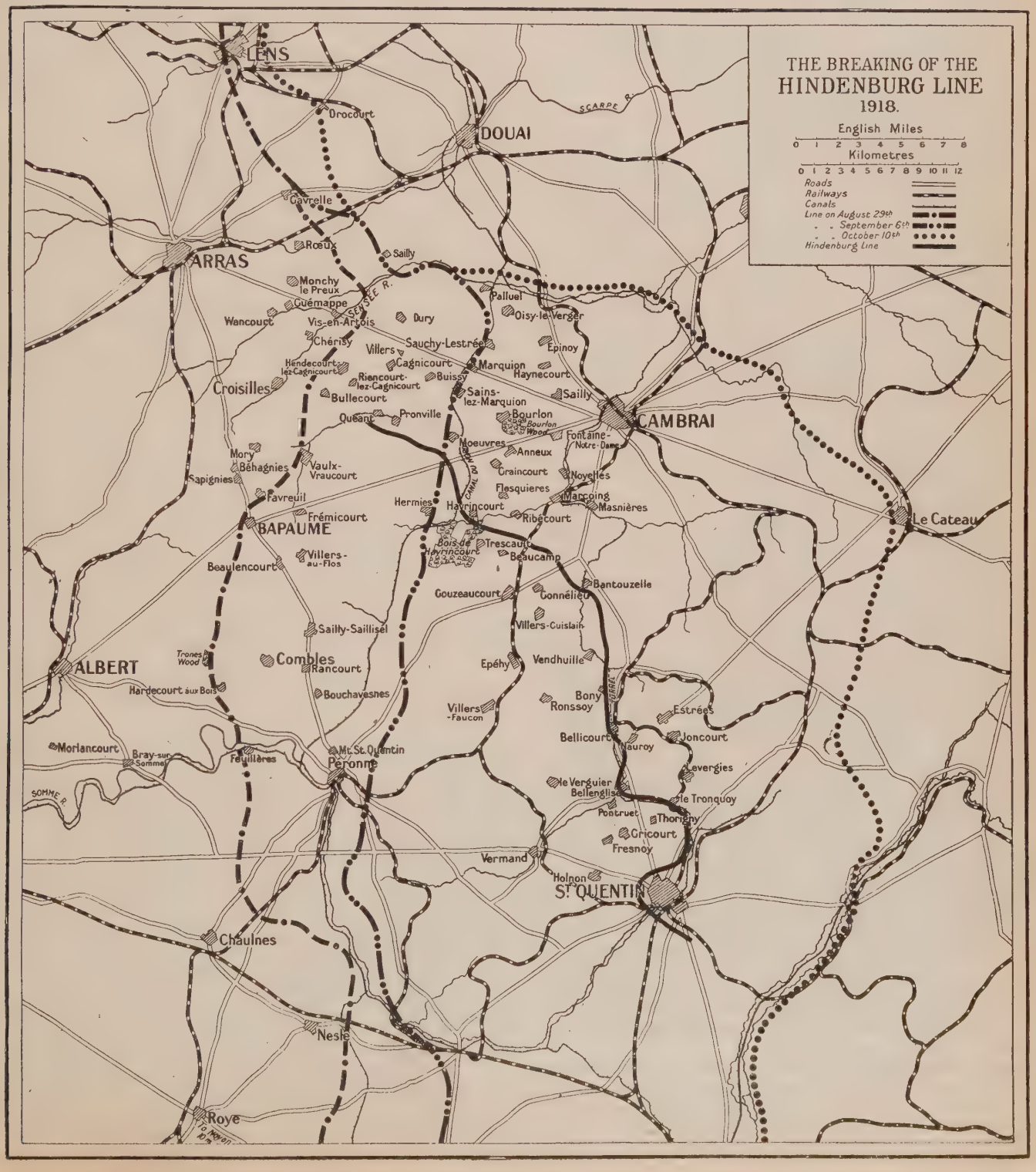
III. THE BREAKING OF THE HINDENBURG LINE

On Aug. 26 began the third stage of the series of offensive operations which formed the British share of the Allied advance to victory. This stage culminated on Oct. 5 in the capture of the last and strongest system of German defence, known as the Hindenburg Line. The first stage had been the attack by Rawlinson's IV. Army, assisted by the French I. Army under Debeney, eastwards and southeastwards from Amiens with the object of freeing the Paris-Amiens railway. In the second phase the British III. Army under Byng had extended the front of the attack northwards by a successful thrust towards Bapaume. The British I. Army under Horne was now to broaden the front of attack by driving eastwards from Arras with the object of turning the German positions on the Somme battlefields.

Hindenburg Line Described.—The Hindenburg Line consisted of a heavily wired system of trenches which ran northwards from St. Quentin to the village of Bantouzelle approximately parallel to the Schelde Canal. This portion was known to the Germans as the Siegfried Line. From Bantouzelle the main line of trenches ran northwest to Havrincourt, whence it turned north and followed the line of the Canal du Nord to Moeuvres. From Moeuvres it ran northwest past Quéant and Bullecourt to the original German front line east of Arras. Within this northern bend in the system, and covering the approaches to Cambrai lay several switch lines and defensive positions, the most formidable of which were the Drocourt-Quéant Line which ran in a northerly direction from the Hindenburg Line at Quéant and the Canal du Nord which passed by Moeuvres to the Sensée.



On the night of Aug. 25–6 the British line extended from a point northwest of Chaulnes where the right of the British IV. Army joined the left of the French I. Army, east of Bray, west of Bapaume to Croisilles, and thence northwest to the old British line, southeast of Arras. The IV. Army had the Australian and III. Corps in line; the III. Army, which extended northwards from a point east of Albert, had the V., IV., VI. and XVII. Corps. The I. Army front was held by the Canadian Corps and the VIII. and I. Corps, of which only the Canadian Corps, astride the Scarpe, was involved in the operations to be described. The German troops who were to bear the brunt of the impending blow were the left wing of Below's XVII. Army, the II. Army under Marwitz and the right wing of Hutier's XVIII. Army.

The Offensive Launched.—At 3:00 A.M. on Aug. 26 the Canadian Corps under Sir A. Currie attacked the German positions astride the Scarpe on a front of 5½ miles. The attack was carried out by the 2nd and 3rd Canadian Divs. and the 51st Highland Div. supported by 45 tanks and some 600 guns. The XVII. Corps of the III. Army co-operated on the right. The attack was a complete success. The Bavarian II. Corps and Bavarian I. Res. Corps were driven back through Wancourt, Guémappe, Monchy and Roeux, and by evening, in spite of strong counter-attacks, the Canadian Corps had established itself well to the east of those villages. On Aug. 27 the attack was continued by the same divisions, and Chérisy, Vis-en-Artois and Gavrelle fell into their hands. On the following day the Canadian 3rd Div. made further progress, and that night both divisions were relieved, the Canadian 2nd Div. by the Canadian 1st while the British 4th Div. relieved the Canadian 3rd. During the next few days considerable progress was made. This advance brought the British to within assaulting distance of the formidable trench system known to the Allies as the Drocourt-Quéant Line, and to the Germans as the Wotan Line. The capture of this system, would, it was anticipated, turn the whole of the German organised positions for some distance southwards. Preparations were put in hand to launch the attack on Sept. 2. The XXII. Corps took over the front north of the Scarpe held by the 51st Div. and relieved that division by the 11th.

The Drocourt-Quéant Line Attacked.—By the evening of Sept. 1 all preparations for the attack of the Drocourt-Quéant Line were complete. The main attack was to be carried out by the Canadian Corps, whose principal task was to break through the defences between Hendecourt and Sailly. The XXII. Corps, also of the I. Army astride the Scarpe, was to secure the Canadian left, while the XVII. Corps of the III. Army, advancing on the right of the Canadians, was to capture the maze of trenches at the junction of the Drocourt-Quéant and Hindenburg lines, and turn the last named defensive position from the north. The XVII. and Canadian Corps were then to push on up to and if possible beyond the Canal du Nord.

The attack of the Canadian Corps was launched at 5:00 A.M. by the Canadian 1st and 4th and the British 4th Divs., supported by some 500 guns and 40 tanks, on a front of 4½ miles. All resistance on the first objective was speedily overcome, and by 9:15 A.M. the whole system of trenches on the front of the Canadian Corps was in the hands of the assaulting troops. On the XVII. Corps front, the attack was launched at the same hour and met with equal success. The 52nd Div. stormed the network of trenches at the junction of the two systems, and after heavy fighting succeeded in overcoming all resistance. The 57th Div., attacking north of the 52nd, pressed forward south of the Canadians, and by nightfall had swung round to the right and were threatening the villages of Quéant and Pronville from the north. The 63rd Div., which passed through to exploit the success, had heavy fighting during the afternoon, but by dark had reached the railway east of Quéant.

During the afternoon the Canadian Corps met with increased opposition, particularly from machine-guns on the British 4th Div. front, but by the evening an advance of some 3 m. had been made and British troops had captured Cagnicourt, Villers and Dury, and were approaching the outskirts of Buissy. Eight thousand prisoners and many guns were captured, bringing the total captures on the I. Army front alone since Aug. 26 to 16,000 prisoners and 200 guns. In eight days the 10 British and Canadian divisions employed by the I. Army had defeated 13 German divisions and driven them back 10 m., out of all their organised positions in front of Cambrai. Troops of the III. and IV. Armies prolonged the attack southward on Sept. 2, and substantial progress was made, though the fighting was severe.

The results of this most successful operation became obvious at once, as on the night of Sept. 2–3 the Germans fell back to the line of the Canal du Nord from Péronne to Hermies. The following day they commenced to withdraw from the Somme, south of Péronne, and by the night of Sept. 8 they were back on a line Vermand (6 m. west of St. Quentin)-Epehy-Havrincourt and thence along the east bank of the Canal du Nord to the Sensée.

Preparatory Operations Continued.—The Canal du Nord, behind which the German forces facing the I. Army and left of the III. Army had now established themselves, was far too strong a natural position to warrant attack without very careful preparation. The next three weeks were therefore devoted by the British forces on this front to the organisation of an operation which eventually took place on Sept. 27. South of Havrincourt the German main line of resistance was the Hindenburg Line, but strong forces were still occupying advanced positions in the trenches which formed the old British and German lines prior to the German offensive in March 1918. These had to be captured before the Hindenburg Line itself could be assaulted, and to this end operations were undertaken by the British III. and IV. Armies.

On Sept. 12 the III. Army attacked with the IV. Corps and the VI. Corps on a 5 m. front in the neighbourhood of Havrincourt Wood. A considerable advance was made and the villages of Trescault and Havrincourt were captured. Meantime the IV. Army had continued to press the German withdrawal, and between Sept. 11 and 17 the line had been pushed forward at several points. On Sept. 18 a much more extensive operation was undertaken, in which the IV. Army in conjunction with the III. Army attacked the German forces on a 17 m. front from Holnon to Gouzeaucourt. The French I. Army co-operated on the right. The final objective of the main attack was the old British outpost line running past Pont Ruet, west of Bellicourt, Bony and Vendhuile. It was not intended that this final objective must necessarily be reached on the first day—and in fact it was not reached until after several days of very severe fighting.

At 7:00 A.M. on Sept. 18 the IV. and III. Armies attacked in heavy rain. The attack was supported by 23 tanks and 978 guns, and in some sectors dummy tanks were used with considerable success. The IX. Corps advanced on the right with the 6th and 1st Divisions. The first objectives were taken at 9:00 A.M., but the 6th Div. was checked at Holnon and west of Fresnoy. The 1st Div. was more successful, but was unable to reach Pont Ruet, and both divisions suffered severe casualties. The Australian Corps had very heavy fighting, particularly in and about Le Verguier, and was held up in front of its final objective till dusk. During the night a successful attack was made which completed the operation on the Australian front.

North of the Australians the III. Corps attacked with the 74th, 18th, 12th and 58th Divs., and met with very stubborn resistance. Ronssoy was captured by the 18th Div. and Epehy by the 12th and 58th Divs., but little progress was made beyond these places. The V. Corps of the III. Army continued the front of attack to the north and all divisions made considerable progress, though it was not found possible to take Gouzeaucourt on this day. Minor operations were undertaken during the succeeding week, which resulted in the capture of Gricourt and Pont Ruet by the IX. Corps, and by Sept. 26 the British line had been advanced to a position from which the attack on the main Hindenburg system could be launched. In this last series of operations 15 divisions of the British III. and IV. Armies had driven back 20 divisions of the German II. and XVII. Armies into the Hindenburg defences, and inflicted on them a loss of 12,000 prisoners and 100 guns.

The Storming of the Hindenburg Line.—All was now ready for the great effort to break through the Hindenburg Line. The strategic plan decided on by Marshal Foch and the Allied Commanders-in-Chief involved the launching of four convergent and practically simultaneous offensive operations. The Americans were to attack west of the Meuse in the direction of Mézières. The French offensive, also against Mézières, was to be launched west of the Argonne. The British were to break through the Hindenburg Line between St. Quentin and the river Sensée and advance on Maubeuge, while an Allied force (British, French and Belgian) under the King of the Belgians, was to attack in Flanders in the direction of Ghent. The results to be obtained from these offensive operations depended in no small degree on the success of the British attack in the centre, where a threat to the German vital systems of lateral communication would re-act on their defences elsewhere. It was here, too, that the German system of defence was most highly organised, and here success or failure might be expected to produce the greatest moral effect, both from the military and political points of view.

In accordance with the above general strategic plan the French and Americans attacked on Sept. 26; the British offensive commenced on the 27th, and the Allied attack in Flanders was launched on the 28th. Haig's plan was to strike first with his left wing in the direction of Cambrai, while the right wing, which was faced by the more formidable defences, was to attack later after a very heavy preliminary bombardment. It was hoped that any success obtained by the left wing would draw off the German reserves, and deceive their higher command as to the point where the main blow was to fall.

A very heavy bombardment was opened on the night of Sept. 26–27 on the front of the British I., III. and IV. Armies, and at 5:20 A.M. on the 27th four corps attacked on a front of 13 m. from Gouzeaucourt to the neighbourhood of Sauchy Lestrée. On the northern flank the Canal du Nord was too formidable an obstacle to be carried in face of opposition, and consequently the plan was conceived of crossing on a comparatively narrow front, and then of turning the line of the canal further north by a divergent attack from the point of crossing. This difficult manoeuvre was most successfully carried out. On the right the 5th and 42nd Divs. of the IV. Corps established and held a strong flank between Beaucamp and Ribecourt. On their left the VI. Corps advanced with the 3rd and Guards Divs., and captured Ribecourt and Flesquières, while the 62nd and 2nd Divs., passing through, continued the advance in the direction of Marcoing. Further north the 52nd and 63rd Divs. of the XVII. Corps forced the passage of the canal and, after heavy fighting, established themselves in Graincourt, and the 57th Div., in close co-operation with the Canadians, reached Anneux.

On the I. Army front the Canadian Corps attacked with the Canadian 4th and 1st Divs., and in the half light of dawn stormed the canal on the line Moeuvres-Sains-Marquion. With irresistible impetus the Canadian 4th Div. pushed on to Bourlon village and wood where the Canadian 3rd Div., taking up the attack, advanced towards Fontaine Notre Dame and Sailly. On the left the Canadian 1st Div. was equally successful, and having captured Sains and Marquion, advanced rapidly towards Haynecourt and Sauchy Lestrée, while the British 11th Div. passed through and captured Epinoy and Oisy-le-Verger. Meanwhile the 56th Div. of the XXII. Corps crossed the canal, west of Sauchy Lestrée, cleared that village and advanced on Palleul. By the evening of Sept. 27 over 10,000 prisoners and 200 guns had been taken. As soon as the crossings of the canal were secured the British and Canadian engineers began to construct the necessary bridges, and in spite of heavy artillery fire completed their task with remarkable speed, and contributed in no small degree to the success of the operation.

On Sept. 28 the advance was continued and Gouzeaucourt, Marcoing, Noyelles, Fontaine Notre Dame, Sailly and Palleul were taken, and a footing was obtained on the east bank of the Schelde Canal at Marcoing. At 5:50 A.M. on the morning of Sept. 29, after a preliminary bombardment lasting over two days, in which some 1,600 guns were employed, the British IV. Army advanced to the attack, covered by an intense artillery barrage. The front of attack extended from Holnon to Vendhuile, a distance of about 12 miles. On the right the IX. Corps met with complete success. The 1st Div., advancing south of the bend in the Canal at Bellenglise, established a flank facing southeast from Gricourt to the Le Tronquoy tunnel. The 46th Div., which was faced by a most formidable task, advanced with the greatest gallantry, and with the assistance of rafts, mats and even life-belts, stormed the canal at and north of Bellenglise and rushed the German trench system west of the canal. The German defences here faced south, and the British troops swung to the right and took them in flank and rear, capturing many prisoners and guns. By 3:00 P.M. the 46th Div. had broken through the Hindenburg Line to a depth of 3 miles, routed four German divisions, and taken over 4,000 prisoners and 70 guns at the small cost of 800 casualties. The 32nd Div., passing through, completed the capture of the Hindenburg Reserve Line, and by nightfall had taken 800 more prisoners and 20 guns.

Work of the American Corps.—On the left of the IX. Corps the American II. Corps had been superimposed on the Australian Corps. The task of the American troops was to break through the Hindenburg Line at and north of Bellicourt, where the St. Quentin Canal passes through a tunnel. The Australian 5th and 3rd Divs. were then to take up the attack and advance on more distant objectives. The Americans advanced with the greatest gallantry, but owing to inexperience and impetuosity they omitted to secure the captured ground as they advanced. The German troops, swarming up out of their dug-outs and shelters in the tunnel were consequently in position to oppose the supporting Australian divisions as they came up and it was only after very heavy fighting that the Australian 5th Div. on the right finally succeeded in reaching the Hindenburg Reserve Line about Nauroy. The Australian 3rd Div. following up the Americans could make but little headway and was finally checked in front of Bony.

On the left the III. Corps carried out their task of securing the left flank of the IV. Army. On the same day the III. Army achieved an important success by securing the canal crossings at Masnières and northward as far as Cambrai, while the I. Army front was advanced northwest of that town. On Sept. 30 the break in the Hindenburg system was widened by the capture by the IX. Corps of Thorigny and Le Tronquoy, and on the same day the Germans abandoned Villers Guislain and Gonnelieu. On Oct. 1, in co-operation with the French I. Army who occupied St. Quentin, the IX. Corps took Levergies and the Australians captured Joncourt, Estrées and Bony. The III. and I. Armies also achieved important successes. During the first week in Oct. the XIII. Corps relieved the III. Corps north of the Australians and a series of successful minor operations were carried out on the fronts of all three armies, and by Oct. 5 the whole of the rearward lines of the Hindenburg system were in British hands.

Results of the Offensive.—During this nine days' battle 30 British and two American divisions had broken through the last and most powerfully organised system of German defences, had overwhelmed 39 German divisions and captured 36,000 prisoners and 380 guns. The effect of the British victory was decisive on the subsequent course of the campaign, and though there was still to be hard and bitter fighting before the termination of hostilities on Nov. 11, only natural obstacles such as woods, rivers and villages now lay between the British Armies and their objective at Maubeuge.

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IV. THE BATTLE OF THE MEUSE–ARGONNE

In its main outlines the plan of the Meuse-Argonne attack was agreed upon in a conference between Marshal Foch, General Pétain, and General Pershing at Bombon, on Sept. 2 1918. The decisions of this conference were embodied in a general directive

issued by Foch and elaborated by Pétain into precise orders for the two armies concerned—of Pershing and Gouraud.

Allied Plans.—The general objective named for the combined attack on the front was Mézières. The American I. Army was to attack on the front from the Meuse to the Argonne and the French IV. Army to attack from the Argonne to Suippe. The direction for the attack of the two armies was Buzancy-Mézières, but the first objectives named were the Hindenburg Line on the front Brieulles-sur-Meuse–Romagne-sous-Montfauçon–Grandpré. The American attacking troops consisted of three army corps of three divisions each in the front line and three divisions in reserve. This force was strengthened by the addition of 180 French aeroplanes, 239 French tanks, and 1,712

French guns and mortars. Of the American troops in the front line only one division was regular, and six of the remaining eight divisions lacked any previous battle experience.

German Forces Engaged.—The German positions between the Meuse and the Argonne were naturally strong and had been strengthened by every possible artifice. Vauquois, a fortified hill east of and overlooking the Aire valley, was regarded as an impregnable fortress, and Montfauçon, dominating the whole plateau, afforded not only a strong defensive position, but observation and command posts which greatly aided in controlling the defence of the entire sector. German troops in the line on the front of attack consisted of only five divisions, four of them of inferior quality and the fifth, a Guard division, much worn from intensive fighting further north and sent to this supposedly quiet sector for rest. Among the German divisions immediately in reserve only one was rated first-class. Thus the German infantry actually in line was out-numbered about four to one, since the American divisions had twice the infantry strength of the German divisions, and a decisive artillery and air superiority.

Prior to the attack General Pershing caused various feints and ruses suggestive of coming American attacks to be employed in the Luneville sector east of the Moselle as well as in and south of the Vosges Mountains. This had served to distract the attention of the German General Staff and led it to expect an attack to the east or south rather than west of the Meuse. The real attack, consequently, had the advantage of being almost a complete surprise.

First Attack: Sept. 26.—Following an artillery preparation of three hours, the attack was begun at dawn on Sept. 26. On the first day the attack progressed well. The I. Corps on the left stormed Vauquois, reached its objectives in the Aire valley, and even made sensible progress in the Argonne forest. On the right the III. Corps crossed the difficult Forges brook, and also gained its objectives, but in the centre the V. Corps was held up in passing through the woods in its front, and was unable to take Montfauçon although the III. Corps had passed beyond it on the right. On the second day Montfauçon was gained and the attack went forward, but not so far as had been planned. On the third day, Sept. 28, still less advance was made in the centre and not what was hoped for on the left.

By this time the German reserves from outside the sector began to pour in and by the fourth day, having nine divisions in the line, the Germans made strong counter-attacks, which were partially successful in regaining lost ground. The German artillery was also greatly increased and from the favourable flanking artillery position on the heights east of the Meuse and in the Argonne forest hampered the advance of the American troops, in what had now become an advanced salient in the American line between the Meuse and the Aire rivers. The weather for the first three days had been favourable, but on the 28th drizzling rain set in, which added to the difficulties both of the tactical handling of troops and of their supplies. The reconstruction of roads across no-man's land has been found especially difficult on the front of the centre corps, on account of the depth of the shell-battered zone created by years of intensive fighting.

Offensive Renewed, Oct. 4.—West of the Argonne the attack of the French IV. Army had not been successful in making any appreciable advance and American reserves were called for to reinforce the French IV. Army, as well as to replace tired divisions in the I. Army for a general renewal of the offensive on Oct. 4. This renewal of the attack was successful on both flanks of the Argonne. On the west the French IV. Army captured Blanc Mont, while east of the Argonne the right of the I. Corps gained an advance of 10 km. on the right bank of the Aire, an advance exploited three days later by bringing a flank attack on the upper Argonne from the east, which resulted in the capture by Oct. 10 of the entire forest, and enabled the French and American Armies to connect their flanks through the pass of Grandpré.

The failure of the I. Army to gain its objectives on the western half of the Meuse-Aire plateau in its attacks of Oct. 4 made it clear that a broader base was required to push the attack beyond the main Hindenburg Line, and that the possession by the Germans of the heights east of the Meuse afforded them too favourable artillery positions and observation posts to make possible an extended advance west of the Meuse. Accordingly on Oct. 5 Pétain placed at the tactical disposal of the I. Army the French XVII. Corps, at the time passively holding the line east of the Meuse, and directed that, reinforced by some American divisions, it should be called upon to gain the line Dun-sur-Meuse-Damvillers. This attack was made on Oct. 7, coincident with a renewal of the attack on the west. By Oct. 10 the I. Army was, in general, up to the rearmost carefully prepared German positions in this region, known as the Kriemhilde Stellung. On Oct. 11 Pétain called for a renewal of the attack on both banks of the Meuse with the same objectives as before on the east bank, but with the breaking of the Kriemhilde Line and the capture of Buzancy as the objectives on the west bank. This attack was carried out on Oct. 14 and resulted in small material gains, including the Côte Dame Marie, Cunel and Romagne-sous-Montfauçon.

Preparations for Final Attack.—The troops by this time were well worn and for the remainder of the month the I. Army had of necessity to limit itself to local operations and to preparations for a systematic renewal of the offensive. On Oct. 12 the I. Army front, which had hitherto extended to the east to the Moselle, was divided into two army sectors, and on the 16th General Pershing transferred the immediate command of the I. Army to Lieutenant-General Liggett, and exercised supervision, as group commander, of both armies.

On the German side there was no lack of appreciation at either Army or General Headquarters of the threat which the American attack constituted. Von der Marwitz declared to his army, on Oct. 1, "It is on the firm resistance of the Verdun front that depends the fate of the great part of the Western Front, perhaps even of our nation." Hindenburg wrote in his memoirs:

"It was plain that the situation could not last. Our armies were too weak and too tired. Moreover the pressure the American masses were putting upon our most sensitive point in the region of the Meuse was too strong."

During the month of Oct. the German Army, pressed at all points, had used up nearly all its available reserves of fresh divisions, and no longer had means of replacement of depleted or exhausted units on the front line. The result was that the carefully prepared general attack on Nov. 1 broke through the enemy's line at all points and henceforth it was a case of rapid pursuit, with occasional rear-guard actions until the Armistice on Nov. 11. The chief preoccupation on the Allied side during this pursuit was holding the troops in leash in their sectors and determining who should have the honour of first entering important towns such as Sedan. The main line of the Carignan-Sedan railway, the real objective of the Meuse-Argonne attack, was brought under artillery fire on Nov. 3, and reached by the I. and V. Corps on Nov. 7, while the III. Corps had by the same date forced the crossing of the Meuse and advanced 10 km. to the north and east.

The I. Army during the Meuse-Argonne operation had employed 22 American and four French divisions. Of the American divisions 12 were engaged on other fronts during part of the time. On the German side in addition to the five divisions originally in the sector 38 divisions had in the course of the battle been put into the line. The maximum strength of the American troops engaged at one time was 896,000, their losses were 117,000 killed and wounded, their captures 26,000 prisoners and 846 guns.

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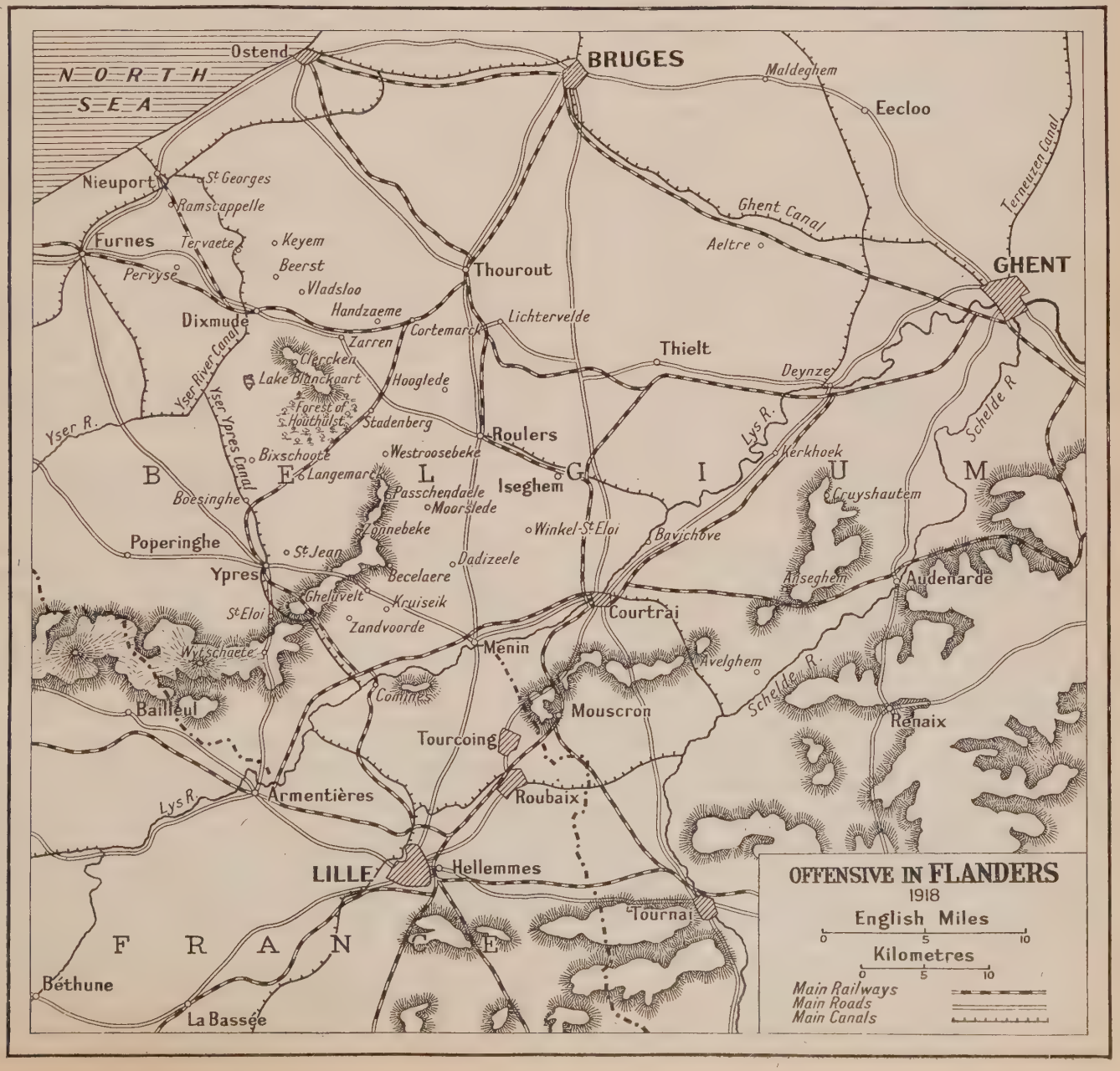
V. THE OFFENSIVE IN FLANDERS

By the end of Aug. 1918 the initiative in operations had been definitely lost by the Germans. Strengthened by American co-operation, Marshal Foch planned a triple attack in which Franco-American forces were to attack on both sides of the Argonne: the main British forces to break through the Hindenburg Line; the Belgian Army with some British and French troops to operate in Flanders. The three échelons were to move off on Aug. 26, 27 and 28, respectively, at intervals of 24 hours.

Allied and German Forces.—The Flanders Army Group, created Sept. 11, and placed under the command of King Albert, included the Belgian Army of 12 infantry divisions and one cavalry division; the British II. Army of 10 infantry



divisions; and, later, the French VII. Corps and II. Cav. Corps, with a considerable reinforcement of artillery. The Commander-in-Chief of the Allied armies decided that the first operation should have as its object the occupation of the Clercken hills heights, the forest of Houthulst and the Passchendaele-Wytschaete-Comines ridge. From these points a second offensive delivered in the direction of Roulers-Courtrai might be expected to bring about the evacuation of the Belgian coast and the industrial region round Lille.

The German IV. Army (Gen. von Arnim), lying between the sea and Armentières, had 16 divisions: the Marine group (2nd Marine Div., 38th Landwehr Div. in line, 1st Marine Div. in reserve); the Guards Res. Group (13th Res. 11th and 12th Bav. Divs. in line, 23rd Div. in reserve); the X. Res. Group (236th and 8th Divs. in line, 187th in reserve); and the Guards Group (11th Res. and 56th Div.). The last two of these groups were facing the British, the first two the Belgians. Four divisions were resting: the 16th at Bruges, the 3rd at Thourout, the 16th Bavarian at Iseghem, the 52nd Res. at Courtrai. The marine divisions were fresh and at normal strength but the other divisions had only 60 to 70 men to a company. The disposition of the defence comprised three positions, the zone of the shell-holes and " pillboxes " of the 1917 battle; the *Flandern II Stellung*, marked on the crest by Zarren—Westroosebeke—Passchendaele; and the *Flandern I Stellung* between Handzaeme and the west of Roulers.

Allied Attack: Sept. 28.—At 2:30 A.M. on Sept. 28, 1,800 guns opened fire; and after a bombardment lasting three hours, nine Belgian divisions—of whom two were in the second line—proceeded to the attack on a front of 7 m., extending from Lake Blanckaart to St. Jean, near Ypres. Twenty minutes later, four British divisions (the 9th, 29th, 35th and 14th) attacked between this point and St. Eloi without any artillery preparation. In two hours the zone of the shell-holes had been crossed under a heavy downpour of rain, and by evening the Allied troops had advanced some 5 m. over a sea of mud. The Belgians had carried all before them, taking the Houthulst forest and Passchendaele, and the British had taken Becelaer, Kruiseik and Zandvoorde. On Aug. 29, in spite of counter-attacks by the resting German divisions which had been thrown into the battle, the Belgians had carried Dixmude, Clercken, Stadenberg and Westroosebeke, the latter points being severely contested. Fighting side by side in the best spirit of camaraderie, the Belgian 8th Div. and the British 9th took possession of Moorslede and Dadizeele. Success became complete through some minor engagements on Aug. 30. The total advance was one of eight miles. The whole of the Flanders crest was taken and 9,000 prisoners and 300 guns were captured.

Second Advance Oct. 14.—After a respite of a fortnight in which to organise the roads and transports over the zone of the craters, the Flanders Army Group commenced a second battle, on Oct. 14, to force the *Flandern I Stellung*. On the German side, six new divisions were holding the line (the 3rd, 16th, 32nd, 36th Res. Ersatz Guard, and the 1st Bavarian Res.). Three other divisions (the 3rd Landwehr, 6th dismounted Cav., and 207th) were held in reserve. On the Allied side, four French divisions, with two Belgian divisions to the north and three Belgian divisions to the south, went forward to the attack at 5:00 A.M. on a front of 11m., without artillery preparation. The French took possession of Hooglede and Roulers, the Belgians of Cortemarck and Winkel St. Eloi. On the following day the Belgian 3rd Div., having cut the Ersatz Guard Div. to pieces, gained another 3 m. to the east, reaching Bavichove, northeast of Courtrai, while the British II., V. and XIX. Corps, who were flanking the movement, facing south, threw the Germans back to the Lys after hard fighting, advanced 6 km. and approached Courtrai.

German Retreat to Ghent.—On the morning of Oct. 16 the enemy began to retreat on the front from the sea to the Lys, being completely exhausted. The Allies followed in hot pursuit. On the 17th, the Belgians entered Ostend, the British entered Courtrai and Lille and the French drew near to Thielt. As had been foreseen, Von Arnim, once his centre was broken, abandoned both the coast and Lille, and retired behind the canal that connects Maldeghem and Deynze and is prolonged by the Lys and, further south by the Schelde between Avelghem and Tournai. The Allies got in touch with this new position on the 20th. Ten days later, after a new French division and two American divisions had arrived to reinforce the Flanders Group, King Albert attacked the position, directing the principal effort between the Lys and the Schelde. Complete success crowned this enterprise. Overthrown at Anseghem and Kerkhove by the British II. and XIX. Corps, and at Cruyshautem by the American 37th Div., the enemy was forced to retire behind the Schelde and make his way up stream to Ghent and beyond the Terneuzen canal to the north of that city.

In conformity with Foch's orders an attack against this line was prepared for Nov. 11; the Armistice, however, rendered this fourth battle unnecessary. Since Sept. 8 the Flanders group of armies had advanced 65 km. and had captured 20,000 prisoners and 500 guns. The Belgian Army had fought with distinction. Their casualties amounted to 1,000 officers and 29,000 men.

BIBLIOGRAPHY.—F. B. Maurice, *The Last Four Months* (1919); C. E. M. Mangin, *Comment Finit la Guerre* (1920). *See* also WORLD WAR: BIBLIOGRAPHY. (R. VAN O.)

VI. THE FRENCH ARMIES

In the course of the general offensive extending from Sept. 28 to Nov. 11 1918, all the Allied forces were included in a combination of convergent actions, controlled by the High Command and designed to turn the enemy out of his positions or outflank him.

Disposition of Forces.—Speaking generally, the centre group of French armies (Gen. Maistre) operated from south to north in liaison with the American forces through its right (IV. Army), while the reserve group (Gen. Fayolle) operated from west to east, being in touch with the British forces through its left (I. Army). But in the centre of the French disposition Gen. Pétain specially combined the action of the two groups to fight the battle of the Serre. The V. and X. Armies attacked the " Hunding " position from the front while the right of the I. Army outflanked it from the north. At the extremities of the battle line of the Allied armies French forces were again to be found: on the one hand, in Belgium; on the other, in Lorraine, where the eastern group, under Gen. Castelnau, was preparing the offensive arranged for Nov. 14.

Between July 1 and Sept. 15 the French had lost 7,000 officers and 272,000 men. Their divisions showed an average deficit of about 2,000 men and all available reinforcements had been embodied. But Marshal Foch was opposed to any reduction in the number of divisions. He recommended them to make good their weakness by internal reorganisation of units. There were not enough horses for all the gun teams. Lastly, the re-establishment of communications had involved an allocation of 100,000 men for railway service. Nevertheless these troops were about to go into battle again with a very high morale, prepared for hard fighting and heavy losses, in spite of their reduced strength, great physical fatigue and the prospect of carrying on without rest until the winter.

French Front Extended.—On the left wing of the French line the I. Army (Debeney), which was to support the British right throughout, remaining in close touch, attacked and captured the strong point of Cérisy, south of St. Quentin, on Sept. 27–29. On Oct. 3 it extended its front of attack and, on Oct. 6, occupied Lesdin and progressed towards Fontaine Uterte while lending effective support to the brilliant offensive of the British. On the right and in the centre Pétain decided to lengthen the front of attack by an operation carried out by the V. Army, in order to exploit the early successes to be obtained by the IV. in the offensive it was to launch in conjunction with the American Army. By this means he hoped to reduce the value of the forts of Reims and the Champagne heights. To exploit the possible success of this V. Army he further ordered the X. to " prepare an action by its right wing in the direction of Chavignon and la

Malmaison." On Sept. 30 the V. Army made a surprise attack between the Vesle and the Aisne, following upon the IV. Army's success of the previous day on the Py. It pushed back the enemy on the east bank of the Aisne-Marne canal from Berry-au-Bac to the Neuvilette, taking 2,500 prisoners and 30 guns. This victory, added to that of the French IV. Army, forced the enemy to withdraw to the northeast of Reims, behind the Suippe and the line of the Arnes. On Oct. 8 the combined attacks began afresh. While the French IV. Army established itself on the right bank of the Arnes, the V. on its left forced the passage of the Suippe and the X. crossing the Ailette, gained the heights of Cerney en Laonnois and Jumigny.

Allies' Combined Offensive.—These advances, in conjunction with the progress of the American I. Army, constrained the enemy to execute a wide retreating movement on to the strong position of Fère—Crécy-sur-Serre—Sissonne—Château-Porcien and the Aisne below Grand Pré (" Hunding " and " Brunhilde " positions). By Oct. 15 the French armies were in contact with this position. From Oct. 15 onward operations on the French front consisted of carrying into execution the commander-in-chief's plan of Oct. 11, of which the dominant idea was that of combining in one and the same manoeuvre the push by the reserve group's left wing (French I. Army) and the Franco-American offensive, which were to sweep away the defences of the Serre and the Aisne. Between these two manoeuvring wings liaison was to be maintained by the interior armies (French X. and V.). The operations began on the wings, from Oct. 15, and the enemy succeeded in holding his ground with the aid of forces taken from his centre. Thereafter set in the battle of the Serre, in the course of which the French X. and I. Armies wore out the enemy to such a degree as to place him at the mercy of a new offensive by the wings, which was to be successively renewed against each of the water lines held by the enemy.

Hunding Position Captured.—The French I. Army, charged with the difficult task of simultaneously supporting the attack of the British armies and manoeuvring by the right to turn the enemy resistance on the line Serre-Soissons, carried the Hunding position between the Oise at Mont d'Origny and the Serre below Assis. At the same time the X. Army, attacking on its right, took Verneuil-sur-Serre, Notre-Dame de Liesse and crossed the drainage canal between Vesles and Pierrepont. Under this double menace the enemy, on Oct. 27, evacuated a large stretch of ground between Guise and Crécy-sur-Serre. The French V. Army, attacking west of Chaumont Porcien, had on Oct. 25 wrested from the enemy the last portion of the Hunding position between St. Quentin and the Aisne. The manoeuvre of the left wing, by which Foch intended to break down the line of the Aisne, was thus well under way at the end of October. Operations on the right wing had opened disappointingly for the American I. Army, but a successful attack was launched on Nov. 21; and in the first days of Nov. the enemy, shaken by the assaults of the British and threatened on both wings, began his general retreat from the Dutch frontier to the foot of the Meuse banks. By his capitulation on Nov. 11 he was to escape from the decisive attack that was being prepared in Lorraine for the 14th.

French Offensive in Lorraine.—As soon as the first successes of Gen. Fayolle's and Gen. Maistre's groups of armies between Amiens and Reims had been achieved, the commander-in-chief had instructed the eastern group (de Castelnau) to begin to prepare for operations of the same nature. From Oct. 7 to 19 an initial scheme for a large scale offensive had been studied. On the 21st, Foch decided to attack east of the Moselle as soon as possible, " so as to profit by the favourable opportunity afforded by the enemy's weakness in that region and his general lack of reserves." Instructions were sent to de Castelnau to attack between Seille and Sanon by Mangin's X. Army, which was previously to be withdrawn from the reserve group of armies. The attack was to be covered towards Metz by the American II. Army, and towards the Région des Etangs by the French VIII. Army (Gerard). The offensive was to be exploited in the general direction of Morhange-Sarreguemines; and surprise was to be obtained by the employment of a large number of tanks. These instructions were confirmed by an operation order of Nov. 6, which provided for the participation of the VIII. Army in the exploitation movement on Sarreguemines.

Allied Plan for Nov. 14.—On the same day, Gen. Mangin established himself with his general staff at Tantonville, while the concentration of the troops went forward in secrecy. But there was not another moment to lose. The general retreat of the enemy became more evident and Foch pointed out on Nov. 5 " the evident advantage of opening the Lorraine offensive as soon as possible, remembering that the importance of the means matters less than the *moment* of the attack." Without wasting further consideration on the transport crisis or the exact number of American divisions that would be available, therefore, the attack was to be made on a definite date with whatever forces had been assembled by that date. The offensive was to be launched on the morning of Nov. 14 with 28 divisions (six American), three cavalry divisions, powerful artillery and 600 tanks. To this mass attack the enemy would be able to oppose only six divisions (three Landwehr). The unequal distribution of his forces on either side of the Ardennes mass, which was difficult to penetrate, the loss of the Hirson-Mézières railway by means of which he had formerly been able to make play with his reserves, and above all the binding effects of the Allies' general offensive, put him at the mercy of an attack in Lorraine. Nothing but capitulation could save him from complete disaster.

Pursued by the Allies, fleeing in confusion, without supplies, with rebellion in its rear and revolution in Germany, the German Army, now incapable of serious resistance, signed that capitulation on Nov. 11.

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VIENNA, Austria (*see* 28.50), with a population of 1,863,783 in 1923, is now the capital of the Austrian republic, 28·5% of whose population live in the city. Under the constitution of the Austrian Republic the city of Vienna became an autonomous federal province (*Land*); its municipal council receiving the status of a provincial diet. Although no longer the chief city of an empire, Vienna is still the commercial and intellectual centre of southeast Europe. During and immediately after the World War the distress in Vienna was greater than in any other great European city; but following the application of the League of Nations reconstruction scheme to Austria, the position improved. Foreign relief was no longer distributed, and the position, although the improvement was largely due to borrowed money, was not unpromising.

Less trade has been lost to the capitals of new States than was at one time expected: Vienna in particular has been for centuries a commercial centre, and the banks, personnel, offices, etc., are not easily transferred elsewhere. The export of luxury goods is important, and the transit trade with southeast Europe is increasing; the intermediary trade in foreign goods that do not even enter in transit is growing as Vienna remakes its former business connections. The International Fair, which has been restarted, has been successful; it is claimed that it is second only to Leipzig on the European Continent, and is more international in character. Film making is now one of the chief industries. Housing conditions, very bad before the War, were still a great source of difficulty in 1925, but a number of garden suburbs had been erected with the help of the Co-operative Land Settlement movement, by which houses are built co-operatively; and the municipality had also spent large sums on cottages and tenements. The municipality is wealthy, since so large a proportion of the people of Austria live in Vienna, and has spent largely on city improvements, social welfare, public health, education, etc. Several fine public parks have been made from gardens formerly in imperial possession. Parts of the Hofburg, the huge imperial palace, have been turned into offices and shops, and the larger halls are let out on hire. The Schönbrünn palace is now a popular resort. The city belt railway is in process

of electrification, and a new bridge over an arm of the Danube was opened in 1925. The bodies of Beethoven and Schubert have been transferred from the old Währing cemetery (reopened as Schubert Park) to tombs of honour in the central cemetery.

VIGELAND, ADOLF GUSTAV (1869–), Norwegian sculptor, was born at Mandel in South Norway on April 11 1869. In early youth he received instruction in wood engraving and in 1889 at Christiania (Oslo), produced his first work as a sculptor, a relief depicting incidents from the *Iliad*. He afterwards travelled widely and studied technique under Skeibrok in Christiania and Bissen in Copenhagen. Vigeland's subsequent work deals almost entirely with the primitive emotion of men and women. As his genius developed he forsook his earlier semi-impressionistic form of art and adopted a more classic style. His chief work "The Fountain," which was commenced in 1915, is still unfinished (1926). It was intended, when complete, to consist of 26 large groups of stone and a multitude of minor figures in bronze; the whole depicting the history of mankind, through its vicissitudes from barbarism to civilisation. Vigeland also achieved a wide reputation as a portrait sculptor and was commissioned to execute busts of many prominent men. See M. G. Vidalene, *L'art norvégien contemporain* (Paris, 1921).

VILDE, EDUARD (1865–), Estonian author, was born March 6 1865. He attended the German Revel district school and from his youth he devoted himself to publicist activities as a journalist and author. In 1905 he travelled extensively in Europe, and after the Russian revolution of that year, he emigrated to Copenhagen. In 1910 he visited America, on which he wrote some satires (*Muiged*, 1914). In 1917 he returned home and, three years later, was appointed first Ambassador of the Estonian Republic to Berlin. Vilde composed some 10 long prose works, including a series of voluminous and valuable novels, also two plays, *Pisuhänd* (Dragon) and *Tabmata ime* (The Unattained Miracle). His fiction is of a high order, and deals chiefly with Estonian social problems. His best novels are: *Mantra sôda*, dealing with economic unrest among the Estonian peasantry in the middle of the 19th century; *Prohwet Maltswet* (Prophet Maltswet); *Külmale maale* (The Cold Country of Siberia) and *Mäekula piimamees* (The Milkman of Mäekula).

VILLARD, OSWALD GARRISON (1872–), American editor and publisher, was born at Wiesbaden, Germany, of American parentage, March 13 1872. After graduation from Harvard University (A.B., 1893) he was appointed assistant in U.S. history there, but resigned in 1896 to take up newspaper work. He was a reporter on the Philadelphia *Press*, 1896–7, in which year he joined the editorial staff of the New York *Evening Post*, becoming ultimately president of the company. He also became interested in the New York *Nation*. In July 1918 he sold the *Post*, retaining his connection with the *Nation*, of which he was editor. He also owned *The Nautical Gazette*, New York City.

He wrote *John Brown—A Biography Fifty Years After* (1910); *Germany Embattled* (1915); and *Newspapers and Newspaper Men* (1923).

VILLARI, PASQUALE (1827–1917), Italian historian and statesman (*see* 28.76), was invested in 1910 with the the order of the Annunziata. He died in Florence Dec. 5 1917.

VILNA or Wilno (*see* 28.88), a city, lying within a former province of the Russian Empire of the same name, on the main railway between Berlin and St. Petersburg (Leningrad). In nationality the population (214,600 in 1914), is very mixed, and almost all recent statistics are so tendencious as to be valueless. Greater reliance can be placed upon the percentages given in the Russian Imperial census of 1897.

From the political and cultural point of view, the affinities of Vilna were equally complicated. In the Middle Ages Vilna had been the capital of the little state of Lithuania. After the union of Lithuania with Poland, which brought all parts of the former Lithuanian kingdom under Polish influence, the city became a centre of Polish culture. It was at the same time one of the chief cultural centres of the East European Jews. The successive partitions of Poland brought Vilna under Russian rule, together with the whole of Lithuania and a great part of Poland. The question of the political disposal of Vilna therefore did not arise until Poland and Lithuania re-emerged, this time as separate and mutually unfriendly States, after the World War of 1914–8. No definite frontier between the two states was laid down by the Treaty of Versailles. On Dec. 8 1919 the Supreme Council of the Allies in Paris laid down a provisional eastern frontier for Poland, the so-called "Curzon line," which assigned to Poland most territories where the Polish element was in a majority, but excluded mixed and doubtful districts, the principal among these being Vilna city and province.

Census of 1897	Russians	White Russians	Poles	Lithuanians	Jews	Others
For the Province of Vilna including the City . . .	5·00	56·05	8·18	17·59	12·72	0·46
For the City of Vilna	20·50	4·20	30·90	2·00	40·30	2·10

Meanwhile, during and after the War, Vilna was occupied successively by the Germans, Lithuanians, Bolsheviks, Poles (who held it at the moment when the Curzon line was laid down), the Bolsheviks, who retook it during their invasion of Poland in 1920, and finally by the Lithuanians, to whom the Soviet Govt. ceded Vilna under a peace treaty signed at Moscow on July 12 1920. The subsequent retreat of the Russians brought Polish and Lithuanian troops into collision on the edge of the Vilna area; Poland appealed to the League of Nations; and the League persuaded the Lithuanians to withdraw to the east of the Curzon line, while obtaining a pledge from Poland to respect the neutrality of the Vilna territory east of the line, which was now occupied by the Lithuanians. On these terms a Polish-Lithuanian Armistice convention was signed on Oct. 7 1920 at Suwalki but on Oct. 9 the Lithuanians were driven out of the city of Vilna and the greater part of the province by an independent Polish commander, General Zeligovski. His action was nominally disowned by the Polish Govt., but Vilna has remained since then continuously in Polish hands.

The League of Nations made a number of fruitless attempts to secure a just and satisfactory settlement not based on force and incidentally to reassert its own authority, which had been flouted by General Zeligovski's action. The first abortive scheme was the taking of a plebiscite under the protection of a mixed international force, but in March 1921 this was abandoned in favour of direct negotiations between Poland and Lithuania under the presidency of M. Hymans, representing the League. M. Hymans proposed the incorporation of Vilna in Lithuania as an autonomous canton with special guarantees, on condition that Lithuania contracted with Poland a permanent military and economic alliance. These proposals pleased neither party, and in Jan. 1922 the Council of the League virtually abandoned the case in despair and withdrew its commissioners from the spot. Meanwhile, in the Peace Treaty of Riga, Soviet Russia had accepted a new Russo-Polish frontier running to the east of Vilna up to the river Dvina; and this line was endorsed by the Conference of Ambassadors in a decision published on March 15 1923. In the same decision the Ambassadors laid down a frontier between Poland and Lithuania which assigned to Poland Vilna and the whole district which had been forcibly seized by General Zeligovski. Lithuania refused to recognise this decision but failed to obtain any satisfaction either from the principal Allied Powers or from the Council of the League of Nations. On Dec. 14 1925 the Polish diet passed a bill unifying the Wilno province with the rest of Poland. (*See* also LITHUANIA; POLAND; LEAGUE OF NATIONS.)

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VINCENT, GEORGE EDGAR (1864–), American educationalist, was born at Rockford, Ill., March 21 1864. After graduating from Yale in 1885, he engaged in literary work and in 1886 was made literary editor of the Chautauqua Press. He was president of the Chautauqua Institution from 1907 to 1915 and thereafter honorary president. In 1892 he was appointed fellow at the University of Chicago, receiving his Ph.D. in 1896. He taught at Chicago as instructor, assistant professor, associate professor, and from 1904 to 1911 as professor of sociology. He was dean of the junior colleges from 1900 to 1907 and then for four years was dean of the faculties of arts, literature and sciences. From 1911 to 1917 he was president of the University of Minnesota. In 1917 he was chosen president of the Rockefeller Foundation in New York City; he had been a member of the General Education Board since 1914. Vincent was author with Albion W. Small of *An Introduction to the Study of Society* (1895) and *The Social Mind and Education* (1897).

VINOGRADOFF, SIR PAUL GAVRILOVICH (1854–1925), Anglo-Russian scholar, was born at Kostromo, near Moscow, and educated at the University of Moscow. As a young man he travelled widely, and obtained a working knowledge of at least seven modern languages, before being appointed a professor in his own university. He then interested himself in the Zemstvo movement, and was specially keen on improving the provision for the education of the Russian people. His activities, however, were displeasing to the authorities, consequently he resigned his professorship and in 1902 settled in England, where he had already made friends with many English scholars. In 1903 he was appointed Corpus professor of jurisprudence at Oxford, and there he remained until his death on Dec. 19 1925. In 1917 he was knighted, and his honours included a fellowship of the British Academy. In 1917, on the outbreak of the revolution, he again took part in Russian politics, but as the reformers became more extreme in their tendencies his sympathies vanished, and were finally changed into hostility tempered with grief.

Vinogradoff's first book was on *The Origin of Feudalism in Italy* (1887). This was written in Russian, but his later works were appropriately written in English, and he became recognised as probably the first authority on the early laws and customs of that country. His standard work is *Villeinage in England* (1892), in which he put forward the theory that the Anglo-Norman manor descended not from a condition of serfdom, but from a free village community. His article "Folkland," published in *The English Historical Review* in 1893, put forward an entirely new theory on this subject. His other works are *English Society in the Eleventh Century* (1908); *The Growth of the Manor* (1905); *Roman Law in Mediaeval Europe* (1909). He also wrote *Self-government in Russia* (1915) and *Outlines of Historical Jurisprudence* (1920–2). He wrote for *The Encyclopædia Britannica* and *The Cambridge Modern History*. At Oxford, Vinogradoff conducted a seminar which offered a suitable outlet for his immense store of knowledge. (*See* RUSSIA.)

VINTON, FREDERIC PORTER (1846–1911), American portrait painter (*see* 28.101), died in Boston, Mass., May 19 1911.

VIRGINIA (*see* 28.117).—The population in 1910 was 2,061,612; in 1920, 2,309,187, a decennial increase of 247,575 (12%) and an average annual addition of 24,757; in 1923, 2,398,441, an increase in three years of 89,254, and an average annual addition of 29,751. In 1920 negroes numbered 690,017 as compared with 671,096 in 1910. Urban population in places of more than 2,500 inhabitants was 23·1% of the whole in 1910 and 29·2% in 1920.

The population of the principal cities and its increase were:—

	1920	1910	Increase per cent
Richmond	171,667	127,628	34·5
Norfolk	115,777	67,452	71·6
Portsmouth	54,387	33,190	63·9
Roanoke	50,842	34,874	45·8

Agriculture and Industry.—In 1900 the value of farm property—land, buildings, implements, machinery, livestock—was $323,515,977; in 1920 it was $1,196,555,772, an increase in 20 years of 269%. In 1908 the value of agricultural products was $100,531,000, in 1920 $187,038,000 and in 1924 $165,775,000.

The production of the staple crops was:—

	1920	1924	1925
Maize (bu.)	..	..	36,058,000
Corn (bu.)	50,100,000	35,679,000	..
Wheat (bu.)	11,425,000	9,628,000	8,946,000
Oats (bu.)	4,818,000	4,019,000	5,826,000
Rye (bu.)	864,000	537,000	..
Barley (bu.)	405,000	324,000	..
Buckwheat (bu.)	540,000	348,000	..
Tobacco (lb.)	177,390,000	141,240,000	129,542,000
Hay (tons)	1,235,000	1,545,000	..
Peanuts (bu.)	4,416,000	3,700,000	..
Potatoes (bu.)	13,608,000	19,200,000	11,340,000
Cotton (bales)	19,000	30,000	52,000
Apples (bu.)			8,844,000

The mining and quarrying industry in the decade 1909–19 showed an increase of 34·7% in the number of enterprises, 1·9% in capital and 233·8 in the value of the product, and a loss of 11·5% in mines and quarries, 2·7 in persons engaged and 4·7% in wage-earners.

	1919	1922
Enterprises	202	139
Mines and Quarries	216	140
Persons engaged	15,537	..
Wage-earners	14,547	13,675
Capital	$57,035,775	$59,730,376
Value of product	29,363,449	26,953,329

Virginia in 1920 led in the production of iron, pyrites and soapstone, was third in the production of lime and manganese and sixth in mineral waters. The latest available report lists the pyrites plants as idle. The following figures are from the report of Virginia Bureau of Labour and Industrial statistics:—

	Establishments	Capital	Value of Product
Coal	92	$54,106,000	$23,106,994
Iron ore	6	621,338	901,203
Mineral waters	4	43,800	29,098
Pyrites	Plants idle		
Soapstone	3	342,905	796,287
Millstones, sand and gravel	15	460,600	429,938
Slate	4	275,000	327,604
Miscellaneous ores	7	3,103,596	858,554
Lime	39	5,799,337	5,406,907

Statistics of manufactures show great variations in the decade 1909–20 and after, due to the war prices. In 1909 the value of products manufactured by 5,685 establishments was $219,794,000; in 1919 by 5,603 establishments it was $641,810,000, and in 1923 by 2,010 establishments was $547,927,531. The following figures for 1920 are from the 14th census and for 1923 from the report of the Virginia Bureau of Labour and Industrial Statistics:—

	1920	1923
Establishments reporting	2,159	2,010
Capital invested	$362,328,506	$446,678,544
Materials	..	268,940,460[1]
Value of products	638,936,186	547,927,531
Value added by manufacture	..	185,321,001[1]
Wage earners (average)	129,251[1]	121,416

[1] Figures are for 1921; no record in 1920.

Property Values.—The valuation of property assessed for taxation in 1910 was $756,194,480; in 1920, $1,459,762,653. In 1900 the estimated true value of all property was $1,102,310,000; in 1922 $4,891,570,000, distributed as follows: Real property and improvements $2,772,373,000; live stock, $92,653,000; farm implements and machinery, $35,576,000; manufacturing machinery, tools and implements, $164,146,000; railroads and their equipment, $501,972,000; motor vehicles, $63,113,000; street railways, shipping, etc., $178,308,000; all others, $1,083,429,000. The estimated true value of wealth added in 1912–22

was $2,601,656,214. In 1909 the public debt was $24,956,959, in 1919 it was $23,561,823, and in 1923 it was $21,173,703. In 1910 the state's income was $11,333,490, in 1920, $18,442,324, in 1923, $27,992,317, and the disbursements (1923) were $26,562,012. Between 1910–20 notable reforms were made in taxation and financial administration. The tax laws were in 1915 revised as follows: the state levy on real estate and tangible property was restricted to educational purposes, and state and local levies on intangible property were apportioned at 65 cents and 30 cents per $100 respectively.

Constitution.—In 1910 the state constitution was amended to permit the re-election of county treasurers and commissioners of revenue, and in 1912 another amendment permitted the re-election of city treasurers and commissioners of revenue. In 1912 the Legislature was empowered to classify cities according to population and to provide forms of city and town government, but cities with over 50,000 population were permitted to have special forms of government. Under this amendment the Legislature provided for general charters under the commission, or manager, form, but in 1920 another amendment was ratified which permitted the Legislature to provide special forms of government for any city on condition that the sections of the constitution regarding franchises, changes in city boundaries, public debts and the assessment of property were not violated. In 1920 another amendment removed the requirement of residence within the municipality as qualification for appointment to office in a city Government when technical training was requisite. In 1920, also, the construction of roads was made a proper subject for state debt.

Education.—The cost of public education is borne by the State. In 1922–3 there were 6,563 buildings for elementary schools with 13,606 teachers and an enrolment of 562,998 pupils. For secondary education there were 408 high schools, 49,450 pupils and 2,725 teachers. Separate schools are provided for white and coloured pupils. There is a school at Staunton for deaf and blind white children and one at Newport News for deaf and blind coloured children. Institutions for higher education receiving state support are the University of Virginia, the Virginia Polytechnic Institute, Virginia Military Institute, the College of William and Mary and five Normal Schools, one each at Fredericksburg, Farmville, East Radford, Harrisonburg and Petersburg, the last for coloured students. Other institutions of higher education are: For men—Washington and Lee University, University of Richmond, Roanoke College, Emory and Henry College, Hampden-Sidney College, Randolph-Macon College and Virginia Christian College; for women—Hollins College, Martha Washington College, Randolph-Macon Woman's College, Sweet Briar College and West Hampton College. The school revenue was $4,407,853 in 1910 and $13,791,864 in 1920. In the school year ending in 1923 the aggregate of state, city and county revenue expended for elementary and secondary education was $22,109,791. In 1918 a general property tax was added to the existing sources of school revenue which yielded approximately $660,000. In 1918 school attendance of all children between the ages of 8 and 12 for 16 weeks was required.

In 1920 the legislature submitted for ratification the following amendments to the constitution: legalising the membership of women on school boards, removing the limitation on county and district school tax rates and all limitation on the legislature in enacting compulsory attendance laws, and giving the legislature the power to fix the duties of the state Board of Education. Among statutes enacted in 1920 looking to the improvement of the school system were laws encouraging a nine months' term in rural communities, making the school age 7 to 20 years, provision for a school census, encouragement of rural high schools, conferring on the state superintendent the right to nominate candidates for positions as teachers, provision for physical education and medical inspection and placing the state institutions of higher education on an all-year basis of operation. The railroad mileage in 1922 was 4,668; the electric-railway mileage, 147·27 and the telephone-wire mileage, 379,073. The number of telephones was 155,490.

Legislation.—In 1912 the work of children under 12 years of age in coal mines was prohibited and the 10-hour day for children in factories was extended to workshops and mercantile establishments, with the exception of packing and fruit industries between July 1 and Nov. 1, mercantile establishments in towns of less than 2,000 population and Saturday work in mercantile establishments. In 1918 the minimum age for employment was raised to 16 years. In 1922 the legislature changed the name of the state Board of Charities and Correction to the State Board of Public Welfare, and conferred on it much larger powers, namely supervision of state institutions, licensing of all child-caring institutions, organising of juvenile and domestic relations courts, local boards of public welfare, administration of child welfare legislation, direct handling of all delinquent children and of many dependent and neglected children. The charitable organisations under this board handled 135,000 cases at a cost of $4,279,873, and the correctional institutions 165,399 cases at a cost of $5,526,781. In 1918 a Mothers' Pension Law was enacted which allowed city and county Governments to make payments to widows with children under 16 years of age. In the same year the principle of the uniform Family Desertion Acts was adopted, and an industrial commission was provided to administer a workmen's compensation system.

Three sanatoria for the treatment of tuberculosis have been established. In 1918 a state orthopaedic hospital was established at Richmond. In 1914 the Virginia Home and Industrial School for Girls, a private institution, became the property of the State, and subsequently three other reformatories were taken over. In 1919 the state Prison Board was reorganised, and reforms in prison management were adopted. In 1914 a state forestry commission was established.

Political History.—In every state and national election after 1910 the Democratic party had a majority. In 1909 William Hodges Mann (Dem.) was elected governor, his term being from 1910–4; he was succeeded by Henry Carter Stuart (Dem.), 1914–8; Westmoreland Davis (Dem.), 1918–22; and E. Lee Trinkle (Dem.), 1922–6. (J. S. P.)

VIRGIN ISLANDS (*see* 28.126).—This group, located in the Lesser Antilles, just east of Porto Rico, includes the former Danish West Indies (St. Thomas, St. Croix and St. John), purchased by the United States from Denmark in 1917 for $25,000,000, and the islands of Vieques and Culebra, acquired by cession from Spain in 1898. The popular language of the Danish islands was at first a Dutch *patois*, later English, though Danish was always the official language during the 242-year period of Danish rule.

Area and Population.—The combined area of the three principal islands is 132·47 sq. m., and their population in 1917 was 26,051. St. Croix had 14,901 inhabitants; St. Thomas, 10,191; and St. John, 959. Only 7·4% were white; the rest negro and mixed blood. Charlotte Amalie, now St. Thomas, on the south side of the island of St. Thomas, is the largest town (population 7,747 in 1917) in the islands, is the seat of government, and has one of the finest harbours in the West Indies. St. Croix has two towns, Christiansted and Frederickssted. St. Thomas is 1,400 m. from New York and 1,020 m. from the Panama Canal. The chief products of St. Croix are sugar and molasses. From the *pimenta acris* on St. John and St. Thomas is produced the finest bay oil and bay rum in the world. The islands have been administered by the U.S. Navy Department since 1917.

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VISCONTI-VENOSTA, EMILIO, MARQUIS (1829–1914), Italian statesman and diplomat (*see* 28.129). After representing Italy at the Algeciras Conference the Marquis Visconti-Venosta retired into private life, but on account of his great experience,

profound legal and political culture and sound judgment, he was often consulted by his Government, especially on questions of foreign affairs. He explicitly approved of Italy's declaration of neutrality on the outbreak of the World War. He died in Rome Nov. 28 1914.

VISSERING, GERARD (1865–), Dutch banker and economist, was from 1906–11 president of the Java Bank in Batavia. In 1911 he was appointed adviser on currency and banking affairs to the Chinese Govt., and in the following year became president of the Netherlands Bank. Dr. Vissering was one of the vice-presidents of the Brussels Financial Conference held in 1920 and after the World War his advice was repeatedly sought on matters concerning the stabilisation of the financial position of various countries.

Among his numerous works are *De Javasche Bank; On Chinese Currency* (1912); *The Netherlands Bank and the War* (1917); *De goudquestie* (The Problem of Gold, 1918), *Muntwezen en Circulatie-Banken in Ned. Indië* (currency and circulation banks in the Netherlands East Indies, 1920) *International Economic and Financial Problems* (1920).

VISTULA (German Weichsel, Polish Wisla: *see* 28.146).—Rising in Czechoslovakia, the Vistula runs through Poland, along the frontier of E. Prussia, and debouches through the territory of the Free City of Danzig. Its situation fits it to be a waterway of the first importance, although it is liable to floods and frozen over for three months in the year. It must be made navigable for river-craft at their full capacity during a sufficiently long period of the year; and must be open to international shipping on a footing of equality. At present it is navigable up to Przemsza, but there is not regular traffic above Warsaw, although it is largely used for timber-floating.

Before the War conservancy works had only been carried out on the German part of the river, some 222 km. in length; spur and longitudinal dykes were built to maintain the water level, thereby facilitating the flow of water at flood-time and also improving navigability. Since the War Poland had been too occupied to carry out improvement works, or even much in the way of upkeep. Traffic has greatly decreased, mainly owing to the general economic crisis.

The Vistula requires conservancy works throughout its whole course. The mean water-level should be maintained by the construction of spur and longitudinal dykes to narrow the normal river-bed; the river should be regulated at low-water level in the interests of its navigability, which might also be improved by the construction of reservoirs on the upper courses of some of the tributaries.

Under Article 18 of the Treaty concluded at Versailles on June 28 1919, between Poland and the Allied and Associated Powers (the so-called "Minorities Treaty") Poland undertook to apply to the river system of the Vistula (including the Bug and the Narew), pending the conclusion of a general convention on the international régime of waterways, the régime set out in Articles 332–337 of the Treaty of Versailles, that is to say, the régime applicable to International Waterways.

Serious differences of opinion arose as to the interpretation of the legal status of the Vistula. It has been asserted that Article 18 should be held to provide for the possibility of the Vistula being subject to the régime of the Barcelona Convention (*see* INLAND WATER TRANSPORT), once that Convention has been ratified by Poland, and should the Vistula come under the general definition contained in the said Convention. But those who urge this theory do not consider that the Vistula comes under this definition, since the criterion therein accepted is that the part of the river which is naturally navigable should traverse or separate several States.[1] As the right bank of the Vistula in Eastern Prussia has been given to Poland to a depth of 50 metres in land, Germany is not a riparian State; and the Free City of Danzig should not in law be considered as a State.

On the other hand it has been urged that the words "pending the conclusion" mean that the régime of Articles 332 to 337 will be automatically superseded by the régime of the General Convention as soon as the latter has been concluded, and this regardless of the fact whether the Vistula will, or will not, eventually come under whatever general definition is established by the General Convention given in the said Convention. Those who put forward this second argument assert that the Minorities Treaty certainly did not contemplate a temporary international régime for the Vistula, since such an arrangement would have been contrary to all ideas of an international régime. They maintain that, if it is to the interest of international shipping to have certain guarantees of freedom of navigation and equality of treatment, that interest does not cease with the conclusion of an international convention. Further, they are of opinion that the Vistula is included in the category of navigable waterways referred to in paragraph 2 of Article 1 of the Barcelona Statute. A solution to this acute legal controversy will hardly be found unless the dispute becomes an inter-State one and comes before the Permanent Court of International Justice. Navigation cannot be fully developed without equality of treatment for all flags. The acceptance of this principle by the States concerned, particularly Poland, would be in their own true economic interest.

[1] See Article 1 of the Barcelona Statute.

See *Vistula: Traité des Minorités entre les principales Puissances alliées et associées et la Pologne du 28 juin, 1919* (Great Britain, Treaty Series, 1919, No. 8). (R. RN.)

VISTULA-SAN, BATTLES OF THE.—The middle of Sept. 1914 marked a distinct stage in the World War, both in the Western and Eastern theatres. The first clashes of the main armies on either side had ended. The general staffs of the contending Powers had to take stock of the results and to make new plans accordingly (*see* EASTERN EUROPEAN FRONT and map).

German Position.—To Falkenhayn, who had succeeded Moltke as the arbiter of German strategy, the problem of the Eastern Front must have presented itself somewhat as follows: The battle of the Marne had shaken, if not shattered, the whole foundation of the ambitious German plan, built up through long years of preparation, tested till failure seemed impossible. The immediate overthrow of France could not now be achieved; but the West remained still the decisive theatre and no further reinforcements could yet be spared for the East. Something, however, must be done to rally the beaten Austrians and to save the important industrial area of Silesia from invasion. The victories over Samsonov and Rennenkampf in East Prussia (*see* MASURIA, BATTLES IN) had rendered that province secure from invasion for some time, but these battlefields were too far distant from Galicia for success to bring relief to the Austrians. Direct assistance was required. Accordingly $5\frac{1}{2}$ corps, the bulk of the forces in East Prussia, were transferred by rail to the Cracow-Częstochowa area in the latter half of September.

This move required some 750 trains and was completed between the night of Sept. 16–17, when the troops began to entrain about Königsberg and Lötzen, and Sept. 28, when they were deployed on the frontier of south Poland ready to advance. They were formed into the IX. Army under Hindenburg, with Ludendorff as his chief of staff. The VIII. Army was left in East Prussia with much reduced forces. The plan was for Hindenburg's army to advance against the stretch of the Vistula between Zavikhost and Deblin (Iwangórod), with the intention of turning the northern flank of the main Russian forces, which were at this time concentrated in Eastern Galicia. A part of the Austrian I. Army (Dankl) was to advance on the north bank of the Vistula to the right of the Germans, while the main Austrian forces moved to the attack south of the Vistula, the IV. Army (Grand Duke Josef Ferdinand) and III. Army (Boroevich) towards the lower San and Przemyśl, while the II. Army (Böhm-Ermolli) from the Carpathians moved in the direction of Chyrow and Sambor, south of Przemyśl.

Russian Problems.—On the Russian side, at the same period of mid-Sept., the most urgent tasks of the commander-in-chief were to reconstitute his northwestern front, shattered by the defeats of the I. and II. Armies in East Prussia, and to build up a central force in Poland about Warsaw. First-line troops from

Siberia and Turkestan, which had not been available for the opening engagements, had now arrived, and a large number of additional reserve divisions were in the field. The IX. Army, which was originally to have formed the nucleus of the central force, had been despatched south in the early days of Sept. to the rescue of the hard pressed IV. Army (*see* LEMBERG, BATTLES OF), and was now with four other Russian armies (IV., V., III., VIII.) in Eastern Galicia, on the line of the San and Dniester. The supply of these five armies, comprising some 18 or 19 corps, crowded on a comparatively narrow front, was extremely difficult.

As early as Sept. 22 three corps were ordered to move north to relieve the congestion. Shortly afterwards, information was received of the enemy concentration and advance, and a rapid change in the disposition of the armies became necessary to meet this threat. The question arose whether a line could be built up in Poland west of the Vistula with sufficient speed to render it safe to accept battle in advance of the river, or whether the change of front should be carried out behind the shelter of the river barrier. The safer course was chosen; and the principal masses moved to the north in rear of the Vistula, only cavalry forces being left to oppose the hostile advance in trans-Vistula Poland.

The decision was undoubtedly wise, but it involved certain grave disadvantages. It meant the surrender of the whole of southwest Poland to the enemy, severe hardships to the troops in traversing the almost roadless region south of Lublin, and the eventual forcing of passages over the Vistula. Three armies, the IV., IX. and V., moved north, while the III. Army took over the line of the San. The great wheel was completed by the third week in Oct., by which time the V., IV. and IX. Armies, in that order from north to south, lined the Vistula from about Gura Kalvarya (south of Warsaw) to Zawichost. Meanwhile a new II. Army had been formed round Warsaw.

Austro-German Offensive Fails.—The Austro-German advance, which began at the end of Sept., met only slight opposition till the lines of the Vistula and the San were reached. During the advance, however, the regrouping of the Russian forces became evident and showed that the original German plan was no longer applicable. The main weight of the offensive of Hindenburg's army was therefore shifted northwards against Warsaw, the whole of the Austrian I. Army being moved to the left bank of the Vistula and extended from Sandomierz to below Deblin. By Oct. 12 fighting was general on the whole front. Hindenburg's army was within a few miles of Warsaw, but had greatly superior Russian forces against it; while all along the river from Warsaw to Zawichost the Russian counter-offensive was battling for passages to the left bank.

South of the Vistula, the Austrian IV. and III. Armies had driven in light Russian forces and reached the line of the San by Oct. 10, causing Radko-Dimitriev's III. Army to raise the siege of Przemyśl. But they could make no headway in their efforts to force the line of the San. Nor did the II. Army, advancing from the Carpathians towards Sambor and Chyrow, meet with any greater success.

By Oct. 17 it was obvious to Hindenburg that his offensive could not succeed. North of the Vistula, the German IX. Army and Austrian I. Army were now assailed from Warsaw, from Deblin and from Zawichost by four Russian armies; while south of the Vistula the three Austrian armies could make no progress against the Russian III. and VIII. Armies. The Austro-German attacks were, however, continued till the 21st. They were succeeded by violent Russian counter-attacks, which lasted till the 27th. Hindenburg then broke off the battle and led his IX. Army rapidly back to the frontier, destroying all communications as he retired. Dankl's Austrian I. Army withdrew in more leisurely fashion. Between Oct. 31 and Nov. 2 it held the Russian pursuit at arm's length in the Kielce-Opatów region; and then retired behind the Nida. On the San, fighting continued till the end of Oct., without marked advantage to either side. But early in Nov. the Austrian armies broke off the battle and withdrew, the IV. and III. towards Cracow, the II. to the Carpathians.

Hindenburg's first invasion of Poland had only relieved the pressure on Austria for a time. Its failure left Germany's ally still further exhausted. It was a bold move, typical of Ludendorff's strategy. But he seems to have under-rated the Russian leadership and to have over-rated the fighting powers of the Austrians. The skill with which the Russians changed front and the complete failure of the Austrians to make any impression on the weakened forces behind the San placed the German IX. Army in a perilous position. It was perhaps fortunate for it that the numerous Russian cavalry showed little aptitude for pursuit.

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VITAMINS.—There are several vitamins recognised. Fat-soluble A vitamin is present in certain fats, particularly in cod-liver oil, fish roe, liver, egg yolk and in green vegetable leaves. This is necessary for growth, fertility and resistance to infective diseases. Water-soluble B vitamin, present in the seeds of plants, egg yolk, yeast and in many fruits and vegetables, also is necessary for health, fertility and resistance to infective disease. Want of this vitamin produces in particular beri-beri, a disease commonly caused by the polishing of rice. The rice berry is thus deprived of this vitamin and becomes a deficient food for natives who live largely on rice. There ought to be a sufficiency of this vitamin in the food eaten in order to ensure proper digestion and utilisation of the food and to keep up appetite. Water-soluble C vitamin is present in most juicy fruits and vegetables; its absence produces scurvy. There is also the antirachitic principle or vitamin D, which prevents rickets and is richly present in cod-liver oil, and can be obtained by irradiating cholesterol or phytosterol with ultra-violet rays.

Cholesterol is a constituent of animal cells and phytosterol of plant cells. An animal, or child, can be prevented from becoming rickety when fed on a deficient ricket-producing diet, by being irradiated or by being given cod-liver oil or irradiated cholesterol. A very small daily dose of the last suffices.

Irradiation with ultra-violet rays appears to endow the atoms of cholesterol with energy. Probably when the skin is irradiated the cholesterol in the skin becomes activated and absorbed. With its help a sufficiency of the salts of calcium and phosphorus required for bone formation are absorbed from the alimentary canal in place of being excreted in the faeces, and thus the deficiency of the diet as far as the bone formation goes is made good. It has not proved possible to separate vitamin D from irradiated cholesterol as a chemical substance, and the activity of irradiated cholesterol is found to be very easily destroyed, *e.g.*, by over-irradiation or by recrystallisation. Vitamins may be concentrated by certain means, but no vitamin has yet been isolated and its nature determined. Their presence is detected by feeding experiments.

In addition to the above four vitamins there is a vitamin E necessary for breeding power, which is most richly contained in the germ of wheat and red meat. Want of this vitamin in animals leads to the death and absorption of the embryos while within the womb of the mother, and so to sterility. A, D and E vitamins are soluble in fats, while B is soluble in water and appears to be a basic substance containing nitrogen. C is water-soluble and very easily destroyed by cooking or canning foods. Fresh, young, green vegetables, eaten as salads or lightly cooked are a most important source of the vitamins. So too are fish, which derive them from the plankton of the sea.

The miller takes away the germ and outer layer of the wheat berry and these valuable parts are given to rabbits, pigs and fowls as bran and middlings. We get white flour robbed of its vitamins and of some of the protein and most of the very important salts of phosphorus which whole wheatmeal contains. Rice, cornflour, sago, tapioca, pearl barley, pea flour, oatmeal, split peas and lentils are similarly impoverished by the miller. What are needed are wholemeal, with the germ ground very fine so as to be digestible, whole peas, beans and lentils, salads, fruits and vegetables, milk and butter of cows fed on green grass and so rich in vitamin A. Stall-fed cows' milk is deficient. (L. E. H.)

VITTORIO VENETO, BATTLE OF.—Diaz's plan for the bigger offensive finally decided for Oct. 1918 (*see* ITALIAN CAMPAIGNS) was to concentrate on the Piave front between Pederobba and Fagaré (east of Treviso), to cross the river and break through by way of Conegliano to Vittorio Veneto, dividing the Austrian V. and VI. Armies which held the river line from the sea to Valdobbiadene. The attack was fixed for Oct. 16, but bad weather and a rise of the Piave caused a delay which was used to extend the plan of operations.

Italian Plans.—It was decided to open the action with an attack by the IV. Army (nine divisions) in the Grappa sector, with the double object of drawing the enemy reserves from the Feltre sector and of breaking through in this direction. The attack on the Piave was to be carried out by three armies, the XII., VIII. and X., of which the first and last had been formed

specially for this offensive. The XII. Army (one French division and three Italian) was commanded by Gen. Graziani, the commander of the French troops in Italy; and the X. Army (two British divisions and two Italian) by Lord Cavan.

The main drive was to be made by the VIII. Army (14 divisions), attacking from below Pederobba to Ponte della Priula. The XII. Army was to advance northward outside the Piave, while the X. Army was to attack the right wing of the Austrian V. Army and form "a defensive flank to cover and protect the principal manoeuvre of the VIII. Army" (Gen. Diaz's report). On the battle front from the Brenta to Fagaré were massed 41 divisions, 22 in line and 19 in reserve. Against this force the Austrians had 23 divisions in line and immediate reserve, and 10 more divisions within reach. The Piave-Grappa front was divided between two army groups: Boroević's Piave Group (V. and VI. Armies), from the sea to Valdobbiadene, and the newly formed Belluno Group, under Gen. Goglia, from Valdobbiadene to the Brenta.

Austrian Forces.—The disposition of the Austrian troops and guns showed a fear for the Grappa positions and a failure to divine the direction of the main Italian attack. In the Grappa sector the Belluno Group had eight divisions in line and three in immediate reserve, while the infantry was backed by some 1,200 guns. The Austrian VI. Army, on the other hand, with seven divisions in line and two in support, had only about 500 guns against a mass of over 2,000. Opposite Lord Cavan's X. Army the right wing of the Austrian V. Army had three divisions in line and one in support.

Allied Attack Opens.—The Italian IV. Army, under Gen. Giardino, attacked at dawn on Oct. 24, and though some headway was made the enemy put up a very stubborn resistance. Already a very fine piece of work had been carried out by British troops of the X. Army, who in the early hours of the same day occupied the northern part of the long shoal island of the Grave di Popodopoli, crossing the main channel in small flat-bottomed boats punted by Italian specialist troops (*pontieri*), and driving back or capturing the enemy outposts. The general attack should have followed the next night, but a sudden rise in the river, which was coming down in heavy flood at seven miles an hour, counselled delay. It was not until the night of Oct. 26, when the southern part of the Grave di Popodopoli had also been occupied by Italian troops of the X. Army, that the bridges began to be thrown across the river for the main attack.

The Crossing of the Piave.—Eleven crossing points were selected, one at Pederobba for the right wing of the XII. Army, seven on the VIII. Army front, and three for the X. Army, at the Grave di Popodopoli. The XII. and X. Armies threw their bridges successfully, but on the VIII. Army front only two of the seven sets of bridges could be established, both on the north of the Montello. Next day three bridgeheads were established: opposite Pederobba, north of the Montello, and opposite the Grave di Popodopoli. The most important advance was made in the latter sector, where the X. Army succeeded in advancing to a depth of over two miles, on a front of about four miles. The British XIV. Corps took 3,500 prisoners, and 2,100 were captured by the Italian VI. Corps.

This was the most successful advance of the day. The bridges of the VIII. and XII. Armies were all destroyed during the day. At Pederobba some headway was made, and the troops of the VIII. Army, who attacked towards Sernaglia, gained about a mile. But the right wing of the Army (VIII. Corps) was unable to throw its bridges, and only a detachment of storm-troops reached the left bank. There was a gap of some six miles between the left wing of the VIII. Army and the British XIV. Corps, which formed the left wing of the X. Army, and the chief move in the general manoeuvre was checked. The VIII. Corps had been detailed to push straight for Vittorio Veneto, and the fact that it had been unable even to start its advance threatened to throw the whole battle out of gear.

No better fortune attended the efforts made on the following night to bridge the river east of the Montello. The swift current and the enemy guns defied all attempts to establish the bridges, and the engineers suffered very heavy casualties. In spite of the initial successes, the situation was unsatisfactory, but after the first failure to cross the river east of the Montello, Gen. Caviglia, who commanded the VIII. Army and had the general direction of the attack, had detached the XVIII. Corps from his reserves, to pass under the command of Lord Cavan, cross by the X. Army bridges, push north and clear the front of the troops who were held up. The move was entirely successful. The XVIII. Corps under Gen. Basso crossed the river in the early hours of Oct. 28 and attacked northward, while the rest of the X. Army continued its advance.

Position on Oct. 29.—At the close of Oct. 28 the XVIII. Corps had gained nearly four miles and had crossed the railway north of the Priula bridges. The British XIV. Corps had gone right through the Austrian positions and had patrols out on the Monticano, while the Italian XI. Corps was threatening the enemy troops on the Lower Piave. The bridgehead was 10 miles wide and four miles deep. The XII. Army and the left wing of the VIII. had also made good progress, and at last the VIII. Corps was crossing the river, between Nervesa and Ponte di Priula. The prospects of the following day were bright, for the separation of the Austrian V. and VI. Armies was effected; and the VI. Army, heavily attacked in front, was threatened on its left by Basso's XVIII. Corps.

On the evening of Oct. 29 an Italian flying column entered the town of Vittorio Veneto. The attacking armies had already taken 33,000 prisoners, and the situation of the Austrian troops on the Piave was hopeless. Next day resistance broke down, and the general retirement ordered on the 29th became a complete rout. The troops on Monte Grappa had hitherto held firm against the repeated attacks of the IV. Army, and had made

many counter-attacks. But here too, on the night of Oct. 30, a retreat began that was to turn into a flight.

Austrian Collapse and Armistice.—Late on the evening of Oct. 30 the Austrian command announced that in view of the discussions regarding an armistice which were being conducted between Germany and the United States, "our troops fighting on Italian soil will evacuate the occupied region." On the same day the order for a general retreat was given, and that evening, in the Val Lagarina, Gen. Weber von Webernau, commander of the Austrian VI. Corps, made a formal demand for an armistice. Next day he and his staff were taken to the Villa Giusti, near Padua, and discussions were begun. It was, of course, necessary to communicate with Versailles, where the Allied War Council was discussing the question of a reply to Germany's demand for an armistice.

Meanwhile the fighting continued, and the armies of the Monarchy crumbled away. The Italian VI. and I. Armies attacked in the Trentino, and the III. Army, which had crossed the Piave two days before, was already taking part in the pursuit of Boroević's broken divisions. On the night of Nov. 2–3, although the Armistice was not yet signed, the Austrian command issued an order for the cessation of hostilities. It was at first revoked by the Emperor Charles, but was reissued and reached the front on the morning of Nov. 3. In point of fact, the terms of the Armistice were only agreed on verbally on the afternoon of Nov. 3, and signed at 6:30 P.M. Hostilities were to end at 3 P.M. on Nov. 4.

The Austrian surrender was complete. The troops of the Monarchy were to retire beyond the Treaty of London line, leaving all war material and railway equipment. The army was to be demobilised except for 20 divisions at pre-War peace strength, and the Allies were to have the right to occupy any strategic points in Austria-Hungary which they might deem necessary, and were to have free right of passage and use of Austro-Hungarian means of transport "over all road and rail and water-ways in Austro-Hungarian territory."

Conclusion.—When hostilities ceased, Italian troops were far up the Trentino and into Cadore, and to the east the line of the old frontier was passed and the middle waters of the Isonzo were reached. On Nov. 3 Trieste had been occupied from the sea, and half an hour before the expiration of the term fixed by the Armistice an Italian force was landed at Zara. More than 300,000 prisoners had already been counted by the Italians, and the total figure was in the region of 500,000. A number of troops who had been cut off were allowed to pass the frontier after being disarmed, but not much more than half of the Austro-Hungarian troops on the Italian front reached the territory of the crumbling empire. All material was left behind, including some 7,000 guns.

The Austro-Hungarian armies, in spite of bad food and growing depression, began by putting up a stout resistance. The troops in the Grappa sector in particular not only resisted firmly but counter-attacked with great vigour, and punished the Italian IV. Army very heavily. Giardino lost over 23,000 men, more than three-fifths of the total casualty list, which exceeded 35,000. The fighting on the river front was stiff at first, but the defenders were heavily out-gunned (their main artillery concentration was in the Grappa sector), and they were out-manoeuvred and out-fought by the attacking infantry. They were already soundly beaten when the order to retreat was given. Some of the reserve units had shown a disinclination to move up to the front, and two brigades had previously been sent to the rear because they could not be trusted. The troops in reserve had been more affected than those in line by the news of the general breakdown in Austria-Hungary, and they had no stomach for what must have seemed to them a useless fight. But, on the whole, the Austrian soldiers showed a good spirit until obviously beaten.

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VIVIANI, RENE (1863–1925), French politician, was born at Sidi-bel-Abbès, Algeria, Nov. 8 1863. While still a young man, he made a considerable reputation as a lawyer, and in 1893 was elected Socialist deputy for Paris. It was not until the close of his life that he left the Chamber to enter the Senate. In Oct. 1906 he was placed by M. Clemenceau at the head of the recently-created ministry of labour. In the following month he made a famous speech in the Chamber, in which he affirmed his atheistic belief. For these views he was often severely criticised subsequently. "We have put out the lights of heaven," he said, "and they will never be lit again." It was M. Viviani who was responsible for the law with regard to workmen's pensions. In July 1909 when M. Briand succeeded M. Clemenceau as Premier, M. Viviani continued to be Minister of Labour. In Oct. 1910, in consequence of the attitude adopted by the Government in regard to the threatened railway strike, he tendered his resignation, with the result that the Briand Cabinet was broken up and had to be re-formed. In Dec. 1913 he became Minister of Public Instruction in the Doumergue Cabinet.

In June 1914 M. Viviani became Premier and Minister for Foreign Affairs. He was on his way back from Russia with M. Poincaré when the Austrian ultimatum was issued against Serbia on July 23rd; this formed the prelude to the World War. On his return he immediately took affairs into his own hands; and it was he who decided to withdraw the French troops 10 km. behind the frontier in order to give proof of France's pacific attitude. When Germany declared war he made a magnificent speech in the Chamber which had an electrifying effect on his audience. On Oct. 29 1915 he was succeeded as Premier by M. Briand, in whose Government he became minister of justice. After the fall of the Briand Cabinet in March 1917 he no longer took any important part in public affairs. M. Viviani died at Clamart (Seine) on Sept. 7 1925 after a long and painful illness. His gifts as a speaker were remarkable; his eloquence, with its wealth of imagery and brilliant metaphor, has probably never been equalled in the French Parliament. But it was, above all, the rôle he played during the tragic events of July and Aug. 1914 which caused his name to go down to history. (P. B.)

VLADIVOSTOK, Russia (*see* 28.169), capital of Primorsk, a province of Union of Soviet Socialist Republics, now governed by a Soviet, had a population before the World War of 91,000, about one-third Chinese and the majority of European extraction. The closing of the Russian free customs zone in the Far East in 1909 and the subsequent disturbed conditions have had a most detrimental effect on trade; in 1925 a free port zone for transit traffic was opened in the hope of bringing improvement. (*See* JAPAN.)

VOCATIONAL TRAINING.—Logically, the term vocational training should include preparation for the practice of medicine, law and other professions; but it is convenient to restrict it to courses of regular instruction intended to fit boys and girls for commerce, domestic life or some branch of industry. The rapidly growing complexity of industry and commerce and the intensity of international competition compelled all the progressive nations to consider the provision of vocational training, in this sense, to replace or to supplement the methods of apprenticeship (*q.v.*) which sufficed in simpler times. It is, moreover, widely held that under the conditions of modern life, especially in great cities, some form of education, continued through the critical years of adolescence, is needed to preserve the physical, intellectual and moral health of the masses of the people; and vocational training, with its appeal to the practical interests of young wage-earners, is regarded as a particularly effective form for this purpose.

Administration.—In some countries vocational schools are administered as part of the general educational system. In England, for instance, they are provided by the ordinary local authorities for education and subsidised through the National Board of Education. In other countries vocational training is treated rather as a distinct educational function. Thus in the United States the Smith-Hughes Act of 1917 set up a Federal Board for Vocational Education, independent of the Bureau of

Education and charged with the duty of encouraging vocational training in the several states. In Wisconsin there have been, since 1911, distinct boards for general and industrial education with separate taxing powers; but so complete a division within a state is exceptional.

Types of Courses.—In the chief countries many large cities provide vocational schools offering "all-day" courses lasting from two to four years, sometimes in combination with a modified form of trade apprenticeship. These prepare pupils for office business and other commercial activities, or serve industries such as agriculture, engineering, furniture-making, upholstery, dressmaking, which offer scope for highly trained skill or taste, scientific or technical knowledge and capacity for leadership. But by far the greatest amount of vocational training is given everywhere in part-time continuation classes: *i.e.*, classes which provide a few hours of instruction per week for boys and girls who have left the elementary schools and have already entered upon some occupation. In parts of Germany and Czechoslovakia attendance at continuation classes, generally in the evening and on Sundays, was long ago imposed upon elementary school leavers; but the modern tendency, largely influenced by the pioneer work of Kerschensteiner at Munich is to require employers to release their young employees for instruction during working hours. In England and Germany laws making this system universal and compulsory have been adopted since the War, but financial difficulties in both countries prevented their coming into immediate effective operation. In the United States the effect of the Smith-Hughes Act has been to multiply part-time and especially evening continuation schools much more rapidly than all-day schools and in some states attendance is required by law.

In some countries "works schools," maintained by employers for the training of their employees, are an important supplement to the public provision for vocational education. They are especially numerous and well-organised in Germany, but in England and the United States met with some disfavour on political and educational grounds.

Finally, it should be noted that programmes of vocational training almost always include some teaching intended to continue and widen the student's general education. Instruction in the duties of citizenship is common, and in many cases attention is given to physical training and simple hygienic teaching.

Vocational training involves many matters that are still debated. These include the questions whether vocational schools should be organised for single trades or should offer a general industrial training, how far they should aim at technical training for its own sake or use it rather as a general educational instrument, and what mode and amount of co-operation is desirable with bodies representing commerce and the trades. As regards the age of training there is a strong disposition to postpone specific vocational teaching as long as possible, and to prepare for it by "pre-vocational" courses, practical in bias and outlook and having general cultural value. (T. P. N.)

VOGAN, BORIS ANDREEVICH: *see* PILNYAK.

VOGT, HANS (1890–), German inventor, was born Sept. 25 1890 at Wörlitz, Bavaria, Germany. He began his career as an inventor in the sphere of high frequency technology, telephone research and earth current telegraphy. In 1918 he began to collaborate with Joseph Massolle and Dr. Engl, and this led to the formation of the Triergon-Arbeitsgemeinschaft, which aimed at the creation of the speaking film. On Sept. 17 1922 the first public exhibition of the speaking film was held at the Alhambra in Berlin. The voice is photographed directly on to the film band after conversion of the acoustic oscillations, which are taken with an inertialess microphone (kathodophone), and are changed by a photoelectric cell into light pulsations. Reproduction is effected by an electrostatic telephone with mica membrane (statophone). An essential feature of the experiments was the effort to work as far as possible with inertialess elements, so as to secure the absolute coincidence of the mouth movement with the sound. From the speaking film, Vogt further developed a new process for the production of very loud gramophone records by first taking the photograph photoelectrically with his apparatus and then engraving the gramophone plates while the film band was running off quite slowly. He found that with this arrangement the inertia of the gramophone needle did no harm, and could engrave deeply without any detriment to purity of tone.

VOGÜÉ, EUGÈNE MELCHIOR, COMTE DE (1848–1910), French author (*see* 28.172), died in Paris March 24 1910.

VOICE SOUNDS (*see* VOICE 28.172; PHILOLOGY 21.416; PHONETICS 21.462; RESPIRATORY SYSTEM 23.185; PHARYNX 21.359).—The human voice—as used in English and other European speech—can be produced in two different forms, namely (1) unvoiced, *i.e.*, breathed or whispered speech, and (2) voiced speech.

In unvoiced speech the vocal chords are more or less separated so that the air from the lungs passes continuously between them. In voiced speech the vocal chords are brought closely together so that the forcible passage of the air between them sets up a rhythmical vibration of the chords which causes the air to enter the vocal cavities in corresponding rhythmical puffs.

Vowel Sounds.—Until recently the accepted theory was that sounds like i as in eat, e[1] as in men, æ as in hat, were each due to two separate resonances, that ɑ as in calm, was produced in some voices by a single resonance, and in others by two resonances, and that ɔ as in all, ou as in no, u as in who, were all due to single resonance (1). According to Helmholtz's theory (2) the lower series of double resonances is set up in the cavity behind the tongue, and the upper in a tubular neck formed by the tongue and lips, while in the case of the single resonant sounds, the whole oral cavity is supposed to act as a single resonator. Graham Bell, the inventor of the telephone, and K. J. Lloyd both held that all vowel sounds were due to double resonance (3).

Recent observations (4) have confirmed the views of Graham Bell and Lloyd, and shown that all the English vowel sounds depend primarily on two characteristic resonances—the one formed in the cavity in front of the tongue—*i.e.*, between the point of nearest approach of the tongue to the palate and the lips—and the other in the cavity behind the tongue—*i.e.*, between the same point and the vocal chords. Both cavities behave as Helmholtz resonators connected in series. Each can be independently tuned, by varying its capacity or by varying the size of its orifice to air and (or) to the adjoining resonator. Increase of capacity lowers the resonant pitch; of orifice raises it.

The following table shows typical resonances observed by ear in the whispered vowel sounds of the writer's voice, using the Southern English "Public School" pronunciation:—

Vowel Resonances

Vowel Symbol	As in	Upper Resonance	Lower Resonance	Vowel Symbol	As in	Upper Resonance	Lower Resonance
i	eat	♯d′′′′ 2,434	f′ 342	ʌ	up	♯g′′′ 1,625	♯a′′ 912
ɪ	it	♯c′′′′ 2,169	♯f′ 362	ɑ	calm	♯d′′′ 1,217	♯g′′ 812
eɪ	hay	♯c′′′′ 2,169	d′′ 574	ɐ	not	♯c′′′ 1,084	♯g′′ 812
ɛ	men	c′′′′ 2,048	♯d′′ 608	ɔ	all	b′′ 966	♯f′′ 724
æ	hat	a′′′ 1,722	♯g′′ 812	ov	know	♯a′′ 912	b′ 483
ɝ	earth	♯g′′′ 1,625	e′′ 645	u	who	♯f′′ 724	♯f′ 362
ə	sofa	g′′′ 1,534	e′′ 645	ʊ	put	♯a′′ 912	♯d′ 304

The resonances are given in musical notation and in number of complete vibrations per second (c′ = middle c on the pianoforte, about 256 vibrations per second). In the series from ɝ to ʊ inclusive, an additional high frequency component between 2,169 and 2,732 appears. The upper resonance of i to ov can be varied over a range of 5 to 8 semitones, and u and ʊ by 10 semitones, while the lower resonances can all be similarly varied over a range of about 8 semitones (the other resonance, in each case, being kept nearly constant) without losing the vowel character. Comparable resonances have been found—using purely instrument methods—by Crandall and Sacia (5).

[1] The vowel symbols are those of the International Phonetic Association.

Artificial Production of Vowel Sounds.—Potter (6) experimentally reproduced the English vowel sounds by a reed attached to a spherical indiarubber resonator of suitable aperture which was appropriately compressed (while sounding the reed) so as to produce approximately the form of the human mouth cavity. All the English vowel sounds have recently been produced by combining two suitably tuned Helmholtz resonators in series and energising them by a continuous current of air, for unvoiced sounds, or by a pulsating current produced by a vibrating reed or equivalent for voiced sounds (7). The material of the resonators does not appreciably affect the vowel character. The additional high resonances are of secondary importance, since recognisable reproduction may be made without them. Artificial vowels have also been produced by J. Q. Stewart (8) and by Dr. Eccles (9), substituting electrical resonating circuits for acoustic resonators.

Diphthongs differ only from vowels in that their resonances change progressively from those of the initial to those of the terminal vowel which together form the diphthong. They can be reproduced by resonators of progressively variable pitch. Consonants also are produced in speech by resonance in the vocal cavities (10) (11). They differ from the vowel in that 1. they depend essentially on more than two resonances—due to the functioning of more than two cavities, 2. they depend (like the diphthongs) on characteristic movements of the vocal organs which produce corresponding changes of resonance and of amplitude (loudness), 3. the orifices of the resonators (or some of them) are more constricted than those in the case of the vowels, or are temporarily closed altogether and suddenly released as in forming the so-called plosives, p, b, t, d, k, g and the nasal consonants m, n and ŋ (ng), 4. the resonators are not always in series with the air current which energises them. Thus they may be in parallel—as when the air is passed simultaneously through both mouth and nose; or a resonator may be lateral to the air current, as when passage through the mouth is closed by the tongue or lips and the air passes behind the soft palate into the nasal cavity and out at the nostrils. In such cases the air current flows past the inner orifice of a lateral single-orificed resonator formed inside the mouth. Closure of the tongue against the back or the front of the palate produces a lateral resonator of high or medium pitch characteristic of the nasal consonant ŋ (ng as in hung); closure of the lips produces a lateral resonator of the maximum capacity and lowest pitch, characteristic of m.

The consonants can be artificially produced, like the vowels and diphthongs, by passing air (vibrating or not as the case may be) through resonators of variable number and capacity and/or orifice (10). In the cheirophone the variable multiple resonator is formed by the hands of the operator, so as to produce recognisable sentences (12). (*See* SOUND.) Certain consonants have also been reproduced by electrical resonance (8).

In the natural production of vowel sounds, the soft palate may be closed against the back of the throat so as to close the passage to the nasal cavity, or it may be drawn forward so as to open that passage more or less. The best quality of voice production appears to be obtained by avoiding nasal resonance, except in connection with the nasal consonants m, n, and ŋ (ng). In the French nasal vowels ɛ̃ (pain) ã (temps) ɔ̃ (bon) œ̃ (un) the nasal resonance is characteristic. The so-called nasal quality heard in English speech in parts of the North American continent appears mainly to depend on the formation of an additional resonator of high pitch by (unconscious) constriction of the pharynx (13). Broadly speaking, the voice sounds of human speech are due to characteristic postures (for vowel sounds) and gestures (for diphthongs and consonants) of the vocal organs—the tongue, lips and soft palate.

The function of the larynx, in voiced speech, is to increase the range of audibility (from about 10 to 20 times) by increasing the resonance of the cavities through or past which the air current flows. It also gives to speech the power of inflexion—*i.e.*, of variation of the musical pitch of the voice, as in song. The unvoiced consonants s, *ʃ* (sh), f, and *θ* (th as in thigh) and the unvoiced aspirate, all of which carry no laryngeal energy and are incapable of emotional or musical inflexion, are inferior to all other voice sounds. (*See* SINGING.)

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VOLAPUK: *see* UNIVERSAL LANGUAGE.

VOLGA (*see* 28.193). After many vicissitudes the waterborne traffic was (in 1926) beginning to regain its former importance. A great deal of dredging has been done, but many of the steamers and river ports are suffering severely from lack of adequate upkeep, though regular services are now maintained. Through the Mariinsky and Volga system, steamers now run from Leningrad to Astrakhan, and thence to Persian ports.

VOLLENHOVEN, CORNELIS VAN (1874–), Dutch jurist was in 1901 appointed professor of colonial law in the University of Leyden. He achieved a wide reputation as an authority on the common law of the Dutch East Indies and in international law. His chief work is *Hetadatrecht van Nederlandsch-Indië* (The Common Law of the Dutch East Indies; 1906–18). His other works include *Miskenningen van het adatrecht* (1909); *Drie treden van het volkenrecht* (1918); *De Indonesiër en zijn grond* (1919), and became president of the Royal Academy of Sciences at Amsterdam.

VOLLMAR, GEORG HEINRICH VON (1850–1922), German socialist (*see* 28.195), died on June 30 1922.

VONDRÁK, VÁCLAV (1859–1925), Czech philologist, was educated at the University of Vienna, where he studied first romance philology and afterwards Slavonic languages. In 1893 he became lecturer on Slavonic languages and literature at the University of Vienna. He wrote a large number of works mainly dealing with Church Slavonic and its literature. Later he devoted himself largely to the study of comparative Slavonic philology.

His chief works are: *Altslovenische Studien* (Vienna, 1890); *Omluvě Jana Exarcha Bulharského* (Prague, 1896); *Studie Zoborn Církevněslovanského písemnictvi* (Prague, 1903); *Vergleichende Slavische Grammatik* (Göttingen, 1906–8).

VOROSHILOV, KLEMENTIY (1881–), Russian soldier and politician, was the son of a workman. At the age of seven he began to work in the mines and only learned to read when he was 12 years old. He became a revolutionary in 1903, and in 1906 was a delegate to the Stockholm congress of the Bolsheviks. In the following year he was sentenced to banishment for organising strikes and similar activities, and in banishment, except for escapes and rearrests, he remained until 1914. His military career began in the Ukraine where he organised a detachment of partisans and carried on guerilla warfare against the German forces of occupation. Shortly afterwards he was commanding a small army and when it fought its way out, this army became the nucleus of the X. Red Army, the command of which was entrusted to Voroshilov. When the Germans left the Ukraine, Voroshilov became a member of the Ukrainian Soviet Government. He was later associated with Budenny as a member of the revolutionary military council of the I. Cavalry Army.

In March 1921, when the Kronstadt revolt broke out during the sitting of the tenth congress of the communist party, Voroshilov, together with other delegates to the Congress, went to Leningrad and took an active part in the suppression of the revolt. At the same congress he was elected a member of the central committee and in May 1921 was appointed to command the Northern Caucasian military district. In 1924 he was appointed commander of the troops in the Moscow district, and a member of the revolutionary military council of the Union. After the death

of Frunze in 1925, he became president of the revolutionary military council and commissar for military and naval affairs.

VOSS, RICHARD (1851–1918), German dramatist and novelist (*see* 28.215), died at Königsee, Thuringia, July 10 1918. The following works by him have been published since 1910: *Erdenschönheit: ein Reisebuch* (1911); *Brutus auch Du!* (1917); *Das Haus der Grimani* (1917); *Aus meinem Reisebuch Skizzen und Stimmungen* (1918); *Erinnerungen* (1920); *Der Erlösung etc.* (1921); *Bergasyl* (1922); *Alpentragödie* (1923).

VOTING: *see* ELECTORAL LAWS.

WAALS, JOHANNES DIDERIK VAN DER (1837–1923), Dutch physicist, was born at Leyden Nov. 23 1837. He first attracted notice in 1873 with his treatise *Over de continuïteit van den gas-en vloeistoftoestand* (On the continuity of the gaseous and liquid state) by which he gained his doctor's degree. In 1877 he was appointed professor of physics in the University of Amsterdam, a post which he retained until 1907. In 1880 he discovered the "law of corresponding states" which aided Dewar in the liquefaction of hydrogen and Onnes in that of helium. His third important discovery was that of the law of mixtures. In 1910 he was awarded the Nobel Prize for physics. He died at Amsterdam March 9 1923.

WACE, HENRY (1836–1924), Anglican divine (*see* 28.224), died at Canterbury Jan. 9 1924.

WAGES (*see* 28.229).—In the following section, which should be read in connection with the articles on COST OF LIVING and PRICES, the movements of wages in the period 1914–26 are considered. During the 10 years preceding 1914 average money wages had risen about 10%, a rise which was completely neutralised by the synchronous rise of prices, and in 1914 there were agitations for increases of wages which were discontinued at the outbreak of war. (*See* also INSURANCE, SOCIAL.)

I. IN GREAT BRITAIN

Rates of Wages and Earnings.—In the movement of wages it is specially important to distinguish between rates of wages and earnings. Rates of wages are time rates, sums payable for work in a definite time (an hour, a week consisting of a recognised number of hours or, rarely, a longer period), or piece-rates (sums payable for the performance of a definite task, or as additions to or in combination with time-rates, when the rate depends both on the quantity produced and the time taken in producing it). Earnings are the sums actually received by an employee, generally computed for a week or a year; the term is used specifically when the amount received on piece rates is in question, and is also used to include payments for overtime in the case of time workers. Time rates are generally stated for the normal week, or, if the rate is an hourly one, as in the building trades, both for the hour and for the normal week; to get a comparable statement for piece-rates it is necessary to compute the average earnings of a number of men who worked normal hours. In modern times a statement of time rates generally relates to rates agreed to by associations of employers and employees, often as the result of arbitration; these are frequently minimum rates, and the relation between minimum rates and the average of those actually paid to a group of workpeople can only be ascertained by special inquiries such as those undertaken by the Board of Trade in 1886 and 1906. The assumption has to be made that between such inquiries average rates have kept the same proportion to minimum rates, which is only true over a short period and in the absence of disturbing causes.

For piece payments the assumption that earnings move by the same percentage as the rates can never yield more than an approximation to the facts, and during the War such an assumption would be completely invalid even if reference was only made to earnings in a normal week, since there were very important changes in facilities for production, in the effort put into the work and in the nature of the work. In the absence of any general information about earnings, statistics in the war period must be confined to statements of time and piece-rates, which do not give a true picture of the economic position of the working class in that time; in 1920, however, industry was more nearly normal and overtime was relatively uncommon, so that a comparison of rates between 1914 and 1920 or more recently is not altogether misleading. In making such a comparison the general reduction of hours in 1918 and 1919 must be borne in mind; usually at the dates of reduction piece-rates and hourly rates were raised so as to give approximately the same earnings for the reduced as for the longer week, and weekly rates were the same before and after the reduction, but in some industries an increase for the week was arranged at the same time.

Movement of Wages.—From early in 1921 till the end of 1925 unemployment was serious, especially in the engineering and shipbuilding industries, and after the middle of 1924 in coal-mining, and therefore average earnings of all workpeople had increased less than is shown by the index numbers given below. The movement of wages is shown in the following table, where it is illustrated by the changes in eleven important industrial groups. Up till 1919 the general average given is the simple average of the lines above; afterwards it is that stated from time to time in *The Ministry of Labour Gazette*, where it is roughly computed on the basis of all changes known to the Ministry.

It is important to realise that the table deals only with changes in rates, except in the case of miners, where the average earnings per shift of all employed is the basis, and these rates refer to whatever was the recognised normal week at the time of record. Rates rose very gradually in the first two years of the War, then more rapidly to the date of the Armistice. After a slight pause there was a great increase during the boom period of 1919–20; the maximum was attained at the end of 1920, after the general recession of prices had begun, and the subsequent fall only became marked at the date of the coal strike in April 1921. Reductions were very rapid for about 18 months, till at the end of 1922 stability was attained at about 70% above the pre-War

Estimate of Movements of Time-rates or Piece-earnings (for the normal week at each date) in the United Kingdom, 1914 to 1926
(Expressed as percentages of rates in 1914 for each industry.)

	1914 July	1915 July	1916 July	1917 July	1918 July	1919 July	1920 July	1921 July	1922 July	1923 July	1924 July	1925 July	1926 Jan.
Bricklayers	100	103	108	123	160	188	228	222	168	161	165	170	170
Bricklayers' labourers	100	103	113	133	180	225	284	265	185	177	183	191	191
Printers (compositors)	100	100	105	120	157	196	246	265	237	214	213	213	213
Railwaymen	100	110	120	155	195	225	280	257	213	203	203	203	203
Dock labourers	100	101	130	150	193	209	266	265	200	167	200	200	200
Cotton operatives	100	105	110	110	157	202	259	210	169	160	160	160	160
Woollen and worsted operatives	100	115	126	144	164	196	239	243	183	180	180	180	180
Engineering artisans	100	110	111	134	173	199	231	229	188	146	146	146	146
Engineering labourers	100	..	..	154	213	255	309	309	249	178	178	178	178
Coalmining	100	113	129	136	187	224	260	[2]	147	152	170	164	..
Agriculture, England and Wales	100	112	..	..	189[1]	210	260[1]	260	175	156	156	174	174
General average (*Labour Gazette* after 1919)	100	105 to 110	115 to 120	135	175	210	250 to 255	245 to 255	185 to 190	165 to 170	170	175	175
Cost of Living Index number (*Labour Gazette*)	100	125	147	180	205	205-210	252	219	184	169	170	173	175

[1] August. [2] Strike.

rates; the movements during the three years from 1923 to the end of 1925 were almost insignificant.

Real Wages.—Comparison with the cost of living index suggests at first sight that real wages (*i.e.*, wages measured by their purchasing power) fell in the years 1914–7 and rose from 1917 to 1920; actually it is probable that the effective rise in the cost of living was less than measured by the index number till perhaps 1921, and that the reduction of unemployment and prevalence of overtime maintained real earnings from soon after the beginning of the War till the Armistice, and that they were substantially increased during the subsequent boom. For a short period during and after the winter of 1920–1 wages maintained their advantage, but from the middle of 1922 onwards the wage index is practically identical with that of the cost of living. (*See* COST OF LIVING: diagram.)

The general gain during 10 years was a reduction of hours of work by about 10%, with no change in the real wages received. The average of the particular industries included in the table, however, shows a gain of 5% of weekly wage rates over prices. It is evident that there are important divergences from the average. These are due to two causes: the upward movement of unskilled relative to skilled wages, and the failure to maintain high rates in industries specially dependent on foreign markets. The bonuses granted during the War (especially in the earlier years) were generally in the form of flat increases to all operatives to meet the increased cost of food, which gave a greater relative increase to the unskilled man. Thus in 1914 the hourly wage of a bricklayer and his labourer was 11½d. and 8d. respectively, but in 1920 was 28d. and 25d., so that the bricklayer's hourly wage had increased 143% and the labourer's 212%; further, whereas before the War (and indeed during practically the whole of the 19th century) the labourer's wage had been two-thirds of the artisan's, it was for a short period in 1920 89/100 of it; subsequent reductions were greater in the labourer's wage, and at 21½d. and 16½d. in 1925 respectively the proportion four to three had been nearly reached. Meanwhile, summer weekly working hours were reduced from 50 in 1914 to 44 in 1920. This example is illuminating, because the nature of the work done has not changed. A similar contrast, originating in the same way, is found between the increases in the engineering artisan's and labourer's rate.

Unskilled Labour.—Rates for other unskilled labour, if naturally sheltered from foreign competition, such as work for local authorities, at docks and on railways, increased to about the same extent as those of builders' labourers. Part of the optimistic programme after the Armistice was to give a permanent lift to wages in industries which were regarded as underpaid before the War; notably to railwaymen, agricultural labourers and women in the less organised trades; and generally there was an attempt to determine wages according to needs as well as according to the market value of the work. Railway wages were fixed at the beginning of 1920 at a level well above that commensurate with the cost of living, and it was arranged that they should rise and fall in proportion to that cost on the basis of the higher standard established. In agriculture minimum wages were established in the summer of 1918, and raised step by step, till in Aug. 1920 they averaged at least 160% above the pre-War level. Subsequently, in face of the great fall in the world's prices of food, the legal minimum was abolished in Sept. 1921, and wages in 1923 and 1924 fell to a low level; in the summer of 1924 the Agricultural Wages Act re-established minima with a county organisation and wages rose early in 1925. Women's wages in 1926 appeared to be at about double the rates of 1914.

Engineering, Textiles and Coal.—The most conspicuous example of a fall in real wages is that of engineering artisans, whose weekly time-rates show a net rise from about 39s. in 1914 to 56s. or 57s. in 1923; the standard rates in all towns have been increased by 7s. or 8s. and by a bonus, reduced to 10s. in 1923, amounts which apply to labourers and machine-men as well as to fully skilled men. Piece-workers have done better. As a contrast to this the skilled men in the "sheltered" trade of printing have more than doubled their time-rates.

In the woollen industries the wage changes have been very complex, and it is doubtful what the exact average effect has been. Cotton wages afford an example of the changes in an industry where piece-rates are general. In July 1914 the piece-rates were 5% above the standard list; by May 1920 rates were 215% above the standard, 30 points of the rise being awarded to compensate the reduction of hours from 55½ to 48 weekly; by March 1923 they had fallen to 95 above standard. If the output per hour before and after the reduction of hours had been exactly the same, the earnings at the maximum date would have been $\frac{315}{105}\times\frac{48}{55\frac{1}{2}}\times 100 = 259\%$ of those in 1914, and from March 1923 onwards $\frac{195}{105}\times\frac{48}{55\frac{1}{2}}\times 100 = 160\%$; the numbers in the table are calculated on this basis. In fact, the output per hour has probably increased and full time earnings increased by about 80%, but earnings have been very seriously affected by short time.

The history of coal wages is too complicated for treatment here, and must be studied in the various Royal Commissions that have recommended regulations and rates. Earnings per shift, as officially computed, have increased more than nominal piece-rates, owing to the existence of a minimum wage and other circumstances; but their change differs greatly from district to district, so that in 1925 in some districts the increase over 1914 in money earnings was somewhat greater than the rise in prices, and in others much less than that rise. (*See* COAL.)

Standardisation of Rates.—Alongside the wage changes now discussed there has been a movement towards standardisation of rates throughout Great Britain, in which wages in the worse paid districts have been raised the most—the effect of which is not completely shown in the table—and towards wage bargaining on a national basis in which the relative standards are nominally preserved; but with each flat change (*e.g.*, an increase of 3s. to compositors in all districts) the relative rates are disturbed. Further, there is a continual shifting of the relative numbers engaged in the various occupations and industries, and over the period a definite change in the proportions of men to women, boys and girls. The result of these movements, combined with alterations in piece-rate systems, is to make an accurate measurement of the change in average full time earnings of all workers impossible, at least until an adequate wage census has been taken.

BIBLIOGRAPHY.—A. L. Bowley, *Wages and Prices in the United Kingdom, 1914 to 1920* (1921); see also *The Ministry of Labour Gazette* (London, monthly). (A. L. Bo.)

II. IN THE UNITED STATES

The beginning of the second decade of this century found the wages of working people lower, both in dollars and cents and in purchasing power, than they are in 1926. The wages of unorganised and unskilled workers were considerably lower than the wages of unionised and skilled workers and the wages of women workers were particularly low.

A study made in 1914 of women's wages in the United States concluded that 75% of the female wage-earners received less than $8 weekly and 50% received less than $6 and that these wages were further reduced some 20% by lost time and unemployment. The New York State Factory Investigating Committee examined the payrolls of over 2,000 stores and factories during 1913 and 1914 and found that out of 57,000 women and girls, 60% earned less than $8 a week. Of 14,000 married men, 7,000 earned less than $15 a week. The causes of these low wages were numerous: There were no strong labour organisations among this group of wage-earners; unmarried women wage-earners felt that their work was only temporary and married women usually had other sources of income; employers failed to recognise a relation between wages and productivity; the constant stream of immigrants furnished an abundant supply of labour willing to work for low wages and made unionisation of them difficult because of their divergent languages and customs.

During the World War wage rates and money earnings rose appreciably, but owing to the great rise in prices the real earnings

expressed in purchasing power did not materially gain and some studies show that it actually declined. During the period following the War and especially after 1920 a material improvement seems to have taken place in real earnings. During this post-War period the cost of living has been declining, while, in some industries, wages have advanced and in most industries they have not shown any marked decrease from their War-time level.

Mr. Ethelbert Stewart, U.S. Commissioner of Labor Statistics has recently prepared some figures which indicate this course of real earnings. Table I is adapted from his study.

TABLE I. *Union Wage Rates and Cost of Living*

1910–25
(1913 = 100)

Year	Index number of union rates of wages per hr.	Index number of cost of living	Relative purchasing power of wages as measured in cost of living
1910	94·4	93·0	101·5
1911	96·0	92·0	104·3
1912	97·6	97·6	100·0
1913	100·0	100·0	100·0
1914	101·9	103·0	98·9
1915	102·8	105·1	97·8
1916	107·2	118·3	90·6
1917	114·1	142·4	80·1
1918	132·7	174·4	76·1
1919	154·5	188·3	82·0
1920	199·0	208·5	95·4
1921	205·3	177·3	115·8
1922	193·1	167·3	115·4
1923	210·6	171·0	123·2
1924	228·1	170·7	133·6
1925	237·9	173·5	137·1

It will be noted that this table is based on hourly rates of wages in unionised industries. Since it is constructed on hourly rates it does not take unemployment into account. It indicates what workers would receive if their employment were constant. As yet no study of American wages has been made which takes into account unemployment. In 1918 a canvass of some 12,000 families living in 92 localities in the United States was made and a typical wage-earner's family budget was drawn up. The index number of cost of living in Table I shows the fluctuations in price of commodities included in this budget.

In order to have some idea of the trend of real earnings in unorganised industries, Mr. Stewart prepared similar figures for three unorganised or only partly organised industries. Table II. indicates the trend in these industries.

TABLE II. *Real Earnings in Three Unorganised Industries*

1910–25
(1913 = 100)

Relative Purchasing Power of Wages Measured in Cost of Living			
Year	Boot and Shoe Factories	Woollen Mills	Cotton Mills
1910	98·9	96·8	94·6
1911	102·2	98·9	97·8
1912	95·3	104·5	101·4
1913	100·0	100·0	100·0
1914	98·1	100·0	100·0
1915	..	..	..
1916	91·3	107·4	101·4
1917	..	..	..
1918	80·3	110·7	102·6
1919	..	..	..
1920	111·3	170·3	155·4
1921	..	..	..
1922	124·3	160·2	132·7
1923	..	..	..
1924	125·4	176·3	147·0

From these figures it appears that non-union wages have gained more proportionately than have union rates, but it must be remembered that they started from a considerably lower level, *e.g.*, the average union wage rate in 1913 was 45·9c. per hour and $1.09 in 1925; the average wage rate in cotton mills in 1913 was 14·8c. per hour and 37·2c. in 1924; the average rate in woollen mills in 1913 was 17·7c. and 53·3c. in 1924; the average wage rate in the boot and shoe industry was 24c. in 1913 and 51·6c. in 1924. It should also be noted that in the unionised occupations there are practically no women, while in these three industries both women and men are employed.

Mr. Stewart's calculations are based upon wage rates. Another method of approaching this problem of the trend of purchasing power of wages is to study annual earnings of employed workers. This has been done recently by Prof. Paul H. Douglas of the University of Chicago. Prof. Douglas has calculated the average yearly earnings of employed workers in several industries and deflated these figures by a cost of living index so as to get at the purchasing power of money wages. His study, like that of Mr. Stewart, does not take unemployment into account. Table III. summarises his findings:—

TABLE III. *Money Value and Purchasing Power of Average Annual Earnings of Employed Workers in Manufacturing and Transportation*

(1914 = 100)

Year	Index of Cost of Living	Average Annual Earnings of Employed Workers		Relative Purchasing Power of average annual earnings as measured in cost of living	
		Manuf'g	Transp.	Manuf'g	Transp.
1910	92·0	$ 558	$ 678	104	93
1911	94·9	537	702	97	94
1912	95·6	550	714	99	95
1913	98·5	578	752	101	97
1914	100	580	787	100	100
1915	98	568	806	100	104
1916	107	651	858	105	102
1917	129	774	972	104	96
1918	157	980	1379	108	112
1919	179	1158	1492	111	106
1920	205	1358	1785	114	111
1921	176	1180	1619	116	117
1922	166	1149	1567	120	120
1923	169	1254	1575	128	119
1924	169	1256	1572	128	118

The wages of transportation workers have been higher than the wages of manufacturing workers throughout the entire period. But the lower paid manufacturing workers have made greater proportional gains than have the transportation workers. The transportation workers are still better off, but their differential over the manufacturing group is smaller than before the War. This is the same development which was observed above in the comparison of union and non-union rates. Neither the manufacturing nor the transportation workers gained in purchasing power during the War. The first gain came during the closing year of the War and considerable improvement has occurred during the post-War years.

A number of factors have probably contributed to this increase in purchasing power of wages. There has been a great increase in the total annual production of the country. Not only has the total production of the country increased, but the amount per wage-earner has increased. Technological improvements have been made, processes perfected and efficiency increased. In 1909 the index of output per wage-earner stood at 140 while in 1923 it had reached 152. This increased product has made the payment of higher money wages possible and has tended to lower the cost of living. In addition to this, there has been a marked decline in the value of farm products in recent years and this has made for a lower cost of living. In 1919 the purchasing power of farm products has been calculated at 102. By 1923 it had declined to 87. The lower farm products go in value the more of them the worker's wages will purchase and the greater the real earnings of the worker will be.

Another major factor which has increased the well-being of the working class is the decline in immigration. The immigrant has always underbid the American worker, depressed the wage level and been difficult to unionise. This leads one to ask if trade unionism has had anything to do with this recent increase in earnings.

The proportional gains have probably been greater in the unorganised than in the organised trades and in addition to this the membership and funds of trade unions have declined during the period of the wage increases. But this is not conclusive evidence that trade unionism has been of no value. In the first place, a rise in wages in the unionised industries is bound to increase the wages in non-union industries unless a great surplus of labour prevents it. Further, there is a growing practice among employers, in unorganised industries, of paying higher wages in an effort to keep the union out of their industries and we must not overlook, as was explained above, that the non-union wage increases began at a much lower level than union wages. In the second place, the decline of union membership and funds largely represents a partial contraction of the inflated War-time membership. If these developments are taken into consideration, it would seem more accurate to place trade unionism along with the other factors as one of the causes of the recent increase in real earnings.

(J. R. Co.)

WAGNER, ADOLF (1835–1917), German economist (*see* 28.235), died in Berlin Nov. 8 1917.

WAHHABI (*see* ARABIA 2.263).—In 1900 'Abdul 'Aziz, the son of 'Abdulrahman the exiled fourth son of Faisal, conceived the idea of re-establishing the dynasty of his ancestors. By a bold stroke he captured Riyadh. Slowly but steadily he recovered the lost provinces, and by 1914 he ruled the territories of Faisal except the Hasa province which by a surprise attack he captured from the Turks at the beginning of that year. Meanwhile he had begun to consider his plans for the future, and, being ambitious to extend his rule to the limits of the first Wahhabi Empire, he not unnaturally based his scheme on the project of an intensive revival of the Wahhabi creed. History taught him that the weakness of such a creed lay in the impossibility of keeping it at white heat among the shifting elements of a nomad society, easily wearied by ceaseless effort. It taught him at the same time—witness the experience of Ibn Rashid—that the naturally centrifugal character of Arabian society would defy any attempt at permanent empire-building without the impetus of religious emotion. To give permanence to such an emotion it was necessary to change the essential character of the nomad tribes with which he had to deal, and history again taught him that, if land was available to settle in, the nomad would naturally turn to a sedentary life of agriculture—witness the populations of Syria and 'Iraq recruited from time immemorial from the ranks of the Arabian Bedouin (Bedawin).

Settlement of the Nomads.—His scheme was no less than to tempt the nomads to settle in villages under the influence of religious fervour and to hold them in their new life by the ties of agriculture. His difficulty was to find cultivable land not already occupied and water to water it withal, but the success which has attended his efforts may be judged from the fact that in 15 years some 50 villages have been founded in Central Arabia with a population probably not far short of 50,000 souls in the aggregate. The first of such villages, 'Artawiya in Eastern Najd, was founded in 1912 and served as a model for others following in rapid succession. The nucleus in each case was a mosque provided for from state funds which also provided the inhabitants with rifles and the services of a religious teacher. For the rest they set themselves to build houses, dig wells and cultivate the land. As each community took root it became automatically a territorial contingent of Ibn Sa'ud's standing army. On these contingents, fearless and ferocious, Ibn Sa'ud has mainly relied in the furtherance of his imperial ambitions, while retaining in reserve the citizen contingents recruited from the towns on a conscription basis.

Tenets of the Ikhwan.—The *Ikhwan* (brothers), as these village communities are called, purport to follow in detail the practice of the Prophet, and regard as infidels all who do otherwise. Their enemies are the enemies of the true faith and their every campaign is therefore a *Jihad* (holy war), death in which is a sure passport to Paradise. Another feature of these communities is the complete elimination of all tribal distinctions. The old pastime of tribal raid and counter-raid is discountenanced. The blood-feud is no more. And the Bedouin generally are rapidly becoming permeated by the *Ikhwan* spirit to such an extent that the nomad tribes of Central Arabia may be regarded as a single religious fraternity where natural *points d'appui* are the numerous *Ikhwan* settlements in their midst. The settled town communities of Nejd are Wahhabi in spirit and in practice, but cannot be regarded as forming part of the inner circle of the faith, which only comprises the Bedouin whether settled or nomad. In the matter of doctrine the Wahhabis (*Ikhwan*) differ from their fellow-Moslems in rejecting a large mass of tradition which they regard as un-authentic. Like all Moslems they regard the Koran (Quran) as the Word of God and therefore the foundation of their social code, but there is admittedly much in the Koran and much not in it which from the earliest days of Islam required explanation or consideration. Such matters were freely dealt with by the Prophet in conversation or in his practice, the records of which were subsequently collected in the form of "Traditions of the Prophet" which, being generally handed down by word of mouth, grew in volume as time progressed. And it was freely recognised that the authenticity of some traditions was less well established than that of others.

The various schools of Sunni Islam owed their existence to differences of opinion on such matters, but the basis of the Wahhabi faith is exclusive reliance on only two collections of Traditions (those of Al Bukhari and Al Muslim), whose authority is admitted by all schools, and the rejection of all else in respect of which there is doubt. Thus the Wahhabi interpretation of the creed of Islam is common ground to the whole of Sunni Islam (except for its specific denunciation of the use of tobacco), whose other schools differ from it in allowing a greater laxity of belief and practice on the strength of traditions whose authenticity is in dispute. The Wahhabi movement is therefore quite aptly recognised as a Puritan movement within Islam. For bibliography, *see* ARABIA.

(H. St. J. B. P.)

WALES, PRINCE OF: *see* EDWARD, PRINCE OF WALES.

WALES (*see* 28.258), had in 1921 a population of 2,206,712. In the years immediately preceding the outbreak of War in 1914, Wales was deeply distracted by acute political divisions and widespread industrial unrest. Historical, physical and other conditions peculiar to Wales tended to aggravate anxieties and uncertainties prevalent throughout the United Kingdom. The prospect of the settlement of the grave constitutional crisis that had arisen between the two Houses of Parliament intensified interest in measures of a highly controversial character which directly concerned Wales as a national entity. Thus, the disestablishment and disendowment of the Church of England in Wales had been the most constant and, usually, the most prominent issue in Welsh elections since 1868. The demand for Welsh autonomy, either as an independent measure or as part of a general scheme of federal devolution, had been attracting interest and support. Such proposals found their strongest response in those parts of Wales—the North and West—where the great bulk of the population was Welsh in speech and tradition and nonconformist in creed.

Urbanisation.—But the centre of interest in the life of Wales had been establishing itself definitely in the northeastern and southeastern regions, with their growing concentration of population and productive wealth. These regions were becoming intensely industrialised, and the process was extending steadily up the valleys. Rural depopulation was proceeding at an accelerating rate with a concomitant decay of agriculture and of rural life generally. In the first decade of the century the rural population of Wales declined by about 27%. Of the twelve counties in England and Wales, which in 1911 had the smallest number of inhabitants to the square mile, seven were Welsh "rural" counties. These showed an absolute decrease in the density of population found in two only of the five English counties included in the same list. Owing to the relatively unattractive conditions of agricultural labour, the proximity of the "Works," the decay of tillage and the consolidation of holdings to form large sheep runs, the manhood of the rural areas was steadily draining into the urban centres and mining valleys of industrial

Wales. South Wales with a population rapidly growing, largely through immigration from rural Wales, from all parts of the British Isles and even from foreign countries, was becoming a vast and closely knit industrial community. Men representing a variety of national and cultural traditions found in their economic condition the only basis of mutual understanding, of common action and, in short, of a growing class consciousness. The coal miners formed much the largest body of workers engaged in a single industry in Wales and Monmouthshire (251,400 in 1911). The steady advance in the cost of living, clearly marked for some years before the War and the fermenting of new ideas kept the community in a state of unrest which frequently issued in trade disputes concerning the remuneration and conditions of labour. Moreover industrial Wales was acquiring great influence in the world of British industry.

National Consciousness.—The national identity of the Welsh people received striking official recognition a month after the coronation of King George V., when the King's eldest son was formally invested with the title and insignia of Prince of Wales in a full representative Welsh Assembly in Carnarvon Castle. The ceremony of investiture, occasionally witnessed in the English Parliament in the Middle Ages, was then, for the first time, performed in Wales and in a Welsh assembly. The claim of Wales to separate treatment on the ground of special conditions resulting from her distinctive historical development has since received practical recognition in some of the great administrative measures passed by the Imperial Parliament. Thus, a Welsh Commission with headquarters in Cardiff, was made responsible for the administration in Wales of the National Health Insurance Act (1913). Under the same Act the campaign against tuberculosis was entrusted to the King Edward VII. (Welsh) National Memorial Association. Some of the measures of reconstruction and development passed in the post-War period are likewise administered in Wales on a national basis. That Welsh national consciousness, evidenced by the demand for administrative autonomy and by the claim for legislative autonomy in Welsh affairs (Welsh Home Rule Bill, April 1914) is not incompatible with the fundamental unity of the British Commonwealth was conclusively demonstrated in the World War, 1914–8.

Welshmen in the War.—In proportion to the population Wales sent the highest number of volunteers to the British fighting forces. Welsh troops, including considerable numbers of monoglot Welshmen, served on the fighting fronts of three continents. At home some of the gravest burdens of official life were borne by Welshmen. At the close of 1916 the supreme direction of affairs was entrusted to a Welsh speaking Welshman, Mr. D. Lloyd George. Lord Rhondda, long a leading figure in industrial organisation in Wales, subsequently undertook the control of the distribution of the food supplies of the country.

Religion and Education

Religion.—In 1914 the Bill for the Disestablishment and Disendowment of the Church of England in Wales passed the Imperial Parliament. It provided that the secularised portion of the endowment of the Church should be applied to specified national purposes mainly educational. An amending Act (Sept. 1919), which revised the financial provisions of the original Act, definitely closed a long and embittered struggle. "The Church in Wales" faced the problem of reconstruction with energy and marked success. The task of framing a constitution, begun in 1917, was completed in 1922. Under this Constitution the supreme authority is vested in the Governing Body, an assembly fully representative of the Clergy and laity of "the Church in Wales." Diocesan, ruridecanal and parish assemblies, constituted on the same principle, exercise delegated powers within their respective areas. The representative body holds and, in general, administers all the property of the Church. In 1920 the Bishop of S. Asaph (Dr. A. G. Edwards) was elected the first Archbishop of Wales, it being laid down by the Constitution that "the Office of Archbishop shall be held by a Diocesan Bishop of the Church in Wales." The speedy creation of two new dioceses (Monmouth, 1921; Brecon and Swansea, 1923) demonstrates the high measure of statesmanship in counsel and vigour in action possessed by the reconstituted Church.

Meanwhile the Nonconformist bodies were gradually drawing closer together under the general style of the Free Churches, which, after the Disestablishment of the Church, was replaced by that of the Evangelical Churches. The need of closer union was felt and emphasised on all sides, and the Evangelical Churches readily found in several directions opportunities for whole-hearted co-operation. But the attempt to maintain a national organisation representing all the Churches (the Welsh National Council of Evangelical Churches) has, so far, not proved conspicuously successful. Although the Welsh Baptists still maintain the Close Communion and, therefore, remain officially outside the movement for the union of the Churches, the deepening consciousness of the fundamental unity of spirit and aims is profoundly affecting the mutual relations of the Church in Wales and the various Evangelical Churches.

The Roman Catholic Church, represented in industrial Wales by large communities mainly recruited by immigration from Ireland and by scattered communities of native tradition in the border counties, steadily extended its organisation.

Education and National Culture.—The Intermediate Education Act (1889) had given to Wales a system of public secondary education and had led to the creation of a representative national body, the Central Welsh Board, charged with the inspection and examination of the schools. In 1894 the three colleges of Aberystwyth, Cardiff and Bangor were, by Royal Charter, constituted into a national University of Wales. To supervise the administration of the various Education Acts a Welsh Department of the Board of Education was set up in Whitehall in 1907. Thus for some years before the War the administration of education in Wales had been largely national. The National Library of Wales was founded in Aberystwyth in 1911 and the National Museum of Wales in Cardiff in 1912.

The final report of the royal commission on the universities under Lord Haldane's chairmanship was issued in 1918. While approving the continuance of a single national university for Wales, it contained recommendations of the greatest importance to the university and to Wales. A Supplemental Charter (1920) enabled the university to be reconstituted in accordance with the recommendations of the commission. The new Constitution is broadly based on national and popular support. In the university court which is the governing body, a majority is ensured to the representatives of the Welsh county and county borough councils. The local authorities contribute a penny rate to the support of the university, which receives an equal sum from the Imperial Exchequer. Through sub-committees of the court, *e.g.*, the council of music, the board of Celtic studies and the extension board, the university directly fosters educational and cultural activities over the whole of Wales, etc. In 1925 the colleges were responsible for the work of 130 "extramural" classes (university tutorial and preparatory classes) engaged in the systematic study of a considerable variety of subjects both in the great industrial centres and in the remote country villages. The university College of Swansea was established in 1920 as a fourth Constituent College of the university. Local interest and support secured for the applied sciences a strong position among the studies prosecuted in the new college. The Representation of the People Act (1918) created the University of Wales a Parliamentary constituency represented by one member.

Meanwhile a departmental committee had been set up by the Board of Education to inquire into the organisation of secondary education in Wales. The most significant of the recommendations included in its *Report* (1920) was that there should be established a National Council of Education for Wales. This proposal gained considerable support. It is probably the most generally acceptable of the various schemes (Home Rule, Devolution, Secretary for Wales) advanced in recent years with a view to increasing Welsh autonomy. It is usually interpreted to mean the creation of a separate and autonomous authority in Wales for primary, secondary and university education.

Language and Literature.—In these years the demand for the fuller recognition of the language, literature and native culture of Wales in all branches of public education has been urged ever more insistently. The 1918 Education Act, which required local education authorities to prepare schemes of instruction adapted to suit the requirements of their respective areas, led to a considerable extension of the use of the Welsh language in the schools, notably in the industrial region of South Wales. A departmental committee of the Board of Education was set up in 1925 to inquire into the position of the Welsh language in the schools and colleges of Wales.

The movement in favour of the greater utilisation of the native language and traditional culture derives its strongest impulse from the Welsh Churches and from the Sunday schools, the Eisteddfod, the literary society and the Cymmrodion societies. More recently the Welsh Drama movement has powerfully reinforced the older organisations and has, in addition, provided a new interest of cultural value. Contemporary Welsh literature surpasses, in volume, breadth of outlook and quality, that of the 19th century. The influence of the scholars and writers trained in the national colleges is clearly discernible in this revival and development of the Welsh literary tradition.

Rural and Industrial Conditions

Rural Life.—A Welsh agricultural council was established before the War to keep the Board of Agriculture in touch with the particular needs and interests of the industry in Wales. There was, however, a growing conviction that the adequate treatment of the agricultural problems of Wales required the creation of a Department of Agriculture for Wales with resources and powers similar to those possessed by the Scottish and Irish Departments. In 1901 the Agricultural Co-operative Movement spread from Ireland into Wales. At the end of 10 years societies were to be found throughout the country with a membership of 6,000. The transactions of the societies represented a sum of over £290,000 in 1912. This rapid expansion was confined almost exclusively to the distributive phase of the movement. The average size of holding in Wales was 47 ac. and the smallholders were quick to grasp the advantage of co-operative purchasing of foodstuffs, implements, etc. The co-operative marketing by a few societies of dairy produce in West Wales and of wool in North Wales represented the productive side.

The prosperity of agriculture during the War strengthened the demand for improvement in the remuneration and working conditions of land labourers. Organisation spread rapidly among the farmers and farm labourers. The Agricultural Labourers' Union made great progress. Numerous branches of the Farmers' Union were formed, and in 1918 an independent Welsh Farmers' Union was established. Before the close of that year minimum wages for agricultural labourers had been fixed by law.

Social and economic changes have altered largely the structure and outlook of the life of the Welsh countryside since 1911. The breaking up of landed estates after the War enabled large numbers of Welsh farmers to acquire the freehold of their farms. The application of more scientific methods to all branches of farming and the extension of organisation and co-operation have helped to stabilise the condition of prosperity which dates from the war period.

In many ways the War served to draw rural Wales out of its isolation. Thousands of land workers who had served in foreign countries returned home with a new and broader outlook. The rapid development of road transport obliterated the formerly sharp distinction between town and country. Village institutes, women's institutes, tutorial classes, lecture courses and dramatic and musical societies are now firmly established in the rural areas. The social and intellectual advantages of urban life appear relatively much less conspicuous than they did formerly. The latest census returns suggest that rural depopulation is abating. Of the eight counties of England and Wales which showed a decrease in population in the inter-censal period (1911–21), two only were Welsh counties.

Industrial Wales.—Widespread industrial unrest, marked by frequent and protracted conflicts, characterised the years 1911–4. One fruitful source of trouble among the coal miners, namely, the remuneration for work done in "abnormal places," leading to the demand for a minimum wage, was removed by the passing of the Coalminers' Minimum Wage Act Nov. 27 1912. Trade depression was fairly general; there was much unemployment in the anthracite coal area, while the cost of living advanced steadily. The War induced a great outburst of activity and consequent prosperity in the coal-mining and metallurgical industries of South Wales. On the other hand the slate-quarrying industry in North Wales, which in 1911 gave employment to 12,800 men, was paralysed by the cessation of building operations. Hundreds of the workers migrated to the more favoured mining areas. Industrial peace was, however, of short duration, and by 1917 the position in the coal-field had become critical (*see* Coal). During and since the War the anthracite coal area in West Wales was greatly developed.

The slate quarrying industry in North Wales has recovered a considerable degree of prosperity through the general resumption of building operations and the industrial development of Snowdonia is proceeding steadily. Some of the industries started or greatly stimulated in Wales in the War period have become definitely established, notably oil refining in Swansea and various metallurgical industries in North East Wales (Flintshire). Copper smelting, which formerly ranked as one of the chief industries of South Wales, is decaying somewhat. In the period 1911–21 the most rapid increase of population occurred in the three Welsh counties, Flintshire, Monmouthshire and Glamorganshire. A satisfactory and lasting settlement of the coal question would almost certainly open a new era of industrial expansion and growing prosperity and progress in Wales.

Conclusion.—Whether or not the Welsh language and the traditions of native culture, which have withstood, with remarkable tenacity, successive processes of Romanisation, Normanisation and Anglicisation, will maintain themselves despite the advance of cosmopolitan industrialism, is becoming a question of deep interest and concern in Wales. It is, however, highly significant that the most vigourous manifestations of the vitality of native elements are, at present, found in the populous industrial areas.

Bibliography.—E. L. Dobbins, *South Wales as the Chief Industrial Centre of the United Kingdom* (1922); Sir J. Rhys and Sir D. B. Jones, *The Welsh People* (1923); N. Edwards, *The Industrial Revolution in South Wales* (1924); Sir O. M. Edwards, *Wales* (1925).

(E. E. H.*)

WALES, UNIVERSITY OF (*see* 27.775).—A royal commission was appointed, in 1916, to enquire into the organisation of university and post-secondary education in Wales. In 1920, a supplemental charter, embodying, with certain exceptions, the recommendations of the royal commission, was granted. This added a fourth constituent college, University College, Swansea, to the university. The original three colleges are the University College of Wales, Aberystwyth; the University College of North Wales (Bangor); and the University College of South Wales and Monmouthshire (Cardiff). The university is now in receipt of the produce of a penny rate from each of the county and county borough councils in Wales and Monmouthshire, amounting, in the year 1924–5, to £54,498 7s. 10d.

The charter reconstituted and enlarged the university court as the supreme governing and legislative body of the university, and established as an executive body the university council. In both these bodies, the majority of the members are elected by the county and county borough councils of Wales and Monmouthshire. The university senate was replaced by a smaller elective body, the academic board. A larger measure of autonomy in academic matters was given to the colleges. By the new charter a board of Celtic studies, an extension board, a council of music, a Press board, and an appointments board were constituted by the authorities.

New Chairs and Buildings.—The University College of Wales, Aberystwyth, has, since 1910, established a chair of Welsh

literature, a chair of Colonial history, the Wilson chair of international politics, and a chair of music. The University College of North Wales established a chair of Welsh literature. In the Welsh National School of Medicine, at Cardiff, full-time professors of medicine and surgery and a part-time professor of obstetrics and gynaecology have been appointed. A tuberculous diseases diploma open to registered medical practitioners, has been instituted. The chairs founded at Swansea are classics, English, Welsh, modern languages, philosophy, education, mathematics, physics, chemistry, metallurgy and engineering. A faculty of technology has been established in the university, and the Cardiff Technical College, provided by the corporation of Cardiff, has been recognised as a technological institution.

The college at Bangor has completed its arts and administrative buildings. Its science buildings, now (1926) in the course of erection, are being provided by public subscriptions as the North Wales war memorial. The college at Aberystwyth has erected a college hall with accommodation for 2,500 persons, and the old students of the college have provided buildings for a college union. The permanent physical and chemical laboratories of the University College at Cardiff are (1926) in process of erection. Of the buildings given to the Welsh National School of Medicine by Sir William J. Thomas, the institute of physiology was completed and the department of public Health well advanced in 1926. The University College of Swansea commenced in 1920, buildings on the site in Singleton Park given by the Swansea corporation. New buildings for the science departments and for some of the arts departments have been erected. The extramural work of the university has grown steadily during the last four years, and in the session 1924–5, 75 university tutorial and 31 preparatory classes were held, with a total enrolment of 2,389 students.

The majority of the county councils and county borough councils in Wales and Monmouthshire have agreed to contribute the produce of one-eighth of a penny rate in aid of the Welsh National School of Medicine, in addition to the penny rate contributed for general purposes. This contribution, added to subscriptions guaranteed for five years and donations, brings in an income of over £7,500 per annum for the school of medicine.

Benefactions.—Among the most important benefactions received since 1910 are the following:—

(*a*) An anonymous gift of £100,000 to the University College of Wales, Aberystwyth, for the endowment of chairs of international politics, Colonial history, geography, Welsh literature, music and for a directorship of extramural studies, as well as for other objects.

(*b*) A gift of £37,500, from Miss E. C. Talbot for the endowment of a Mansel-Talbot chair of preventive medicine in the Welsh National School of Medicine.

(*c*) A gift of £50,000 from Mr. Daniel Radcliffe for the benefit of the university.

(*d*) A gift, estimated at a total value of £90,000, from the corporation of Swansea in respect of the provision of land, buildings and equipment for the University College of Swansea.

(*e*) A gift of £10,000 from the Misses Davies, Llandinam, to the national council of music for the endowment of a university directorship of music for Wales.

(*f*) A grant of £14,000 from the Rockefeller fund trustees in aid of the medical unit of the Welsh national school of medicine.

(*g*) An anonymous gift of £10,000 for the purpose of enabling post-graduate students to prosecute research.

(*h*) A gift of £25,000 from Mr. David Davies and the Misses Davies, Llandinam, for the endowment of a David Davies professorship of tuberculosis.

(*i*) A bequest by Mr. Lloyd Roberts to the University College of North Wales, Bangor, of the capital value of about £34,000.

(*j*) A gift of £10,000 from Sir Thomas D. Owen for the establishment of a department of hydroelectrics at the University College of North Wales, Bangor.

Numbers of Students.—The numbers of students in the colleges have greatly increased since the World War. The highest numbers were reached in the year 1920–1, when the full-time students reached 2,926, including the ex-service men who received special grants from the Government. The numbers of full-time students in residence since 1920–1 are as follows: 1921–2, 2,850; 1922–3, 2,696; 1923–4, 2,663; 1924–5, 2,643.

WALLACE, ALFRED RUSSEL (1823–1913), British biologist (*see* 28.275), died at Broadstone, Dorset, Nov. 7 1913. In 1908 he received the O.M. Among his latest publications were *The World and Life* (1910) and *Social Environment and Moral Progress* (1912).

WALLACE, SIR DONALD MACKENZIE (1841–1919), British author and journalist, was born Nov. 11 1841. He was educated at the Universities of Glasgow, Edinburgh, Berlin and Heidelberg and at the Ecole de Droit, Paris. When 28 years of age he was invited by a friend to visit Russia, and became so much interested that he remained there for six years. His *Russia* (1877) had a great success, and was at once recognised as a classic. Shortly after its appearance Mackenzie Wallace became correspondent of *The Times* in St. Petersburg (Leningrad); in 1878 he was moved in a similar capacity to Berlin, thence to Constantinople, and after the battle of Tell-el-Kebir (1882) to Egypt. From 1884–9 he was in India as private secretary to the Viceroy, Lord Dufferin, and to his successor, Lord Lansdowne. From 1891–9 he was director of the foreign department of *The Times*. In 1899 he undertook the editorship of the New Volumes (issued in 1902 as the 10th edition) of *The Encyclopaedia Britannica*, but only remained on this work a few months. He had been created K.C.I.E. in 1887, and was made K.C.V.O. in 1901. In addition to his book on Russia he published *Egypt and the Egyptian Question* (1883) and *The Web of Empire* (1902). Sir Donald, who was a remarkable linguist, speaking some 20 languages, died at Lymington, Hants, Jan. 10 1919.

WALLACH, OTTO (1847–), German chemist, was born at Königsberg. He studied in Göttingen, was made extraordinary professor in Bonn, and in 1889 became ordinary professor in Göttingen, retiring in 1915. In 1910 he was awarded the Nobel Prize for chemistry. In Göttingen he directed the chemical Institute of the university, was also a member of the Royal Society of Science in Göttingen and corresponding member of the Prussian Academy of Science. His researches were mainly concerned with the essential oils and the terpenes. With Tiemann and Semmler he was one of the scientific founders of the German synthetic perfume industry, which owes much to him. An appreciation of his life's work is contained in the *Wallach Festschrift* of the University of Göttingen (1909).

WALLENBERG, KNUT AGATHON (1853–), Swedish banker, the eldest son of A. O. Wallenberg, the founder of the Stockholm Enskilda Bank, served as an officer in the Swedish Navy from 1874 to 1881. In 1874 he became a member of the board of directors of the Stockholm Enskilda Bank, was its managing director from 1886 to 1911, chairman of the board from 1911 to 1914 and again from 1917. Wallenberg exercised a great influence on industrial and economic development in Sweden; in conjunction with the *Crédit Lyonnais* he introduced Swedish state bonds on the French financial market in 1890, and co-operated in the floating of several Swedish state loans. He was a member of the board of directors of the Banque du Maroc from 1917 to 1920 and was succeeded therein by his brother Marcus. Wallenberg took part in the establishment of the Banque des Pays du Nord in 1911 in Paris, and of the British Bank of Northern Commerce in 1912 in London, which in July 1921 became Hambro's Bank. He was a member of the First Chamber of the Swedish Parliament from 1906 to 1919, and chairman of the Swedish chamber of commerce from 1912 to 1914 and again from 1918. In the Hammarskjöld ministry he was Foreign Minister from 1914 to 1917 (*see* SWEDEN). In 1918 he and his wife gave about 25 million krone to a fund for religious, social, scientific and educational purposes and for the encouragement of trade and industry.

WALLENBERG, MARCUS (1864–), Swedish financier, brother of K. A. Wallenberg, began his career as a naval officer, and then studied and practised law. He afterwards became a member of the managerial board of the Stockholm Enskilda Bank, being appointed managing director in 1911 and vice-chairman in 1920. He founded, or reorganised, a number of industrial undertakings in Sweden, and also, in 1905, the Norsk Hydro-elektrisk Kvaelstof Aktieselskab in Norway, and was one of the founders of the Central Bank for Norway and of the Swedish Industrial Union. In 1916 and 1917, and in 1917–8,

he took part in the negotiations with the Allied Powers concerning trading matters. He became a member of the neutral Powers' economic section of the Supreme Economic Council at Paris in 1919, took part in the Amsterdam meeting in 1919, and was Swedish representative at the Brussels Economic Conference in 1920. He was the finance delegate at the Genoa Conference in 1922, became a member of the Finance Committee of the League of Nations in 1924, and also chairman of the committee for arranging the tax on German industry under the Dawes Plan.

WALLER, LEWIS (1860–1915), British actor (*see* 28.283), died at Nottingham Nov. 1 1915.

WALSH, WILLIAM JOHN (1841–1921), Roman Catholic divine, was born in Dublin Jan. 30 1841. Educated in Dublin and at St. Patrick's College, Maynooth, in 1867 he was appointed professor of dogmatic and moral theology at Maynooth. In 1878 he became vice-president of the college and in 1881 succeeded Dr. Russell as president. Dr. Walsh took a keen interest in politics and served on several committees and commissions. He was partly responsible for the appointment of the commission to enquire into the working of the Queen's Colleges, and he became a member of the senate of the university (*see* 14.754). In 1885 he was summoned to Rome by the Pope and appointed archbishop of Dublin. This office he continued to hold till his death in Dublin, April 9 1921. Dr. Walsh's activities extended far beyond his official duties. In 1891 he became a commissioner for education in Ireland and, in 1908 a member of the Dublin statutory commission which established the Catholic National University, Dr. Walsh being elected chancellor. In politics he was a Nationalist, but he strongly opposed compromise with the British Govt., and after the rebellion of 1916 he supported the extremists, making no secret of the fact that in the election of Dec. 1918 he voted for a Sinn Fein candidate.

Dr. Walsh's published works include *A Plain Exposition of the Irish Land Act of 1881* (1881); *The Queen's Colleges and the Royal University of Ireland* (1883-4); *The Irish University Question* (1890).

WALTER, BRUNO (1876–), German conductor of opera, was born in Berlin Sept. 15 1876. Walter, whose real name was Schlesinger, received his training in Berlin at the Sternsche Konservatorium. He studied under Ehrlich, Buszler and Robert Radecke, and first appeared as conductor of opera at the Municipal Theatre in Cologne. He then filled the same position in Hamburg, Breslau, Pressburg (Bratislava) and Riga. He went afterwards to the Royal Opera House in Berlin, which sphere of activity he exchanged in 1901 for the Court Opera in Vienna, where he conducted until 1912. On Jan. 1 1913 he became general musical director at the Munich court opera in succession to Mottls. On Oct. 1 1922 he retired from that position, and later became general musical director of the Municipal Opera in Berlin. Walter wrote three symphonies, a string quartette and other musical pieces.

WANAMAKER, JOHN (1838–1922), American merchant (*see* 28.302), died in Philadelphia Dec. 12 1922.

WAR (*see* 28.305).—The years 1914–8 have dug so deep a trench across the history of civilisation that the epithet "pre-War" implies a remoteness not to be measured in time. Nothing has suffered more from this ageing process than military literature. The old principles may hold good, but Napoleonic, American, Franco-Prussian and Manchurian illustrations are already obsolete.

The very word "war" has acquired a new significance. "War is the armed conflict of states, in which each seeks to impose its will upon the other by force"—so we have always been told. Today, aided by the revolutions which have rummaged the archives of foreign offices and court-martialled generals, we can go farther. We can perceive for the first time clearly the figures of ambassadors and general staff chiefs. In Isvolski's letters we hear strange echoes of our own "military conversations." Behind the smooth-spoken diplomats the soldiers manoeuvre. The common citizen is, in fact, at last able to get inside the skin of that mysterious entity, the State, which, like Father Saturn, has an ingrained habit of devouring its own children. "I am the State," said the King of France. "The State is Power," said Treitschke. "The State is Finance," said Napoleon. "The State is a mutual benevolence combine," said Kant. "The State is Reason in action," said Hegel. Actually, in its relation to war, the State has now been proved to be the state of mind of Europe, inflamed by its own ministers, periodically craving for adventure.

I. MANKIND AND THE MACHINE

To one who was in Hungary, Turkey and the Balkan States in 1908, and who, between that date and 1914, witnessed manoeuvres in Austria, Germany, Russia and England, it seems certain that already in those days the young men felt war keeping step with them in their ranks. Then, suddenly, some barbarian threw a bomb. The governments, who had for years kept their taxpayers blind to their own errors by saying, "an enemy hath done this," completely lost their heads and, before they knew where they were, the drums were beating and millions were on the march towards the hour of zero. From 1906 onwards the face of the clock wore its everyday expression, but beneath its smooth surface the alarm was set to "The Day," and emperors, parliaments and reason could only sit outside, watching the rhythmic beat of the pendulum.

Because good Europeans hate war in 1926 it does not follow that they hated war in 1914 or that they will hate it in 1964. Because Sir Bedivere has flung Excalibur far out into the mere let no one imagine that the glamour of the sword is forever quenched. Against that spiritual symbol the shield of Locarno, welded by the spectre of the falling franc, will form a poor protection. Today pacifists speak to the converted, but their young sons have been born with the old instincts. Those who have seen with their own eyes and suffered in their own bodies know the ugly truths of war, but they cannot convey their knowledge to the young generation. The old lack imagination to tell; the young lack imagination to believe. Nothing will stop war save a Second Advent of Christ. The year 1926 finds war in the melting pot where it is much more likely to take on a new shape than to corporate. Great Britain and the United States should use this respite to overhaul their machinery. Let neither of those great, but strangely improvident, nations imagine that because they mean to do the right thing by humanity they will on that account escape the challenge of the sword. Does not Hegel tell us that tragedy is the conflict, not of Right and Wrong, but of Right and Right? Was it wrong for Russia to want one small ice-free port for all her swarming millions? Was it wrong for Japan to think of her own swarming millions and to object? Was it not right of the Southern States to struggle for self-determination? Was it not right of the Northern States to say No? Two good ideas came into collision and bang went the cannon. Suppose even that the League of Nations was as supreme in the regions of morality as was once the Pope, could it put a hook in the nose of a leviathan like Russia?

Mobilisation and the "Nation in Arms",—The first glimpses we get of humanity show war, tiger-like, springing out of the primeval forest and forcing man to realise loyalty, camaraderie and self-sacrifice. Since then war has clung as close to man as his own shadow, until, incredible as it may one day seem, by 1870 the civilisation of European nations had come to be measured, not by their arts, learning or religion, but by their wealth, by the numbers of their trained fighters and by their equipment. Before 1870 the methods of projecting the trained fighters into action and maintaining their numbers were secondary; after 1870 they became primary. One of these methods was "mobilisation"—the science of rendering an army capable of movement; the other was the "nation in arms."

All over Europe mobilisation schemes were worked up to the highest degree because a flying start meant that the earlier battles would lie beyond the home frontier. To begin mobilisation 24 hours sooner than the enemy was so much gained in time and space. As mobilisation itself sheds no blood the logical implication of this has escaped notice. But seeing that once started it cannot be stopped, that it substitutes action for negotiation, and that it forces threatened nations to follow suit, wholesale mobili-

sation is, in effect, war. Historians in search of a scapegoat on whom to discharge the sins of Europe may spare themselves the trouble of sifting impalpable intentions. The culprit is that Government which first gave the order for a complete mobilisation.

The doctrine of the " nation in arms " was first made completely possible by railways. Its idea is that the State has a lien on all men of military age; that the State should earmark those wanted for war, and that the rest should carry on " business as usual." But, since the World War, the brains of the suave Attilas who, in bowler hats and kid gloves, perambulate our modern cities, have hatched out a new thought. The " nation in arms " is to become the " nation at war." Next time the whole tribe are to go, literally, under fire. Next time all the life, all the machinery, fuel, food, wealth, transport of the State are to be drawn into the net and developed for purposes of destruction. This is the fixed goal of military intention, but it may be that the process will be reversed. Instead of the " nation in arms " being further expanded into the " nation at war," it may be that we shall have to revert to small, highly technicalised armies. For, in the view of the present writer, the combination of mobility, fire-power and protection against bullet and poison gas, which the internal combustion engine has given to aeroplanes, tanks and mechanical supply and transport units, will render our existing types of fleets and marching troops—horse, foot and artillery—as helpless as were the peasants of the Jacquerie when they encountered knights in impenetrable armour moving rapidly on horseback.

Mechanical Warfare.—Supposing the other nations of the world refuse to rise to the spiritual heights which would foreshadow a Second Advent, the English-speaking peoples should welcome at least the advent of the internal combustion engine. For the rifle, bomb and bayonet are as cheap and easy to obtain as the bow and arrow and they are more simple to handle. The war value of the Asiatics, the semi-Asiatics of Russia and of the Africans will, for generations to come, lie in mass tactics and the horde. The war values of northern Europe and America lie in the individuality of the fighter. These are biological characteristics. Unless civilisation can speedily equip itself with more complicated and brainy weapons than rifles, bombs and bayonets the hordes may overwhelm the individuals. It will be another story if we can shift the implements of force from rifles and bayonets to aircraft, submarines and tanks. The British Empire and the United States can manufacture war engines on the grand scale; they are alive with young leaders of initiative and action; the men of the North have a genius for handling and tending machines. In these respects Asiatics lag behind, and Africans are nowhere. The leading Asiatic nation, for instance, possesses daring pilots, but cannot, on the large scale, keep delicate machines in trim. Therefore, it behoves every nation that has the will to live to put its military house in order forthwith, and the British, especially, should at least put off their general strikes until they have evolved a super-chief of the General Staff.

II. LORD KITCHENER

Never, in the history of the art of war, has the world been treated to so much war and so little art as in the conduct of the World War. One reason was the lack of artists. An artist with a pen uses as few words as possible, an artist with a pencil as few lines, an artist with a sword as few lives. But would even a Marlborough, who had so biting an experience of the infirmities of councils, have struggled against a French Plan XVII, a British Cabinet, and a British War Office from which the brain had been removed? By their very first move the Government, aided by Lord Northcliffe, had set aside the Army Council and reverted, to the methods of the days of Queen Anne. Be it remembered we are discussing the conduct of modern war in its technical aspect, and the last great example is still very close to us. An encyclopaedia is supposed to supply information; but in this case knowledge is so incomplete and space so limited that the only way to convey to the student a true impression of the conduct of the war of 1914–8 is to use famous names and familiar events, disclosing—though it be for the first time—some of the truth which underlay their outward and piously recorded actions.

An Intense Individualist.—The British Govt., yielding to an impulse, mainly emotional, pulled Lord Kitchener off his ship to conduct the war. The appointment gave confidence to the whole Empire, as well as to Lord Kitchener's old comrades in arms who remembered his flashes of instinct, his stonewall fortitude, his driving power, his industry—all his many just claims to be a superman. But the nation and many soldiers did not realise how intensely individualistic Lord Kitchener had remained. His mind entirely rejected the sweeping changes which took place in the British War Office and command headquarters in 1904. He knew the British Army as a finished article sent out for him to use. Railway transport, " intelligence," military hygiene, any sort of " deal " or " wangle "—leather for the men's shoes, silver for their medals, cigarettes for their canteens—interested him. The strategy and tactics used in outwitting individuals fascinated him, but strategy and tactics in their continental aspect were to him as a book that has been deliberately left upon the shelf. On his way home from the Manchurian campaign in March 1905, the British officer who had been attached to the Japanese Army was ordered to break journey at Calcutta, so that the Govt. of India might learn the latest developments of war at first hand. But once Lord Kitchener had realised that there was no blue china in Feng-hwang-cheng he lost interest in the subject: it was Lord Curzon who wished to hear about the 11 in. howitzers, the barbed wire and the trench mortars.

Much of the modern technique of his own profession was positively distasteful to Lord Kitchener. Up to the time when he left the Army in 1909, these marked idiosyncrasies were shielded from general knowledge by the small bodyguard of loyal and competent officers who had in his campaigns surrounded their hero. Some have said that in 1914 he was no longer the man of Omdurman and Pretoria. That may be so, but not in the sense that Earl Kitchener was less than " K." On the contrary he had become more so. There had been no weakening in his character, but some of his characteristics—his impatience, his lack of confidence in others, his secretiveness, his determination to keep certain things (troops, munitions, information) entirely in his own hands—had actually grown upon him. Through 10 years' exercise of unlimited power these characteristics had made headway and he, Kitchener, had quietly determined to conduct and win the World War, not by rule, but by his own rule of thumb. Also, let it be said at once, had he been able still to wield his unlimited power, he might still have played the magician. But he had lost his magic ring of devoted and intimate experts who were trained soldiers, who understood him and understood also exactly how far they might venture to go in keeping him in touch with both the Press and with his orthodox advisers.

The War Office in 1914.—Just at the moment when Kitchener first entered the war office it had become, in theory, the Imperial power house. In theory every officer, clerk, typist was standing by as in a man-of-war steaming into action. Actually the apparatus had been dismantled. The chief of the general staff, the adjutant-general and the director of military operations had only been put in a month or two previously. The first of these had never, either in peace or war, practised the general staff side of soldiering, or shown any taste for it. He had been appointed because he was a sound administrator of regulations and because, being at the same time inflexible and just, he was rightly believed to be the best officer to restore the spirit of discipline so seriously shaken by the Curragh revolt. As it was obvious that, even for the seven weeks' war then anticipated, he would need coaching, he was to retain the services of an officer whose reputation and experience would greatly have strengthened his hands. This subordinate was Sir William Robertson, whose commissioned service had been passed on the general staff. But, to the amazement of himself and of the Army, on mobilisation he was sent to assume duties he had never before practised as Quartermaster-General in France. His gay escape from the war office was at once a catastrophe and a portent. The general staff work of the high direction was to be handed over to personages who, whatever their value in other branches of the conduct of war, were profoundly ignorant of the principles and technique of policy, strategy and tactics.

Kitchener's Idea.—Lord Kitchener might have recalled a born chief of the general staff, Sir Douglas Haig. He did not do so for exactly the reason which induced him to let Robertson go. A strong chief of the general staff was to him, not a support, but a rival. A chief of the general staff who would have taken his proper place in the war councils of the nation must have spoiled his plan. He meant to run this great war by himself, just as he used to run the South African War from Pretoria. But here, at the last lap of the course, destiny, his old friend, failed him. His very first move miscarried. Before Sir John French left England he had to receive formal instructions. Whether Kitchener wrote them or not he signed them. In some respects they are unlike Kitchener, being reminiscent rather of the "hedging" instructions issued by Kuropatkin to Stackelberg. For instance: "the gravest consideration" (*sic*) "will devolve upon you as to participation in forward movements . . . . where your Force may be unduly exposed to attack"; but then he knew that French was apt to be over-confident at the outset. Another sentence, however, surely betrays its author: "I wish you distinctly to understand that your command is an entirely independent one, and that you will in no case come in any sense under the orders of any Allied general." Upon this emphatic paragraph Kitchener meant to base his own personal, if intermittent, conduct of the British operations; these in their turn would lead, during the long war which he almost alone foresaw, to the command of the whole of the Allied Forces.

Had not these projects been nipped in the bud, at least the conduct of the War would have been more original. The man who conceived and carried out the gigantic idea of planting down all the barbed wire in the world on to the South African sub-continent would have done something out of the common. Lord Grey of Falloden says in the chapter of his book which treats of strategy, that "when the opposing armies had dug themselves in from Switzerland to the sea, no one was more perplexed than Kitchener." Naturally. It has always been a mystery how Kitchener passed into Woolwich, but he could deal with the fact when he bumped up against it. As early as Sept. 1914 he said, "I am only an engineer but the Kaiser would have been out of the Aisne by now had I been there to shove them all along." And it was so!

French v. Kitchener.—When French was continuing his retreat to the southwards of Ham with a speed which, from that point onwards, had become unnecessary, the Prime Minister, in response to appeals from our Allies, begged his new Secretary of State for War to go over to France and explain personally to the commander in the field that the independence given him in his instructions was not meant to cover the withdrawal of his forces from the line of battle. Kitchener would rather have waited a little longer, but the pressure was great and he consented.

He went in uniform and alone. Had he taken two Army Councillors with him, a secretary and a flag, he might have done anything and worn uniform or not as he pleased. As it was, he had no one to keep him right on what seemed a mere point of etiquette, though really it went to the root of his aspirations. His dress implied openly that he was prepared to give executive orders. He knew Sir John French intimately. He knew that the main fault of that fine commander was an undue optimism, balanced at the other end of the spectrum by undue pessimism. He knew that, popular as French might be, he himself stood, imaginatively, on another plane. He knew that the ardour which the mere sight of himself in uniform would create must double the fighting value of the Expeditionary Force. He knew also that his power over human beings was latent; that it could not be communicated by word or letter; that it depended upon the weight of his personality on the spot and in action. That is where the Kitchener books go astray. They give little samples of the sort of things he could not do: the Magician escapes them. Colonel House is the only one who "gets there" and yet even Colonel House does not see how, on his own showing, Kitchener at their interview outwitted him."[1] But although Kitchener was prepared for French, he had not reckoned upon an ambassador. He was encountered not only by his old subordinate in the field—now no longer subordinate—but also by the threat of an appeal to the Foreign Office, a department for which his respect was childlike. He was technically out of court in his uniform, and so, like a tiger which has missed its spring, he came growling home. His whole method of handing over the tactics of an enterprise to a subordinate and of then, at any crisis, suddenly applying his formidable personality and urging everyone to unheard-of efforts was shattered—once and for all.

French had defeated Kitchener and more than Kitchener. He had been hustled by him for a couple of years in South Africa, not to his disadvantage. But here was his chance to throw off the old yoke and so, with Sir Francis Bertie's help, the battle of the Marne was delayed. General Joffre's orders for the battle of the Marne were written on Sept. 4 and it is stated in the book "1914" by Lord French that "on this night (Sept. 4) I ordered the British Forces to retreat a few miles further South." No one can say whether to fight the battle of the Marne earlier would have been an advantage or the reverse—what can be said is that with Kitchener himself in the field, the troops would have been inspired to make the supreme effort of their lives, both in the attack and in the subsequent pursuit.

III. BRITISH CONDUCT OF THE WORLD WAR

Lack of a General Staff Doctrine.—The British Empire, then, went to war without a general staff to advise Cabinet, Committee of Imperial Defence or War Office. Lord Kitchener—a soldier who never, to the day of his death, was able to appreciate the idea of a general staff, which he regarded as a subtle device to suppress commanders-in-chief,—Lord Kitchener shouldered everything. For some 18 months the higher direction carried on without having any clear notion of the direction in which the main stream of their efforts should flow. Working in the dark, distracted by differences of opinion, the conduct of war became so spasmodic, so erratic that, by the time Sir Archibald Murray and Sir William Robertson had at last brought home to the Cabinet the meaning of the words "general staff," it had become rooted in its evil ways. Students will best realise the cause of the confusion and lack of consistency in British Councils by reading the remarkable letter Sir William Robertson wrote to Lord Kitchener in Dec. 1915, when the post of the Chief of the Imperial General Staff had been offered to him.[2] So succinctly, so clearly did it lay down the relations which should exist between the war council of a democracy and the chief of a general staff that, considering by whom and to whom it was written, it is bound to become a classic.

Yet, upon the immediate conduct of war, it made but a fleeting impression. For the wisdom seemed to melt out of the words under the glitter of the rising star of Mr. Lloyd George, of whom M. Clemenceau is reputed to have said that "he fancied himself the first Napoleon." Perhaps, but he was no soldier. So small a difference and yet one which turned all the other resemblances into caricatures! Napoleon thought he could dispense with a general staff. So did Mr. Lloyd George. He was not going to have his hands tied by any general staff doctrine. He told Colonel House "he had found soldiers self-opinionated and unsatisfactory," and he clung to that opinion until he met at last a soldier whose views coincided with his own; for what he wanted was a Berthier to valet his genius and dress it up in khaki, a situation accurately gauged by the most acute personality in the Army, General Sir Henry Wilson. As things turned out, the letter of Sir William Robertson—bravely written and bravely taken—remained a dead letter until Foch did, at the end, what Kitchener, under happier auspices, might have done at the beginning.

Students may find it useful to take a few cases in which the British higher direction betrayed its lack of general staff doctrine, and then to go on to reflect that in hundreds of smaller issues, from day to day and hour to hour, similar incoherences were

[1] Colonel House, on his interview with Lord Kitchener, May 12 1915: "I was impressed by his fairness and the impartial way he discussed our possible entry into the War. While it was the clever way to talk to me, he did not do it for that reason, for how could he know what would or would not influence me?" The last dozen words are funny. Did no one warn Colonel House that he was about to put himself *en rapport* with a man who, clumsy as he might seem, was uncanny in his thought-reading powers?

[2] Sir W. R. Robertson, *From Private to Field Marshal*, p. 239.

taking place: (1) The Territorial associations, the only organisation for expansion, discarded. (2) The main force on the Western Front and its out-flanking detachment at the Dardanelles, handled, in regard to dates of battles, transfers of picked troops, howitzers, aeroplanes and high explosives as if there were no sea, no ships, no interchangeability—as if, in fact, the two sets of operations were separate wars in water-tight compartments. (3) Four raw divisions launched direct from home billets into the midst of a great battle at the Dardanelles when very ordinary common-sense would have sent them to relieve war-seasoned divisions in French trenches who would at once have grasped the situation at Suvla Bay. (4) The British entry into the eel-trap of Salonika, constructed by the French Cabinet and General Joffre for political purposes and generals. (5) The Admiralty torn in two by the struggle between Mr. Churchill and Lord Fisher—between the Black Sea and the Baltic. Once the student has weighed these questions for himself he will understand that the most serious flaw in the British equipment for the struggles of 1914 and 1915 was not the lack of big guns but of a chief of the Imperial General Staff armed with a doctrine and strong enough to catch hold of brilliant amateurs like Mr. Winston Churchill and others and wheel them into line before they approached the Prime Minister; strong enough also to support the Cabinet against the combined pressure of the French Govt. and the G.H.Q. of their own Expeditionary Force.

Had Mr. Asquith been 20 years younger he might have straightened out the tangle. As it was he took off his hat first to Lord Kitchener and next to Mr. Winston Churchill. When they differed he compromised. Clever compromise may keep cabinets together; war is uncompromising. The British Empire began its conduct of the war with the Cabinet of Aug. 5 1914. The exact emergency for which the Six Divisions had been prepared had arisen and 20 civilians, soldiers and sailors were asked what should be done with them! The War, thus begun, was carried on by a series of happy thoughts. This is the cold shade under which modern British soldiers have fought the World War to a finish. Armies, fleets and aircraft form only a part of the nation at war. Only one man can unite in his person, policy, finance and military action—that is the Prime Minister.

The Higher Direction and Strategy.—Strategy and tactics are to be dealt with in their technical aspects elsewhere; here they will only be indicated from the standpoint of the higher direction.

Experience shows that, within his own sphere, the commander should be left as free a hand as possible in bringing his strategy into line with state policy. If there is but one theatre of war the general should be left to solve the problem entirely in his own way, when, other things being equal, he will beat a general tied to the apron-strings of his Government. Roberts marched on Kabul from the Shutargurdan Pass with only transport enough to move half his force on alternate days, putting time above strength. No higher direction would have shouldered the desperate risk of fighting the battle of Charasia with half an army against the whole of the Afghan regulars whilst the mountain tops were white with the watching tribesmen. Wolseley told his own Royal commander-in-chief, his own army and the British Press that he was about to march from Alexandria upon Cairo—then took ship for Ismailia! These were simple cases and it was well for the Empire that Lord Lytton gave Roberts a free hand and that Wolseley took a free hand for himself.

Somewhat less simple was the case of Buller, who was left to make up his own mind whether he should march northwards through the Orange River Colony or whether he should first relieve Ladysmith. More complicated still was the Manchurian problem, when Kuropatkin found the whole of his wise strategy bedevilled by the Tsar and by Admiral Alexeyev. Nothing was left for him but tactics and administration. Thereby Russia lost the War. The strategy of the Japanese navy and army was, on the other hand, given the completest independence which has ever, in modern history, been granted by prime minister, emperor or king to naval or military commanders. This was because in Prince Yamagata the Japanese had a defence minister whose rank, age and prestige secured his strategy from being at any time hampered by state policy. As regards the conduct of the War, he was supreme, excepting in the region of finance. Fleet and army moved like one service. Great Britain never approached these most fortunate conditions.

Political Control.—But whenever there are several distinct theatres of war, then the higher direction is bound to do some directing and the autocrat or prime minister who can draw the delicate line between guidance and interference shows himself a master of his craft. In the years from 1862–4 Federals and Confederates had their "easterners" and "westerners." Which of the two war theatres, Richmond or the Mississippi, held the true goal of victory? Till 1864 the Federal generals were uncontrolled from Washington, and Washington all but lost the war. Then that apt pupil, Abraham Lincoln, learned when to guide Grant and when to leave him alone, and the North won. In the South, Lee, left without political control or guidance, won so long as guidance was not needed. But when guidance was wanted and failed, not all his generalship could give victory to fools in the Cabinet.

At its outbreak, the World War presented a more simple and straightforward problem than any of the cases quoted. Plan XVII. was a cut-and-dried fixture. Had Joffre, on the first day of the war been replaced by his antithesis, Foch, Plan XVII. would have stood, though not for so long. The die was cast, in fact, and, if the strategy was unsound, it could only be retrieved by sound tactics and "human bullets." State policy should have effaced itself and left the field entirely free for the naval and military commanders and their strategy. Yet, at the Cabinet of Aug. 5 1914, there was nothing to show that the opinion of Sir John French counted for any more, on a question of pure strategy, than that of civilian amateurs or soldiers about to be subordinate to him in the field. Eight months later the Dardanelles campaign was undertaken, and from that moment onwards the necessity for clear-cut, emphatic direction from Whitehall became vital. There was none. State policy was of two minds. The General Staff had ceased as a governing body to exist. Neither Kitchener nor the Prime Minister ever decided which was momentarily the main strategic current—eastwards or westwards. Not one word to the commander in the East of the political trend of affairs in Italy or the Balkans; not an effort to use the amphibious power of Great Britain to move troops, big guns and high explosives from one theatre to the other, a feat which the Central Powers could not have emulated in any way—not at least until Bulgaria came into the War (*vide* the *Memoirs of General von Falkenhayn*). Each year that followed brought in a new theatre of war and with each came a greater need for higher direction and, it must be added, for a British Yamagata or Abraham Lincoln.

What was the attitude of the higher direction on the "Kill Germans" strategy and tactics? In the absence of a general staff can anyone say? Even now it can only be surmised that the attrition system was supported by the Cabinet. Napoleon once said that the destruction of the main force of the enemy was the true war objective. But Napoleon's maxims are like postage stamps; stick them on any opinion—it will get there! All through the War this axiom was trotted out to support a strategy which involved tactics culminating in the suicidal frontal attack. "The main force of the enemy" was the avowed objective during the Champagne offensive of 1915 where the flower of the British Empire was sacrificed for half their number of Germans. The French Cabinet and British G.H.Q. in France were at one in the violence of their opposition to any turning movement beyond the sacred boundaries of "la Patrie." They were within bombing range of the Germans and, to them, the argument that "side-shows" were an avoidance of the "main force of the enemy" made personal appeal. But Jomini, who knew Napoleon so well, repudiates the notorious axiom. In the 8th edition of the *Encyclopædia Britannica* it is written:—

> In war it has been laid down as a fundamental axiom by successive military writers, including Jomini and the Commandant of our own Staff College, Colonel MacDougall, that to obtain success in the shortest time the greatest force should be brought to bear, in the right direction, on the weakest or most impressible point of the enemy.

In so far as the line of battle on the Western Front had become static it gave no scope for strategy which, by its dynamic quality, is the natural antidote to dugouts and attrition. Strategy, in fact, had been elbowed off the mainland of Europe and only hung on at her skirts. The British higher direction, by leaving the conduct of the war to the French Cabinet and the British G.H.Q. in France, are responsible for Festubert and Loos—expenditures at the wrong time and place; expenditures wasting human energies and high explosives a small proportion of which, applied to a weakly covered flank by an amphibious power, must have been decisive.

IV. THE FUTURE OF WAR

Time and space have ever been the dominating factors of strategy: fleets and armies become daily more mobile: acceleration is in the air. But what is the good of all this to a pedestrian higher direction? The velocity of the motions of the mind of a cabinet can be gauged by the new conductor of strategy they have just created. A cabinet committee has hatched out a " Super-Chief of the general staff in commission " to advise the prime Minister. The three chiefs of staff to the three services are to meet under the chairman of the committee of Imperial defence and are to consider themselves a super-chief! But the general staffs of the three services and of the Dominions are human beings. " I can deal with a man, not with a committee," said Sir Douglas Haig to Lord Milner and so say the Commonwealth and Dominion services. Aircraft are challenging ships and railways. Palaces, Houses of Parliament, arsenals, power houses, banks may be put out of action within a very few hours of a declaration of war. The chiefs of the general staff of each service will be concentrated upon their own land, sea or air forces, with every fibre of their being, but the Super-Chief of the general staff in commission will have vanished—he will have resolved himself into his three elements—and with him will have gone the Prime Minister's right hand!

If the higher direction be well advised in leaving their commander as free a hand as possible in his strategy the same principles apply, even more strongly, to his tactics. For here we enter the domain of the commander, the artist, the only individual now left in war who stands outside of the preconceived and who, by his personal inspiration, may crumple up the best laid plans. He it is who has it in his power to spread confidence by merely looking confident or, by one brief inspection, to infect a gallant army with despair. He it is whose learning must have become instinctive, who must possess both moral and physical courage, who must enjoy fighting, and yet always seek for his victory in manoeuvre rather than in slaughter. The nation possessing a great commander has half the battle in hand every time. For war becomes a science only during peace. Numbers, armament, training, national characteristics can all be weighed and calculated in peace-time, but when " The Day " arrives the human will enters upon the scene and may stultify statistics. In 1908 the Adjutant General to the Forces spent his leave inspecting the mobilising troops of the Hungarians and the Balkan nations. He reported to the War Office that the Bulgarian infantry were second to none in Europe. The judgment proved itself sound in the campaign against Turkey. In the campaigns against the other Balkan States and the Allies the Bulgarians went to pieces. They deserved to be defeated; they felt this, and they were defeated. Owing to moral factors the Bulgarian Army lost 50% of its value.

Military Strength and Policy.—The higher direction cannot always pre-arrange moral factors, but it can see that its army does not lag behind in the material factors. In his book *1914* Lord French remarks, " I cannot help wondering why none of us realised what the most modern rifle, the machine gun, motor traction, the aeroplane and wireless telegraphy would bring about. It seems so simple when judged by actual results." This—the astonishment of an ex-chief of the Imperial general staff—is not quite fair to those who had at least urged that the War Office windfall (spent on extra cavalry horses) should be devoted to heavy artillery. History only repeats itself because lack of imagination repeats itself. If any personage of transcendental quality could possibly spare time to concentrate for a fortnight upon the military problems of Greater Britain he would find that the defence forces of the Empire have been very busily spending the past four years in working up for another " I cannot help wondering why none of us realised." One of the first things a prime minister (for instance) would discover was that he had not carried out his part of the bargain laid down in the Field Service Regulations which say that the Government will at all times, at their discretion, keep the Chief of the Imperial General Staff informed as to the drift of their policy and that he, on his part, will prepare accordingly.

Unfortunately post-War Govts. have given no indication of the drift of their policy except that they are " drifting " towards the obligations of Locarno. Under Asquith, Haldane and Grey there was what is called a tacit understanding between the sailors, soldiers and politicians. Faced by so clear-cut an issue Territorial and Regular vied with one another in the race for efficiency and became what they were. Since the War there has been less cohesion and less enthusiasm, because men can never do their best when they feel instinctively that their chiefs do not know what they are driving at. The bulk of them are quite well enough educated to feel sure that the next European war will be decided in the clouds and yet they see their chiefs in the Navy and Army each struggling for the lion's share of the military budget. The phantom Super-Chief of the Imperial general staff in commission cannot judge between them, for he is a trinity holding, on that point, three diametrically opposed views. War may be a long way off but since this article began to be written it has drawn a little closer. Were it only for the sake of tactics there is crying need that the British get their military house in order, especially in its top storey. The rank and file and lower deck ratings are the most splendid stuff imaginable. The officers have war experience. The masses of trained fighters are still fit to take the field. But there is no head. Only the Prime Minister can be head in war, and he is not equipped for the task nor kept in practice during peace. He has neither a Defence Minister nor a living Super-Chief of the General Staff to take his ideas on policy and give him back a technical view of their bearings upon his defence force estimates.

A Mechanicalised Army.—Tactics being an art which is largely concerned with material and visible factors reflects the emptiness of the British military top storey most clearly. As soon as possible after the War it was the duty of the higher direction to evolve a new model army. That was the moment to cut down the man strength of the divisions and replace the lost fighting strength by machines. Instead of that the problem was shirked. Writing on the efficiency of the Army in Sept. 1925, Field Marshal Sir William Robertson, by no means a revolutionary or fanciful personage, says of the tank that it " has not yet been accorded the prominent place in our war preparations which it merits." The Field Service Regulations tell us, he goes on to observe,

> That during the comparatively brief period which has elapsed since tanks were first used, their characteristics have changed materially; that further rapid changes and improvements will probably take place; and that until these experimental stages have been passed through a temporary organisation must necessarily be adopted.

But the War ended in 1918 and still there are only a handful of tanks tacked to the old 1914 divisions of Regulars and without any tanks at all for the Territorials! Roberts drove this " wait and see " heresy out of the Indian Army when, in 1882, he found that the Armstrong guns purchased ten years previously for the defence of the roadstead of Madras were still lying unmounted on the beach. He was told " further rapid changes and improvements will probably take place, etc., etc.," and so they did, for although the guns could not be fired, the responsible officer was discharged.

Seven solid years have been squandered, masses of money have been misspent, while Great Britain has been waiting, hoping to see some other nation create a new model army, of which every man, in virtue of his equipment, will be worth half a dozen of those British soldiers who took part in the autumn manoeuvres

of 1925. Then, presumably, the intention is to set to work and copy it. Does anyone really still imagine, after all that has been learnt about war, that this would be tolerated? From the time of the Armistice onwards one or two military enthusiasts have done what they could to press these views upon the British people. At last, the ideas of a mechanicalised army began to make headway until, at the royal banquet of 1924, there was a reply. "The rifle and bayonet," reaffirmed the responsible official, "are the infantryman's chief weapon. The battle can be won in the last resort only by means of these weapons." Two months later, at Bisley, returning to the charge, he told the marksmen there assembled that "mechanicalisation would help to get them to grips with the enemy, but once at grips the issue lay with the man and the rifle and bayonet would decide battles as they always had done." There stood the riflemen of England, worthy descendants of the archers of Agincourt. There stood the war leader, assuring them they were still lords of the battlefield. And yet—how if a single enemy tank had appeared upon those Bisley ranges?

Since then there have been manoeuvres in India and in England, at which, for the first time, a fringe of machines have been tacked on to the skirts of the main 1924 organisation. There were the armies, longing to be at one another and yet—no battles! The lessons drawn from these manoeuvres will fall under the heading of tactics. From the more general standpoint of war, suffice it to say that, few as were the machines, they so set the pace as to leave the old-fashioned troops out of it. Clearly, cavalry and infantry must not be too proud to take a hint from their civilian brothers who find that the motor 'bus gets them there and that the horse 'bus does not.

To write an article on war is easy; to read it at a time when universal lip-service is being paid to peace needs courage. Those who have come so far in company with the writer may be trusted, therefore, not to flinch from the reflection that the chemical warfare committee, as shown in the Army List, is not in any way relaxing its activities since the white dove, hatched out at Locarno, began to fly over the earth. This being so, one may be fairly sure that in no other country is there any slacking-off in these preparations by men to poison their fellow-men when the next "Day" comes along. The most convinced pacifist need not then scruple to carry his thoughts onward to the contemplation of a new model army, even although the idea has hitherto been persistently rejected by responsible authorities. For there is a tide in the affairs of men, and although admiralties let go every anchor they possess and war offices megaphone to their generals, "back to 1914," that tide will prove in the end too strong for their tackle.

An army must be built up round something. The fabrics of Greek Art and Roman Law rose from the foundation of the heavily armed hoplite and the steel-clad legionary. In 378 A.D. heavy cavalry swept these pillars of society out of military significance until 1314 A.D. After that came the day of infantry again first in conjunction with archers, afterwards as fighters of dual functions, the bullet and the bayonet their weapons. These survivals of Blenheim, Waterloo and Mons were, at least until a few months ago, the supreme arbiters of war in the eyes of British military authority. But let the student look up, for Victory is winged. Sea and land forces have become the servants of the air force. The navy will be represented more and more by fleets of seaplane carriers. The functions of armies will be to push on as fast as petrol can drive their machines to seize advanced bases and depots, whence ever more extended air raids can be delivered. The atom round which the British defence forces must be grouped is no longer a human being—it is an internal combustion engine. (*See* STRATEGY; TACTICS.) (I. H.)

WARD, SIR ADOLPHUS WILLIAM (1837–1924), British man of letters (*see* 28.319), died at Cambridge June 19 1924. He was knighted in 1913. His *Germany 1815–1890*, 2 vol. (1916–7) was a notable addition to his published works.

WARD, JAMES (1843–1925), British psychologist and metaphysician (*see* 28.320), published, after 1910, *The Realm of Ends, or Pluralism and Theism* (1911, 3rd. ed. 1920); *Heredity and Memory* (1913); *Psychological Principles* (1918, 2nd ed. 1920); *A Study of Kant* (1922). He died March 4 1925.

WARD, SIR JOSEPH GEORGE (1856–), New Zealand politician, was born at Emerald Hill, Melbourne, April 26 1856, his father being a merchant. He was educated privately in Melbourne and at a state school at the Bluff, New Zealand, and at the age of 13 entered the Post and Telegraph Department. At 21 he became an export merchant, and in 1887, after nearly 10 years' experience of municipal politics, he entered Parliament as Liberal member for Awarua. Appointed treasurer in the Seddon Cabinet of 1893, he was the Prime Minister's chief lieutenant until Mr. Seddon died in 1906, and then succeeded to the Premiership and the leadership of the Liberal party. He had not the dominating personality or immense popularity of Mr. Seddon, but he showed practical administrative ability of a high order and pioneered several important reforms, such as loans to settlers, the All-Red cable service, and penny postage for New Zealand.

Sir Joseph was a staunch Imperialist, and unlike many of his contemporaries in the other Dominions, believed in subsidising the Imperial Navy rather than creating separate fleets. To this end he offered the Home Government a Dreadnought—or if the need arose, two—in 1909. His Ministry was defeated in Feb. 1912, but Sir Joseph Ward—he had been knighted in 1901 and was made a baronet after the Imperial Conference of 1911—returned to office as Minister of Finance in the National (War) Cabinet of 1915–9. In 1917–8 he was a member of the Imperial War Cabinet and in 1919 represented New Zealand at the Peace Conference. In 1919, after representing Awarua continuously since 1887, he lost his seat, and in 1923 he was defeated in a by-election for Tauranga. He then definitely retired from politics and devoted himself to business. (G. C. D.)

WARD, LESTER FRANK (1841–1913), American geologist and sociologist (*see* 28.320), died in Washington, D.C., April 18 1913. His numerous minor publications, together with biographical notes, were issued under the title, *Glimpses of the Cosmos*, 6 vol. (1913–8), the last five volumes posthumously. See Mrs. E. P. Cape, *Lester F. Ward*, a personal sketch (1922).

WARD, MARY AUGUSTA (1851–1920), British novelist known as Mrs. Humphry Ward (*see* 28.320), died in London March 24 1920. Since 1910 she had published *The Case of Richard Meynell* (1911), a study of Modernism and, in a sense, a sequel to *Robert Elsmere; The Mating of Lydia* (1913); *The Coryston Family* (1913); *Delia Blanchflower* (1915); *Eltham House* (1915); *A Great Success* (1916); *Lady Connie* (1916); *Missing* (1917); *The War and Elizabeth* (1918), and a posthumously published novel, *Harvest* (1920). She had also in 1918 published her memoirs, *A Writer's Recollections*, and publications connected with her War propaganda work were *England's Effort* (1916); *Towards the Goal* (1917); and *Fields of Victory* (1919). The Passmore Edwards Settlement, in Tavistock Place, London, was renamed after her the Mary Ward Settlement, this being a tribute to the great interest she had shown in its work. Her husband, Thomas Humphry Ward, long associated with *The Times*, died in May 1926.

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WARD, WILFRID PHILIP (1856–1916), British man of letters, was born at Ware, Hertforshire, Jan. 2 1856, the second son of William George Ward (*see* 28.321). Educated at St. Edmund's College, Ware, Ushaw College, Durham and the Gregorian University of Rome, he became lecturer in philosophy at Ushaw College in 1890, and examiner in mental and moral science to the Royal University of Ireland, 1891–2. In 1906 he became editor of *The Dublin Review*. He was the author of numerous books: *The Wish to Believe* (1884); *The Clothes of Religion* (1886) *W. G. Ward and the Oxford Movement* (1889); *W. G. Ward and the Catholic Revival* (1893); *Life and Times of Cardinal Wiseman* (1897); *Aubrey de Vere, a Memoir* (1904); *Life of John Henry Cardinal Newman* (1912) and several volumes of essays. He died in London April 8 1916. A biographical notice of him, written by his wife, Josephine Mary (b. 1864), was published as a preface to his *Last Lectures* (1918).

WAR GRAVES.—One of the most interesting pieces of organisation resulting from the World War is represented in the Imperial War Graves Commission, which was constituted on behalf of the governments and peoples of all parts of the British Empire, and charged with the care in perpetuity of the graves of their sailors and soldiers.

Origin of the War Graves Commission.—With a view to ensuring the permanence of the graves of British soldiers buried in France discussions took place early in the War between the British military authorities responsible for the marking and registration of the graves and the French Government. On Dec. 29 1915, the latter passed a law which provided that all Allied graveyards on the soil of France should be acquired by the Government of the Republic at its own expense, and that the rights of ownership should be enjoyed in perpetuity by the Allied nations concerned.[1] This practical tribute to the valour of the British armies was profound in its effect on the relations between the two Allies during the War. Under this law it was possible for an *association régulièrement constituée* by an Allied Govt. to be entrusted with the care of its graves in France. The result was the establishment in Great Britain (Jan. 1916) of a National Committee for the Care of Soldiers' Graves, the presidency of which was accepted by the Prince of Wales.

As the fighting extended it became evident that the care of the graves after the War and the erection of permanent memorials would be a task too extensive for a body with the limitations of the national committee to undertake. Among these limitations was the lack of direct representation of the Dominions and other parts of the Empire, whose soldiers were falling and being buried side by side with those of the United Kingdom. In a memorandum addressed to the Prime Minister, dated March 15 1917, the Prince of Wales, as president of the national committee, suggested that the formation of "a joint committee of the governments of the Empire, or a statutory body of commissioners somewhat on the lines of the Development Commission," should be proposed to the forthcoming Imperial Conference. The question was accordingly laid before the conference on April 13 1917, when a resolution was passed praying His Majesty to grant a royal charter for the constitution of an Imperial War Graves Commission, which should be empowered to care for and maintain the graves of those fallen in the War, to acquire land for the purpose of cemeteries and to erect permanent memorials in the cemeteries and elsewhere. The charter was passed under the great seal on May 21 1917, and the commission, of which the Prince of Wales became president, was established.

Constitution of the Commission.—The members of the commission are the Secretary of State for War (ex-officio chairman), the Secretary of State for the Colonies, the Secretary of State for India, the First Commissioner of Works and the representatives of Canada, Australia, New Zealand, South Africa and Newfoundland. The charter further provides for eight non-official members appointed from time to time by the Sovereign.

The commission's deliberations during their first year resulted in the double proposal laid before the next Imperial Conference on June 17 1918, that £10 per grave should be taken as the probable cost of the construction of cemeteries, and that the cost of carrying out the decisions of the commission should be borne by the respective governments in proportion to the numbers of the graves of their dead. It is hardly necessary to emphasise the significance of the adoption of this proposal; a precedent may thus have been established with far-reaching effects; at any rate a most interesting experiment in co-operative administration among the nations of the British Commonwealth had been initiated. It is based on the principle that each shall be financially responsible in proportion to the amount of service rendered on behalf of the whole. In this connection it is important to note that estimates are presented yearly in identical form to each of the participating governments, the respective Parliaments being asked to vote a proportion of the total in accordance with the decision of the Imperial Conference of 1918 referred to above. The commission administers the grants in aid thus received through a finance committee, which meets regularly at short intervals and which is attended by a representative of the Treasury of the United Kingdom to advise and assist. The principle of complete co-operation runs through all the work of the commission, the participating governments being represented in the administrative personnel, both in London and abroad, on the same proportional basis as has been adopted for the sharing of expenditure.

Policy.—One of the first acts of the commission was to lay down as a guiding principle that the graves of all ranks should be treated on a basis of absolute equality. With this principle as a foundation, the commission invited Sir Frederick Kenyon, director of the British Museum, to report on the best method, in his opinion, of discharging their responsibilities.

Sir Frederick's recommendations, which were adopted by the commission, were briefly as follows: 1. The erection of uniform headstones over all War graves. 2. The erection of two central monuments in each cemetery where possible. 3. The collection of isolated graves into selected cemeteries.

Among the architects entrusted by the commission with the preparation of architectural designs were Sir Edwin Lutyens, Sir Reginald Blomfield, Mr. Herbert Baker, Sir Robert Lorimer and Sir John Burnet. The headstones are 2 ft. 8 in. in height, 1 ft. 3 in. in breadth, and 3 in. in thickness. Each stone as a rule bears at the top the badge of the regiment or unit. Then follow the military details with the name of the deceased and the date of his death, below which is carved the symbol of his faith, while at the foot of the stone is engraved a personal inscription chosen by the next-of-kin. Of the two central monuments the great altar-like Stone of Remembrance, designed by Sir Edwin Lutyens bears the inscription chosen by Mr. Rudyard Kipling, "Their name liveth for evermore." The other memorial is the great Cross of Sacrifice designed by Sir Reginald Blomfield, to the shaft of which is fixed a crusader's sword of bronze.

In addition to the marking and care of the graves the commission were entrusted with the commemoration of the missing dead or those sailors and soldiers who have no known graves. This is no small task, for the number of these is over 400,000. Several memorials to the missing dead had been completed by the end of 1925. Among these are the three Naval Memorials to those lost at sea which stand on prominent sites at the three ports which throughout Britain's naval history have been intimately connected with the sea service. Other memorials to the missing are those at Cape Helles, at Lake Doiran in Macedonia, at Port Tewfik and at the Menin Gate, Ypres. The last, which was still under construction in 1925, bears the names of some 60,000 officers and men ". . . who fell in Ypres Salient, but to whom the fortune of war denied the known and honoured burial given to their comrades in death." Cemetery and memorial registers are published by the commission. These registers when finished will present a complete record of the Empire's dead.

The unprecedented nature of the task with which the commission was charged is obvious; its complexity and magnitude will be realised when it is remembered that the 725,000 known graves for which they were responsible were scattered all over the world in many different countries with different laws and customs, some of them the enemy countries with whom special provisions were made in the Treaties of Peace to ensure the graves being respected; and there are no less than 15,000 burial places in different parts of Europe and the East where British sailors and soldiers rest, the great majority being in civil cemeteries containing small groups of graves, but some 1,500 of them being cemeteries of considerable size, the largest containing 12,000 graves. As has been seen, the permanent construction work carried out in these cemeteries is of a simple but durable kind, but the commission's gardeners set to work immediately after the Armistice, without waiting for the erection of the permanent headstones, planting shrubs, grass and flowers.

Permanent Maintenance.—As a guarantee that the graves and memorials shall be forever cared for, the various Governments

[1] Later on, the governments of Belgium, Italy, Greece, Egypt and Palestine followed the lead of France by passing equally generous measures.

of the Empire represented on the commission have undertaken to provide permanently the income required for maintenance at the accepted standard of upkeep laid down by the commission. After discussion it was agreed that an endowment fund amounting to £5,000,000 should be established for this purpose by the United Kingdom and Dominion Govts. and this fact was announced to the House of Commons on July 30 1925, by Sir Laming Worthington-Evans, at that time chairman of the commission. Sir Herbert Lawrence, Mr. E. R. Peacock and Sir Fabian Ware were appointed the first trustees of the endowment fund. On the occasion of their appointment, the Prince of Wales wrote in a letter to the chairman " we shall thus be able to honour the pledge given to all the relatives of the dead who can now be assured that the last resting-places of those whom they lost in the War will be properly cared for."

French and American Graves.—While, as a rule, the Allies adopted methods of commemorating the fallen similar to those described above, the great differences in the numbers of their casualties and in the conditions obtaining in the different countries rendered certain divergences unavoidable. France, on whose soil lay over three million allied and enemy dead, was faced with the problem of honouring her fallen soldiers without clogging the wheels of industry and agriculture, which were beginning to revive under peace conditions, even in the devastated areas where the graves lay thickest. The British helped to solve the difficulty by concentrating all isolated graves into cemeteries which would forever mark the British battle-line. The French adopted the further expedient of giving the next-of-kin the opportunity of having their dead re-buried at the state's expense in the churchyard or burial-ground of their native place, while those who were left would rest in great national cemeteries constructed by the state as a lasting monument to the heroism of the soldiers who died for France.

Many of the fallen soldiers of the American Expeditionary Force were borne back across the Atlantic to rest in their native land. The American authorities would no doubt have hesitated to undertake a task of such difficulty had not a pledge been given before a single American battalion left the United States that no American soldier who died fighting for his country and the liberties of nations should be left to lie on foreign soil except at the express wish of his next-of-kin. Of the 100,000 American dead, those left to rest in France were grouped together in three or four great cemeteries. The plan of construction of those cemeteries is based on the principle of uniform treatment of the graves, a conception which appears to have been first put into practice by those who laid out Arlington National Cemetery, the burial place of those who fell in the American Civil and other wars of the United States. (F. W.)

WARREN, WHITNEY (1864–), American architect, was born in New York City Jan. 29 1864. After studying at the École des Beaux Arts, Paris, under Daumet and Girault (1885–94), he began the practice of architecture in New York, later becoming associated with Charles D. Wetmore in the firm of Warren and Wetmore. They specialised in railway architecture, hotels, business buildings and residences, and were architects for the New York Central, Michigan Central, Canadian Northern and Erie railways. Their numerous structures in New York City include the Chelsea docks, the Grand Central Station and the hotels Belmont (1905), Vanderbilt (1910), Biltmore (1912) and Commodore (1916). Warren was an intimate friend of d'Annunzio, accompanying him to Fiume, and was later appointed diplomatic representative in the United States of the " free state of Fiume." In 1920 he was chosen by the international committee to reconstruct the library of the University of Louvain, destroyed by the Germans in 1914. He was the author of *Témoignage d'un Citoyen Américain, Les justes revendications de l'Italie: la question de Trente, de Trieste et de l'Adriatique* (1918). Many of his addresses were published and widely distributed.

WARSAW (*see* 28.334), the capital of Poland, had a population of 931,176 in the city alone, and 936,046 in the administrative district of 121 sq. km., in 1921; 72·3% were Poles and 34·6% Jews. The municipality had a substantial surplus in 1924, and work was begun on extending the water and drainage systems; it was also proposed to build slaughter houses and lay fresh paving. The suburban electric railway is being extended to Żyrardów. Since the foundation of an Orthodox Church, independent of the Russian Patriarch, in 1922, Warsaw has been the seat of its archbishop. There is also an exarchate of the Russian church, and a Roman Catholic archbishop. The Russian cathedral, the outward sign of Russian domination, has been demolished, and the university, evacuated during the War, was reorganised in 1918 as a Polish body. The bridges over the Vistula were destroyed by the Russians in their retreat. The Poniatów bridge, joining Warsaw to the suburb of Praga, was reopened in 1925. Another bridge was rebuilt at once by the Germans. A French Institute was built in 1925, and the erection of a radium institute and hospital was begun as a national monument to Madame Curie, a native of Warsaw, who laid the foundation stone. A Soviet chamber of commerce was opened in 1926. Stubborn battles between the Russian and German forces took place in the neighbourhood of Warsaw in 1914. In 1915 the Russians withdrew to the right bank of the Vistula, and the Germans entered the city. The first Polish parliament was held in Warsaw in 1919 (*see* VISTULA-SAN, BATTLES OF THE).

WASHINGTON, BOOKER TALIAFERRO (1859–1915), American negro teacher and reformer (*see* 28.344), died at Tuskegee, Ala., Nov. 14 1915, as the result of a breakdown due to overwork. He was the author of *My Larger Education: Being Chapters from My Experience* (1911) and *The Man Farthest Down; a Record of Observation and Study in Europe* (1912).

See B. F. Riley, *Life and Times of Booker T. Washington* (1916).

WASHINGTON, D.C. (*see* 28.349), capital of the United States, enjoyed its share of prosperity following the close of the World War and grew in importance and population until its inhabitants numbered in 1925 approximately 500,000, one-third of whom were born within the District. Many thousands of federal employees were brought there for war purposes in 1917, on whose subsequent departure the government force resumed normal conditions. The city is becoming more beautiful each year with its added parks and attractive buildings, and an average of 9,000 visitors register at its hotels every day. To regulate automobile traffic, which constituted one of the city's chief problems, a traffic bureau was provided in 1925.

Buildings.—An idea may be gained of the value of improvements steadily going on in the district by a reference to the assessment, at full value, for the buildings erected during the years 1923, 1924 and 1925, the total for the three years being $86,366,211, that for 1925 alone being $42,729,000. The most beautiful and important building recently erected is the head-quarters of the chamber of commerce of the United States, located opposite the White House on ground where once stood the residence of Daniel Webster. It is for the use of American business men, including more than 1,350 chambers of commerce and trade associations and 15,000 business firms and individuals scattered over the United States and the world. The building consists of a series of meeting-rooms seating from 125 to 400 persons each, and an auditorium with a seating capacity of 1,000. Another building recently erected is the Washington Auditorium at 1900 E street, N.W., with a seating capacity of 6,000. At Ninth street and New York avenue is a new building erected by the American Federation of Labor as its head-quarters. The Gallinger Hospital, in the extreme southeast part of the city, was opened in 1923 to the district poor, for whom it was constructed. The corner stone of the Victory Memorial building in the Mall at Seventh and B streets, N.W., was laid by President Harding Nov. 14 1921. The building is to be erected by private subscriptions and when finished is to cost $10,000,000.

Other important buildings begun or completed include the John K. Mullen Memorial Library in the grounds of the Catholic University of America, the corner stone of which was laid by Cardinal Hayes on April 22 1925, the Jewish Community Centre, at Sixteenth and Q streets, N.W. (corner stone laid on May 3 1925), the Wardman Park Hotel, the Hotel Washington and a large number of other hotels and apartment houses. A proposed

structure is the new home of the National Press Club to cost $9,000,000 and to occupy the site of the Ebbit Hotel at F and Fourteenth streets, N.W. The Francis Scott Key bridge has been opened to traffic, and work on the Episcopal Cathedral of SS. Peter and Paul is making good progress. To give better access to Arlington National Cemetery and contiguous parts of Virginia, a new bridge is to span the Potomac beyond the Lincoln Memorial. This will be one of the most handsome bridges in the world and will cost together with its approaches $14,750,000; it will be completed about 1930. A much needed local improvement now nearly completed is the new water service. Including the $3,000,000 aqueduct from Great Falls, 14 m. northwest of Washington, the necessary reservoirs and other incidental work, the total cost of this undertaking will be $9,160,000. This service will augment the district water supply by 100,000,000 gal. of water a day, and together with the old service, which has been in use for 65 years, will give the city a total water supply of 180,000,000 gal. a day, enough for a population of 1,000,000 inhabitants. In the District of Columbia there are 70 major buildings that are Government-owned, the total value of federal property being estimated at $275,348,737.

Streets and Parks.—In 1925, Congress provided for a National Capital park commission, to have at its disposal an annual appropriation for the purchase of parks and recreation grounds, and the 6,000 and more acres now set aside for these purposes will hereafter receive regular and substantial additions; already 54% of the city is in parks, streets and alleys. There are 527 m. of streets in the District, paved and unpaved. Asphalt predominates, though many of the roadways are of cement and macadam, comparatively few being unpaved. Congested traffic conditions are being relieved by widening the roadways in the downtown area; Thirteenth street from F to I has been treated in this way, and a number of others are to follow.

Monuments and Memorials.—A number of these have been added to the city's parks and reservations, the more prominent being the Dupont Memorial in Dupont circle; the statue of Dante, by Ettore Ximenes, sculptor and Whitney Warren, architect, unveiled in Meridian Hill Park, Dec. 1 1921; Joan of Arc (a copy of the original statue which stands in front of the cathedral in Rheims, France) unveiled in the same park, Jan. 6 1922, by Mrs. Harding, wife of the President, and Mme. Jusserand, wife of the French Ambassador; a memorial to Joseph J. Darlington in Judiciary square, executed by C. P. Gennewein; statue of Edmund Burke (gift of Sulgrave Institute) at Massachusetts avenue and Eleventh street, N.W., unveiled Oct. 12 1922; equestrian statue of Gen. U.S. Grant, by Henry Merwin Shrady, sculptor, in the Botanic Garden, facing the Capitol building, unveiled April 27 1922; statue of Alexander Hamilton, first Secretary of the U.S. Treasury, unveiled May 17 1923; shaft south of State, War, and Navy building, erected to the memory of more than 5,000 men of the First Division, U.S.A., who died in the World War; statue of Bishop Francis Asbury of the Methodist Episcopal Church, unveiled at Sixteenth and Mount Pleasant streets, Oct. 15 1924; and a duplicate of the famous statue by Dumont of Gen. San Martin, in Buenos Aires, being erected in Judiciary square. A memorial to John Ericsson, to form the first portion of the Arlington Memorial bridge, will be completed in 1926.

Education.—The District is making rapid progress in education. Early in 1925, Congress authorised a five-year building programme. The Act will make it possible to abandon in a few years the many unsuitable buildings now in use and will reduce elementary classes to a standard of not more than 40 pupils to a class. This bill, effective July 1 1925, provides for additions of something like 220 rooms to school buildings already erected; a number of junior high schools, a new manual training school, a new business high school, six buildings for graded schools to contain 92 rooms, together with gymnasiums, assembly halls, rest rooms, dining rooms and kitchens. A considerable number of sites are also provided for. The Appropriation Act for the fiscal year 1925–6 provides for new buildings and grounds to cost $4,176,500, $5,168,000 for teachers' salaries and $2,812,437 for textbooks, repairs, etc.—a total for educational purposes of $12,156,937. In the years 1921–5, approximately $7,000,000 was spent for building sites and buildings. The enrolment of pupils at the close of school in June 1925 was 67,000.

Manufactures.—The output of manufactured products is rapidly growing; the total aggregate output was $73,108,000 in 1923. Printing and publishing newspapers and periodicals are the most important industries. Their total output amounted to $18,227,000, an increase of 20·1% over 1921. The number of persons employed was 1,308, a figure slightly exceeded by the number of employed in the bread and other bakery industries. The average number of wage-earners employed in privately owned factories with output valued at $5,000 or more was 9,823, and the total wage payments $14,796,000.

Finance.—One of the principal indications of the district's healthy financial condition is its personal income tax returns. Of less than half a million people living there in 1923, 75,796 made returns showing a net income of $284,622,234, or 1·8% of the nation's total; the income taxes paid amounted to $8,083,050. A smaller total of tax was paid by each of 34 states. While only 6·94% of the nation's population filed income tax returns during this period, 15·92% of the district's residents submitted returns. (J. C. P.*)

WASHINGTON (*see* 28.353), a state of the United States of America. The population in 1920 was 1,356,621, an increase of 214,631 or 18·8% over the population of 1910, as against an increase of 120·4% in the preceding decade. The density of population in 1920 was 20·3 per sq. m.; in 1910, 17·1. The urban population (in 35 places of 2,500 or more) was 55·2% of the whole, as against 53% in 1910. The population of cities having more than 90,000 inhabitants was:—

	1920	1910	Increase per cent
Seattle	315,312	237,194	32·9
Spokane	104,437	104,402	·003
Tacoma	96,965	83,743	15·8

The most significant change in the characteristics of the population was the increased number of Japanese, and especially Japanese women. In 1920 there were 17,114 Japanese, or 1·3% of the total, the percentage of males being 65·3. One reason for the proportional increase of females was the privilege, prior to the legislative session of 1921, of acquiring title to land in the names of native-born children of Japanese parents. The total population in 1925 was estimated by the United States Bureau of Census to be 1,510,280.

Agriculture.—During the decade 1910–20 the number of farms increased from 56,192 to 66,288; the acreage of improved land from 6,373,311 ac. to 7,129,343 ac.; and the value of all farm property from $637,543,411 to $1,057,429,848. The average value of land per ac. in 1910 was $44.18; in 1920, $60.22. By 1925 the number of farms had increased to 73,266. The following table shows changes in acreage, production and value of chief crops:—

Year		Acreage (In thousands	Production (In thousands)	Value (In thousands)
Wheat	1909	2,118	40,920 bu.	$35,102
	1919	2,494	41,838 bu.	91,207
	1925	2,072	36,848 bu.	47,981
Oats	1909	270	13,228 bu.	5,871
	1919	192	8,073 bu.	8,073
	1925	254	11,176 bu.	5,812
Barley	1909	172	5,835 bu.	3,332
	1919	85	2,250 bu.	3,375
	1925	91	3,094 bu.	2,104
Maize	1909	26	563 bu.	404
	1919	35	902 bu.	1,623
	1925	58	2,030 bu.	1,928
Potatoes	1909	58	7,667 bu.	2,994
	1919	55	5,867 bu.	12,320
	1925	54	7,840 bu.	12,920
Hay	1909	743	1,400 tons	17,200
	1919	1,064	2,014 tons	47,717
	1925	943	2,103 tons	31,471

Crops of increasing importance are bulbs, flowers, vegetable seeds, flax, filberts and English walnuts. Prohibition increased enormously the demand for berry juices. Three-fifths of the loganberries produced in the United States come from Washington (1,157,778 qt. in 1919, valued at $208,402). The evergreen wild blackberry (supposed to have been introduced from Hawaii) is spreading through the river valleys, and the fruit is shipped in carload lots to the canneries. The production of the chief orchard crops in 1915, 1920 and 1925 in thousands of bushels was as follows:—

	1915	1920	1925
Apples	7,300	21,502	28,700
Pears	564	1,140	2,300
Peaches	566	155	870

The following table shows the growth in number and value of domestic animals during the decade 1910–20:—

	Year	Number	Value
Horses	1910	280,572	$ 9,680,849
	1920	296,381	25,069,336
Mules	1910	12,185	1,776,297
	1920	23,091	2,930,813
Milch cows	1910	186,233	7,988,133
	1920	289,635	23,648,537
Sheep	1910	475,555	1,931,170
	1920	623,779	7,750,407
Swine	1910	206,135	1,674,927
	1920	264,747	5,049,249

In 1917–8 condenseries used 205,657,654 lb. of whole milk to produce 1,844,097 cases of condensed milk, valued at $8,870,825. Cream and butter were sent to the cities from 110 creameries. In 1919 in 19 factories the production of cheese was 2,004,365 lb., valued at $348,669.

During the decade 1910–20 the irrigated farms increased from 7,664 to 13,271, irrigated acreage from 334,378 ac. to 529,899 acres. The Reclamation Service of the Federal Govt. has impounded the waters in Keechelus Lake (Kittitas county) and other lakes to serve large projects in the Yakima valley. The largest enterprise is the Columbia Basin project, to utilise the waters of Pend d'Oreille lake and river for the irrigation of 1,750,000 acres.

Mining.—For all producing mines and quarries, the number of enterprises in 1919 was 83, and in 1909, 93; the average number of wage-earners in 1919 was 5,050, and in 1909, 6,904; the aggregate horsepower used in 1919 was 38,198, and in 1909, 20,742; wages in 1919 were $7,466,000, and in 1909, $5,891,000; value of products in 1919 was $13,329,000, and in 1909, $10,538,000. Production of gold in 1924 was 13,000 fine oz.; in 1920, 7,000 fine oz.; in 1910, 39,000 fine ounces. Production of silver in 1924 was 194,000 fine oz.; in 1920, 178,000 fine oz.; in 1910, 205,000 fine ounces. Production of copper (in lb. fine) was 979,000 in 1924; 2,126,000 in 1920; 65,000 in 1910. Production of coal (in net tons) was 2,400,000 in 1924 (estimated); 3,757,000 in 1920; 3,912,000 in 1910. In the decade 1910–20 five new cement plants were established in the State, and large quantities of Portland cement were exported. Of increasing importance are clay products, such as paving brick, sewer pipe and terra cotta.

Manufactures.—The following table shows changes in manufactures between 1909 and 1923:—

	1923	1919	1909
Establishments	3,029	4,918	3,674
Wage-earners (average)	111,663	132,928	69,120
Wages	$156,435,000	$194,968,000	$49,766,000
Primary horsepower	593,330	687,436	297,897
Cost of materials	$372,044,000	$443,178,000	$117,888,000
Value of products	$678,543,000	$809,623,000	$220,746,000

The chief items were lumber and timber products, flour-mill and grist-mill products, slaughtering and meat-packing, butter, cheese and condensed milk, malt liquors, salmon fishing, canning and preserving. The State contains 16% of the total water-power resources in the United States.

Ports.—During and immediately after the World War the commerce passing through the district of Puget Sound was second only to that of New York. A law approved on March 14 1911, authorised the organisation of ports. Seattle, Tacoma, Aberdeen and other cities have taken advantage of this law to improve their harbours and to build great wharves and other conveniences to handle the increasing commerce.

Highways.—The State has embarked upon the task of providing an extensive system of improved roadways. These include the Washington link of the Pacific Highway, intended to extend from Alaska to the Straits of Magellan, another highway around Puget Sound to the Pacific; and highways across the Cascade Range and eastern Washington.

Forests and Parks.—The Federal Govt. maintains the Mount Rainier National Park (324 sq. m.) and the Mount Olympus National Monument (299,370 acres). National forests include 12,000,000 ac. within the State.

History.—Ernest Lister, Democrat, became governor in 1913 and was re-elected in 1916. He died June 14 1919, and was succeeded by Lt.-Gov. Louis F. Hart, Republican. Governor Hart was re-elected in 1920. He recommended what is known as the Governor's Administrative Code of 1921, one of the most significant changes in the State government since its organisation. In 1921 the legislature passed a law restricting alien ownership of land, aimed especially at the Japanese. The word "alien" is so defined that it does not include an alien who has in good faith declared his intention to become a citizen of the United States, but does include all other aliens and all corporations and other organised groups of persons, a majority of whose capital stock is owned or controlled by aliens or a majority of whose members are aliens. Gov. Hart was succeeded by Roland H. Hartley.

Commerce developed rapidly during the years 1910–26. In Seattle there were, in 1921, 24 resident consuls representing foreign countries. The greater number of vessels coming to ports of Puget Sound were under the Japanese flag and branches of Japanese banks were established. Progressiveness was shown in such legislation as the working men's compensation law (1911), initiative and referendum (1913), recall of public officers (1913) and aid for destitute mothers (1915). To meet the high cost of government the legislature in 1921 enacted laws levying a poll-tax on every person between the ages of 21 and 50, and a tax of one cent on each gallon of gasolene used by motor vehicles; the tuition charges in State institutions of learning and the fees for licences for automobiles and for fish dealers and others were also increased. (E. S. M.)

WASHINGTON CONFERENCE.—Preliminary invitations to a Conference at Washington on the limitation of national armament "in connection with which Pacific and Far Eastern questions could also be discussed" were issued by President Harding in July 1921, to Great Britain, France, Italy and Japan. On Aug. 11, formal invitations were sent to these Powers, to China and later to Belgium, the Netherlands and Portugal, President Harding having been authorised by Congress on July 11 1921, to arrange for the conference. As American delegates Mr. Harding designated Secretary of State Hughes, Elihu Root, Senators Lodge and Underwood; the British Empire was represented by Mr. Balfour (as he then was) Lord Lee of Fareham, Sir Auckland Geddes and Sir Robert L. Borden, as principal delegates; France by M. Briand, M. Viviani, M. Sarraut and M. Jusserand; Italy by Signor Schanzer and Signor Ricci; Japan by Prince Tokugawa, Admiral Kato and Ambassador Shidehara; China by Mr. Wellington Koo and Mr. Sze.

Opening of the Conference.—The conference assembled on Nov. 12 1921, was addressed by Mr. Harding, and elected Mr. Hughes as its chairman. The latter at once placed the American proposals on naval disarmament before the gathering; they were so precise and far-reaching as to cause general surprise. Mr. Hughes proposed that there should be a naval "holiday": "for

a period of not less than 10 years there shall be no further construction of capital ships." He then presented a definite plan for the scrapping of certain of the older capital ships and of capital ships under construction, and the restriction of capital ship replacements by an agreed maximum of tonnage, as follows: for the United States and Great Britain 500,000 tons each, for Japan 300,000 tons—a " 5–5–3 " ratio. Discussion of the tonnage allowance for France and Italy was reserved for later consideration. The directness with which Mr. Hughes stated his case evoked hearty response from the delegates and the public, and he was at once supported by the British delegation. " We can no longer content ourselves," Mr. Hughes said, " with investigations, with statistics, with reports, with the circumlocution of inquiry. . . . The world wants a practical programme which shall at once be put into execution." At the second plenary conference, held on Nov. 15, the representatives of France, Japan and Italy also accepted the principles of the Hughes proposals, leaving the technical details for consideration by the experts.

In the plenary session of Nov. 21 the subject of military armament was introduced by Mr. Hughes, who said that the United States had followed its traditional policy of reducing its own regular military establishment to the smallest possible basis. He recognised, however, the special difficulties existing in Europe. M. Briand explained the attitude of France as based on her need for security in Europe; expressing the readiness of his country to take any steps necessary to ensure peace, he emphasised the necessity of a genuine atmosphere of peace, a " moral disarmament," before physical disarmament could be attempted. This atmosphere, he maintained, was lacking—chiefly because of what France regarded as the incomplete pacification of Germany. France, he claimed, had already reduced her army by a third, and was planning to reduce it by a half. Complete demobilisation, however, was impossible for her under the conditions existing in Germany and Russia. M. Briand concluded with an appeal for the moral support of France by other nations, and this evoked a sympathetic response. Signor Schanzer, however, made plain the desire of Italy that " the general limitation of land armaments may become a reality within the shortest space of time." The result of the attitude of France was to establish the impracticability of discussing any definite plan for the limitation of armies. A sub-committee was appointed, however, to consider the question of aircraft, poison gases and the rules for the conduct of war.

The agenda of the conference were dealt with by two committees of the whole, one composed of the delegates of the five principal Powers to deal with limitation of armament, the other composed of delegates of all nine Powers to deal with matters affecting the Pacific and the Far East.

Meetings of these committees and their sub-committees were not open to the public; their results were reported formally at the open plenary sessions, of which six were held. The decisions reached were in regard to navies, including submarines; poison gases; the Pacific Ocean and its islands; and Chinese affairs.

The Question of Capital Ships.—The committee on armament discussed fully the maximum tonnage and ratio of capital ships to which each Power should restrict itself; and on Dec. 20 a provisional agreement was reached. Japan maintained (Dec. 20) that 60% of the quota proposed for the United States and Great Britain was insufficient for her defensive needs, and asked that it be increased to 70%; her delegates were especially unwilling to sacrifice the " Mutsu," a new capital ship (in large measure paid for by popular subscription), which, under the Hughes plan, would have to be scrapped. This obstacle was overcome by permitting Japan to retain the " Mutsu," on condition that an older ship, the " Setsu," should be scrapped. This change gave Japan two post-Jutland ships and an increased capital-ship tonnage, to offset which it was agreed that the United States should complete two ships still in process of construction, and that Great Britain should construct two new vessels not to exceed 35,000 tons each. In replacement tonnage the ratio was to stand thus: United States and Great Britain 525,000 tons each and Japan 315,000 tons—a ratio of 5–5–3. This agreement was stated to be contingent upon a suitable arrangement for France and Italy, who had been offered a replacement tonnage of 175,000 each. But M. Sarraut, representing France, held out for an aggregate of 350,000 tons, to be constructed on a replacement basis from 1925 onwards. The controversy was finally laid before M. Briand, who had returned to France; he agreed to accept for France the maximum of 175,000 for capital ships, but made his consent conditional on the obtaining of a larger proportion of auxiliary craft and submarines, which were regarded by France as purely defensive weapons. " The idea which dominates the Washington Conference," he telegraphed, " is to restrict naval armaments which are offensive and costly. But I do not believe that it is the programme to deny to a nation like France, which has a large extent of coast and a great number of distant colonies, the means of defending its communications and its security."

The Question of Submarines.—The French reply settled the problem of capital ships, but a warm controversy was provoked over submarines. Mr. Balfour proposed their complete abolition. Mr. Hughes proposed a reduction of submarine tonnage for the United States and Great Britain to 60,000 apiece, and approximately the *status quo* for France, Japan and Italy (31,500 for the first two, 21,000 tons for the last). But the French delegates refused to accept less than 90,000 tons for submarines and 330,000 for cruisers and auxiliary craft. Mr. Balfour then made it plain that, failing action against the submarine itself, Great Britain could accept no limitation for anti-submarine craft.

As a result, the treaty, as finally agreed upon by the five major Powers, did not include limitation of total tonnage of submarine or auxiliary craft. Limits, however, were placed upon the total tonnage of aircraft carriers and upon individual tonnage of capital ships and cruisers, as well as upon the calibre of guns carried.

The failure of the British attempt to abolish the submarine was mitigated by the passage of a series of resolutions presented by Mr. Root and later embodied in a treaty. As accepted, they stated the rules of international law as to " visit and search " on the high seas, and declared that belligerent submarines are not exempt from these rules. They invited the adherence of all civilised Powers to this statement. In the third place, they recognised that the use of submarines as commerce destroyers was practically impossible without violation of these rules, and that prohibition of such use should be accepted as a law of nations; they declared the assent of the contracting Powers to such prohibition, and invited that of all other nations. No definition of a merchant ship was adopted. In the fourth place, they declared that commanders of all ships transgressing international rules should be subject to punishment for piracy. Aircraft limitation was rejected by the conference, after a technical report of the sub-committee had declared limitation to be impracticable, but an inquiry commission was appointed. The abolition of the use of poison gas in international warfare, on the other hand, was advocated by the Naval Committee Jan. 7 1922, on the motion of Mr. Hughes, and prohibition of poison gas was embodied in a treaty.

Problems of the Pacific.—In respect of the problems of the Pacific a new treaty was drafted and presented at the plenary session, Dec. 10 1921, between the United States, Great Britain, France and Japan. It pledged each to respect the rights of the others in relation to their insular possessions and insular dominions in the Pacific, to accept mediation in case of controversy over these possessions and to open frank discussions if their rights were threatened by any other Power. The treaty was to remain in force for 10 years, and upon its ratification the Anglo-Japanese Alliance was automatically to be terminated. A reservation accompanied the treaty embodying provisions to the effect that it should not be deemed an assent on the part of the United States to " mandates " granted in the Pacific under the Peace Treaty of Versailles, and should not preclude agreements relative to mandated islands. (*See* SINGAPORE.)

The reservation also excepted from arbitrable controversies questions lying within domestic jurisdiction of the contracting Powers. To the treaty was later appended a second agreement,

defining the phrase "insular possessions and insular dominions" in such a way as to exclude Japan proper from its scope. The representatives of the United States and Japan also signed a treaty regarding Yap, according to which the United States was to have free access there on a footing of entire equality with Japan in all that related to cable and radio service, and received certain privileges and exemptions in relation to electrical communications. Subject to various conditions the United States consented to the administration by Japan of the mandated islands in the Pacific north of the equator.

Attitude Towards China.—Chinese problems were presented (Nov. 16 1921), by Mr. Sze in the form of 10 points, which the conference was asked to adopt (*see* CHINA). They called for recognition of the territorial integrity and political and administrative independence of China, the "open door" neutrality and the complete removal of all political, jurisdictional and administrative restrictions upon the Chinese Republic. The general attitude of the conference towards China was crystallised (Nov. 21) when four resolutions presented by Mr. Root were adopted. They declared the intention of the Powers to respect the sovereignty, the independence and the territorial and administrative integrity of China, their desire to maintain the principle of equal opportunity for the commerce and industry of all nations and their agreement not to seek special rights or privileges. Details of specific arrangements to be enforced led to long discussions. A resolution was adopted (Dec. 24) providing for the voluntary withdrawal of foreign post-offices from China Jan. 1 1923, on condition that China should maintain efficient service and continue the supervision of the foreign co-director-general. The problem of extra-territorial rights could not be settled definitely, but it was referred to an international committee for intensive study and report within a year. The demand for the withdrawal of foreign troops from China was referred to a sub-committee, and finally it was agreed that, while the principle of withdrawal was accepted, the issues raised should be made the subject of inquiry, in order to determine the conditions upon which withdrawal must depend.

On the other hand, the Powers passed a resolution urging China to reduce the large military forces maintained by the military governors. The relinquishment of foreign leaseholds in China was not actually secured (though Great Britain announced her readiness in this respect if other countries would join her); but China's fight for "open diplomacy" was virtually won when a resolution was passed (Dec. 8) pledging the nine Powers not to enter into any agreement that might impair the force of the four Root resolutions. As regards the customs tariffs, the demand of

Map showing the mandates affecting the Islands of the Pacific as laid down by the Washington Conference. Tinted areas not to be fortified further. Fiji (with Rotuma Island) forms a British Colony by itself. Other British Possessions (excluding Australia and New Zealand) are under the administration of the High Commissioner for the Western Pacific.

China for complete autonomy was not granted, nor the request made, in view of the nation's financial necessities, that her quota be raised from 5% to 12½%. It was decided, however, that China's customs revenue should be increased by $46,000,000 silver annually, through an advance to 5% effective, a surtax of 2½% and a surtax not exceeding 5% on luxuries. The Treaty provided for the convening of a Tariff Revision Commission at Shanghai, the opening of which was delayed until Oct. 1925, owing to the internal troubles of China. Other resolutions included agreements that foreign radio stations should transmit only government messages, that there should be no unfair discrimination in railway rates, an expression of hope that the railway system might be unified under Chinese Govt. control, and an agreement for the establishment of a board of reference for Far Eastern questions.

Shantung.—The question of the Japanese occupation of Shantung entailed long negotiations which at times seemed to reach a dead-lock, especially those relating to the Tsingtao-Tsinan-fu Railway. Largely through the mediation of Mr. Hughes and Mr. Balfour, a separate agreement was finally reached between Japan and China and signed Feb. 4. It provided for the return to China of the former German leasehold and 50-km. zone in Shantung, and the withdrawal of Japanese troops and gendarmes; China was to purchase the Tsinan-fu Railway for $30,000,000, but, before complete redemption, there were to be appointed a Japanese traffic manager subject to the direction of the Chinese managing director, a Japanese accountant and a Chinese accountant of equal rank. Japan renounced all rights to foreign assistance stipulated in the Chinese-German Treaty of 1898, and relinquished the maritime customs at Tsingtao and former German public properties. As to Siberian problems, Baron Shidehara made a full statement to the effect that it was " the fixed and settled policy " of Japan to respect the territorial integrity of Russia, and to observe the principle of non-intervention in the internal affairs of that country, as well as the principle of equal opportunity for the commerce and industry of all nations.

The Treaties.—The decisions taken by the conference were embodied in seven treaties and various supplementary resolutions: (1) *Five-Power Treaty Limiting Naval Armaments*, designating the capital ships to be retained by each contracting Power and determining the ratio of capital ship replacement—525,000 tons for the United States and Great Britain, 315,000 tons for Japan, 175,060 tons for France and Italy each—or 5–5–3–1.66. This treaty also limited the tonnage of individual capital ships to 35,000 and the calibre of guns to 16 inches; individual cruisers were limited to 10,000 tons and their guns to eight-inch calibre. Aircraft carriers were limited in general to an individual tonnage of 27,000 with a total tonnage of 135,000 for the United States and Great Britain, 81,000 for Japan, 60,000 for France and Italy each. With certain exceptions the *status quo* was to be maintained with regard to fortifications and naval bases in the Pacific. (2) *Five-Power Treaty Relating to the Use of Submarines and Noxious Gases in Warfare*, embodying the resolutions described above. Accompanying these treaties were two resolutions for a commission of jurists to consider amendment of the laws of war and limitation of their jurisdiction. (3) *Four-Power Treaty*, between the United States, Great Britain, France and Japan, relating to the insular possessions and the insular dominions in the Pacific Ocean, with an accompanying Declaration. (4) *Four-Power Treaty*, between the same Powers relating to the foregoing, and defining " insular " so as to exclude Japan proper from its scope. (5) *Nine-Power Treaty*, relating to principles and policies to be followed in matters concerning China, as described above. This was supplemented by 10 resolutions embodying the decisions taken as to a board of reference, extra-territoriality, foreign postal agencies, foreign armed forces, unification of railways, Chinese military forces, existing commitments of China or, with respect to China, the Chinese Eastern Railway. The treaty embodied the Root resolutions as its Article I., and strongly emphasised the principles of the " open door." (6) *Nine-Power Treaty*, relating to Chinese customs tariffs. (7) *Chinese-Japanese Treaty*, regarding Shantung. Two other treaties connected with the work of the Conference were: *United States-Japanese Treaty*, regarding Yap; and the *Six-Power Treaty*, allocating German cables in the Pacific. The Conference on Limitation of Armament was formally terminated Feb. 6 1922. On March 1 the U.S. Senate ratified, by a vote of 67 to 22, the treaty with Japan regarding Yap.

By June 9 1923, all the signatory Powers except France had ratified the Five-Power Treaty in relation to the use of Submarines and Noxious Gases in Warfare, the Nine-Power Treaty relating to Principles and Policies to be followed in Matters concerning China, and the Nine-Power Treaty relating to Chinese Customs Tariff. France ratified the last two on July 20 1925, but had not, up to Feb. 1926, ratified the treaty in relation to the use of Submarines and Noxious Gases. By July 28 1923, all the signatory Powers had ratified the Five-Power Treaty limiting Naval Armaments; also the Four-Power Treaty relating to Insular Possessions and Insular Dominions in the Pacific Ocean, the Declaration accompanying this treaty, and the treaty supplementary thereto.

Norway adhered on Sept. 23 1925, to the treaty relating to Chinese Customs Tariff; and on Nov. 13 1925, to the treaty relating to Principles and Policies concerning China. Denmark and Sweden signified their adherence to the treaty relating to Chinese Customs Tariff on Aug. 27 1925 and Sept. 11 1925, respectively.

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(C. SEY.)

WASSERMANN, AUGUST VON (1866–1925), German professor of medicine, was born Feb. 21 1866 at Bamberg, in Bavaria. He studied in Erlangen, Munich, Strasbourg and Vienna, and in 1888 began to practise as a physician in Strasbourg. He was then engaged as an assistant to the Robert Koch Institute for Infectious Diseases, Berlin, where, from 1906, he directed the department of experimental therapy and serum research. In 1913 he became director of the Kaiser Wilhelm Institute in Berlin-Dahlem. Wassermann achieved international fame and reputation by his discovery of sero-diagnosis in syphilis—the so-called Wassermann Reaction—which enables both past infection and the activity of the process of the disease to be ascertained. In addition he investigated the problem of a cure for cancer and collaborated with P. Ehrlichs in introducing the diphtheria serum into practice. In later years Wassermann sought to obtain a sero-diagnosis of active tuberculosis; as to the practical utility of the latter as a reliable diagnosis, however, there is still a considerable divergence of views. He died in Berlin March 15 1925.

His works include: " Allgemeine Einleitung zur Lehre von den Infektionskrankheiten " in Ebstein and Schwalbe's *Handbuch der praktischen medegia: Influenza, Immunität und Serumtherapie* and *Hämolysine, Zytotoxine und Präzipitine* (1910).

WASSERMANN, JAKOB (1873–), German writer, was born at Fürth, Bavaria, March 10 1873, the son of a small merchant. After an unhappy youth spent in wandering and poverty he settled in Austria, and it is about Austria and Austrians that he writes. His literary life, as he himself has said, began " when realism and naturalism were rampant " but he remained a

solitary figure owing allegiance to no school. His first novel *Die Juden von Zirndorf* was published in 1897, but it was *Die Geschichte der jungen Renate Fuchs* (1900) which first brought him fame. Many of his works have been translated into other languages but *Christian Wahnschaffe* (1919), published in America as *The World's Illusion* (1920), first made him known to the English-speaking world. Other translations into English followed: *Gold* (1920) *Faber, or the Lost Years* (1925). Some of his novels were collected under the title of *Der Wendekreis* (1920–2); his other works include *Das Gansemännchen, Casper Hauser* (1908), and an autobiography, *Mein Weg als Deutscher und Jude* (1921).

WATER, PURIFICATION OF (*see* 28.404).—Great changes have occurred in waterworks procedures since 1910. They began with the successful chlorination of the Lincoln water supply in 1905, consequent upon the typhoid epidemic there (about 50,000 inhabitants, over 1,000 cases of typhoid fever and 100 deaths).

Chlorination.—In the United States and Canada chlorination, for some years past, has been the rule, not the exception. In England, progress has been much slower, but the World War greatly altered things, thanks to the initiative of men like Horrocks and Sims Woodhead. Further, the bold step taken by the Metropolitan Water Board in chlorinating so huge a volume of water as over 100,000,000 gal. a day proved a great incentive to further investigation of this tremendous asset in the work of water purification.

The "chlorinators" plead that inasmuch as they destroy practically all the non-sporing bacteria of intestinal origin they incidentally kill all the microbes associated with epidemic waterborne disease. It is a bold claim, but apparently sound on the basis of current knowledge. The "anti-chlorinators" urge that a "doped" water is *prima facie* open to condemnation, and assert that there have been conspicuous failures in the chlorination processes in the past due to break-downs in the plant, or to dangerous compromises between doses sufficient to sterilise the water and yet small enough to avoid taste troubles. They further claim that natural processes (*e.g.*, storage and slow sand filtration) remove at least 98% of the total number of bacteria in the original water of whatever sort they may be, and that prolonged experience has shown that this is an absolute protection from the diseases associated with the ingestion of impure water.

A third school claims that all purification processes are merely a retrograde movement—that safety lies alone in choosing virgin, uncontaminated sources of water supply, requiring no sort of purification. It is possible to sympathise strongly with this exalted attitude of mind, but practically we must face, to an increasing extent, the necessity of rendering impure waters safe for domestic use. As regards the "chlorinators" and the "anti-chlorinators," there is much to be said on both sides, and each case should be judged on its own merits. Chlorination is an exceedingly cheap process; less than one shilling per 1,000,000 gal. of water treated may suffice. It is disputed how the chlorine acts. Some say it has merely an oxidation effect, others claim that it has an intrinsic bactericidal action.[1] The dose is usually from 0·25 to 0·5 of available chlorine per 1,000,000 (2·5 to 5 lb. of chlorine per 1,000,000 gallons). The time required for sterilisation varies according to the dose and the quality of the water. A few minutes may suffice, but one to five hours, or even longer in certain cases, should be aimed at.

Administration.—The chlorine can be administered as a soluble hypochlorite (*e.g.*, alkaline sodium hypochlorite), or as a solution of bleaching powder (chloride of lime), or as a solution made from the gas liquefied in and liberated from metal cylinders. The latter process is now most extensively used, and there are some highly ingenious forms of apparatus for measuring accurately the gas as it flows from the cylinders through the chlorine apparatus on its way to the vessels or towers used for its final solution. Whatever method is adopted, it is highly important that the mixture of the chlorine and the water to be treated should be rapid and complete.

Successes.—The success of the treatment is determined by the destruction of *B. coli*, a non-sporing excremental microbe, slightly more hardy than the typhoid bacillus and the cholera vibrio. It is also gauged by the circumstance that there are places where the incidence of water-borne diseases has been modified to a most gratifying extent since, and apparently as a result of, the introduction of chlorination processes.

Taste Objections.—Taste troubles have been a most serious factor in the problem. Frequently, in consequence, the dose has been reduced below the limits of safe sterilisation. Recently, however, knowledge has increased by leaps and bounds. It is now known that the presence of certain bodies (*e.g.*, phenoloid substances) in excessively minute amount (less than 1 in 1,000 millions) may be the root of the trouble.[2] These impurities may arise from atmospheric contaminations, or be conveyed by liquid pollutions (*e.g.*, washings from roads, etc.). Fortunately, valuable remedies (taste preventers) have been found, *e.g.*, potassium permanganate and ammonia (dose about 0·2 per 1,000,000 the latter in terms of nitrogen). Even the organic matter, naturally present in waters, is a taste preventer, or "remover" of real value.[3] There is no reliable indication that chlorinated water has any deleterious effect on man, the lower animals, fish-life or horticultural operations. On the whole, the same may be said as regards its alleged injurious effect on metals. Chlorination is a factor of great importance in water purification, although this admission may be coloured with certain cautious limitations. It can increase the margin of safety and can bring almost any water to any pitch of epidemiological perfection required. In the language of "the man in the street," chlorine, in doses of 0·25 to 0·5 per 1,000,000, can render dangerous waters safe without giving them (at all events in conjunction with taste removers) any unpleasant taste, or conferring on them any undesirable characteristics. Beyond all question, chlorination has come to stay, although it may be wise to regard it as a most valuable adjunct to other purification processes rather than as an absolute panacea.

Excess Lime Process.—In 1912 a new method of purification called the excess lime process was described.[4] In softening waters lime is added in amount equal to, or just short of, what is necessary to combine with the dissolved carbonic acid in the water and with the bicarbonates. Carbonate of lime is formed, which, being practically insoluble, is thrown down as a precipitate. This mechanically purifies the water to a considerable extent, but does not produce a true bactericidal effect. In the excess lime method slightly more lime is added, so as to leave the water caustically alkaline, and this produces a marked bactericidal action. The amount of excess necessary depends on the duration of contact and the amount of impurities in the water, but one part of lime (as CaO) per 100,000 parts of water is usually sufficient.

The following quotation[5] may serve to illustrate the usefulness of the excess lime method:—

> . . . the experiments carried out by us during the last two years at the Langford experimental station of the Southend Water Co., using water from two comparatively small rivers, show that by acting on Sir A. Houston's suggestion to use excess lime better results can be obtained than by the use of chlorine, since chlorine does not remove any of the organic matter in solution, whereas the excess lime will remove at least 50% of this. Waters, therefore, which a few years ago would have been considered quite unsuitable for a supply, and which no system of purification then known would have rendered safe, can now be utilised.

The method proved highly successful (1917) at Accra (Gold Coast Colony) in dealing with an impure swamp water used for water works purposes. Its successful use in 1913 enabled Aberdeen[6] to decide on the retention of the River Dee as a source of water supply, thus saving over £100,000 on alternative schemes. In 1914 it was shown at Sunbury that the raw River Thames could be purified to a wonderful extent.[7] For example, the ten worst samples of the river water and of the outlet from the first tank gave, on the average, colour estimations of 155 and 37 respectively, a reduction of 76%. *B. coli* was found to be absent from 10,000 c.c. of the treated water, on ten separate days.

The method has disadvantages: for example, the cost, the difficulties attendant upon the neutralisation of the excess of

caustic alkalinity and the problem of disposing of lime sludge in the case of hard waters. On the other hand, the advantages are considerable. Questions of taste are eliminated. Hard waters may be softened and soft waters hardened by the process. Hard impure waters are not only softened and rendered safe bacteriologically but improved greatly, as judged by physical and chemical standards.

Water Tests.—The physical, chemical and bacteriological tests used in the examination of waters have not altered very materially during recent years. Physically, observations are made of the colour (using a colour meter), turbidity (gravimetrically, or with some form of turbidimeter) and opacity (as shown, for example, by passing a beam of light through the water), etc. Chemically, the chief tests are still for ammoniacal, albuminoid and oxidised nitrogen, chlorides, oxygen absorbed from permanganate, hardness, etc., although new tests, like the determination of the hydrogen-ion concentration, are being used extensively. Bacteriologically, the number of bacteria (especially at 37° C.) and the *B. coli* test still hold the field. In connection with the latter test, a vast amount of work has been done, but we are still uncertain what significance should be attached to the various races of *B. coli* encountered in water analyses. The tendency is to insist on the possession of, say, two positive attributes (lactose+indol+) which characterise human faecal microbes and then judge the matter on a *quantitative* basis. On the whole, the attempts to differentiate between *B. coli* of human intestinal origin and those derived from the lower animals, fish and birds have been most disappointing. The modern teaching is that as it is economically possible, by adequate purification processes, to eliminate (or nearly so) all "lactose+indol+*B. coli*," this standard should always be aimed at. Speaking generally, nearly all are agreed that there should be no *B. coli* of the kind referred to in 100 c.c. of water in more than half of the samples examined.

Results.—The interpretation of results has altered considerably during recent years, especially in those cases where chlorination is practised. The tendency is rather in the direction of condoning certain imperfections of quality (*e.g.*, the amount of organic matter present) provided that *B. coli* is killed. It is considered that if *B. coli* is destroyed the occurrence of epidemic water-borne diseases is impossible and that therefore other inferential indices of safety lose much of their significance. But those who cling to past traditions regard chlorination as a short cut to apparent rather than real purity.

Natural Methods.—These methods of purification have not been neglected of late years. The value of storage is being increasingly recognised. The three factors making for safety are equalisation, sedimentation and devitalisation. By equalisation is meant the dilution and averaging of any sudden access of pollutions to the water "feeding" a storage reservoir. Sedimentation means the settling out of solid impurities. Devitalisation implies the gradual extinction of undesirable bacteria under the conditions of storage which are unfavourable to the continued vitality of pathogenic microbes. Nature's method of purification has certain disadvantages. Just as some things die, so do others multiply, sometimes with embarrassing results. There are the diatoms, the protozoa, green and blue growths, etc. Some of these growths give rise to taste troubles (*e.g.*, tabellaria, synura, uroglena, etc.); others exercise a serious blocking or choking effect on sand filtration processes (*e.g.*, asterionella, synedra, cyclotella, fragilaria, etc.). Copper sulphate (in doses of 0·1 to 1·0 per 1,000,000; 1 to 10 lb. per 1,000,000 gal.) has been proved to be a valuable algicidal agent. The smaller doses have no injurious action on fish, but with the maximum doses great care must be exercised, especially in the case of trout.

Filters.—A new and interesting development is the suggestion that rapid (mechanical) filters should be used to remove nearly all the suspended matters (including algal and other growths) from water, and worked at the very rapid rate of 100–200 gal. per sq. ft. per hour. In order to cover the additional cost involved it is hoped that it may be feasible to work slow sand filters at six instead of two gal. per sq. ft. per hour as a final filtration process. The underlying idea is that slow sand filters might be worked considerably faster than is usual if rapid filters were used antecedentally to remove the bulk of the suspended matters. Those who favour these departures usually advocate chlorination as an additional safeguard, or, at all events, as a stand-by measure.

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See also *Dr. R. J. Reece's Report to the Local Government Board on the Epidemic of Enteric Fever in the City of Lincoln, 1904–5*, No. 226 (1906); Dr. A. Houston, "B. Welchii, Gastro-enteritis and Water Supply," *Engineering News Record*, vol. 89, p. 484 (1921); *The Official Circular* of the British Waterworks Association gives the most up-to-date account of all matters of interest relating to water supplies, including purification. (A. C. Ho.)

WATERHOUSE, JOHN WILLIAM (1847–1917), British painter (*see* 28.370), died in London Feb. 10 1917.

WATERLOW, SIR ERNEST ALBERT (1850–1919), British painter (*see* 28.381), died at Hampstead, London, Oct. 25 1919.

WATER POWER: *see* HYDROELECTRIC ENGINEERING.

WATERWAYS: *see* INLAND WATER TRANSPORT.

WATSON, JOHN BROADUS (1878–), American psychologist, was born at Greenville, S. C., Jan. 9 1878. He graduated at Furman University (A.M. 1900), continuing his studies at the University of Chicago (Ph.D., 1903). After serving as assistant and instructor in experimental psychology at the University of Chicago, he was appointed professor of experimental and comparative psychology at Johns Hopkins University in 1908, becoming also director of the psychological laboratory there. He became known as the leading exponent of behaviourism. In 1917 he served as major in the aviation section of the Signal Corps, U. S. Reserves, and with the A. E. F. He was editor of *The Psychological Review*, 1908–15; became joint editor of *The Journal of Animal Behavior* in 1910; and editor of *The Journal of Experimental Psychology* in 1915. *See* BEHAVIORISM.

Watson wrote *Animal Education* (1903); *Behavior—An Introduction to Comparative Psychology* (1914); *Homing and Related Activities of Birds* (1915); *Suggestions of Modern Scientists Concerning Education* (1917); *Psychology* (1919); and *Behaviorism* (1925).

WATSON, JOHN CHRISTIAN (1867–), Australian politician, was born at Valparaiso, Chile, April 9 1867, when his parents were on their way as emigrants to Australasia. He was educated at the public school of Oamaru, N. Z., and as a boy began work as a compositor. He also made an early entrance into politics, attaching himself to the Labour party, which came into prominence during the great strike of Australian dock and transport workers. He was president of the Sydney Trades and Labour Council in 1890. From 1894–1901 he was a member of the N.S.W. Legislature. In 1901 he was elected to the Commonwealth Parliament, and for a short time in 1904, on the resignation of Deakin, he led a Labour Ministry. He resigned after a few months, though he continued to lead the Labour party until 1908, when he retired from public life.

WATTERSON, HENRY (1840–1921), American journalist (*see* 28.418), was among the first to urge, in 1911, the nomination of Woodrow Wilson as Democratic candidate for President. In Aug. 1918, he retired from active editorship of the Louisville (Ky.) *Courier-Journal*, remaining "editor emeritus" till April 1919, when he severed all connection with the paper because of its support of the League of Nations. He died at Jacksonville,

Fla., Dec. 22 1921. He was the author of *Old London Town* (1910); *History of the Manhattan Club* (1915); and "*Marse Henry*"; *an Autobiography* (1919).

WATTS-DUNTON, WALTER THEODORE (1832–1914), British man of letters (*see* 28.422), died at Putney, London, June 6 1914.

WEALTH AND INCOME (*see* 28.437).—Before the World War fair progress had been made in different countries in the more accurate computation of annual income and in its capitalisation on sound lines in order to arrive at aggregate wealth. But the methods varied very widely. Much depended on the degree of civilisation which had been attained, on the methods of taxation in force, and on the extent to which statistical measurement had been pursued; and even if the War had not intervened it would still have been impossible to get a complete picture of the total income or wealth of the world. Such figures as have been offered are rich chiefly in speculation, and, as the following analysis of fundamental principles will show, they depend largely on the methods of investigation which have been adopted.

I. GENERAL CONSIDERATIONS

In some respects the World War assisted research in this wide field of finance; in others it added substantially to its difficulty. Everywhere (including countries nominally neutral in the strife) public debt was largely increased. Acute disease, usually described as inflation, overtook the currency of the nations. Valuation of almost anything, save within narrow limits, became hazardous; and the stress laid on monetary or nominal income, as opposed to real income (in the sense of purchasing power), was in itself a complication which rendered valid comparison almost impossible. For these reasons it would be idle to attempt any review of world income and wealth in the period since 1910—the central feature of which must be the virtual revolution brought about by War conditions—without preliminary notice of certain basic principles. These principles throw important light on this form of public financial computation and comparison.

The summary presented to the Royal Statistical Society by Sir Josiah Stamp in May 1919 endeavoured to present the position as in 1914. As he himself explained, it was a first attempt and necessarily elementary in character, but since then there has been no serious challenge of its main conclusions. In all problems of the kind there is the constant danger of partisan estimate. Apparently competent authorities had argued that the wealth of the United Kingdom in 1914 was approximately £10,000,000,000; others had placed it as high as £24,000,000,000. Much depends on the use to which estimates of the national wealth are put. They are available as tests of progress, affording comparison with different years; they show the accumulation of capital, the distribution of wealth, and the effect of changes in the rate of interest or in the value of money. They may be employed to test the relative prosperity of resources of different nations; or for comparisons of income with capital and property; or to reveal the distribution of wealth according to individual fortunes, with the changes in that distribution; or to facilitate the consideration of the applicability and probable yield of specific schemes of impost or taxation such as a capital levy; or for the purpose of dealing with questions relating to war indemnities, in which case even simple inquiry has shown that wealth or income at any given moment is not the sole test of ability to pay indemnity or make reparation; it is at best only a partial test.

In such investigation there are innumerable intricate and highly technical problems. The mass of recent work in different countries has emphasised the difficulty of careful and authoritative estimate. It is not easy to secure adjustment as at a uniform date, 1914; in addition to the disturbing effects of war there is the abiding problem of the comparability of like subject matter. Reliable as it might be for broad purposes in 1914, it has since been subject to great variation, and the range of error at the present time is probably considerable. The wealth of a tribal community is not readily comparable with that of a people advanced in civilisation, and although the illustration may be regarded as extreme the ramifications of war disturbance have been so great that the remark is still applicable in certain parts of the world.

Public Debt.—But the substantial consideration is present-day effort to measure the aggregate of gross personal wealth and to make strictly accurate allowance for public debt and its consequent burden of taxation. For even if all the debt is held internally, neglect of its influence, viewed as a capital obligation and the cause of heavy annual taxation, may lead to ridiculous results. Although the debt is held within the State, it has been described as a concealed liability, through taxation, on income and capital generally. In this matter the usual method is to count as wealth the individual holdings in Government stock and to deduct the debt as a mortgage on the property held by the State or the collective community. There is not, however, uniform practice in different countries. The magnitude of the problem which is raised by this apparently simple principle may be gathered from the following comparison of the pre-War and post-War public debt of the leading nations.

Public Debt by Countries

Country	1913 Pre-War	Post-War	
		Year	Debt
	£000,000's omitted		£000,000's omitted
The British Empire			
Great Britain	706	1923–4	7,766
India	307	1923–4	585
Canada	69	1921–2	500
Australia	335	1922–3	923
New Zealand	92	1922–3	219
South Africa	126	1921–2	179
Other Countries			
United States	245	1921–2	4,715
France	1,315	1922–3	11,472
Germany	1,055	1919	9,850
Italy	611	1919	3,124
Belgium	185	1919	784
Austria	510	1919	3,470
Spain	382	1923	478
Holland	97	1924	286
Japan	272	1921–2	323
Russia	1,046	1917	3,415
Portugal	130	1922–3	525
Denmark	20	1922–3	66
Norway	20	1922–3	85
Sweden	36	1922–3	79
Switzerland	68	1919	148
Greece	48	1922	316
Rumania	66	1919	445
Servia	27	1919	234
Czecho-Slovakia	..	1919	388
Hungary	270	1919	1,587
Poland	..	1919	440
Bulgaria	35	1919	218
Turkey	151	1919	412
Egypt	94	1923	93
Argentine	124	1919	127
Latvia	..	1919	24
Finland	..	1919	74
China	130	1919	172
Chile	33	1919	50
Siam	6	1919	7
Brazil	194	1919	180
Total	8,805	..	53,759

The various currencies have been converted into sterling at par of exchange, *e.g.*, $4.867 = £1, or 25·225 fr. = £1.

Definition of National Wealth.—These statistics must be read in conjunction with the vital fact that the deduction of debt from State property will often give a minus quantity. In such questions, there is still much confusion of thought. The wealth of a country may mean either the value of objects within its boundaries or the wealth of its inhabitants including foreign possessions, but excluding wealth within the country held by people abroad. This confusion was very well illustrated in the prolonged discussion of the taxable capacity of Ireland; it constantly recurs in kindred problems at the present day, notably in the effort to arrive at working arrangements to avoid double taxation. Again,

wealth in private hands is not easily defined. In the various shades of ownership Sir Josiah Stamp has summarised absolute personal disposition of the whole value, trust interests, collective ownership with only potential specific allocation to individuals, collective ownership without the possibility of individual allocation, communal wealth such as city and local property, and national property including even the instruments of defence. Much controversy still attends the inclusion or the non-inclusion of the valuation of domestic service by members of families. And there are still many countries in which stock or produce occupies a large place in total valuation; in post-War fluctuation values have varied very widely at short intervals, rendering all the more difficult every effort to estimate aggregate wealth.

Estimates Based on Taxation.—It is important to notice also the various methods of computing wealth and income. Many of them are necessarily based on data arising from taxation of income, especially collective taxation or taxation at the source. The immediate advantage of this system is the comprehensive result; on the other hand there is liability to error owing to tax evasion, omissions from the scheme of tax, and difference of practice in the basis of capitalisation, that is, in the number of years' purchase adopted. Many estimates rely on the taxation of income on individual returns. But there also arise the tendency to considerable evasion, the omission of all income held collectively, and the difficulty of determining the ratio of income to capital on the average, the last point making capitalisation no easy task.

Many estimates proceed on the basis of data arising from the annual taxation of capital. It varies on particular classes of property; and these particulars supply only a part of the whole capital valuation. Other estimates have relied on material arising through the taxation of capital at irregular periods, such as the statistics of estates passing at death and chargeable with death duties. This method has always provoked controversy as to the multiplier which should be employed in order to indicate aggregate value. Within recent years the multiplier has undoubtedly been greatly improved, but it is still open to doubt on certain essential points. In his review of the private wealth of Australia, Mr. G. H. Knibbs described two methods. Under the first there was determination of the average interval of time between the passing of estates to the successors in title, generally called the devolution-interval method; under the second there was ascertainment of the average rate of the passing of estates during any period under review, commonly called the devolution-rate method. Further difficulties in the use of property returns for such a purpose include defects in administration, the evasion of a particular duty the statistics of which are being used, the effect of *inter vivos* gifts in keeping a certain proportion of wealth from passing with the frequency of ordinary intervals for estates as a whole, legal points affecting estate duties, the fact that vital statistics are constantly changing, the problems which are raised by the method compiling the vital statistics themselves, and the actual growth of wealth in the period under review.

The Census System.—Of other methods, the inventory system aims at valuation in the aggregate of each form in which wealth is embodied without regard to ownership by individuals, companies or others. It is often called the objective method. To a large extent, however, it depends for success on the existence of statistical material compiled for other purposes, *e.g.*, the statistics of imports and exports, local government taxation, the valuation of mineral and other resources and kindred material. The chief defects of this method are probably the impossibility of testing how far the ownership of the wealth is within the country or not, the difficulty of determining whether all forms of wealth have been included, the risk of overlapping, as in stocks and shares duplicated with real property owned by companies, the divorce from all tests of profit-earning capacity, and the task, where averages are employed as factors, of accurately determining them.

In some countries, notably France, Germany, Spain, Australia and the Argentine, the inventory method has been applied by single observers; in the United States it summarises the collected results of many investigators, and is called a census. In the census method proper a statement is taken from each individual declaring the whole of his wealth and income. It depends very much on the completeness and efficiency of the tax in question. The British method of depending largely on taxation at the source (that is, by deduction before dividends or other payments are made to the recipients) is clearly very much more reliable than the tax system of other countries destitute of that feature. The occupational census method is used for dealing with wage-earning classes and smaller incomes to which ordinary income tax statistics are not applicable. In the net output or census of production method the total value of work done or goods produced in a year is determined; the value of the raw materials is deducted; and the added value is taken as the fund which forms the income of the people. Broadly speaking, in the British census of production in 1907 the net output was the gross output (selling value) less the cost of the materials used. The new census of production in which Great Britain is now engaged should be of substantial value in the next effort to estimate both aggregate income and aggregate wealth (*see* PRODUCTION, CENSUS OF).

II. THE WEALTH OF VARIOUS COUNTRIES

With these fundamental principles in mind it is easier to follow such statistics of the wealth and income of the leading countries of the past 15 years as are available; their incomplete, and often irreconcilable character is already fully explained.

Great Britain and the United States.—Bound together in a debt settlement covering the next 60 years, and closely associated in many of the post-War financial operations, it may be convenient to group Great Britain and the United States of America. Before the Royal Statistical Society in 1914 Mr. Edgar Crammond estimated British capital wealth at £16,472 millions; in *British Incomes and Property*, published in 1916, Sir Josiah Stamp put the aggregate amount in 1914 at £14,319 millions. Estimates of income are generally made up of the income of the income-tax paying classes, compiled from the tax statistics, the income of the wage-earning classes, and the income of others below the income-tax limit which was the subject of special inquiry by the British Association some years ago. For 1911 Sir Josiah Stamp put British income at £2,090 millions, of which almost exactly half was attributable to wages and small salaries, £926 millions to incomes over £160, and the rest derived from miscellaneous sources. On a similar basis the figure was £2,250 millions in 1913–4. That figure, rather than the £2,400 millions which was frequently in debate, was accepted in authoritative circles. Since the World War estimates have varied enormously; in 1925 (in the absence of much of the reliable material for such an investigation, they ranged from £2,500 millions to nearly £4,000 millions, the latter being clearly extravagant.

For more than three-quarters of a century America has relied on the census conducted by the Washington Bureau; but Sir Josiah Stamp has pointed out that, although called a census, it is more strictly an inventory, "as far as possible on a tax basis, for it does not require individual statements of personal wealth, but delegates the construction of the inventory to a large number of officials for different areas, under careful, uniform instructions." Expressed in sterling, the total national wealth of the United States was, in 1912, put at £38,577,000,000; the population was rather more than 95,000,000; and the national wealth per head of population £404. Most of the leading authorities on the income of the United States have urged the practical impossibility of estimating with more than general accuracy. Dr. King thought that it might be attempted either by test of the consumption of the people, or of the production of the nation. The second method was probably preferable, for information regarding retail prices was scanty and unreliable, and in such "consumption" which takes place for purposes of further production there was the substantial difficulty of duplication. But in 1910 the total money income was placed at £6,272 millions, £68 per capita, £307 per family, or £5,861 millions on the basis of net goods consumed.

Mr. David Friday, dealing with the taxable increase of the United States, has estimated the income of the United States as

a whole for 1917 and 1918, and also as subject to excess profits and income taxation. By the net product method his figure was £13,400 millions. The Hon. A. C. Miller, of the Federal Reserve Board, estimated the income for 1917 at more than £10,000 millions. Other authorities have put it as high as £14,000 millions, chiefly by adopting the 1910 basis of Dr. King, adding 31% for increased production and 71% for increase in prices. In this work the subject is discussed by Professor T. N. Carver. (*See* UNITED STATES; *Finance and Wealth.*)

Germany.—In the case of the German Empire Dr. Helfferich, director of the Deutsche Bank, published in 1913 an analysis of aggregate income and capital. The total income of personal taxpayers and persons exempt appeared to be £1,092 millions, compared with £1,058 millions in 1911. Statistics later than 1913 should be used with caution, but for that year Dr. Helfferich made an increase which brought the aggregate income to £2,105 millions. Several of the leading British authorities contend that there may be 5% error in the estimate of tax-free incomes either way, and that the 10% addition for evasion is a minimum figure which should probably be increased to 20 per cent or thereabouts.

Taking the statistics about the property tax in Prussia as a basis in capital valuation Dr. Helfferich made a 20% allowance for taxable property omitted, analysed the position of private property legally exempted, dealt with the position of more than 5,500,000 owners, made certain allowances for furniture, utensils and clothing, and for property in impersonal ownership, and finally arrived at an aggregate of £7,850 millions. On the assumption of a like basis for the other States he concluded that the aggregate for the German Empire was probably £12,750 millions, to which he made additions for State railways, profit-making undertakings of State and municipalities, schools, churches, parks and similar unproductive property, all of which, after deduction of public debts, gave a grand net total of £13,950 millions for 1911. But this total was checked by reference to fire insurance statistics for that year, which gave a total of more than £16,000 millions, and from further analysis of tax method and fire insurance method a final figure of £14,150 millions was derived. This may be taken therefore, as a fair estimate.

France.—Comprehensive treatment of the corresponding problem in France by M. Rene Pupin, published in 1916, recognised, as regards income, four methods of computation. These were a coefficient giving a constant relation between rental values of premises and the incomes of their inhabitants; the reckoning of income from the amount of taxes paid; the classification of trades and callings according to local areas, with a coefficient of productivity; and "successive approximations" under which an effort is made to reach the net income or annual produce from capital and work at the disposal of the French people after paying all the general expenses of their enterprises. In the period immediately preceding the outbreak of the World War Pupin's total of individual incomes in France was £1,280 millions, but to that sum substantial additions had to be made for the undistributed profits of companies, the subsistence of nearly 5,000,000 persons living on the holdings of their farms, together with land belonging to the State and other territorial jurisdictions. For 1911 Pupin's estimate upon the direct method of the capital resources of the French people was £11,420 millions, compared with £11,380 as estimated by Peret for 1912 and £12,100 millions by Thery for the same year. A later estimate by another authority, but dealing with 1913, was almost exactly £12,000 millions or approximately £300 per head. The following ten years probably saw an increase in this figure, in spite of the tremendous losses caused by the World War.

Italy.—Italy is rich in computations of aggregate wealth, but weak in estimates of annual income. Two of the leading authorities estimated that in 1914 the aggregate wealth of the Italian people was £4,484 millions and £4,000 millions respectively; Gini certainly took very great pains by local inquiry in each of the areas to ascertain the extent of the deficient valuation of land and buildings, a problem which, as most of the critics have contended, dominates the estimate. The weakness of Italian tax data makes it practically impossible to offer reliable estimate of the national income of Italy, nor is much assistance to be derived from the occupational census. In his survey of the direct costs of the World War Bogart adopted a current estimate of £800,000,000.

Other Countries.—The statistical material of other countries varies very greatly, both in scope and reliability, but the following figures of annual income and aggregate wealth, together with the years to which they apply, are offered from such material as is available:—

Country	Year	Total Income Million £ (approx.)	Total Wealth Million £ (approx.)
Spain	1913	228	2940
Holland	1910	..	1050
Sweden	1913	..	777
Belgium	1913	..	1181
Norway	1911	..	184
Australia	1915	257	1643
Canada	1915	..	2285
Japan	1914	325	2400
Argentine	1914	..	2400

War conditions which, as already indicated, interrupted the normal work of neutrals as well as belligerents have in many cases prevented the compilation of later and probably more accurate statistics. There are, however, certain broad general conclusions. The United States would appear to have a considerable absolute lead in real wealth, and in the rapidity of its increase; the difference between the United Kingdom and Germany has probably been exaggerated; the effects of the thrift of the French people are readily traceable; and Japan has made remarkable progress, allowing, however, for the fact that over 60% of her population is engaged in agriculture and lives on an amount per head which would be regarded as impossible in Europe. To complete the picture in such form as is possible, there should be offered the latest estimate of the national wealth of some of the chief countries. Six of these are taken for our purpose, namely Great Britain, United States, France, Italy, Canada and India.

National Wealth of Certain Countries

Country	Year	National wealth	In sterling at par	In sterling at current rate of exchange in May 1926	Current rate of exchange in May 1926
Great Britain	1923	£ 20,000 millions	..	£20,000 millions	..
Canada	1923	$ 25,000 millions	£ 5,100 millions	£ 5,400 millions	$4.465 = £1
India	1922	Rs. 15,000 crores	£10,000 millions	£10,000 millions	15rs. = £1
United States	1923	$355,000 millions	£72,900 millions	£81,200 millions	$4.37 = £1
France	1923	Fr. 1,200,000 millions	£47,600 millions	£14,400 millions	82·88 fr = £1
Italy	1923	L.611,000 millions	£24,222 millions	£ 6,100 millions	100 15-32 lire = £1

Cost of the War.—By the side of these figures must be set the cost of the World War. The statistics on the following page deal with the six fiscal years 1914–9 inclusive; they do not cover the total outlay of the War period, but they are substantial representation of gross and net cost, a problem which is in process of constant adjustment as inter-Allied debt arrangements are completed:—

Cost of the War[1]
The Cost of the War—Entire period covering the six fiscal years 1914 to 1919 inclusive
(In pounds—000,000 omitted.)

Nations	Total expenditure	Gross cost	Net cost
Allied and Associated Powers			
Great Britain	11,076·0	10,112·0	9,001·9
Australia	476·7	364·1	330·8
Canada	762·7	520·3	521·9
India	687·1	212·0	212·0
New Zealand	234·4	114·0	87·5
Union of South Africa	159·0	40·7	29·2
Crown Colonies	182·0	41·5	41·5
Total British Empire	13,577·9	11,404·6	10,224·8
Belgium	411·8	284·8	..
France	7,926·2	6,894·8	5,785·9
Greece	115·1	67·0	8·6
Italy	4,432·7	3,828·2	3,024·6
Japan	419·1	115·9	115·9
Portugal	235·3	141·5	112·9
Rumania	308·8	224·3	139·5
Russia	5,312·7	4,099·9	3,355·0
Serbia	119·0	89·4	..
United States	8,105·0	7,516·5	7,435·0
Total Allies	40,963·6	34,666·9	30,212·2
Central Powers			
Austria-Hungary	4,068·4	2,957·5	2,752·0
Bulgaria	261·0	164·0	66·2
Germany	10,341·1	9,666·7	9,666·7
Turkey	451·8	260·3	143·0
Total Central Powers	15,122·3	13,048·5	12,627·9
Grand Total	56,086·9	47,715·4	42,840·1

[1] Adapted from Inter-Ally Debts, by H. E. Fisk, Bankers' Trust Company, N. Y., 1924.

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WEATHER: *see* METEOROLOGY.

WEAVER, JAMES BAIRD (1833–1912), American lawyer and political leader (*see* 28.439), died at Des Moines, Ia., Feb. 6 1912.

WEAVING: *see* TEXTILE MACHINERY.

WEBB, SIR ASTON (1849–), British architect, son of Edward Webb, engraver and painter, was born in London May 22 1849. His advance in the architectural profession was rapid, and he was elected president of the Architectural Association in 1884, and of the Royal Institute of British Architects in 1902. One of his earliest commissions was the restoration of the beautiful church, St. Bartholomew's, Smithfield, London. Among many other public works of importance carried out by Sir Aston Webb, who was knighted in 1904 and made K.C.V.O. in 1914, were the building of the new front of Buckingham Palace, and the design of the architectural settings for the Queen Victoria Memorial there, as also the imposing Admiralty Arch at the other end of the Mall, London. He was also responsible for the completion of the Victoria and Albert Museum, the Royal College of Science and other institutions at South Kensington. In Jan. 1919 he was elected president of the Royal Academy, being the second architect chosen to fill that post. He resigned the presidency owing to ill-health in 1925, when he was made G.C.V.O.

WEBB, SIDNEY (1859–), British writer and politician (*see* 28.455), from 1909 played, with his wife Beatrice, an increasingly important part in moulding the opinion of British Labour and supplying it with an intellectual armoury. Mrs. Webb was a member of the royal commission on the Poor Laws, whose Minority Report, issued in 1909, was the work of herself and her husband. They were concerned in the founding of the weekly *New Statesman* in 1913, and for some time before that had been busily promoting the development of the London School of Economics and Political Science, a department of the University of London where Mr. Webb was professor of public administration. From 1915–25, he was a member of the Executive of the Labour party, for which he wrote *Labour and the New Social Order*. In 1918, he stood unsuccessfully for London University as a parliamentary candidate; in 1922, after an extraordinary educational campaign by himself and Mrs. Webb, he was returned as M.P. for a Durham mining constituency, Seaham Harbour, with an immense majority, which was maintained at subsequent elections. In 1919, Mr. Webb was a member of the royal commission on coal mines, and put before it a complete plan for the nationalisation of the industry; in the same year he served on the committee on trusts, set up under the Profiteering Acts. His inclusion in the first Labour Govt. was a matter of course; but his presidency of the Board of Trade, an office which he held in 1922–23, was not marked by any striking innovations.

Among the publications of Mr. and Mrs. Webb after 1906, the following were the most important:—*English Local Government: The Manor and the Borough* (1908); *The Break-up of the Poor Law* and *The Public Organization of the Labour Market* (1909); *English Poor Law Policy* (1910); *The State and the Doctor* (1910); *The Story of the King's Highway* (1913); *The History of Trade Unionism*, new and revised ed. (1920); *A Constitution for the Socialist Commonwealth of Great Britain* (1920) and *The Consumers' Co-operative Movement* (1921), and *The Decay of Capitalist Civilization* (1921) in which, after being active members of the Labour and Socialist movement for over 30 years they for the first time frame an indictment of the capitalist system. Mr. Webb also published *Grants in Aid* (1911); *How to Pay for the War* (1916); *The Works Manager To-day* (1917); and *The Story of the Durham Miners* (1921). In 1926 Mrs. Sidney Webb, who before her marriage was Miss Beatrice Potter, issued an autobiographical work, *My Apprenticeship*.

WEBER, MAX (1864–1920), German economist, was born at Erfurt April 21 1864, and studied jurisprudence at Heidelberg, Strasbourg, Berlin and Göttingen. He took up the teaching of Roman law and commercial law in Berlin in 1892, and became professor of commercial law and German law at the university of that city in the following year. In 1894 he was appointed professor of national economy at Freiburg (Baden). Three years later he was transferred to Heidelberg, but resigned his appointment on grounds of ill-health in 1903, and lived in Heidelberg as a private individual until the revolution of 1918. He then accepted an invitation from the university of Munich. During the ardent political disturbances of this period he proved himself in lectures and writings a most penetrating, practical and vigourous critic, whose opinion was backed by encyclopaedic knowledge. He died in Munich June 14 1920. Weber first became known for his works on Roman and then German agrarian history. His first important work was *Die römische Agrargeschichte in ihrer Bedeutung für das Staats—und Privatrecht* (1891). Later he occupied himself principally with sociology and social philosophy, as in *Die sozialen Gründe des Untergangs der antiken Kultur* (1895).

Other works are *The rural Community*, lecture delivered before the international Congress in St. Louis (1904); *Russlands Uebergang zum Scheinkonstitutionalismus* (1906). The following works were published after his death: *Gesammelte Aufsätze zur Religionssoziologie* (1920, 1921); *Gesammelte politische Schriften*, and *Gesammelte Aufsätze zur Wissenschaftslehre* (1922); *Wirtschaft und Gesellschaft* (1921); *Wirtschaftsgeschichte* (1923); *Gesammelte Aufsätze zur Soziologie und Wirtschafts Geschichte* (1924); *Gesammelte Aufsätze zur Soziologie und Sozialpolitik* (1924).

WEDEKIND, FRANK (1864–1918), German dramatist, was born in Hanover July 24 1864, his father being a doctor. He was educated at his father's château at Lenzburg in Switzerland, and in 1883 took up journalism. Afterwards he became an advertising manager and then, in 1890, secretary of a circus in Paris and London. In 1896 he contributed political articles to *Simplicissimus* and in the following year he set up as an actor and producer in Leipzig, moving in 1898 to Munich. He acted in his own dramas with his wife, and a company on tour, which made yearly visits to Berlin and performed at the Deutsches Theatre. Wedekind's dramatic works deal mainly with erotic problems, sharp criticism being directed against middle class society. They include *Kammersänger* (1900); *Büchse der Pandora* (1904); *Hidalla* (1906); *Oaha* (1908), *Schloss Wetterstein* and *Franziska* (1912).

The scenes are generally symbolic and the characters are representative of types rather than individuals. Wedekind also wrote poetry, novels, *Mine-Haha* (1906), etc., and essays. He died in Munich March 4 1918. See A. Kutscher, *Frank Wedekind* (1924).

WEDMORE, SIR FREDERICK (1844–1921), British art critic and man of letters (*see* 28.466), died at Sevenoaks, Kent, Feb. 25 1921. He was knighted in 1912. His later publications include *Memories* (1912), *Painters and Painting* (1913) and a novel, *Brenda Walks On* (1916).

WEEKS, JOHN WINGATE (1860–1926), American public official, was born at Lancaster, N.H., April 11 1860. He graduated from the U.S. Naval Academy in 1881, served two years as midshipman, then resigned from the navy and became assistant land commissioner of the Florida Southern Railroad. In 1886 he helped to organise the banking and brokerage firm of Hornblower and Weeks, Boston, Mass., of which he was a member until 1912. In 1890 he joined the Mass. naval brigade, and during the Spanish-American War commanded the second division of the auxiliary U.S. naval force on the Atlantic coast. From 1894 to 1900 he was a member of the Mass. military advisory board and of the military board of examiners. After serving as alderman of Newton, Mass., he was elected mayor (1903–4). In 1905 he was chairman of the Mass. Republican state convention. During 1905–13 he was a member of the national House of Representatives and as a member of the committee on banking and currency took an active part in framing the Aldrich-Vreeland Currency Bill. In 1913 he entered the U.S. Senate, but was defeated for re-election in 1919. He was a member of the Senate committee on military affairs during the World War. In 1921 he entered the Cabinet of President Harding as Secretary of War. In this office he served also in the Cabinet of President Coolidge, but resigned on account of ill-health Oct. 12 1925. He died at his summer home, Lancaster, N.H., July 12 1926.

WEI-HAI-WEI (see 28.494), a territory with an area of about 288 sq. m. to the west of the Shantung peninsula leased to Great Britain by China under a convention of July 1 1898. The population is about 246 foreigners, including officials and naval and military detachments, and 154,146 Chinese. The question of the rendition of the territory to China arose at the Washington Conference, when Mr. (Lord) Balfour proposed to restore the district if it would facilitate the Sino-Japanese agreement in Shantung. He made a definite offer on Feb. 1 1922 after the announcement of the Agreement in Shantung to surrender the lease of Wei-Hai-Wei, subject to the territory remaining available as a summer resort for the British China squadron. In a letter addressed to the Chinese delegations on the following day it was suggested that a joint commission should be set up to study the question on the spot and arrange the details of the transfer. Provisional agreement was in fact reached on May 31 1923, under which the greater part of the British Govt. property was to be handed over to the Chinese Govt., who were asked in return to provide facilities for a trading and residential settlement and to leave certain buildings and an area of the harbour free for limited use by the British Admiralty. Objections were raised by the Chinese authorities to the details, and up to the end of 1925 no further steps had been taken in the matter. (*See* CHINA.)

WEINER, LEO (1885–), Hungarian musical composer, was born in Budapest April 16 1885 and studied composition under Hans Koessler at the Royal High School of Music in that city, where he was subsequently (1907) appointed professor of composition, and later of chamber music. His works include the orchestral plays: *Serenade* (1906, awarded the Budapest Lipótvárosi Kaszinó Prize), *Carnival*, *Scherzo* and accompanying music to a play by Michel Vörösmartz entitled *Csongor ēs Tünde*. Chamber music: two string quartets (the second of which gained the Coolidge Prize in America, 1922), two sonatas for violin and pianoforte, and a ballad for clarinet and pianoforte (also for orchestra). Weiner's music shows great delicacy of feeling and a meticulous care for detail. His style is classical and he ignores both the romantics and the ultra-modern school.

WEIR, WILLIAM DOUGLAS WEIR 1st BARON (1877–), British politician and business man, was born May 12 1877, the son of James Weir of Over Courance, Dumfriesshire. His talents for business organisation were recognised by the Coalition Govt. during the World War, when he was appointed director of munitions for Ireland, a post which he held in 1915–6. In 1917–8 he was controller of aeronautical supplies and a member of the Air Board. In the same year (1918) he became director-general of aircraft production at the Ministry of Munitions, an appointment which he held in conjunction with a seat on the council of that department; and also (April–Dec.) Secretary of State and president of the Air Council. In 1919 he was appointed chairman of the advisory committee on civil aviation. Lord Weir was managing director of the engineering firm of G. & J. Weir, Ltd., Glasgow, which constructed the "Weir" steel houses, about which there was a good deal of controversy in 1925 and 1926. He received a knighthood in 1917 and in the following year was raised to the peerage and sworn of the privy council.

WEISMANN, AUGUST (1834–1914), German biologist (*see* 28.499), died at Freiburg-in-Baden Nov. 6 1914. His latest publications were an estimate of Darwin's work and *Die Selektionstheorie*, both published in 1909. See Ernst Gaupp, *August Weismann* (1917).

WEISS, BERNHARD (1827–1918), German theologian (*see* 28·499), died in Berlin Jan. 14 1918.

WEKERLE, SANTOR (1848–1921), Hungarian statesman, (*see* 28.500). During the World War he stood firm for union with Austria and took office as Prime Minister for the third time in Aug. 1917. In Oct. of the following year, after the fall of Fiume, he resigned. He died in Budapest Aug. 26 1921.

WELDING (*see* 28.500).—This article discusses electric welding and gas-torch welding. A third form of welding, thermit welding, is discussed in the article THERMIT.

I. ELECTRIC WELDING

Spot Welding.—The important development known as spot welding is a modification of the Thomson process, peculiarly applicable to uniting overlapped sheets of metal by welded "spots" or localised areas of union of the sheets in place of riveting them. It leaves little or no projection or deformation on the outer surfaces of the sheets so united.

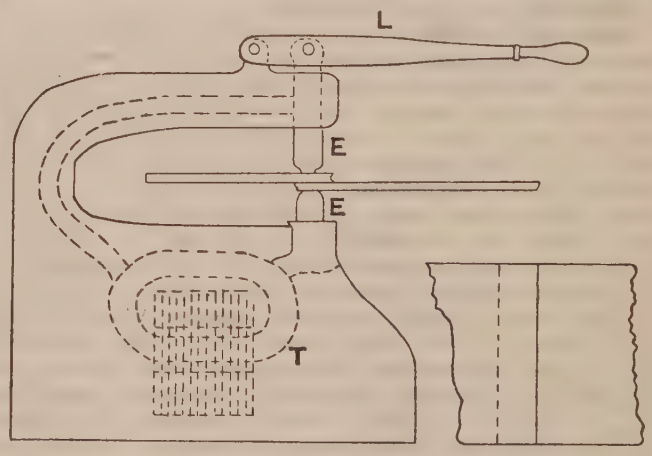


FIG. 1.—Spot Welder with electrodes (E). FIG. 2.

The machine for such work is called a "spot welder," and usually has two electrodes arranged in a vertical line, one above the other. The electrodes consist of short, heavy, blunt copper bars, E E (fig. 1) (watercooled in the larger machines); the upper electrode E is made movable up and down under control of a manually operated pressure lever, L, or by a piston actuated by air or water pressure controlled by a valve. The opposed ends of the electrodes, which bear upon and form contact with the sheets to be united, are usually chamfered or given the form of frustums of shallow cones. This reduces resistance loss in the electrodes and adds to their rigidity and durability. The electrodes, as in other resistance welders, are made the terminals of

the heavy secondary circuit of a welding transformer, T, the usual single turn of large section. The current is large, but is delivered to the work at low voltage.

The weld which unites the sheets is a spot, usually round in form, confined in extent to the area covered by the ends of the electrodes. The opposed faces of the sheets are thus locally and quickly heated to welding temperature, and the pressure of the electrodes causes complete union; such welded spots are successively made at intervals over any extent of surface of the sheets as in riveting (see figs. 2 and 3). While spot welding has been

FIG. 3.—Two welded sheets

found to be best adapted to the union of overlapped sheets or edges of comparatively thin metal, plates of $\frac{1}{2}$ in. or more in thickness may be spot-welded by heavy welders constructed for the purpose. In some of these, for mechanical and electrical reasons, two spot welds are made simultaneously by the same current passed in series through two spots covered by two pairs of opposed electrodes connected in series in the welding circuit.

Projection Welding.—Another form of welding, known as "projection" welding, resembles spot welding, differing therefrom, however, in the use of electrode faces which do not in themselves determine the welded area or spot, and in permitting the instantaneous union of plates or pieces at many parts of their surfaces. Raised spots or projections are formed on one or both pieces, which when brought together form the paths for current and consequent development of welding heat irrespective both of the other parts of the plates and of the electrode contact with the sheets. The contact covers a wide extent of the pieces to be welded, and serves to press them together as the projections between them become heated and softened.

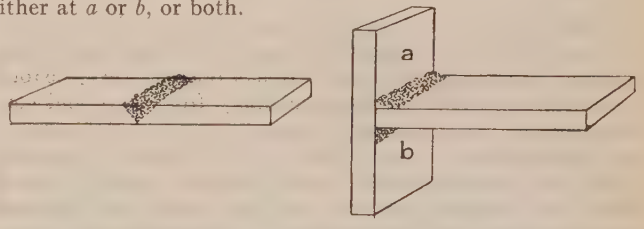
Roller Welding.—In roller or line welding, for forming continuous lapped seams in sheet metal work, the overlapped edges of the sheets to be united are passed steadily between an upper copper roll with an edge of the width of seam weld desired, and a conducting mandrel, plate or similar copper roll forming the under electrode. The weld so formed is a line or strip of a width determined by the width of the contact surface of the welding roll. Thin steel tubes with lap welds are made by this method, and it has also found application in the construction of thin metal containers such as steel thermos bottles, the parts of which are united without solder.

Flash Welding.—By the Thomson resistance process welds are made by light contact of the pieces during heating, followed by quick application of heavy pressure to force the heated surfaces together. With iron and steel the method secures a very strong weld, and the heating is confined closely to the weld itself. Moreover, there is a saving of time and often of energy. The speed of output in resistance welding was at first limited by the comparatively restricted energy supply and the capacity of the electric welding machine to deliver it to the work. This was especially true of operations such as the longitudinal welding of a seam in making steel pipe. With the modern extension in electric supply from large stations and enlargement of the capacity of welding transformers, etc., rates of production several times that of early practice have been achieved, with a possibility of future increase. In one enterprise alone, making electrically welded steel tubing, a production of over 100,000,000 ft. a year, or about 20,000 m., has been reached.

Percussion Welding.—If an electric condenser of large capacity be discharged by wire terminals of relatively small section made to approach each other in line, the discharge occurs with a flash of light at or before actual contact, depending on their potential difference. With sufficient capacity of condenser the restricted areas of the opposed ends of the discharge wires are brought superficially for an instant to a high temperature, and if immediately pressed into firm contact will weld or unite. Modifications of this process tending to increase the range and scale of its application have been brought out.

Electric Arc Welding.—This process of fusion and union of metals in which an electric arc is the source of heat has now a wide extension. Many forms of arc-welded joint in steel structures have already been to a degree standardised. The arc terminal applied to the work (usually the negative electrode when direct current is used) is a wire or rod of mild steel, mounted in a suitable holder manipulated by the operator, upon whose skill the perfection of the work largely depends. These electrode wires ordinarily vary in diameter according to the scale of the work or current strength used, and range from $\frac{3}{32}$ in. to $\frac{3}{16}$ in. or more. As the welding wire is rapidly consumed in the operation of fusing a joint, etc., it is constantly fed forward. Automatic arc welders have been devised in which the arc separation is controlled automatically and the wire fed automatically from a reel. In operation the arc voltage may be from 10 to 20 volts and the current traversing the arc 80 to 200 ampères or more.

The welding is attended by much sputtering and projection of fused and superheated globules of iron from the end of the wire electrode toward the cooler and heavier masses of the work-pieces. In fact, the deposition of metal on the work is possibly due to a jet of iron vapour from the electrode wire, carrying fused iron globules as a result of explosive boiling of the iron. This action would be a natural consequence of the central area of the end of the electrode wire being at the highest temperature, as it loses heat by radiation less readily than the outer surface of the wire at the arc. This central area reaches a temperature of about the boiling point of iron. The temperature of the arc is so high that the surface of the work-pieces, however massive such pieces may be, is penetrated and fused so that the metal of the work is incorporated with that from the welding electrode wire. The welding may be regarded as a progressive filling or plastering action by condensed iron vapour and fused iron. The operation is facilitated by coating the electrode wire lightly with mineral films, such as lime, which probably act by furnishing volatile material which adds to the stability of the arc. Depending on the strength of current in the arc and the skill of the operator, from 1 lb. to 2 lb. of metal per hour may be deposited in effecting the welds. When plates of over $\frac{3}{16}$ in. in thickness are to be butt welded they should be bevelled before abutting them, so that a groove of not less than 60° flare shall be provided, to be filled with the fused metal (*see* fig. 4). Where the plates meet at an angle, as in fig. 5, the fused metal is deposited either at *a* or *b*, or both.



FIGS. 4 and 5.—Welding Operations

Arc welding can be carried on even upon the under side of the work (such as a boiler or tank *in situ*). The actual rate at which seams can be made in arc welding naturally depends upon the thickness of the plates to be united, the kind of joint to be made and other conditions. With automatic machines on small work it may rise to about 2 ft. per min., while in heavy work by hand operation it may not exceed 2 in. per minute. Ordinary arc welds on steel may possess a tensile strength of as high as 50,000 lb. per sq. in., but arc welds under tension showed little elongation before fracture, and were consequently brittle on bending. This defect of arc welds in steel or iron has, however, been removed by recent inventions preventing absorption of deleterious substances and oxidation of the metal of the weld, which instead of being brittle becomes highly ductile as well as strong. Such improvements are the result of laboratory research work by one of our large industrial organisations. Cast iron is amenable to arc welding when proper precautions are taken. Likewise bronze or copper and its alloys may be welded, a favourable condition for which is preheating of the workpieces. In these welds

the carbon arc is employed, as it is found to favour the proper union of the weld metal with the other pieces.

Arc welding has usually been done by the use of direct current, and special dynamo generators are constructed for supplying the current, with regulating characteristics suitable to welding. The alternating-current arc is, however, adaptable to welding, provided the frequency is not too low. Arc welding is employed in the construction of tanks, and in caulking the seams of tanks which must retain oil or thin liquids without leak. It is much used for repair work. It is readily applicable to joining broken pieces and to replacing metal worn away in use, *e.g.*, the restoration of rail surfaces of tramways *in situ*. It is generally less costly in application than the other forms of fusion welding, such as that by the use of oxygen blowpipe or thermit welding. The improvements which have been made point to a greatly extended application of arc work in the future; as in the construction of steel ships, pressure tanks and steam boilers without riveting.

(E. T.)

II. GAS-TORCH WELDING

Gas-torch welding is variously known as "autogenous" welding, "oxy-acetylene blowpipe" welding, "hot gas flame" welding, "fusion" welding, and other terms which are more or less accurate, general and confusing. The gas combinations more commonly used for torch or blowpipe welding are either oxygen-acetylene or oxygen-hydrogen. Of these two, oxy-acetylene is in more general use for welding, while oxy-hydrogen, on account of its longer flame, is generally used to supply heat for steel-cutting torches. The oxy-acetylene flame has a maximum heat, under ideal conditions, of about 3,400° C., and oxy-hydrogen about 2,000° C.

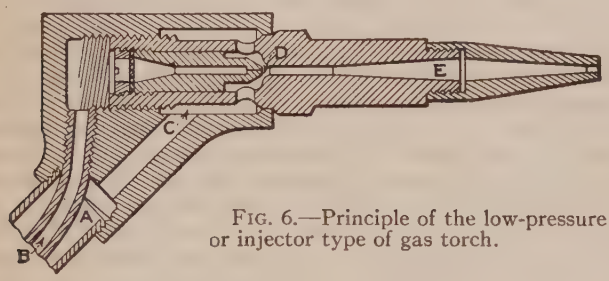


FIG. 6.—Principle of the low-pressure or injector type of gas torch.

The use of a blowpipe or torch in some form was known to the ancients, but the high-temperature gas flame is principally a development since 1910. The application of the oxy-acetylene torch to metallic welding dates experimentally from 1901 and commercially from 1903; Edmond Fouché, Paris, who did considerable experimenting in conjunction with Picard, is generally credited with making the first really practical torch. The early torches used both oxygen and acetylene under high pressure, but this proved too dangerous, and a low-pressure or injector type was next used. Following this was the Gauthier-Ely positive- or medium-pressure torch, which used both gases under moderate and independent pressure. The injector and the positive-pressure types are the ones now in commercial use. The development of the latter is largely due to Augustine Davis and Eugene Bournonville.

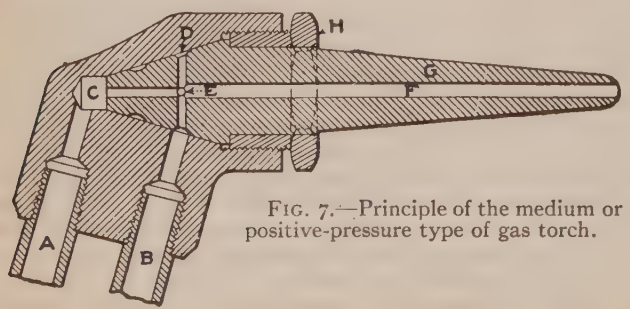


FIG. 7.—Principle of the medium or positive-pressure type of gas torch.

The fundamental principle of the low-pressure or injector type of torch is shown in fig. 6. The acetylene enters at A and the oxygen at B. The acetylene, at less than 1 lb. pressure, goes to chamber C, from which it is sucked by the oxygen, under 5 to 30 lb. pressure, pouring out of nozzle D, and is carried along with the oxygen into the mixing chamber E. The thoroughly mixed gases issue from the nozzle of the torch, where they are burned.

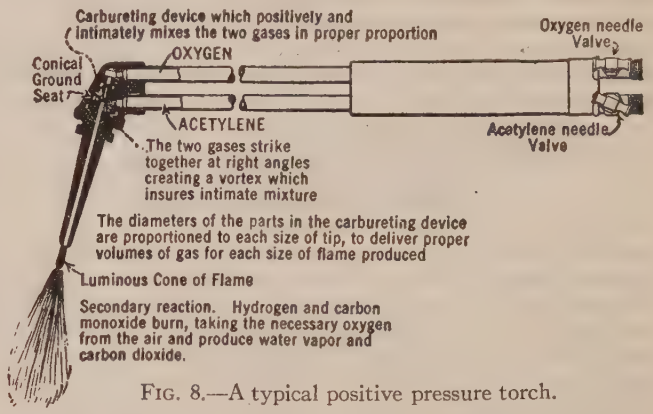

Carbureting device which positively and intimately mixes the two gases in proper proportion
Oxygen needle Valve
OXYGEN
Conical Ground Seat
ACETYLENE
Acetylene needle Valve
The two gases strike together at right angles creating a vortex which insures intimate mixture
The diameters of the parts in the carbureting device are proportioned to each size of tip, to deliver proper volumes of gas for each size of flame produced
Luminous Cone of Flame
Secondary reaction. Hydrogen and carbon monoxide burn, taking the necessary oxygen from the air and produce water vapor and carbon dioxide.

FIG. 8.—A typical positive pressure torch.

Positive-Pressure Torch.—The positive-pressure torch principle is illustrated in fig. 7. Here the oxygen, at from 1 to 14 lb. pressure, enters at A, and the acetylene, at from 1 to 24 lb. pressure, enters at B. The oxygen enters the small chamber C and thence out through the centre hole. The acetylene goes to chamber D and also out through the centre hole. The two gases start to mix at E and are thoroughly mixed in the channel F in the torch nozzle G. A typical positive-pressure torch is shown in fig. 8. Torches are made with tips set at various angles from 90° to straight, the latter being principally used in welding and cutting machines. Where the work is heavy the tips are water-cooled. In welding very thin metal the edges are often turned up or "flanged" and the torch used to fuse them together without using any additional metal. On heavier work the edges to be welded are **V**'d out at an angle of from 60° to 90°, and this channel is filled in by using a welding rod or wire, care being taken to obtain perfect fusion between the old metal and new. Welding of this kind is progressive, as the welder gradually

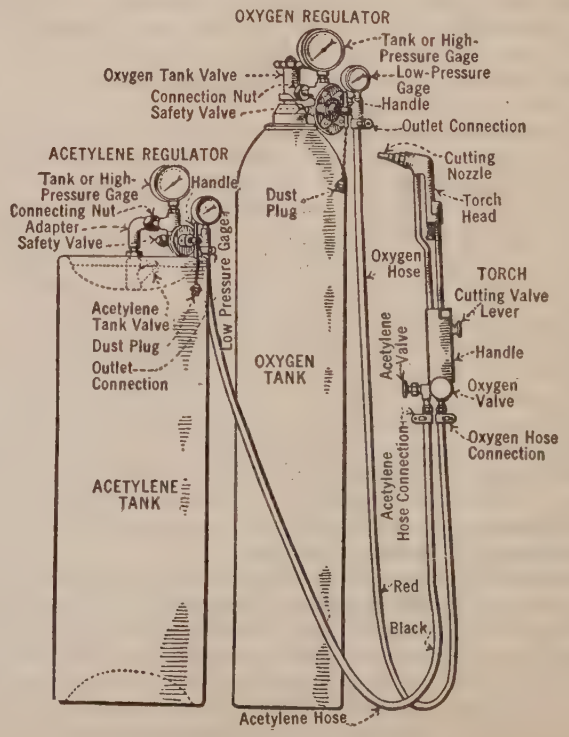


FIG. 9.—Typical oxy-acetylene cutting unit.

works along the channel, filling as he goes. The torch is given a weaving motion from side to side in order to fuse the sides of the

V and to puddle in the added metal from the rod. On all torch welding work allowance must be made for expansion and contraction, and on repair work of complicated design, like an automobile cylinder, preheating with charcoal, gas-and-air torches or other means is usually necessary. Preheating is also sometimes resorted to in order to save the more expensive gases. Nearly all of the common metals may be welded with the gas torch, though some are more difficult than others. Steel ship or boiler plate is about the easiest, though aluminium, cast iron, copper and many alloys present no serious difficulties.

Cutting Torches.—The set-up for a welding outfit is practically the same as that of the one for cutting shown in fig. 9. A cutting torch, however, differs from a welding torch in that it has a separate high-pressure oxygen vent. The cutting of steel and wrought iron is based on the fact that a jet of oxygen directed on to a previously heated spot of steel causes it to ignite and burn away rapidly in the form of iron oxide. The oxide runs or is blown out of the cut or " kerf " in a stream, provided the torch is fed along properly. The tips used for cutting may have one or several heating jets preceding or surrounding the cutting oxygen jet. Only steel or wrought iron can be successfully cut on a commercial scale, though channels or slots may be melted in any metal. A typical job of steel plate cutting is shown in fig. 10, and a typical cutting torch in fig. 11. Cast iron is cut with difficulty, and only by using a special tip and highly preheating the oxygen in a positive-pressure torch or by using an excess of acetylene and an unusually large tip on the low-pressure types.

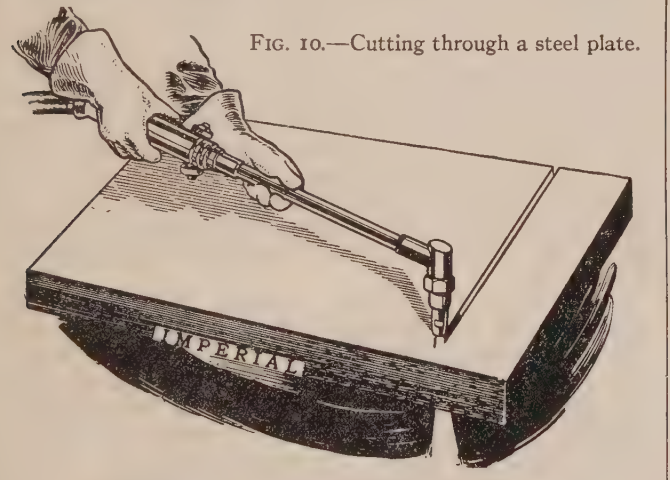


FIG. 10.—Cutting through a steel plate.

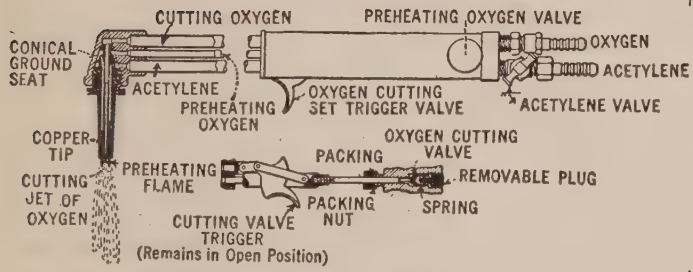


FIG. 11.—A typical cutting torch.

Gas Supply.—The same sources of gas supply are used in cutting as in welding. These are, commonly, cylinders or drums containing the gases under pressure up to 225 lb. per sq. in. and from 50 to 100 cu. ft. capacity for acetylene, and 1,800 lb. per sq. in. and from 100 to 200 cu. ft. capacity for oxygen or hydrogen. Acetylene, however, may be generated on the premises, in which case the pressure must not exceed 15 lb. per sq. inch. Obviously, pressure as great as that mentioned for cylinders must be reduced for use in the torch, and for this purpose regulators are used which automatically keep the gases supplied to the torch close to the pressure for which they are set. In many large plants practically automatic gas-torch welding machines are used for straight or circular seam welding of drums, cylinders, tubes, kettles and the like.

Cutting Machines.—Cutting machines are much more commonly used than welding machines. The cutting machines range from the simple, hand-fed, straight-line cutters to complicated motor-driven automatic machines that will cut rounds, squares, ovals or other patterns. One type of cutting machine is made on the pantograph principle, and by following a template or pattern the operator can use two torches and cut two separate steel plates at once. A cutting machine will, as a rule, cut a narrower and more even kerf than can be done by hand. Under favourable conditions a machine can be made to cut a kerf not over $\frac{1}{32}$ in. wide, while a careless or inexperienced operator with a hand torch may cut a kerf $\frac{1}{8}$ in. or more in width. Torches are also now made so that divers can cut steel ship plates while completely submerged under water. (E. VI.)

WELFARE WORK: *see* INDUSTRIAL WELFARE.

WELLHAUSEN, JULIUS (1844–1918), German Biblical scholar and Orientalist (*see* 28.507), died at Göttingen Jan. 7 1918.

WELLINGTON, New Zealand (*see* 28.513), has recently increased largely. Onslow, Karori and Miramar have been incorporated in the city area, which has now an acreage of 15,951, with 1,613 ac. of reserves. The population of the city proper was 94,340 in 1923, and that of the whole area was 114,510 in 1924. There is a town belt of 970 ac., which is leased for grazing but is open to public access. Robertson Park, (3 ac.) was given to the city in 1919, and Keith Izard Park (11 ac.) in 1921. The municipality owns a seaside resort outside its boundaries at Days Bay, which has been renamed Williams Park in memory of the donor of a large sum of money towards its purchase. The municipality has also controlled the sale and supply of milk since 1919, and has a butter and cheese factory 47 m. from the city. In 1924 a water supply scheme was finished, involving a pipe-line from the Orongorongo river to Karori reservoir and a tunnel two miles long under the mountains. A power station at Evans Bay was finished in 1925, and water and drainage schemes are being carried out at Onslow and Karori. An automatic telephone exchange was built in 1925.

WELLS, HERBERT GEORGE (1866–), British man of letters (*see* 28.514), continued between 1910 and the outbreak of the World War to publish novels of which the plots are subordinated to sociological speculation. The most famous of these, *The New Machiavelli* (1911) describes an ambitious reformer who begins his political career as a Liberal member of parliament, and then, disgusted by party politics, advocates a democratic, an almost socialistic imperialism, but is ruined by the publicity given to his private amours. In *Marriage* (1912) are described a husband and wife who, despite the romance attending their first meeting, bore each other until they leave civilisation and rediscover themselves in icy and dangerous Labrador. Mention should also be made of *The Passionate Friends* (1913), *The Wife of Sir Isaac Harman* (1914) and *The Research Magnificent* (1915) which, despite the date of its publication, is essentially a pre-War novel. *Boon* (1915) was not immediately acknowledged by Mr. Wells. This work, nevertheless, displays Wells at his best. That impartial artist Henry James is fiercely mocked, more fiercely perhaps than he deserved; and a flood of Mr. Wells' excellent scorn is directed against such journalists as Mr. E. B. Osborn of *The Morning Post.* The wild asses of the devil have been released, and until they could be gathered again, civilisation was in jeopardy. War broke out; and eagerly, perhaps too eagerly, Mr. Wells tried to corral those errant asses.

During the War Mr. Wells' liberal imagination was freely given to the support of the allied cause. A host of pamphlets, written at red heat, championed Western Europe against the brutal stupidity which Mr. Wells thought to discover both in the German enemy, and the cruder English propaganda. *Mr. Britling sees it through* (1916) is the best known of his War time publications. This novel explains the mentality of a British publicist, whose eldest son is at the front, and finally displays Mr. Britling, half maddened by the outrages of war, and wholly broken hearted because his best beloved son is dead, poring over an atlas, and tracing new frontiers. Subsequently Mr. Wells failed to resurrect his novelistic talents. *The Undying*

Fire (1919) more nearly resembles a philosophic dialogue than a story, and has been awarded less praise than it deserves. *Men Like Gods* (1923) was a bold and brilliant experiment in Utopianism, but too often crude satire took the place of intelligent criticism. In *The Dream* (1924) Mr. Wells mingled prophecy and humour, and found that his public was tired of the future. Therefore in *Christina Alberta's Father* (1925) he magnificently returned to his earlier manner, and again succeeded in impressing upon the general imagination the delightful creatures of his fancy.

Meanwhile, in his *Outline of History* (1919–20), Mr. Wells gave his most powerful and his most delightful criticisms of modernity. Many have found fault with the book. Scholars have been shocked by the author's contempt for Caesar and Napoleon, or have denounced in the prehistoric chapters a too ready acceptance of fragile hypothesis as solid fact; and partisans have declared that Mr. Wells, despite the expert advice given to him, remains a slave of the late Victorian materialism. No one else, however, has written a history of the world, and Mr. Wells, in the interim, holds the ground. Moreover, it supplies as no other history has done, a fairly complete conspectus of the past.

No one has done, or can do, more than Mr. Wells to suggest an alternative to our present civilisation. Mr. Wells is radically minded, and would like to replace what is by what might be. He is also so susceptible to fashion, that he is unable to break away from the apparatus of ordinary civilisation. He has, however, ideas of his own. In the clash of these three things, Mr. Wells is in danger of losing direction. Apart from his literary talents, Mr. Wells seems, by the influence exercised on his juniors, to belong to the tradition of Carlyle and Ruskin. He has supplied rebellious youth with a formula whereby existing institutions are challenged and condemned, and he has offered to conformists a prospect of a civilisation steadily increasing in strength. In his style he avoids both Carlyle's obscurity and Ruskin's affectations, and his pure bright English will survive the themes on which it is expended.

Bibliography.—John D. Beresford, *H. G. Wells* (1915); Edward Guyot, *H. G. Wells* (1920); Ivor J. C. Brown, *H. G. Wells* (1923).

(H. C. Ha.)

WELSH LITERATURE (*see* 5.640).—The period 1910–25 marks the emergence of a new school of poets with new aesthetic ideals, a fresher and wider outlook and, it may almost be said, a new diction and vocabulary. Its poetry represents the hard-won triumph against the Puritan rigidity which lay heavy on the last decade of the 19th century, and the reaction against the provincialism which the cultural isolation of Wales had intensified. The new influences were twofold. First, the more scholarly study of Welsh literature, particularly of the age of Dafydd ap Gwilym and the 15th century, and the scientific investigations of the language and of Welsh history, revealing the literary heritage of the Middle Ages, showed the necessity of purging the language of corrupt grammatical forms, English idioms, and alien style and mannerisms. Secondly, with the wider culture came foreign influences, French, German, Irish, the Classics and English poetry. The translations of Heine by J. Morris Jones revealed to some extent the secret of that supreme lyricist. The lyrical art of Eifion Wyn is surer and more adequate in technique than that of his predecessors, whilst his *Awdl y Bugail* had shown that lyric diction was possible in the alliterative strophes.

Scholarship and learning reacted on literature, and the first fruits appeared in the work of T. Gwynn Jones, the leader of the new school and its most accomplished craftsman. His *Ymadawiad Arthur, a chaniadau ereill* (1910) announced the advent of a poet of the first rank. The title poem, the winning ode of the national Eisteddfod of 1902, was the flaming manifesto of the new school. No such music had been heard in Wales since the Reformation. The rich decoration and missal-like colours of the poem conjured up the glamour and enchantments of the past. Both the subject and its treatment are symptomatic. The romantic legend of Arthur replaces the former theological or Hebraic theme. The diction and vocabulary are in the tradition of the classical age of Welsh poetry. This is not to say that the poem is pedantic or archaic, but rather that the artist has so absorbed the spirit of his models that he has created his own medium by extending and enriching the resources of his speech. Equally characteristic is the superb mastery, unrivalled in this period, of the strict metres, the artistic economy of words, the grave and resounding music and the vivid and accurate descripton of external objects by which the poem conveys the impression of a splendid canvas. A powerful historical imagination, fortified by wide reading but illumined by poetic intuition, has inspired much of Gwynn Jones's best work, such as the beautiful *Penmon* in this collection, and *Madog*. The promise of the first volume has been more than fulfilled. In *Madog*, among the greatest achievements of Welsh poetry, the stately movement of the elegiac is adopted. with alliteration virtually replacing the older harmony of quantity, producing a noble and sonorous line adequate to the lofty theme and perhaps the best expression of the poet's genius. *Tir na N-Og* (1916) a lyrical drama, displays to the full his command of the alliterative metres, which are here made to yield some exquisite music.

W. J. Gruffydd is a poet of considerable, if unequal, achievement. His fearless advocacy of the new school has presented a wide target for the hostile. His early poetry was criticised as imitative, and certainly its inspiration is largely derived from his reading. Keats, Shelley, Swinburne (whose rather sickly *Dolores* stanza is imported), Kipling, Hardy and the moderns furnish a too obvious contribution. But this springs not so much from poverty of inspiration as from the impact of fine poetry on a sensitive intelligence, and his work is rarely incompetent in craftsmanship even when merely purveying the manner and ideas of other poets. *Ynys yr Hud* (1923) shows a marked advance. There are traces of the early weaknesses—reminiscences of other poets, though fainter and less imitative, and touches of bitterness, though now often rising to a noble anger. At his best, as the poet of the common Welsh life of the villager, the quarryman, the farmer and the shopman, Gruffydd must rank high, and he, almost alone of his contemporaries, has conveyed the romance and realism of the fast-vanishing sea life of the North Wales coasts.

The publication of *Yr Haf, a cherddi eraill* (1924), by R. Williams Parry, is a landmark in Welsh literature. This slender volume revealed a wealth of poetic endowment and a purity of song unsurpassed since Dafydd ap Gwilym. The main poem, *Yr Haf*, an ode of summer and young love, although strictly alliterative, is, by the poet's delicate technique and enchanted diction, essentially lyrical. The memorial *englynion* are among the triumphs of poetry. Their restraint and terseness recall the early *englynion* (of the Graves); and, though rich in alliterative effects, they have the inevitable music of true lyric. Parry has also been the most successful in transplanting the sonnet form, and the sonnets in this volume show again his fastidious care in the choice of words to express his moods with the greatest intellectual effect. Remarkable, too, is the outlook of the poet: he stands aloof and indifferent to the clash of parties and creeds which occasionally disturbs the harmonies of his contemporaries: he has the artist's faith in beauty, from which his sensitive, poetic temperament draws its inspiration and sustenance.

The poetry thus brilliantly inaugurated continued to flourish. T. Parry-Williams has marked individuality and accomplishment, but the intellectual content of his poetry often overbears the imaginative element. Cerdd'r Bugail (1918) a posthumous collection of the poetry of Hedd Wyn, a shepherd poet killed in action, attracts notice by its promise and by the mystical strain of its thought. The verse of Cynan at its best has much lyric sweetness and simplicity, but his *Mab y Bwthyn* (1921) and *Y Tannau Coll* (1922) are marred by a false, sentimental treatment of commonplace sex themes.

In prose the output has been disappointing. There has been no successor to Daniel Owen, and no prose writer with the limpid grace of O. M. Edwards. *Hunangofiant Tomi* (1912) and *Tir y Dyneddon* of E. Tegla Davies have charm and show a capacity for dialogue, but their range is limited. The main prose develop-

ment has been in the ephemeral journalism of the period or in the literary reviews such as *Y Llenor* (founded 1922), or in the pages of the learned journals, where Welsh prose is acquiring a flexibility and an adaptability for the requirements of criticism and modern scholarship.

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WEMBLEY, England (*see* 28.517).—The population of this residential suburb of London, which has an area of 4,564 ac. was nearly quadrupled between 1901 and 1921, when it was 16,187. Wembley, now served by three railways (Metropolitan; London, Midland and Scottish; London and North Eastern), provided the site for the British Empire Exhibition in 1924 and 1925. It covered a semi-circular tract about 2¼ m. round, with railways north and south and within the grounds. A main thoroughfare, Kingsway, leading from the north entrance, was flanked by the palaces of industry and of housing and transport, and by the buildings for Australia and Canada, and gave at the southern end upon the stadium, which had an area of 10 ac. and accommodated nearly 100,000 people. Here were staged numerous ceremonies, spectacles and athletic contests. Besides those mentioned above, each major division of the empire overseas had its pavilion, the most notable being those of India, South Africa, New Zealand and Malaya. There was a British Govt. pavilion, with exhibits by various government departments and a scientific exhibit organised by the Royal Society. There were also a palace of arts, an amusement park and many other features designed at once to demonstrate the vast resources of the Empire and to attract the public. (*See* also EXHIBITION: BRITISH EMPIRE.)

WERFEL, FRANZ (1890–), German poet, was born in Prague Sept. 10 1890. During the first 10 years of his career he lived (1911–21) in Hamburg, Leipzig and Vienna. His poetry is contemplative and lyrical, and the idea of the community of souls in all living beings is strongly emphasised in his collections of verse, *Der Weltfreund* (1912), *Wir Sind* (1913), *Einander* (1915), *Der Gerichtstag* (1919) and the selection, *Gesange aus den drei Reichen* (1917). Among Werfel's successful works for the stage are, a German adaptation of the *Troades of Euripides* (1915); and the trilogy, *Der Spiegelmensch* (1920), which was performed in 1921 and 1922 at Leipzig, Stuttgart, Vienna and other cities. In his subsequent works Werfel dealt with general problems in a historical setting. His drama, *Juarez und Maximilian* (1924), represents the differences between democratic-republican and monarchistic thought, while his novel on the opera *Verdi* (1924), contrasts the artistic conceptions of Wagner and Verdi. See A. Luther, *Franz Werfel und seine besten Bühnenwerke* (1922).

WERNER, ANTON ALEXANDER VON (1843–1915), German painter (*see* 28.523), died in Berlin Jan. 3 1915.

WESLEYANISM: *see* METHODISM.

WEST AFRICA, FRENCH (*l'Afrique occidentale française*) (*see* 11.205). The era of peaceful development which followed the establishment of French rule in the interior had led by 1923 to the setting up of civilian administration over the whole of this vast region. The colony of Upper Volta was formed in 1919 from the southern part of Upper Senegal and Niger, which, in 1920 was renamed the French Sudan. The military territory of the Niger was made the Niger Colony in 1922. Mauritania became a colony on Jan. 1 1921. The approximate areas and populations of the separate colonies in 1924 are shown in the table. The European population was estimated in 1925 at 8,000.

The whole of the area is under a Governor-General, who is responsible for services common to all the colonies. Each colony is under a lieutenant-governor.

Colony	Area in sq. m.	Population
Senegal	74,112	1,266,116
French Guinea	89,436	2,026,321
Ivory Coast	121,590	1,301,832
Dahomey	41,302	974,597
French Sudan	356,471	2,561,515
Upper Volta	142,820	3,015,388
Mauritania	154,200	284,598
Niger	404,914	1,149,564
Total	1,384,845	12,579,931

The contentment of the natives and the increase in population and production were evidence of the success of French methods during the period 1910–25. A military force of 16,000 men, of whom 2,000 were Europeans, was maintained in peace time; during the World War large numbers of Senegalese and other native troops were sent to France; the only regions not peaceful during the War period were those bordering the Sahara. Improvement in means of communication was a leading feature of French policy. By 1924 railways from Dakar and Konakri linked the seaboard to the Niger, which in French territory is navigable for over 1,000 miles. About half of the total trade of the colonies is with France and other French possessions. Imports are mainly textiles, hardware, machinery and coal. Some 75% of the exports are oil seeds or other oleaginous products. The cultivation of cotton is actively encouraged; maize and cocoa are exports of growing importance. The total volume of trade in 1924 exceeded 1,000 million fr., as compared with about 640,000,000 fr. in 1919 and 177,000,000 fr. in 1907. For other parts of West Africa see ANGOLA; CAMEROONS; TOGOLAND, etc.

WESTERMARCK, EDWARD ALEXANDER (1862–), Finnish anthropologist, was born at Helsingfors Nov. 20 1862. He was educated at a lyceum in his native town, and at the University of Finland where he later became professor of moral philosophy. In 1890 he went to England, and in 1907 was appointed professor of sociology at the University of London. He made a special study of primitive marriage and ethical origins, and published *The Origin of Human Marriage* (1889); *The History of Human Marriage* (1889, 5th ed. rewritten in 3 vol. 1921); *The Origin and Development of the Moral Ideas* (1906); *Marriage Ceremonies in Morocco*, 2 vol. (1914).

WESTERN AUSTRALIA (*see* 28.539), a state of the Australian Commonwealth. Its area is 975,920 sq. miles. The population in 1925 was 368,027 as compared with 282,114 in 1911. Perth, the capital, which on Dec. 31 1924 had a population of 176,467, and Kalgoorlie, the centre of the gold mining industry, are the chief towns. The principal port is Fremantle, the first port of call for mail steamers from Europe; Albany, in the extreme southwest, is the first port of call for shipping from Europe via the Cape. The farmers are well organised politically, and the Country party plays an important part, in coalition with the Liberals or Nationalists, in the Government of the country.

The gold mining industry, which was for many years the chief source of wealth, has dwindled steadily since 1903, when the output was valued at £8,770,719. In 1923, it was £2,232,179, representing two-thirds of the total Australian production. Steady progress has been made, however, in the development of the primary industries. State-aided immigration, backed up by a vigorous land settlement policy, with liberal financial assistance to settlers through the State Agricultural Bank, has attracted settlers, not only from overseas, but also from the eastern Australian States.

Production and Industry.—Wheat is the principal crop, and in 1925, 1,867,614 ac. were harvested, yielding 23,887,367 bu. In the closer settled areas of the southwest, dairy and fruit farming are making rapid progress. The annual production of the pastoral industry now exceeds £4,500,000. In the northwest territory are millions of ac. of pastoral country awaiting development, and at Wyndham the Government has erected large works for the killing, freezing and canning of meat for export. Western Australia's hardwoods have a world-wide

reputation, especially jarrah and karri, which are indigenous to the southwest districts. Sandalwood is also exported in large quantities to the Far East. Western Australia produces more than one-half of the world's supply of pearl shell. Broome in the northwest is the centre of this industry. The maximum production, reached in 1914, represented a value of £90,000 for pearls and £221,000 for pearl shell.

The manufacturing industries have not been developed to any great extent. A state implement and engineering works was established in 1912 with a view to keeping a check on prices of agricultural machinery. The Government also operates six saw mills. In 1925 there were 3,733 m. of Government controlled railways, on a 3 ft. 6 in. gauge, open for traffic. The completion of the trans-continental railway between Kalgoorlie and Port Augusta in 1917 linked up the Western and South Australian systems. (*See* AUSTRALIA.)

WESTERN FRONT.—For a good many years after the end of the Franco-Prussian War of 1870–1 the military policy of France was defensive. Large sums of money and much labour were spent upon the elaboration of an extensive system of fortifications on the Eastern frontier; and military discussions turned largely upon how those fortifications could best be utilised in the event of a war with Germany. But time passed, and France recovered morally and materially from the effects of her defeat; an offensive and defensive alliance was concluded with Russia, and the establishment of an entente with Great Britain, if it did not assure France definitely of military assistance from that quarter, at least made such assistance possible.

French Military Policy.—Simultaneously with these developments there had been a marked increase in the general efficiency of the French Army; French inventive genius had perfected the best field gun in existence and had made France a pioneer in the conquest of the air. Under these conditions a new school of military thought had grown up, to which the idea of awaiting attack was repellent; the offensive was advocated as the true military policy of France, not only as conferring definite military advantages but as being in consonance with the national character, and as the only means of avoiding a passive acceptance of the horrors of invasion, a course naturally repugnant to a proud nation. The swing of the pendulum was pronounced and in the new zeal for the promotion of the spirit of offence the study of the use of field fortifications was neglected, while the addition of heavy artillery to the field army was opposed as being destructive of mobility and of the *élan* of attack. In this spirit the French plan of campaign was revised, and " plan 17 " came into existence with an immediate and general offensive as its basis.

In the preparation of this plan the attitude of Belgium and of Great Britain were uncertain factors. Provision was, however, made for the eventuality of Belgium permitting German troops to march through her territory, while discussions between the French and British General staffs, authorised by the two Governments, resulted in an agreement, that if Great Britain joined France, her expeditionary force should be assembled in the neighbourhood of Maubeuge. The plan was, however, based upon a fundamental miscalculation as to the strength of the army which Germany could bring against France. While it was accepted that the poverty of Russia's communications would make that country's mobilisation very slow, and that therefore Germany would almost certainly assemble the largest possible army on her western frontiers to meet France, the strength of that army was estimated at not more than 40 to 42 active infantry divisions and ten cavalry divisions. The French General staff was aware that Germany proposed to create on mobilisation a number of reserve divisions, as they themselves also did; but they did not believe that these reserve formations would be like their own, able to take more than a secondary part in the campaign, at least until after a considerable interval.

Plan 17.—Plan 17 envisaged the employment of 10 cavalry, 45 active and 21 reserve divisions organised in five armies, of which the I., II., III. and V. were drawn up from right to left along the frontiers of Alsace-Lorraine and Belgium, Luxembourg, while the IV. formed a general reserve between Verdun and Châlons-sur-Marne. It provided for an immediate offensive into Alsace-Lorraine by the I. and II. armies, to be followed by a general offensive on either side of the fortified zone of Metz and Thionville. When Belgium, proudly refusing the German demand for permission to march through her territory, prepared to resist and Great Britain, declaring war upon Germany, began to put into execution the plans agreed upon between the two staffs, the confidence at French headquarters in the efficacy of plan 17 was complete. The Belgian Army of six divisions and a cavalry division might, with the aid of the strong fortresses of Liége and Namur, be relied upon to delay the Germans for some time, while the French left was assured of the support of a British force of at least four infantry divisions and one cavalry division. General Joffre, the French commander-in-chief, was therefore confident that he had a sufficient superiority of force to justify the agreed policy of attack.

German Plan of Invasion.—The German plan for a war on two fronts was formulated in 1905 by Count Schlieffen, then chief of the General staff, and provided for the earliest possible offensive in the greatest possible strength against France, while Austria was assisted with the minimum of force to hold off Russia. The decision against France was to be sought by a great enveloping movement across the Meuse, through Belgium and beyond the zone of the French frontier defences. Thus a deliberate violation of Belgium's neutrality was planned many years before 1914. This plan was accepted in principle by Schlieffen's successor, the younger von Moltke, but as years passed and the development of the offensive spirit in the French army became evident, it was modified in the direction of strengthening the left flank in Alsace-Lorraine, whereas Schlieffen had maintained to the end of his life that risks should be accepted upon that flank in order that the right should be made as strong as possible.

The plan as it developed in Aug. 1914 provided for the organisation of the force to take the field against France of seven armies composed of 10 cavalry, 72 active and reserve divisions, six Ersatz divisions and 14 Landwehr brigades. The Ersatz and Landwehr troops were intended for the garrisoning of occupied territory and the protection of lines of communications, but the great majority of the reserve divisions were organised in army corps and employed alongside the active divisions. Not only was the organisation and equipment of these reserve divisions far superior to that of the reserve divisions of the French Army, but Germany was ahead of the rest of the military world in the provision and tactical employment of machine guns and of heavy artillery, while her plan of campaign combined judiciously the employment of offensive and defensive methods.

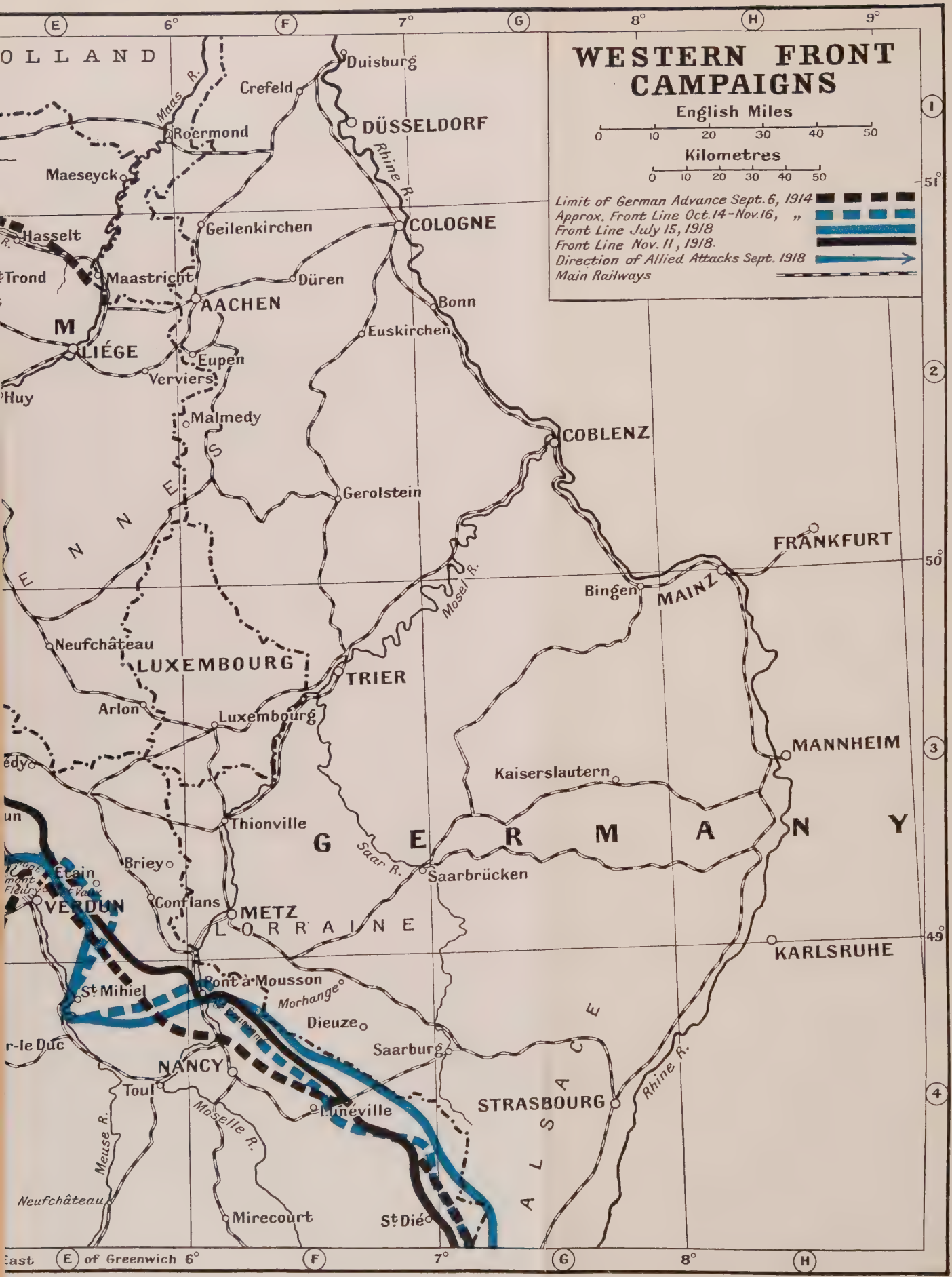
The seven German armies were deployed along the frontier from Switzerland to Holland. On the left the VI. and VII. under the Crown Prince Rupprecht of Bavaria were to act at first mainly on the defensive in Alsace-Lorraine, while the remaining five armies (55 active and reserve divisions, and seven cavalry divisions) formed the great moving wheel against the French centre and left. Of these five armies two, the I. (Von Kluck) and the II. (Von Bülow), comprising 26 divisions and five cavalry divisions, were to cross the Meuse, while the III. (Von Hausen, eight divisions) and the IV. (Duke Albrecht of Württemberg, ten divisions) marched through the Belgian Ardennes. The way for the I. Army was to be opened by a *coup-de-main* of a special striking force under Gen. von Emmick on Liége.

French and German military policies having now been outlined an account of the actual campaigns can be undertaken.

I. OPERATIONS IN 1914

The invasion of Alsace was begun in accordance with plan 17 by a preliminary enterprise on Aug. 8, followed by the main advance of the I. and II. French Armies under Gen. Dubail and de Castelnau on Aug. 14. This advance was stopped on Aug. 20 in the battle of Morhange-Saarburg, in which the French could make no impression on the German defensive positions. The two armies were compelled to retreat to the frontier, where, between Aug. 25 and 27 the attacks of the pursuing Germans were repulsed (*see* FRONTIERS, BATTLES OF THE). Meanwhile, the ap-

NORTH SEA
ENGLAND
Margate
DOVER
Folkestone
CALAIS
DUNKIRK
Furnes
Nieuport
Ostend
Zeebrugge
BRUGES
Eecloo
Schelde R.
Terneuzen
Turnhout
ANTWERP
St. Nicolas
Herenthals
Thourout
GHENT
Malines
Termonde
Aerschot
Alost
LOUVAIN
Audenarde
BRUSSELS
Courtrai
Dixmude
Thielt
Roulers
Yser R.
Langemarck
Poperinghe
Ypres
Menin
Passchendaele
Cassel
Kemmel
Mt. des Cats
Meteren
Wytschaete
Messines
Boulogne
St. Omer
Hazebrouck
Bailleul
Armentières
Tourcoing
Roubaix
LILLE
Tournai
Ath
Hal
Wavre
Aubers
Fromelles
Herlies
Neuve Chapelle
Festubert
Étaples
Montreuil
Béthune
La Bassée
Givenchy
Loos
Lens
Ablain St. Nazaire
St. Pol
Carency
Souchez
Neuville-St. Vaast
Ablain
Telus
Scarpe R.
Douai
Valenciennes
MONS
Charleroi
NAMUR
Sambre R.
ARRAS
Schelde R.
Maubeuge
Dinant
Doullens
CAMBRAI
Avesnes
Abbeville
Bapaume
Le Cateau
Chimay
Albert
Somme R.
Ancre R.
Ancre
AMIENS
Péronne
Guise
Hirson
Rocroi
Chaulnes
St. QUENTIN
Somme R.
Oise R.
Neufchâtel
Roye
Charleville
MÉZIÈRES
Sedan
Cantigny
Montdidier
Avricourt
Lassigny
La Fère
Noyon
Anizy
Carlepont
LAON
Rethel
Ailette R.
Chemin des Dames
Suippe R.
Rheims
Beauvais
Compiègne
Clermont
Soissons
Vouziers
Aisne R.
Fismes
Gisors
Villers-Cotterets
Senlis
Seine R.
Oise R.
REIMS
Oulchy-le Château
Fère en Tardenois
Ste. Menehould
Suippes
Dormans
Châtillon
Château Thierry
Épernay
Mantes
PARIS
Meaux
Marne R.
CHÂLONS SUR MARNE
Versailles
Fère Champenoise
Esternay
Vitry le François
St. Dizier
Melun
Romilly
CHARTRES
Étampes
Seine R.
Brienne
TROYES
Marne R.
FRANCE
CHAMPAGNE
1
2
3
4
49°
50°
51°
2°
3°
4°
5°
A
B
C
D


WESTERN FRONT CAMPAIGNS
English Miles
0 10 20 30 40 50
Kilometres
0 10 20 30 40 50
Limit of German Advance Sept. 6, 1914
Approx. Front Line Oct. 14-Nov. 16, „
Front Line July 15, 1918
Front Line Nov. 11, 1918.
Direction of Allied Attacks Sept. 1918
Main Railways
OLLAND
Maas R.
Roermond
Maeseyck
Hasselt
Trond
Maastricht
Crefeld
Duisburg
DÜSSELDORF
Rhine R.
Geilenkirchen
COLOGNE
Düren
AACHEN
Bonn
Euskirchen
LIÉGE
Eupen
Verviers
Huy
Malmedy
COBLENZ
Gerolstein
FRANKFURT
Bingen
MAINZ
Mosel R.
Neufchâteau
LUXEMBOURG
TRIER
Arlon
Luxembourg
MANNHEIM
Kaiserslautern
Thionville
GERMANY
Saar R.
Saarbrücken
Briey
Etain
VERDUN
Conflans
METZ
LORRAINE
KARLSRUHE
St Mihiel
Pont-à-Mousson
Morhange
Dieuze
Saarburg
NANCY
Toul
Lunéville
STRASBOURG
ALSACE
Rhine R.
Meuse R.
Moselle R.
Neufchâteau
Mirecourt
St Dié
East of Greenwich 6°
7°
8°
9°
E
F
G
H
1
2
3
4
50°
49°

pearance of the Germans before Liége had caused a modification, which had been foreseen as probable in plan 17. The V. Army (Lanrezac) was moved to its left towards the Sambre, while the IV. (Langle de Cary) took its place about Mézières. A movement of the Germans through Belgium on either bank of the Meuse had been foreseen as probable, but the French staff had not considered it probable that the Germans could dispose of more than three or four cavalry divisions and 22 infantry divisions for this purpose, whereas actually they had five cavalry and 34 infantry divisions (I., II. and III. Armies). The result of the miscalculation of German strength was disastrous. Joffre, believing that if the enemy were strong enough on the left to check his attack in Alsace-Lorraine and on the right to move in force through Belgium beyond the Meuse, he must be weak in the centre, proceeded on Aug. 21 to launch his IV. Army and his III. (Ruffey) in the attack of that centre in the Ardennes. This attack failed on Aug. 23, by which time Joffre had become aware of the realities of the situation (*see* FRONTIERS, BATTLES OF THE).

The Germans, after a first failure of a night assault by their infantry, had entered Liége on Aug. 7, though as the forts still held out, this fact was not known at French headquarters. While those forts were being reduced by German heavy artillery, Von Kluck was completing the arrangements for the advance of his I. Army, which met and defeated the Belgians on the Gette on Aug. 18. On the 20th the first German troops entered Brussels and on the same day they began to bombard the forts of Namur (*see* BELGIUM, INVASION OF). Meanwhile the French V. Army had deployed along the Sambre on either side of Charleroi with its right flank on the Meuse above Namur. This army had been reinforced by Joffre from his right and comprised 13 divisions, (three reserve), one cavalry division and a cavalry corps of three divisions attached.

THE ALLIED EFFORT: AUG. 21–SEPT. 13

On Aug. 21 the concentration of the British expeditionary force was almost completed and it began to move forward from behind the fortress of Maubeuge towards Mons. It comprised four infantry divisions, one cavalry division with an additional infantry and cavalry brigade. The strength of the Allied left wing was therefore approximately $17\frac{1}{2}$ infantry and $4\frac{1}{2}$ cavalry divisions, while the Belgian fortress of Namur formed what was regarded as a strong pivot on its right flank and the French fortress of Maubeuge, hastily improved by the addition of field defences, a support to its left flank.

After the battle of the Gette the Belgian Army had entered into the fortress of Antwerp and Von Kluck had detached two army corps, the III. and IX. Reserve Corps, to watch it and cover his flank and communications. This detachment and the provision of a garrison for Brussels, left for the three German armies of the right wing, the I., II. and III., advancing against the allied left, a force of 30 infantry and five cavalry divisions, as against the French estimate, inclusive of detachments left in Belgium, of three or four cavalry and 22 infantry divisions.

Acting on the information as to the enemy's strength supplied by Joffre, Sir John French's little army reached Mons and its neighbourhood on Aug. 22, expecting to advance further into Belgium. It is often suggested by French writers that the concentration of the British army was tardy, and that to this was largely due the loss of the battle of Charleroi. To this it may be answered that the Germans had not expected that the British could arrive in France so soon, and they were completely surprised by their appearance at Mons, while it is obvious that a further advance would merely have made the British position more precarious than it proved to be. When Sir John French's troops reached Mons, he learned that Lanrezac's V. Army had been attacked on the 21st on the Sambre and had lost the crossings over that river. Late on the 22nd he agreed to stand at Mons, to cover Lanrezac's left, believing that he would not be attacked by more than two army corps.

On Aug. 23 Lanrezac learned of the fall of Namur and that his right flank was dangerously menaced by the appearance of the German III. Army on the Meuse above Namur about Dinant. He therefore ordered a retreat during the night of the 23rd–24th, a decision confirmed the next day by Joffre, who had at last become aware of the true strength of the German armies which were attempting to envelop his left. The enemy had proved to be strong enough both to defeat the two great French attacks on either side of Metz, and to march through Belgium west of the Meuse in menacing force. During the 23rd Sir John French, whose army had withstood the attacks of three German army corps at Mons, became aware that his position, which was far in advance of Lanrezac's left, was untenable, and he too ordered a retreat which began the next morning. Thus the whole structure of plan 17 had collapsed within 10 days of the beginning of the first part of the French main offensive.

Plan 17 Replaced.—Joffre at once formed a new plan to meet the danger to his left wing. He decided to swing back his centre and left, pivoting on Verdun, and to create on his left "a mass capable of resuming the offensive while the others hold up the enemy for the required time." The mass, he explained in an order issued on Aug. 25 was to consist of his IV. and V. Armies, the British Army and a new army, the VI. under Gen. Maunoury, to be created from troops drawn from his right.

This order is the key to the manoeuvres which culminated in the battle of the Marne, for it indicates Joffre's purpose, maintained with rare courage in circumstances of great trial, to answer the German attempt to envelop his left by an envelopment of the German right. The French commander-in-chief hoped to be able to begin this counter-offensive from the line La Fère-Peronne, and with that object began to assemble the new VI. Army behind the Somme, in the neighbourhood of Amiens. But the German pursuit proved to be too vigourous. On Aug. 26 Von Kluck caught up the British II. Corps under Gen. Smith-Dorrien, and left its commander no option but to fight at Le Cateau, though this was contrary to Sir John French's intentions.

Sir John French, believing his army to be in grave danger, and being in some doubt as to the power of the French to help him, thereupon ordered a rapid retreat across the Somme and behind the Oise. Joffre, meanwhile, in order to help the British, had directed Lanrezac to stand and attack Von Bülow's II. Army, which he did in the battle of Guise on Aug. 29. Lanrezac requested the co-operation of the British I. Corps, under Sir Douglas Haig, which Haig was prepared to give, but this was forbidden by Sir John French, who held that an immediate further retreat was necessary. This retreat necessarily involved the French VI. Army on the British left and as the French IV. Army had continued also to retreat while Lanrezac was fighting at Guise, the position of the French V. Army became highly dangerous, as it was threatened on both flanks.

Von Moltke's Blunder.—On Aug. 23 the German right had reached positions in advance of that allotted to it in the Schlieffen plan, and in the following days a succession of reports of great victories poured into German headquarters. Von Moltke appears to have been deceived by these reports into thinking that the Allied armies had been decisively defeated, and under that impression he took what proved to be a fatal step. Before the whole of the Russian armies had been concentrated, two had advanced into East Prussia in order to relieve the pressure upon their Western Allies. The comparatively weak German forces opposed to them had been defeated at Gumbinnen on Aug. 20 and there was alarm in East Prussia and even in Berlin.

To relieve the situation on the Eastern front Von Moltke on Aug. 25 ordered two army corps, one from the II. and one from the III. Army to East Prussia, and at the same time it was necessary to detach another corps from the II. Army to besiege Maubeuge. Thus the German right flank, which was required to make the decisive effort, was weakened by six divisions, a force about equal to Sir John French's army, which had been increased by one division on the eve of the battle of Le Cateau. Further, Von Moltke, who was in failing health and physically incapable of personally visiting critical points on the long front, was unable to direct the manoeuvres of his right wing from his distant headquarters, which were established, first at Coblenz and subsequently at Luxembourg.

To obviate this difficulty Von Kluck's I. Army had been placed under the direction of Von Bülow, who commanded the II. Army. This was faulty organisation, since a man occupied with the executive command of one body cannot successfully also direct another. The arrangement, therefore, broke down and Von Kluck was released from Von Bülow's control. When the latter was attacked by Lanrezac at Guise he appealed for help to Von Kluck, who on his own initiative, began on Aug. 30 to wheel inwards, from the neighbourhood of Amiens, in an endeavour to strike at Lanrezac's flank. By this manoeuvre Von Kluck changed direction so as to bring his line of march, which according to the Schlieffen plan had been directed to the west of Paris, to the east of the French capital and he neglected both the French VI. Army and the British, who retreated almost unmolested after the battle of Le Cateau.

On Sept. 1 Joffre, still preoccupied with the situation of his V. Army, which had not been freed from its embarrassments, issued an order for the continuance of the retreat. The left was, if necessary, to retire behind the Seine and Joffre was prepared to abandon Paris rather than his plan of a combined counter-offensive by all the armies of his left wing. This proved in the event to be unnecessary, for the VI. Army had fallen back within the defences of Paris and on Sept. 3 General Gallieni, the Governor of Paris, discovered that Von Kluck was making a flank march to the east of Paris and while preparing Maunoury to attack the German right, got into communication with Joffre and urged an immediate offensive. By the evening of Sept. 4 the V. Army had crossed the Marne and had sufficiently freed its flanks from danger to enable it to play its part in the manoeuvre which Joffre had envisaged since Aug. 25. So on that evening the French commander-in-chief issued the orders which brought about the battle of the Marne (*see* MARNE, FIRST BATTLE OF THE).

Changes in Commands.—Before that battle was joined Joffre had made wholesale changes amongst his generals. Ruffey gave place to Sarrail in command of the III. Army, Franchet d'Esperey succeeded Lanrezac in the V. Army, and a large number of those who at the outset had commanded corps and divisions were removed. Away on the right, too, an event had taken place which had great influence on the issue of the battle of the Marne. Von Moltke, still obsessed by the extent of his victories on the frontiers, believed that it would be possible to carry out a double enveloping movement, and with that end in view instructed the Crown Prince Rupprecht to endeavour to break through to Nancy. That effort, begun on Sept. 4 and lasting for three days of fierce fighting, was broken by Castelnau's II. Army on the Grand Couronné. Thus the German plan which had envisaged the complete defeat of the French armies within 40 days had broken down. The fact was for a long time kept secret from the German people, but one of its immediate results was the replacement of Von Moltke by Gen. von Falkenhayn as Chief of the General Staff.

Operations in Belgium.—We must now return to Belgium, where the Belgian Army was left within the defences of Antwerp, watched by two German reserve corps. That army began on Aug. 24 a sortie to assist the British and French forces fighting at Mons and on the Sambre. Good progress was at first made and the fighting was continued throughout the 25th, but on the 26th, when news was received of the retreat of the Allies and of Joffre's intention to resume the offensive later, it was determined to return within the lines of Antwerp and to await that event. A second and more important sortie took place between Sept. 8, 9 and 13 and its beginning therefore coincided with the decisive day of the battle of the Marne.

Early in September the Belgian staff had information that the Germans intended to move the IX. Res. Corps and a division of the III. Res. Corps to France and to replace them by Marines and Landwehr troops. To prevent this the sortie was begun on Sept. 9 and again began successfully. Its effect was to cause the departure of the IX. Reserve Corps to be delayed, while that of the division of the III. Res. Corps was definitely cancelled. Further, a division of the XV. Corps on the way from Alsace to the extreme German right was diverted to Antwerp. These movements checked the progress of the Belgians, who retired on Antwerp on the 13th, but the general effect of the sorties was to make the Germans feel that Antwerp was a thorn in their flank, which could not be neglected and from this second sortie may be dated the initiation of the German plans for the reduction of the Belgian fortress (*see* ANTWERP, SIEGE OF).

FIXING OF THE FIRST LINE: SEPT.–DEC. 1914

The German armies of the right, retreating from the Marne, stood behind the Aisne. The French re-occupied Amiens and Soissons on Sept. 13 and Reims on the 14th.

The Race to the Sea.—The battle of the Aisne then opened and while it was in progress there began that curious movement of both armies northwards which has been called the "Race to the Sea." During the advance to the Aisne Joffre had impressed upon Maunoury the importance of outflanking the German line and with this object the VI. Army began an attack on either bank of the Oise between Carlepont and Noyon. This was checked by the timely arrival of the IX. Res. Corps from Belgium, and Joffre thereupon prepared for a new outflanking effort under a reconstituted II. Army commanded by Castelnau.

Between Sept. 22 and 24 Castelnau's attacks were stopped by the transfer of German troops from their left flank and the French line settled down into the beginnings of trench warfare through Lassigny, just east of Roye, through Chaulnes to a point on the Somme a few miles east of Bray. Joffre's third attempt to outflank his enemy consisted in the appointment of Foch to the general direction of the operations on the French left and the creation of a new X. Army under Gen. Maud'huy to operate north of the Somme as far as Arras. Maud'huy began his effort on Oct. 2, but so far from being able to turn the German flank he found himself struggling desperately to save Arras. For Falkenhayn had in his turn determined on a great effort to envelop the French and had assembled in Artois a VI. army composed of troops withdrawn from Alsace and Lorraine, where their places were taken by Landwehr. On the flank of the VI. Army eight German cavalry divisions under Von der Marwitz were to sweep across Flanders to the Belgian coast, while the siege of Antwerp was to be pressed to a conclusion.

The result of the collision between the French X. Army and the German VI. Army was to establish the Allied trench line during the first week of Oct., east of Albert, west of Bapaume, along the eastern outskirts of Arras, the western slopes of the Vimy ridge, of which the greater part remained in possession of the Germans, as did the mining towns of Lens and Loos. Meanwhile the German cavalry sweeping round northwards into Flanders had occupied Ypres and Bailleul and sent patrols through Hazebrouck, west of which they were checked by French cavalry supported by territorial infantry and by a brigade of British Marines, which had been landed at Dunkirk on the night of Sept. 19–20. A battalion of this brigade occupied Lille on Sept. 28 but was withdrawn on Oct. 1 to move with the remainder of the brigade to take part in the defence of Antwerp (*see* ANTWERP, SIEGE OF).

British Reinforcements.—Towards the end of Sept. the British Govt., anxious to do everything possible to save Antwerp, was, besides sending reinforcements directly to the Belgian fortress, preparing an expedition for the raising of the siege. This expedition, consisting of the 7th Regular Div. and 3rd Cav. Div.,[1] under Sir Henry Rawlinson, had landed at Zeebrugge on Oct. 6. Meanwhile Sir John French being desirous of regaining touch with the Channel coast and of shortening his line of communication, had suggested to Joffre at the end of Sept. that his army should resume its original position on the Allied left.

When the menace of the German enveloping movement had become clear, the original British bases at Havre and Boulogne had been abandoned, and had been transferred to St. Nazaire on the Atlantic. The British communications with the Atlantic

[1] The 6th Regular Div. had joined Sir John French on the Aisne, and the original cavalry division of the expeditionary force had been expanded into two.

were necessarily impeded by French cross traffic and it would be obviously desirable to reopen the original bases and establish freer and shorter lines of communication. Joffre accepted this view, the British trenches were gradually taken over by the French during the first fortnight of October, and the whole British Army was transferred to Flanders, arriving fortuitously in time to meet another great German attempt at envelopment. This movement was screened by the arrival near Béthune of the French XXI. Corps from the south, which pushed back the right of the German cavalry, only to be stopped in its turn near and south of La Bassée by the German XIV. Corps, which had come up from Metz.

Retreat of the Belgians.—Thus when the British II. Corps detrained at Abbeville on Oct. 8 and 9 the trench line had become stabilised as far to the north as the La Bassée canal. The first development of Falkenhayn's turning movement had been definitely checked and there seemed a reasonable prospect that the British Army arriving in Flanders in support of the French cavalry screen would succeed in overlapping the German right. While these movements were taking place, two events had materially altered the situation in Flanders. On Oct. 10 Antwerp capitulated and the greater part of the Belgian Army retreated along the west to take refuge behind the floods of the Yser valley which had been created by opening the dykes. Sir Henry Rawlinson's force being too late to assist in the defence of Antwerp, assisted in covering the retreat of the Belgians and moved through Bruges and Ghent towards Ypres, while in order to assist the Belgian Army further, a brigade of French Marines had occupied Dixmude.

On Oct. 13 the British 3rd Cav. Div. had re-occupied Ypres and on the same day the Belgian Govt. was transferred to Havre. On Oct. 13, too, Lille, which had been attacked by the Germans on Oct. 8, capitulated. On the day before the fall of Lille, Smith-Dorrien's II. Corps, swinging round with its right on Béthune, had begun to drive back the German cavalry towards the La Bassée-Lille road. By Oct. 17, with a French cavalry corps under General Conneau on its left, it had captured the villages of Herlies and Aubers on its left, and was approaching La Bassée with its right. It was then attacked by the right of the German VI. Army, which was constantly being extended as troops came up from Lorraine.

British Advance.—The British III. Corps under Gen. Pulteney, on its way northwards from the Aisne, had on Oct. 11 begun detraining at St. Omer and Hazebrouck and marched towards Bailleul; driving German cavalry supported by infantry detachments out of Meteren it captured Armentières on Oct. 16, but was unable to advance beyond the outskirts of that town. On Pulteney's left the British Cav. Corps under Allenby, which had marched from the Aisne and reached St. Pol on Oct. 9, moved thence northwards and pushing back German cavalry from the Southern Flanders ridges, occupied Mont des Cats, Mont Noir and the important hill of Kemmel, and obtained a footing on the Messines ridge. On Oct. 19 the I. British Corps under Sir Douglas Haig had concentrated at Hazebrouck, whence it marched towards Ypres and effected a junction east of that town with Rawlinson's force.

On Haig's left a new French VIII. Army under Gen. d'Urbal was coming into existence. This at first consisted only of the Marine brigade already mentioned, a cavalry corps under Gen. de Mitry, and two divisions of territorials, but it was rapidly reinforced. The general direction of the operations of the Allied left was in the hands of Foch, who acted as Joffre's representative. By Oct. 20 battle was joined along the whole front from La Bassée, along the Aubers ridge, just east of Armentières, along the Messines ridge, east of Ypres to Dixmude and thence to the sea near Nieuport. Towards this front both sides were hurrying reinforcements. The British Army was strengthened by the arrival of selected battalions of territorial infantry and of an army corps from India, composed of both British and Indian troops, while on the German side four Army-corps, created since the beginning of the War, were advancing from Brussels towards the Yser. In such circumstances, each side still hoping to be able to outflank the other, the first battle of Ypres began (*see* YPRES, BATTLE OF).

Position at End of 1914.—With the close of that battle and the withdrawal by the Germans of troops for the Eastern front, they adopted perforce a defensive attitude along the whole front. For the Allies there followed necessarily some weeks of rest for the exhausted troops and a period during which the Franco-British forces which had become much involved during the battle were sorted out. The result of these readjustments was that Haig's corps, withdrawn from Ypres, took over the La Bassée front with the Indian corps on its left; Pulteney's III. Corps still held the Armentières section, reinforced by the arrival of an 8th Regular Div. from England and Smith-Dorrien's II. Corps occupied the lines opposite the Messines ridge with its left fronting Wytschaete. Thence northwards, d'Urbal's VIII. Army held the Ypres salient, the Belgian army the line of the Yser and a French detachment watched the coast.

These arrangements completed, the Allied commanders-in-chief planned to take advantage of the weakening of the German armies in the West by endeavouring to penetrate the enemy's defences. There resulted a number of minor enterprises carried out by the French, mainly on the Lorraine front and by the British against the Messines ridge. These endeavours were entirely unsuccessful and served only to inform the Allied leaders that the problem of breaking through lines of trenches protected by barbed wire, defended by resolute men, equipped with quick-firing rifles and machine guns, and supported by modern artillery, was both formidable and new, and required a readjustment of all pre-conceived ideas of the methods of attack. It was in this atmosphere that the year 1914 closed on the Western front.

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II. TRENCH WARFARE, 1915–7

While weary British troops were handing over their lines in the salient to their French comrades at the close of the first battle of Ypres (*see* YPRES, BATTLE OF), and they had time to think of other things than the grim struggle that had just ended, it dawned upon them that the war in the west had entered upon a new phase. The trench barrier had been completed from the North Sea to the Swiss frontier, and a war of movement and manoeuvre, for which most of them had been trained, had become impossible. This was a development which had not been foreseen by the military world of Europe and it took it by surprise. For the Germans this surprise was less unpleasant in the winter of 1914–5 than for the French and the British. The fortifications of the French and Russian frontiers had compelled the Germans to study closely the art and science of siege warfare and to make preparations for such warfare. They had assimilated the experiences of the Russo-Japanese War and had learnt from them to their profit.

The British Army was in very different case. Its chiefs before the War believed that it would be employed only in a war of movement, and the study of siege warfare had been confined to a small body of engineers, amongst whom it was largely theoretical. All the money to be found for the Army Votes had been used in the training and equipment of the Expeditionary Force, and there was none left for the provision of the material required for the attack of fortresses. The cost even of hand grenades, with which experiments had been made when the reports of

British observers in Manchuria came home, was held to be prohibitive. For these reasons the winter of 1914–5 was for the British infantry in France and Flanders a period of unmitigated suffering.

New Allied Plans.—While the soldiers in front were enduring and slowly learning to mitigate the horrors of trench warfare, those behind were planning. There were not lacking active brains in Paris and in London who saw that the assaults upon the ever-widening barriers of barbed wire and the evermore serried lines of trenches must prove a slow and bloody business. These brains sought eagerly for a way round the barrier which would lead to a speedier and less costly victory, and so began the controversy between "Easterners" and "Westerners" which endured while the War lasted.

There were signs early in 1915 of preparation for an Austro-German attack upon Serbia; and Mr. Lloyd George, inspired by his friends in France, proposed at once to save a weak ally and to attack the weakest link in the opposing chain by transferring the bulk of the British army to the Balkans and reinforcing it with the new armies as they became ready for the field. Both the French and the British Commanders-in-Chief hotly opposed this proposal. The lines of communication through Serbia were long and difficult, and it was very doubtful whether they could be made to maintain an adequate force. The transference of the British army to the Balkans must in any event have taken many months, during which it would have been condemned to an inactivity from which the enemy on the inside of the circle, with not only shorter but better communications, would certainly have profited. The Balkan enterprise was therefore condemned, and the immediate outcome of the controversy on the British side was the starting of the Dardanelles adventure.

Joffre's plan was simpler. He desired to attack on the Western Front at the earliest possible moment and with all possible force. It was argued at the time, and has repeatedly been argued since, that it would have been better to have awaited the development of the British Army, the increase of the Allied artillery, the improvement of their stock of munitions and to have employed the interval in gaining advantages over less formidable foes in other theatres of war. To these arguments Joffre's answer was that the Germans were in occupation of a great part of France, that near Noyon they were only 50 m. from Paris, on the Somme they were barely 20 m. from Amiens, the main junction connecting the British and French in Flanders and Artois with the remainder of the French troops, while farther north they were little more than 40 m. from Calais. The French Commander-in-Chief maintained that the security of the Western Front must be a paramount consideration in Allied strategy, and that to secure the position in the West it was necessary to drive the Germans farther back.

Early Battles in 1915

Sir John French was in general agreement with Joffre's views. He at first desired a combined naval and military attack upon the coast of Belgium, but on receiving representations from Lord Kitchener that neither the men nor the munitions required for this operation could be made ready in time, he abandoned this proposal and set himself whole-heartedly to co-operate in Joffre's plans. These plans comprised a grand attack by the British Army north of the La Bassée canal and by the French northern group of armies under Foch on the front between the La Bassée canal and Arras. The hope was that this attack would give the Allies the Vimy Ridge and compel the Germans to evacuate Lille. In order that Foch might have the forces necessary for such a battle it was agreed between the commanders-in-chief that the British should relieve the French troops, who had occupied the Ypres salient when Haig's men had been withdrawn from it after the first battle of Ypres. Sir John French had at the end of 1914 received one more regular British division, the 27th, made up by Kitchener from foreign garrisons, while another, the 28th, arrived early in January. The 1st Canadian Div. disembarked in France in the second week of February. This gave him a total of 13 infantry and five cavalry divisions, besides a number of selected territorial battalions. These reinforcements allowed him to form his command into two armies, the first under Sir Douglas Haig and the second under Sir Horace Smith-Dorrien, and at the same time to extend his front gradually north into the Ypres salient.

Battle of Neuve Chapelle—The British Army, which like other European armies, had been trained to believe in the supreme virtue of attack, had since the beginning of the War, with the exception of the short period of the advance to the Marne and the Aisne, been compelled to fight defensively, and Sir John French desired to give it a wider experience of attack upon entrenchments. For this purpose he had been carefully saving up artillery ammunition by strictly limiting the amount to be expended in the routine of trench warfare, and he calculated that he would have sufficient at his disposal to allow him to engage in a considerable battle early in March. He entrusted the execution of this battle to Haig's I. Army, which was directed to attack the German lines near Neuve Chapelle, an operation which it was hoped would result in a favourable position for the further battle which was to be undertaken later in co-operation with Foch. The battle of Neuve Chapelle opened on March 10 with what was in those days held to be a very heavy bombardment. This bombardment was followed by an infantry assault, which was at first successful, and carried the village of Neuve Chapelle, but was soon brought to a standstill by the enemy's machine-guns. In this battle the British first experienced the difficulty of bringing up reserves at the right time through roads blocked by the débris of battle and over ground scarred by trenches and torn by shell-fire. On the whole, however, both the French and the British were impressed by the result of the bombardment, which was held to promise great things when there should be more guns and more ammunition. Preparations for further battles therefore went forward (*see* Neuve-Chapelle, Battle of).

The Germans, guessing what was on foot, were not slow to interfere with these preparations. On April 17 a portion of Smith-Dorrien's II. Army attacked and gained a footing upon Hill 60, an important feature on the south face of the Ypres salient. The Germans, counter-attacking, promptly regained possession of the hill and followed up this success by a far more serious enterprise on April 22. By then Foch's preparations for the attack on the Vimy Ridge were far advanced, and to obtain the troops he needed for the coming battle he had greatly weakened the French forces left in the north portion of the Ypres salient. Against this portion the Germans launched waves of poison gas discharged from cylinders, which completely overwhelmed the French troops, who had no protection against the gas. The flank of the 1st Canadian Div. was completely exposed, and for a short time a definite breach was created in the Allied line. Fortunately the Germans were unprepared for the extent of their success, and had not the troops at hand to take immediate advantage of it, while the gallantry of the first Canadian Div. and the 28th Div. held the enemy at bay until reinforcements could be brought up. The first complete British Territorial division to arrive in France, the 46th North Midland Div., was fortunately in the neighbourhood, and these and other reinforcements, some contributed by Foch from the reserves he was holding in readiness for his battle, sufficed to save Ypres and to patch up a new line.

But the second battle of Ypres, if it did not give the Germans all the success they might have attained had they been ready to follow up the first success, at least gained a great part of their purpose by weakening the forces and exhausting the meagre supply of ammunition which the Allies were accumulating for their projected battle.

Fromelles and Festubert.—The battle began on May 9 with an attack by the British I. Army under Haig on either side of Fromelles, and an attack by d'Urbal's French I. Army, under the direction of Foch, on a much wider front which extended from the Scarpe to the north of the Souchez. The British attack made very little progress and it was soon evident that the

preliminary bombardment had not sufficed to destroy sufficiently the enemy's defences, or, what was of greater importance, to overcome his machine-guns. Sir John French, however, felt himself bound by his agreement with Joffre and Foch to keep the enemy occupied on his front as long as possible, and the battle of Fromelles became merged in the battle of Festubert, by bringing the front of attack slightly south into what it was hoped would prove more favourable ground.

The experience of Festubert was, however, hardly more favourable than that of Fromelles, for again the German machine-gunners checked all real progress, while the lack of artillery ammunition became more and more felt. The situation was made more difficult in this latter respect by renewed German attacks in the Ypres salient upon the II. Army, now under the command of Sir Herbert Plumer. The situation of the British Army in Flanders was somewhat eased by the arrival of five more divisions of territorials, followed by the first of the New Army divisions, the 9th, but it was lack of shell rather than lack of men which forced Sir John French to stop his attacks, and the battle of Festubert petered out on May 25th.

French Successes.—Meanwhile, on the British right, Foch was making encouraging if slow and very costly progress. In the battle of the Souchez the villages of Ablain St. Nazaire, Carency, Neuville St. Vaast and Thélus were carried by d'Urbal's men, who fought their way doggedly up the west slopes of the Vimy Ridge. The French found the German machine-guns to be the chief obstacle to progress and the prime cause of casualties, particularly in the villages, in which the enemy's machine-gunners fought indomitably from cellar to cellar and in a certain elaborate series of works which became known to fame as the Labyrinth. When the British ceased their attacks on May 25, Foch had made enough headway to encourage him to believe that he could gain the whole ridge, and he determined to continue the battle alone. But for this he wanted more troops, and an extension of the British front, which would set free Frenchmen, while both he and Joffre were fearful lest the new Army divisions preparing to leave England should be sent to the Dardanelles.

British Front Extended.—In May Joffre, therefore, wrote to Kitchener that he proposed to renew the attempts on the Arras front to take Vimy Ridge, while the British Army fought on Foch's left and he made his main attack in Champagne to the east of Reims. To obtain the French troops for this campaign he required the British Army to extend its front to the right and left, and also to relieve de Castelnau's VI. Army on the Somme front. The remainder of the summer was occupied by these changes, which became possible as the New Army divisions arrived from England. The 2nd and 3rd of these to reach France disembarked at the end of May, and six more before the end of July, so that by then the four divisions and the cavalry division of Mons had in 11 months increased to 28 divisions and five cavalry divisions. These reinforcements enabled a British III. Army to be formed under Sir Charles Monro, which took over some 17 m. of front from a point to the south of Arras as far as the Somme, eventually extending its lines to the south of that river. Haig's I. Army prolonged its right south of the La Bassée canal to the neighbourhood of Lens, and thus found itself facing the open plain of Loos, simultaneously the II. Army, now under Plumer, who had taken Smith-Dorrien's place, relieved the remaining French troops in the Ypres salient and brought its left into contact with the right of the Belgians.

The Autumn Campaign of 1915

While these movements were in progress, vast preparations were taking place on the battle-front. Guns, trench mortars, shells and military stores of all kinds had accumulated in hitherto undreamt-of quantities. Joffre and his staff had it in their minds at this time that they were engaged in operations in the nature of a huge siege, and the essential was to blow a practicable breach in the enemy's lines through which the infantry could be poured to the assault.

A study of the previous battles of trench warfare had convinced them that with sufficient guns and sufficient ammunition this was possible. The output of the French factories had been increased enormously, and though the British Ministry of Munitions had hardly yet begun to be productive, still the supply of heavy guns and shells for the British Army had been greatly increased and it was equipped to reply effectively to the German gas. The one fly in the ointment was that there had been a renewal in the British Cabinet of the controversy between the "Easterners" and the "Westerners," and Mr. Churchill had pressed with all his eloquence and skill for a decisive campaign which should open the road to Constantinople. The result was a compromise, and three of the New Army divisions had gone to the East. Some compensation for this was obtained by the arrival of two more New Army divisions in France, and by the formation of a Guards' division, which had been made possible by the creation of new battalions of Guards and the replacement of those already in France by other battalions. This gave Sir John French an additional army corps, which he kept in his hands as a reserve.

Allied Offensive in Champagne and Artois.—Joffre opened his autumn campaign on Sept. 25. In addition to his great attack in Champagne, Foch with the French X. Army attempted once more to storm the Vimy Ridge, while Haig's I. Army attacked between the La Bassée canal and Lens, in conjunction with a secondary British attack to the north of the canal and demonstrations on the front near Armentières. The general plan of the north battle was that Foch, having carried the Vimy Ridge, should advance east to the south of Lens, while Haig pushed east through Loos to the north of Lens and joined hands with Foch beyond that town. In this way the Allies would avoid the mass of ruined buildings and miners' cottages which composed the town and would form admirable refuges for the German machine-gunners.

The tactical methods to be employed on both the south and north battlefields were similar in conception, that is to say, there was to be a great rush forward of the assaulting infantry as soon as the attack had been adequately prepared by the artillery, and the reserves were to follow hard after the first-line troops. Only in the matter of the preparation of the attack was there any essential difference in the methods to be employed by the British and the French. The former had determined to replace an intense bombardment by a discharge of gas from cylinders similar to that from which they had suffered in the second battle of Ypres.

Of the British share in the general plan, the demonstrations in front of Armentières proved quite ineffective, while the attack north of the La Bassée canal failed. On the front opposite Loos, however, the discharge of gas surprised the Germans and overcame the resistance of their first-line troops, though it caused some casualties among the British themselves and made it difficult to direct the attack. Despite this, the first wave of British infantry passed through and beyond Loos, when it appeared that they only needed the prompt arrival of the reserves to secure a very considerable success. Sir John French had, however, kept these back until he saw how the battle progressed, and when they arrived late in the evening the New Army divisions which formed two-thirds of the reserve found great difficulty in making their way through the confusion of the battlefield under conditions entirely strange to them, and were unable to confirm the first success won, so that, though Loos was held, German counter-attacks recovered a considerable part of the ground gained, and in particular the important Hill 70, which dominates Loos on the north (*see* Loos, Battle of).

Worse still, Foch's attack on the Vimy ridge failed almost completely, and the Germans remained in possession of the crest. This alone condemned the north attack to failure, for the British front of battle was not large enough to insure a breach in the enemy's defences sufficiently wide to be exploited successfully. The remainder of the battle of Loos, which lasted until Oct. 15, resolved itself into the repulse of a number of fierce German counter-attacks, which ended in

mutual exhaustion, with the British in possession of the salient extending round Loos to the La Bassée canal.

The great battle in Champagne was an even more severe disappointment because more had been expected. The first news from the field aroused high hopes. The first two German lines of defence were carried on a wide front, and many prisoners and guns were captured, while on the fourth day of the battle the third German line, which was believed to be the enemy's last system of defence, was for a time breached near Sainte Marie; but again the solution of the problem of bringing up reserves at the right time and in good order was not found, while the enemy's reserves, which came up fresh through country which had not been fought over, arrived in time to fill the breach. The battle of Champagne ran on into Nov., developing into a series of struggles for tactical points of importance, but ended with no material change in the position won by the French at the end of the fourth day of the battle.

So the campaign of 1915 closed on the Western Front, with the Allies still asking themselves how it was possible to get through the trench barrier and drive the Germans from France and Belgium. The great bombardment followed by the assault in mass had failed, and some other method of attack was required.

Allied Organisation Revised.—Ere the year closed a new problem had developed in the Near East which had its repercussion on the Western Front. German, Austrian and Bulgarian forces had overrun Serbia, and the Allied Governments had decided to send a relief expedition to Salonika. Part of the troops required for this new enterprise came from the Dardanelles, but more were needed and these had to be supplied from the Western Front. Five divisions of French troops under the command of Gen. Sarrail were ordered off and accompanied by the three British divisions of the III. Army which had been holding the line south of the Somme, the 27th, 28th and 22nd. It was also decided to spare the two divisions of Indian infantry, which had proved such a timely reinforcement at the time of the first battle of Ypres, the horrors of another winter of trench warfare in Flanders, and they were sent off to Mesopotamia.

This reduction of the British Army was made good by the arrival in France before the end of the year of the 2nd and 3rd Canadian Divs. and the 16th Irish Div., and of the 21st, 23rd, 24th, 25th, 26th, 36th and 38th New Army Divs., so that the strength of the British Army in France and Belgium stood at 36 divisions and five cavalry divisions. The Allies on the Western Front had therefore at this time about 3,100,000 men, opposed to 2,000,000 Germans. These figures gave rise to anxious discussion as to what superiority of numbers was necessary to ensure success under conditions of trench warfare, and whether and how the Allies could obtain the necessary superiority.

While these discussions were going on important changes took place in the Allied command. Joffre had hitherto been nominally chief of the French General Staff. He was now definitely appointed commander-in-chief of the armies of the northeast, with de Castelnau as his chief-of-staff. In the British Army Sir John French was brought home to command the troops in Great Britain and was succeeded by Sir Douglas Haig, with Gen. Kiggell as his chief-of-staff, while Sir William Robertson, who had been chief-of-staff to French, became Chief of the Imperial General Staff at the War Office.

Operations in 1916

In Dec. 1915 the first serious attempts to obtain unity of action between the Allies took place, and a conference of commanders-in-chief and chiefs-of-staff of the British, French, Belgian and Italian Armies, attended also by representatives of the Russian and Japanese Armies, was held at Joffre's headquarters. At this conference it was agreed to attack the enemy as early in 1916 as possible, sufficient time being allowed for the training of the New Army divisions that the British Army was receiving, and for the re-equipment of the Russian armies. These plans, however, never matured, because the enemy anticipated them, and it is therefore unnecessary to refer to them further.

During Dec. 1915 and Jan. 1916 the Germans developed considerable activity along the front and made local attacks at Nieuport on the North Sea coast, against more than one point in the Ypres salient, at Givenchy on the Vimy Ridge front, on the Somme, and in Feb. on the Alsace front. The majority of these attacks took the form of experiments in various methods of bombardment which the Germans wished to test in view of a greater effort which they were planning. That effort took the form of a great attack upon Verdun (*see* Verdun, Battle of) which began on Feb. 21.

Both commanders-in-chief were agreed that the principles on which the plans of battle in 1915 had been drawn up required modification. It was seen that the analogy of the great siege did not hold, that something more was required than to blast a great breach in the enemy's lines and then to launch a great assault. The something more was the defeat of the enemy's reserves, which came up fresh and in good order to meet troops when the assault had been thrown into some confusion. It was agreed, therefore, that the first object of battle should be to draw in and exhaust the enemy's reserves, and that until that object had been achieved no decisive success could be expected. So long as the enemy continued to attack Verdun, it would, on this principle, be to the advantage of the French to endure these attacks provided always that the enemy gained no success which would affect seriously the strategical position on the whole front, and provided that the exhaustion of the French man-power was not excessive.

Joffre therefore proposed to fight defensively at Verdun as long as possible, but to be ready to strike back as soon as the situation there appeared to him too dangerous, or as soon as the French Army was approaching the limits of endurance. He therefore asked Haig not only to relieve the French X. Army on the Arras front, but to prepare to attack north of the Somme on a front as wide as the resources of the British Army would permit, and undertook to support that attack with a French attack south of the river on a scale which would depend upon the effect of the battle of Verdun upon the French Army. (*See* Verdun, Battle of.)

Battle of the Somme.—Between Jan. and July the British strength in bayonets and sabres grew from 450,000 to 660,000, and there was a more than corresponding increase in artillery and aircraft. This enabled Haig to fall in completely with Joffre's wishes, and as soon as the relief of the French X. Army was completed he set about preparing for the great attack on the front north of the Somme. The growth of the armies made necessary the creation of a IV. Army under the command of Sir Henry Rawlinson. The III. Army was now commanded by Sir E. Allenby, and Sir Charles Monro, who had gone out to supervise the evacuation of the Dardenelles, returned to command the I. Army. British troops now held a continuous line from the Yser canal to the Somme, and were actively preparing to take upon themselves more of the brunt of the war on the Western Front, a burden of which nearly seven-eighths had hitherto fallen on their French comrades.

In the latter part of May the German Crown Prince redoubled his attacks on the Verdun front, and on the 21st the Germans stormed the Mort Homme hill on the left bank of the Meuse, for which they had been struggling for weeks. Pétain at once called Joffre's attention to the gravity of the situation, and pressed for an early beginning of the counter-offensive on the Somme, but Joffre was anxious to give Haig as much time as possible for the training of his troops, and made Pétain endure yet longer. Fire from the Mort Homme hill had long impeded German progress on the right bank of the Meuse, but with the hill in their possession the enemy in the beginning of June began to press hard on that bank and on the 7th captured Fort Vaux. Thereupon Pétain renewed his representation to Joffre, who in consultation with Haig decided that the battle of the Somme should begin on July 1. The preliminary bombardment was begun a week earlier, on June 24, the day on which the Ger-

mans, after capturing Fort Thiaumont, stormed the village of Fleury and attained the farthest point in their progress towards Verdun.

The battle was fought out in three phases, the first being the struggle up the slopes from the valleys of the Ancre and of the Somme to the south crest of the Somme plateau, the second the struggle for possession of the plateau, the third phase consisting of the advance down the north slopes. The first phase was consummated by a brilliant night attack by the IV. Army on July 14, and on July 17 the British and French troops north of the river were abreast of the French south of the Somme, the French having for some time been established opposite to Péronne. The whole front of attack could again move forward together. The econd phase constituted a long series of fierce struggles, the Germans bringing up more and more troops and disputing every yard of ground, so it was not until Sept. 9 that the British, with the French on their right, were able to look down upon the north slopes of the plateau and the plains beyond.

Progress of the Battle.—By this time two of the objects for which the battle had been fought were gained. The Germans, forced to transfer troops to the Somme, had to relax their pressure on Verdun. The French retook Fort Thiaumont on June 30, while throughout July they slowly regained part of the ground which had been won from them, and on Aug. 17 drove the enemy out of Fleury. Verdun was no longer in danger, and Pétain and Nivelle were able to plan at leisure counter-attacks on a more extensive scale. The second object of the battle of the Somme, the exhaustion of the enemy's reserves, was being obtained as surely. When the battle began, the front attacked by the British was held by six German divisions, that attacked by the French by two. In the two months 36 German divisions had been engaged on the British front, 18 on the French. In the six months of Verdun the Germans had employed 43 divisions in battle, so that their defence on the Somme was far more exhausting than their attacks at Verdun.

At the end of Aug. the failure of Falkenhayn's plans was publicly admitted by his supersession by Hindenburg, with Ludendorff as his chief assistant. The latter, after visiting the fields of Verdun and the Somme, found the German position on the Western Front to be one of great gravity, and the chief problem confronting him to be how to stop " the progressive falling off " of the German fighting power. The situation of the Allies had improved marvellously since June, when men were wondering how long it would be before the Germans entered Verdun. Not only had Verdun been saved and the Germans been forced to fight desperately on the defensive, but the Italians had driven back the attacking Austrians in the Alps and had then passed themselves to attack on the Isonzo. On the Russian front Brusilov had won great victories on the Bukovina and Rumania had entered the war, too late certainly to profit by Brusilov's success, but none the less adding apparently another ally to those who confronted the Central Powers. The whole machinery of the Allies was, for the first time, simultaneously at work, and Joffre's strategy appeared to be triumphant.

It was in these encouraging circumstances that the third phase of the battle of the Somme began on Sept. 15. The attack of that day was made famous not only by the successes won, which were considerable, but by the fact that tanks then made their first appearance in battle.

Despite the employment of tanks, and despite the splendid valour of the infantry of the New Armies, the resistance of the enemy was not broken in the third phase of the battle of the Somme. The days were growing shorter and the weather became uncertain, while the enemy, drawing troops from all parts of the front to prevent his line from breaking, fought with fine courage. By. Nov. 17, when rain and mud put an end to the battle, the Germans had engaged no less than 127 divisions. The enemy's reserves had indeed been worn down; in the valley of the Ancre he was hemmed by Gough's V. Army into an awkward salient, but the weather had broken and it was too late to reap the harvest on the battle-front. The first fruits of the Somme were garnered elsewhere.

The Nivelle Method.—On Oct. 24 Nivelle began an attack on the right bank of the Meuse, and on the following day recaptured Fort Douaumont. This conspicuous success was followed by the recapture of Fort Vaux on Nov. 2. The battle ended in a complete victory for the French, six French divisions overcoming seven German divisions at surprisingly small cost. Nivelle and Mangin, who commanded the army corps engaged, became the heroes of France. The victory was largely due to the skillful handling of massed artillery, and the Nivelle method became famous. Its fame was extended when, on Dec. 14, a second attack won an even more brilliant success, which made Verdun quite secure and brought in 11,387 prisoners and 115 guns, again at small cost.

When the statesmen of Paris and London compared the results of these two battles at Verdun, which had resulted not only in important gains of ground but in the capture in a few days' fighting of more than 17,000 prisoners, with the slow bludgeon work of the Somme in which the British Army in four and a half months had captured 38,000 Germans at a tremendous price, they began to think that they had at last discovered the man for whom they were looking so anxiously.

Operations in 1917

On Nov. 11 1916 Joffre assembled his second conference of commanders-in-chief to consider plans for the following year. It was agreed that the Germans were in great difficulties on the Western Front, and that the situation of the Allies was more favourable than it had ever been.

Strength of the Allies.—The fighting strength of the British Army had grown to about 1,200,000 men, and it was known that considerable further reinforcements would reach France during the first few months of the year. The fighting strength of the French Army had been increased by the incorporation of native troops to about 2,600,000, so that, including the Belgians, the Allies disposed of about 3,900,000 men against about 2,500,000 Germans.

Joffre declared that the French Army could maintain its strength for one more great battle, but that thereafter it must progressively decline, as France had no longer a sufficient number of men of military age to replace losses. He therefore warned Sir Douglas Haig that during the coming year the burden must fall more and more upon the British Army, a position which the British commander-in-chief readily accepted. Germany had recently created a number of new divisions, some of which had been employed against Rumania, but it appeared probable that the transfer of these divisions to the Western Front would be delayed if Russia was able to be active on the Eastern Front, and of this the great improvement in the supply of munitions for the Russian Army held out promise at this time. It was also agreed that, in view of the probable decline in strength of the French Army later in the year and the promised reinforcement of the British Army, the relative superiority of the Allies on the Western Front would be greater in the spring of 1917 than at any time which could be foreseen with certainty.

Foundations of the 1917 Offensive.—For all these reasons it was decided to take the earliest possible opportunity of pressing the advantage won by the battle of the Somme, and of continuing the process of exhausting the enemy's reserves as preparation for an effort which should be decisive. All the armies of the Entente were to be ready to attack in the first fortnight of Feb., the British Army between the Vimy Ridge and Bapaume, the French armies between the Somme and the Oise; and the French attack was to be followed soon after by another in Champagne to the west of Reims. It was further understood between Joffre and Haig that these attacks would, if necessary, be followed by further attacks by the British Army in Flanders. During the winter the British Army was to do its utmost to press the enemy on the Somme battlefield, and to prevent him from recovering from his embarrassment there.

The underlying ideas of this plan were primarily that the policy of exhausting the German reserves should be resumed at the earliest possible moment, and secondly that the utmost effort should

be made to complete the work begun on the Somme. The commanders-in-chief believed the situation to be such that victory could be won in 1917, but they were under no illusion as to the possibility of ending the War by one great blow to be delivered in the spring. Joffre followed up the results of this conference by issuing general instructions embodying the decisions reached, and in these instructions he directed that the first British and French attacks, that is to say, those to be delivered between Vimy and Bapaume and between the Somme and the Oise, were to be ready by Feb. 1.

Nivelle in Command.—No sooner were Joffre's plans completed than a series of intrigues against the French commander-in-chief came to a head. A number of officers of the French General Staff regarded with dismay a proposal to give more and more of the task of consummating victory to the British Army and less and less to the French. They found many supporters among the politicians in Paris, and these were reinforced by others, who feared that the " war of exhaustion " and the process of wearing down the enemy's reserves would end in exhausting France before it exhausted Germany. The cry therefore went up that it was time to have a change in the higher command. Foch, whose bloody assaults upon the Vimy Ridge had not been forgotten, was held to be too much of a " hammer and tongs " fighter, and he was placed on half-pay, while the state of the defences of Verdun before the German attack began was brought up against Joffre. So he was given a marshal's baton, and an honorific position in Paris and Nivelle reigned in his stead.

The new commander-in-chief at once made a drastic change in Joffre's policy and plans. He proposed to increase the weight of the French attack; and in order that he might obtain the French troops necessary he asked that the British should relieve the French VI. and XX. Armies and extend their front south across the Somme as far as the Amiens-Roye road. In return he suggested that Haig should modify his plans for keeping up the pressure on the Germans on the Somme battlefield during the winter, and that the date of the combined attacks should be postponed until March 15.

This meant a delay of six weeks in launching the attacks planned by Joffre, and the enemy would be given time to recover from the effects of the Somme. But it became clear, as Nivelle's plans developed, that there was to be an even more complete change of plan than this. He proposed to apply on a great scale the methods he had employed with such success at Verdun, and to return to the policy which had been discarded after the failure in Champagne in 1915. He intended, by skilful employment of a great mass of artillery, to overcome the enemy's resistance in his front lines, and then to pour in to the assault a great reserve which should break through the trench barrier completely and so change the whole strategical position on the Western Front.

Allies' Mistaken Policy.—Early in Dec. 1916, there had been a change of Government in Great Britain, and Mr. Lloyd George had become Prime Minister. He had made up his mind that the Somme had been a costly failure, and was eagerly looking for some method of winning the War which should be speedier and less costly in life than that of a " war of exhaustion." He therefore welcomed a general who promised a short, sharp and decisive battle, which would be over, one way or the other, within a comparatively short time. So at a conference held at Calais at the end of Feb. 1917, it was agreed between the British and French Governments that the British Army should be placed under the general direction of Nivelle for the forthcoming operations.

This decision violated a fundamental principle of military organisation. A general of a division is not, while still in command of his division, placed also in command of an army corps which includes other divisions, for the good and sufficient reason that if his attention is absorbed by the details of one unit or of one part of the front, he cannot simultaneously give proper attention to the other units or to other parts of the front. The right course would have been to have given Nivelle the general charge of the whole Western Front and to have appointed another commander-in-chief for the French Army. The results of this mistake soon became apparent. On the last day of the Calais Conference news arrived from the British V. Army that there were signs of a German withdrawal in the valley of the Ancre. Some time before, the British airmen had discovered that a great new system of defensive works had been constructed by the enemy covering Douai, Cambrai and St. Quentin, the system which became known to the Allies as the Hindenburg line; and not long after the report from the Ancre came in there were indications that the Germans were preparing to retire from the whole of the Somme battlefield into this life. But Nivelle, not being in close touch with happenings on the British front, did not believe in a German retreat, and issued to Haig orders which were not compatible with the changed situation, and in certain matters went far beyond the agreement reached in Calais. This led to friction, which was adjusted at a further conference in London. By then it had become apparent that the Germans were in retreat on the whole front between Arras and the Aisne near Vailly.

German Retreat to the Hindenburg Line.—The Germans, relieved from pressure on their front during the winter, had prepared for their retreat systematically and brutally. The whole country which had been in their occupation west of the Hindenburg line was devastated, villages were burnt, roads and railways destroyed, fruit trees cut down and everything of any value was removed and mines which exploded at a touch were prepared with diabolical ingenuity. In these circumstances a rapid pursuit became impossible and the Germans were able to delay the advance of the Allies by rearguards, while they removed their heavy artillery and established their main bodies in the Hindenburg lines.

This manoeuvre, planned and successfully carried through by Ludendorff, who with Hindenburg as his chief had suceeded Falkenhayn in Sept. 1916 when the failure of the latter's attack on Verdun had become obvious, effected a great change in the situation to the benefit of the Germans. Not only did it materially shorten their front and thereby enable them to increase their reserves, but their troops exchanged the battered defences of the Somme battlefield with its awkward salients for the strongest lines which had yet been built upon the Western Front. Further, the enemy had withdrawn from a considerable part of the front which Nivelle had intended to attack, and this made necessary a further postponement of his battles, but he still adhered to the main features of his plan. In the altered circumstances grave doubts arose in the minds of some of the senior French generals as to the feasibility of this plan, and when these came to the ears of the French War Minister, M. Painlevé, he assembled a council of war on April 6, on the very eve of the offensive, at which criticisms of the plan were presented by certain of the commanders who were to take a leading part in its execution. Nevertheless, the French Govt. decided not to interfere with Gen. Nivelle.

The Spring Offensive.—It is difficult to conceive of a more unfortunate prelude to a great battle. However, these doubts and hesitations of the leaders were not known to the rank and file of the army or to the French people; and when, on April 9, the spring campaign began by an attack by Allenby's III. Army on the enemy's lines east of Arras, and by the Canadian Corps with one brigade of the 5th Div. on the Vimy Ridge, and met with an immediate success, hopes soared high. The French public was deeply impressed by the rapid capture of the Vimy Ridge, which had for so long resisted Foch's attacks, and great things were expected when the French Army advanced.

The second of Nivelle's blows was delivered by the group of armies of the centre, now under Franchet d'Espérey, against the German front in the neighbourhood of St. Quentin; but Franchet d'Espérey was here in contact with a part of the main Hindenburg line, and he had neither the time nor the means to prepare effectively for an attack upon their formidable defences. The operations of the centre group of armies, which had been intended to be an important part of Nivelle's programme dwindled therefore into little more than a demonstration, which took place on April 14 and had no material results. Nivelle's main battle, which took place on the front between Reims and Anizy, began on April 16. It had been planned that the assaulting

troops should, on the first day of battle, break through the first three German lines. The attack was made by Mangin's VI. Army and Mazel's V. Army, with Duchesne's X. Army and a mass of cavalry in reserve ready to exploit their success. Anthoine's IV. Army struck in to the east of Reims on the 17th. The left of Mazel's attack failed almost entirely; and elsewhere, though the first German line was captured, little progress was made beyond it. The dream of a rapid rupture of the enemy's front had to be abandoned, and a fresh plan of battle had to be formed.

One of the first results of the failure of Nivelle to realise his hopes was that he had to request Haig to press his attacks to the east of Arras with all possible vigour, so as to keep the largest possible number of Germans occupied in that quarter. This entailed a prolongation of the battle of Arras into a period when gains became small and were only purchased at great price. None the less Haig decided that the situation made it necessary to support the French with all his power, and he fought on till May 17, by which time the British Front was established some four miles to the east of Arras and in the plain to the east of the Vimy Ridge.

While Haig was thus battling in the north, Nivelle on the Aisne Front had brought his X. Army into his front line, and by slow and bitter fighting had won his way up the Chemin des Dames Ridge, of which he captured the eastern portion. Early in May it was quite evident that there was no prospect of such a break through as had been planned, and on the 15th the French Govt. replaced Nivelle by Gen. Pétain, while Gen. Foch, recalled from semi-retirement, became Chief-of-Staff in Paris. Pétain's first task was to wind up the operations on the Aisne front, and the battle ended definitely on May 20.

The immediate consequence of this repulse was the outbreak of a series of mutinies in the French Armies, which so affected the morale of the French troops that Pétain found it necessary to appeal to Haig to keep the enemy engaged while he restored the confidence of his men.

Battle of Messines.—If the attention of the Germans was to be occupied by the British armies it was necessary that they should be forced to fight. Upon any part of the British front south of the point where it bends south from the Belgian frontier north-west of Lille it was possible for the Germans to repeat their manoeuvre of March and avoid a battle by retiring into another system of defences, for in doing this they would be merely abandoning a portion of French territory which was of no great value to them, while they might by this method economise sufficient troops to enable them to fall upon the French. On the Belgian front they could not fall back without risking their hold upon the ports of Ostend and Zeebrugge, which were to them important bases for their submarine campaign, and without endangering the security of the chief aerodromes from which their air attacks upon England were made.

For these reasons Haig decided to press the enemy with all his available means upon the Belgian front, and on June 7 he began this campaign with the battle of Messines. This battle was most skilfully and thoroughly prepared by Sir Herbert Plumer, and was fought and won by his II. Army. The battle began with the explosion of a number of huge mines, the secret of which had been preserved by constant and devoted watchfulness on the part of the miners, who had tunnelled beneath the enemy's lines many months previously and awaited patiently the opportunity for their use. The effect of these explosions, combined with a very skilfully planned bombardment of massed guns of all calibres, was such that, except on the right of the attack in the neighbourhood of Messines, the infantry, for once, had little to do. The whole of the Messines-Wytschaete ridge was captured at comparatively very light cost, and the Ypres salient, a name of ill omen for the British army since Oct. 1914, disappeared.

The strength of the British army in combatant troops was now at its greatest. Haig had 64 divisions and ten cavalry divisions under his orders, and a mass of heavy artillery, tanks and aeroplanes. It was well that this was so, for the army was to be called upon to endure greatly while Pétain and his men got their second wind. Nor was it only the situation on the Western Front which called for resolute action, for the condition of the Russian Army was far more critical than that of the French Army. Kornilov had, on July 1, begun an offensive, and if he was supported and encouraged by success in the west it was still possible that the Russians might continue to be a powerful factor in the War.

Third Battle of Ypres.—With these heavy responsibilities on his shoulders, Haig began on July 31 the third battle of Ypres, with a great attack by the V. Army, which had been moved north for the purpose.

As in the case of the battle of the Somme, the first fruits of the third battle of Ypres were reaped elsewhere than on the battle front. The Germans, forced to send more and more troops into the fiery furnace which blazed on the Ypres ridges, were compelled to leave the French alone, and Pétain had time to restore the confidence of his army. Part of his method was the delivery of very carefully prepared attacks on a comparatively small front, supported by a great mass of artillery which should leave the infantry little more to do than to occupy the ground won. The first of these attacks was delivered by Guillaumat's II. Army on the Verdun Front, and was completely successful, ending with the French in possession of all the ground which the Germans had won in six months fighting in 1916. This was followed by a more important attack delivered on Oct. 23 by Maistre's VI. Army, which gave the French the whole of the Chemin des Dames ridge, and resulted in the capture of 11,000 prisoners and 200 guns. Then and not till then Pétain expressed himself as satisfied that his immediate purpose was achieved.

The British troops, struggling in the mud of Flanders could not be told the reasons which had called for a supreme effort from them and the terrible struggle through the mud, unrelieved by any conspicuous success, was a heavy strain upon them. As events turned out it would probably have been wiser to have brought the third battle of Ypres to a close immediately after the French had won the Chemin des Dames, but at that time the British were within a short distance of the crest of the Passchendaele ridge, while information received at G.H.Q. showed that the strain upon the German Army had been far greater, and that there had been a very appreciable lowering of the morale of the German troops.

Haig had yet another blow in preparation. The continued bad weather and the slowness of the progress had caused the abandonment of the project of landing on the Belgian coast, and all hope of driving the Germans from the Belgian ports had gone, but there still appeared to be an opportunity of profiting from the exhaustion of the German reserves before the winter gave them a period for recovery, as it had after the battle of the Somme. A final reason for continuing the struggle was that on Oct. 24 an Austro-German attack had been launched in Italy and at Caporetto had broken through the Italian lines. It was therefore of importance to keep up the pressure upon the Germans on the Western Front. So the third battle of Ypres was continued, until the ridge and village of Passchendaele were captured on Nov. 3.

British Tanks at Cambrai.—A fortnight later Byng's III. Army attacked the German front opposite Cambrai. This battle opened a new era in trench warfare. One of the outstanding difficulties which the trench barrier had created was that it had hitherto eliminated one of the chief resources of generalship, surprise. The time and labour required to prepare for a great bombardment, and the accumulation of the huge stores of material of war on the selected front of battle, made it impossible to conceal intentions from the enemy. But at Cambrai these difficulties were overcome by using a great number of tanks, brought up secretly to take the place of the bombardment in breaking the enemy's defences (*see* CAMBRAI, BATTLE OF).

The attack was made upon one of the strongest parts of the Hindenburg system, but the tanks successfully broke through, and the surprise was complete. At Messines the guns had left nothing for the tanks to do, and in the third battle of Ypres they

had been defeated by the mud of Flanders, but at Cambrai they came into their own. One thing alone was lacking as far as their part in the battle went. The co-operation between the tanks and the artillery in the later stages of the attack was not complete, so that numbers of tanks fell easy victims to the German guns, a lesson of which advantage was taken in 1918.

Of greater importance was the fact that six French and five British divisions had been transferred to Italy to help the Italian army to stem the disaster of Caporetto, so that Haig had not the troops to complete and extend the first successes won at Cambrai. It is a typical illustration of the advantage which their central position conferred upon the Germans that several of the British divisions which would have been invaluable at Cambrai had not reached the Italian front at the time when the Austro-Germans were checked on the Piave and the battle of Caporetto came to an end. So the German counter-attacks won back a good part of the ground which Byng had gained in the first advance, and the battle of Cambrai ended on Dec. 7 in one more disappointment for the Allies.

Lessons of 1917.—The campaign of 1917 on the Western Front had been fatally hampered by the change of plan which had been made by Nivelle when he succeeded Joffre. That change had permitted Ludendorff to prepare for and carry through the retreat into the Hindenburg line, and had postponed the date of the Allied offensive from Feb. 1, the date fixed by Joffre, until April 9—a delay of nine precious weeks. As Joffre had anticipated, it had been necessary for the British Army to bear the brunt of the fighting, but it would have done so under very different conditions if the Germans had been hustled back into the Hindenburg line, as they were in Sept. 1918, and if Messines had been fought at the beginning of April, and the third battle of Ypres had begun on May 30 instead of July 31.

The battle of Cambrai might then have synchronised with the last offensive of the Russian Army, and the combined effect might well have saved that army from dissolution, for adequate French and British reserves would have been available in France to support Byng's attack, and the War might have ended victoriously in the autumn of 1917. As it was, the battles of 1917 showed clearly that the solution of the problems of trench warfare at which Haig and Joffre had arrived was correct. It was first necessary to exhaust the German reserves and then to strike a surprise blow or series of surprise blows. Cambrai had shown how surprise might be achieved. But all this experience, which had been purchased at great cost, had been acquired too late to be put to profit in 1917, owing to the fatal delay in opening the campaign of that year.

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III. THE WESTERN FRONT IN 1918

In the latter half of 1917 there had been numerous discussions between the Allied statesmen and generals with the object of finding some effective means of co-ordinating their efforts, more especially in the military sphere.

THE SUPREME WAR COUNCIL

Up to the time of the crisis created by the defeat of the Italian armies at Caporetto these discussions had produced no result, but one effect of that crisis was the assembly of an Allied Conference at Rapallo, where on Nov. 9 it was decided to create a Supreme War Council of the chief Allied ministers, with headquarters at Versailles. Permanent military representatives of the chief Allied Powers were appointed to assist this council in the preparation of plans of campaign, Gen. Weygand being the French representative, Gen. Sir Henry Wilson the British, Gen. Bliss the American and Gen. Cadorna the Italian.

Before the creation of the Supreme War Council numerous conferences of the Allied ministers had been held to deal with problems as they arose, but there had been no international body charged with the preparation of questions for consideration by such conferences or with supervising the execution of the policy agreed upon. The establishment at Versailles of an international secretariat therefore supplied a need which had long been felt and was a great step forward in securing co-operation in the many spheres in which the Allies had been to a considerable extent competitors. It did not, however, solve the vexed question of the unity of military command, for the military representatives were not members of the Supreme Council, and were advisers only without any executive authority.

Situation in Early 1918.—The first great task before the Supreme Council was the consideration of the plans of campaign for 1918. The situation was serious. The collapse of the Russian Army was complete and on Dec. 22 peace negotiations between Russia and Germany had begun at Brest-Litovsk. For some time past German divisions from the Eastern Front had been arriving in France and Belgium and it was certain that many more would follow. At the beginning of 1917 there had been on the Western Front 170 British, French and Belgian divisions and by March of that year this number had been increased to 178 owing to the arrival of six British and two Portuguese divisions. These had been opposed to 129 German divisions. During 1917 six French and five British divisions had gone to Italy, and four French divisions had been broken up owing to lack of men to maintain them.

As against this decrease in the Allied strength the French had dismounted part of their cavalry and created one infantry division with the men so obtained, while 4½ American divisions had arrived. Therefore the Allied strength had fallen from 178 divisions to 168½, a decrease of 9½ divisions. At the end of Jan. 1918 the German divisions had increased in numbers to 177, a reinforcement of 48 divisions as compared with 1917, thus making a balance in favour of the Germans of 54½ divisions. This change in the situation was the more formidable because it was calculated that the Germans could bring another 30 divisions to the West, while the Portuguese divisions were of uncertain quality and it would be some months before the American divisions would be sufficiently trained to take a full share with their Allies.

The entry of the United States into the War had more than compensated for the defection of Russia and had given the Allies an invaluable naval reinforcement together with equally valuable financial aid, but it was calculated that American military strength, which took longer to develop, would not restore the balance in favour of the Allies before the late summer, and that the intervening period would be one of danger on the Western Front. France had no longer the men to replace her losses and Pétain, the French commander-in-chief, had been compelled to reduce the number of battalions in his divisions from 12 to nine. There were no more divisions to come from England and Haig, owing to lack of drafts, was compelled to follow Pétain's example and reduce the infantry in his divisions to a similar extent. This reduction was offset by a corresponding reduction in the infantry of the German divisions, but in view of the number of the latter, which might be expected on the Western Front, it was more than probable that the Germans for the first time since 1914 would be in a numerical superiority.

It was in these circumstances that the Supreme War Council met at the end of January. It was then clearly necessary to prepare for the possibility of a great German attack. While most of the German divisions coming from the East were being assembled opposite the British front and there were definite signs of military preparation in the neighbourhood of Cambrai, it was far from certain that the main effort of the Germans would be made in that part. It might be decided further to the south against the French or even against the Italians. In such circumstances any one of the Allied commanders-in-chief might if a neighbour were attacked be in legitimate doubt whether such attack were not a feint preparatory to a more formidable effort against him-

self. Some superior authority was therefore required to supervise the whole field of operations and to allocate reserves as and when required.

The Military Executive Committee.—The military representatives could not fulfil the functions of such an authority, as they were without executive power, and therefore after prolonged discussion the Supreme War Council decided to turn the military representatives into a military executive committee with Gen. Foch, then chief of the French general staff in Paris, as its chairman. The function of this committee was to create an Allied general reserve, to determine the location of that reserve and to issue orders for its employment. Opinion was not yet ripe for the creation of a generalissimo and the decision actually reached was a compromise between a number of proposals.

Compromises are rarely effective in war, and this was no exception. The exercise of military command by a committee is always objectionable, for a committee is constitutionally prone to discussions and is therefore very rarely able to act with that promptness which the exigencies of a military situation usually require. Further the committee was the less likely to be prompt in its decisions, because it was located at Versailles and could only obtain information from the front through the medium of the commanders-in-chief. The arrangement, far from unifying command, made it more complicated, in that it left the British and French commanders-in-chief in control of the greater part of their armies, while taking from them that part which was to constitute the general reserve and placing it under an independent body.

Further Unsatisfactory Compromises.—Nor was this the only decision of the Supreme War Council which resulted in an unsatisfactory compromise. Reinforcements, apart from American troops, could only be obtained for the Western Front by withdrawing troops, mainly British, from Italy, Salonika and Palestine. But the Italian statesmen would not consent to any weakening of the Allied contingents on their front, the French statesmen were as strongly opposed to any reduction of the forces at Salonika, while the British ministers were eager to extend the success which Gen. Allenby had won in capturing Jerusalem, by an offensive campaign against the Turks. The Allied chiefs of the staff had agreed at a preliminary conference to recommend to the Supreme Council that a defensive attitude should be adopted in other theatres of war and that all troops not absolutely required for defence in those theatres should be transferred to the Western front.

This recommendation was referred to the military representatives, who reported that the offensive campaign in Palestine should take place provided the Western front was made safe. They did not, however, add their opinion as to the number of troops required to make the Western front safe. The discussion turned on the latter point. The British Prime Minister believed that the experience of the War had shown that the lines of trenches on the Western front were impregnable and that the right policy was to act defensively in France and Belgium, await the arrival of the Americans with a view to a decisive campaign in 1919 and in the meanwhile to take the offensive in Palestine. Finally M. Clemenceau, the French Prime Minister, agreed to the offensive campaign in Palestine on the understanding that no reinforcements should be taken from the Western Front.

Thus the conference closed without making any provision for strengthening the Western front. The sequel was even less satisfactory. M. Clemenceau had brought great pressure to bear on the British Govt. to have the British front in France extended to compensate for the reduction of the French Army. Despite Sir Douglas Haig's protests, made in view of the fact that the Germans were massing opposite his front, he was compelled to extend his right as far South as the Oise, the new front being taken up by the British V. Army under Gen. Gough.

Meantime the Military Executive Committee had reported that it required a general reserve of 30 divisions from the British, French and Italian Armies and to this number the British contribution was to be seven. To the request for this number of divisions Haig replied that in view of the extension of his front and of the steady increase in the number of German divisions, which by the first week in March amounted to 190, he could spare no troops. At a meeting of the Supreme War Council held in London on March 14, the formation of the general reserve was postponed and a week later the great German attack began. One result of these controversies was that the British chief of the staff, Sir W. Robertson, who had been unable to agree with his Government as to the creation of the military executive committee and the offensive campaign in Palestine, was removed from his position and his place was taken by Sir Henry Wilson, Sir Henry Rawlinson becoming military representative at Versailles.

The German Offensive of 1918

The change in the military situation in favour of Germany, brought about by the collapse of Russia and the victory of Caporetto, had towards the end of 1917 encouraged Ludendorff to believe that there was a prospect of winning the War by a decisive victory in the West. He tells us in *My War Memories* that he regarded the situation at that time as favourable in every theatre of war save in Asia, and he held the reverses which the Turks had suffered as of secondary importance. In his report to the Kaiser on Feb. 13 1918, he said:

> The battle in the West which the year 1918 will bring presents the biggest military problem ever set before an army. France and England have grappled with it in vain for two years. . . . It must not be imagined that we are going to have another such offensive as in Galicia or Italy. It will be a stupendous struggle, beginning in one place and continuing in another and will take up a long time (*see* German Offensive).

Ludendorff's Problem.—The first question then to be settled was where the battle should be begun. The advantages of starting with an attack on the French were considered and dismissed because it was believed that such an attack would be answered by a British attack in Flanders, while it was held that exhaustion of French man-power would prevent France from undertaking an offensive on a large scale. Next the strategical situation of the British Army was considered to be less favourable than that of the French, for its lines ran parallel to and at no great distance from the coast of the Channel and any considerable break through the British front would at once make the position of Haig's troops precarious. On the other hand the French Army with more room to manoeuvre might recover from an initial reverse.

It was also the general opinion at German headquarters that the British Army, now almost entirely composed of troops raised since the beginning of the War, had shown itself to be less capable of battle manoeuvre than the French, and that once it was driven from its main defensive lines it would prove an easy victim. Finally Great Britain was regarded as the main prop of the Allies. A somewhat exaggerated view of the privations which unrestricted U-boat warfare were causing in England prevailed and Lord Lansdowne's suggestions for a peace by arrangement were known. It was confidently believed that, if to the threat of starvation could be added a severe defeat of the British Army in France, Mr. Lloyd George's determination to continue the War would be broken and the views of the peace party in Great Britain be made to prevail. On all these grounds it was decided to make the first effort against the British.

Selection of the Point of Attack.—The next question was to choose the part of the British front to be attacked. Prince Rupprecht of Bavaria, who commanded the group of armies on the northern part of the British front, strongly urged an attack on the Armentières-La Bassée front on the grounds that the British would certainly prepare for a renewal of the attack to secure the submarine bases on the Belgian coast, that therefore the British reserves would be massed in Flanders and that such an attack would lead most speedily to the desired object, a war of movement against the British reserves.

There was also the advantage that in Flanders the British lines were nearer to the coast than elsewhere and that a break through there would cause greater embarrassment than on any other part of the front. The objection to this plan was that

the ground in the valley of the Lys, always water-logged during the winter, would not be in a fit state for active operations until about the middle of April. Now, as in 1914, time was a vital factor in the German plans. Then the object had been to defeat the French before the Russians could develop a dangerous offensive. Now the object was to defeat the French and British before the American Army could become a decisive factor in the situation.

German Opinions on United States.—The views held at German headquarters during the winter of 1917–8 on the military effort of the United States were:—

> The United States are forming an army of about 50 divisions of which three only have as yet landed in France. One of them is at the front to be trained. The two others are in need of more training behind the front. By the spring of 1918 the American forces in France may reach a strength of about 15 divisions. The mass of the divisions will only be suitable for use on quiet fronts. Only the three divisions now in France may be expected to take part in a spring offensive. The corps of officers is not yet trained for war on a large scale. On these grounds, the independent use of large American units in difficult positions will be out of the question at present. The drafting of reserves and the arming and equipment of the American troops are good. Training is still inadequate. But the first regiment put in at the front fought well during a German attack and it is therefore to be expected that the American soldier after more training and experience will prove himself a worthy opponent.

These calculations were substantially accurate. The total number of Americans in France at the end of March was approximately 370,000, with a combatant strength of about 150,000 organised in five divisions. The first American divisions took over an active section of the front on April 25 and at Cantigny on May 28 made the first American attack. Ludendorff decided that, in order to anticipate America, the first attack must be made before the middle of April and selected the St. Quentin front. The strategical purpose behind this enterprise was the separation of the British and French Armies. The main axis of the attack was to be directed at first just north of the Somme where it bends westwards to the sea near Péronne. The Somme reached, that river was to be used to hold off the French reinforcements coming up from the south; and the general direction of the attack was to be changed northwestwards so as to round up the British Army against the coast.

The objection to the St. Quentin front was that an attack there led across the devastated area of the Somme battlefields, but Ludendorff held that this disadvantage was more than counterbalanced by the strategic results which the plan offered and by the importance of beginning early. As he had told the Kaiser, this attack was to be but the first of a series, and instructions were issued to army commanders to prepare for such a series along a great part of the front. These attacks were given code names, that on the St. Quentin front being called the "Michael" attack. The date selected for it was about March 20. It was to be followed by a subsidiary attack south of the Oise called "Archangel." Prince Rupprecht was to prepare for the offensive which he had advocated on the Armentières-La Bassée front, to which the name "St. George I." was given and for a second on the Ypres front called "St. George II." The Crown Prince was to prepare an attack in Champagne to which the name "Blücher" was subsequently given.

Preparations for the Offensive.—In order to preserve secrecy, each army was given the impression that its attack would be the first and the most important and therefore the preparations for all the attacks were seriously made. The reserves for the Michael attack were so placed that they could be brought up rapidly by night marches to the St. Quentin front, but could be moved almost as readily for the St. George I. and Blücher attacks. It is interesting to observe the effects of these preparations on the minds on the other side of the line. Sir Douglas Haig in France and Sir W. Robertson in London both deduced from the German dispositions that the first attack would be made on the St. Quentin front and might be expected at any time after March 1. But there could be no certainty that this would be the main German effort and Haig was aware of the preparations for the St. George attacks. In view of the sensitiveness of his left to any threat of a German advance against the Channel ports, and to the fact that a comparatively short advance would enable the Germans to shell Calais and Boulogne with long range guns, he decided to keep the bulk of his reserves north of the Somme and for the same reason to refuse the demand of the military executive committee for divisions for the general reserve.

Pétain, while agreeing that the indications showed that the first attack would be made on the British, was by no means sure that the enemy's main attack would not be delivered on the Champagne front; and his eyes were constantly upon the preparations in that area. Right up to the Doullens conference on March 26, he was chary of sending reinforcements to help the British until he was more certain that a great attack, which might open the road to Paris, would not be made against his own front. The military representatives at Versailles were of opinion that the difficulties of the shell-torn and devastated area of the Somme would prevent an attack on the St. Quentin front, and they expected an attack on the La Bassée-Arras front to take place probably in May. Therefore although Ludendorff was unable to conceal the preparations on the St. Quentin front and Haig's intelligence staff accurately predicted the place and date of the German attack, yet he had made his dispositions with such skill as to keep his enemies in doubt of his intentions even after the Michael attack had begun.

German Offensive of March-April 1918.—Strategically it may be said that the issue of that battle was decided on March 28, when Byng's III. Army defeated the attacks of the right of the German XVII. Army south of Arras. The effect of this combined with the unexpectedly easy success of the attack of the German XVIII. Army against the British right was to cause Ludendorff to make a fundamental change in his plan. Instead of directing his main attack north of the Somme, with the object of using that river as a barrier against the French and of making an eventual turn northwest against the British right flank, he directed his main effort south of the Somme, generally southwestwards. Thus it was committed to an area which could be most readily and speedily reinforced by the French; and when Foch was appointed at Doullens "to co-ordinate the operations of the Allied armies on the Western Front," and had decided to direct all his energies to maintaining the junction between the French and British Armies, the Michael attack was brought to a standstill.

That attack was followed on April 6 by the Archangel attack just south of the Oise. Originally designed as a subsidiary effort to help the Michael attack forward, it was now used to improve the somewhat awkward situation of the XVIII. Army, which had been stopped in a pronounced salient with its head towards Amiens. Having secured some ground up to and slightly beyond the Ailette, the Archangel attack was stopped on April 8. The next day Prince Rupprecht began an attack in Flanders against the front held by the Portuguese in the neighbourhood of Neuve-Chapelle.

Towards the end of March Ludendorff had reduced the plans for the St. George I. and II. attacks to the limits of a secondary enterprise, and the battle in Flanders was begun with no ambitious aims. It at once achieved such success that Prince Rupprecht was authorised to return to his original programme and the Germans had hopes of securing the whole of the Flanders ridges. The St. George I. attack was directed on the important railway junction of Hazebrouck and was stopped at no great distance from that town, but the St. George II. attack delivered against the Ypres salient by the German IV. Army was to a great extent evaded by the timely evacuation of the salient by the British II. Army; and thanks to the arrival of French reinforcements that attack only resulted in the capture by the Germans of the important Hill of Kemmel, the main ridges remaining in the hands of the Allies.

Ludendorff has often been criticised for allowing himself to be diverted by the first success of the battle in Flanders from his original objective, the separation of the British and French Armies, and it has been maintained that had he limited Prince

Rupprecht's efforts, as he had intended to do, and renewed the attacks south of the Somme, he would have captured Amiens and thereby made traffic between the French and British Armies difficult if not impossible. Certainly during April the Allied position in front of Amiens was highly critical, but all the experience of the War had shown that once a great attack had been brought to a standstill the difficulties of restarting it were almost insuperable; and in this case the area behind the front of the German XVIII. Army had been devastated in repeated battles and the communications behind that army were exceptionally difficult, while seeing that French reinforcements arrived from the south to stop the St. George attacks it is reasonably certain that they would have stopped a renewal of the Michael attack upon Amiens, had that been attempted.

Results of First German Attacks.—Though Ludendorff had failed in his main purpose he had gained a greater measure of success than had been won on the Western Front since the beginning of trench warfare, and had for the time exhausted the offensive power of the British Army. Its battle casualties amounted to 14,053 officers and 286,517 other ranks. The Germans captured 65,000 prisoners and 769 guns, many more guns were damaged and a vast quantity of war material fell into the enemy's hands. The losses in material, thanks to the activities of the Ministry of Munitions, were quickly replaced; but the replacement of the casualties, swollen by an inevitable increase in the number of sick, was a more serious matter.

The British age of military service was raised, and 140,000 drafts were sent out, but further help could only come from the secondary theatres of war. Therefore two divisions were brought to France from Italy, the proposed offensive in Palestine was abandoned and two divisions were transferred from Allenby's command, while a number of British battalions were released from Palestine, their places being taken by battalions of the Indian Army. Some more battalions were transferred from Salonika. By these means the ten divisions, mainly from his V. Army, which Haig had been compelled to break up, were gradually reconstituted, and the strength of his command was restored.

But during this period of reconstruction the initiative necessarily remained with the Germans; and Ludendorff, having envisaged a long series of battles, was not disposed to give up the attempt to win victory because his first efforts had not given him all that he had hoped. By the end of May the number of German divisions in the West had reached 207, the greatest number attained, and with 81 divisions in reserve Ludendorff proposed that the Blücher attack should be his next great effort and should be begun on the Chemin-des-Dames front which he knew to be weakly held. The Blücher attack, begun on May 27, swept over the Chemin-des-Dames, across the Aisne and was only stopped on the Marne near Château-Thierry by the timely arrival of American divisions. (*See* GERMAN OFFENSIVE.)

Combined German Attacks.—The result of this battle, which brought the Germans to within 40 m. of Paris, was to leave them in a very narrow salient, with its head on the Marne and, as after the Michael attack, so now, Ludendorff attempted to improve this position, first by an attack intended to reach Compiègne, delivered to the west of the salient by the German XVIII. Army on June 9, and secondly by another attack on the following day on the western face of the salient near Villers-Cotteret. Foch had divined Ludendorff's intention and both these attacks were checked and yielded little result.

Thereafter there followed a pause which proved fatal to the Germans and exposed the underlying fallacy in Ludendorff's plans. He had from the first seen that time was a vital factor, that he must defeat the French and British before the Americans could intervene, and under that impression he had attempted too much at first. If his first attacks had taken the form of a series of limited blows designed to exhaust the enemies' reserves and to culminate in a great final effort when those reserves had been exhausted it is just possible that his application of this policy might have been as successful as Foch's proved to be later. But he had in fact in the Michael, St. George and Blücher attacks attempted to break through, and had been induced by preliminary success to carry on each of these battles into the stage where they yielded little but loss. Consequently his efforts instead of being continuous and progressive were broken by the necessity for rest and preparation. An undue effort left him momentarily weakened.

For some time past Rupprecht had been instructed to prepare for a renewal of the battle in Flanders, which it was hoped would hem the British Army against the coast, but this attack was to be preceded by a great attack on either side of Reims designed to widen the Marne salient and drive in towards Paris. Rupprecht's preparations, which had begun in May, were known both to Haig and to the British Govt. and when the Blücher attack developed at the end of May, and Foch called upon Haig to send eight divisions to help the French, the British Govt. sent Gen. Smuts (then a member of the War Cabinet) to Haig, to inquire whether this would not endanger the British Army. To this Haig replied that Foch, having been appointed generalissimo (he had been given that title at an Allied Conference at Amiens on April 14), must be supported, and that he would take the entire responsibility of sending off the divisions, which went accordingly. It may be mentioned that, as the result of Foch's appointment the Versailles Military Executive Council had disappeared and Sir Henry Rawlinson had resumed command of the British IV. Army.

Allied Position Improves.—The accumulation of Allied reserves between Amiens and the Marne had decided Ludendorff to attempt the attack east of Reims, where he believed the line to be held weakly. But his attacks could not be ready until July 15 and the five weeks' delay since the end of the Blücher attacks had brought a great improvement in the Allied situation. All the British divisions which had been broken up as the result of the Michael and St. George attacks had by then been reconstituted and, as the consequence of a special appeal to the President of the United States made in the crisis of March, and the provision of extra shipping, American troops had been arriving since the end of April at the rate of 300,000 a month.

Thus the number of American divisions ready to take part in battle was steadily increasing. Further Ludendorff's plans became known to Foch and when the German attack was made it was defeated (*see* GERMAN OFFENSIVE). That defeat was promptly followed by a counter-attack in the Marne salient which Foch had prepared for some time (*see* MARNE, SECOND BATTLE OF THE). The success of that counter-attack was so complete as to compel Ludendorff to draw upon his reserves elsewhere and to postpone Rupprecht's projected offensive. Therewith the initiative passed finally from Ludendorff to Foch.

THE ALLIED OFFENSIVE, 1918

Towards the end of July Foch had agreed with the Allied Commanders-in-Chief that in order to keep the initiative and to free lateral communications a series of local offensives should be undertaken, the first by the British on the Amiens front to free the Paris-Amiens railway; the second by the French on either side of Compiègne to free the Paris-Avricourt railway in its northern section; the third by the Americans to free the Paris-Avricourt railway in its eastern section.

Battle of Amiens.—For the first Haig had some time previously instructed Rawlinson to prepare, and now, to extend the scope of the proposed battle, Foch placed Gen. Debeney's I. Army on Rawlinson's right, at Haig's disposal. The battle began on Aug. 8 (*see* VICTORY, ADVANCE TO), and resulted in a triumph for the new type of British tank. Foch, delighted with the British success, urged Haig forward across the Somme to the capture of Péronne, but the British commander-in-chief had no desire to repeat Ludendorff's mistake and allow the unexpected success of a preliminary attack to tempt him into continuing a battle into the stage when the first drive had lost its momentum and further fighting would cause heavy losses in return for small gains.

The battle had achieved its original purpose, the freeing of the Paris-Amiens railway, and Haig insisted that instead of knocking his head against the stiffening resistance of the Germans his attack should be transferred further to the north. So on Aug. 21 Byng with the British III. Army began the battle of Bapaume, the town being captured on Aug. 29. The success of Byng's operations induced Haig to extend his front of attack still further to the north and on Aug. 26 Horne's I. Army, co-operating with the left of Byng's III. Army, began the battle of the Scarpe, which drove the Germans back from in front of Arras into the main defences of the Hindenburg system.

Further Allied Successes.—Meanwhile the second of the limited offensives had begun and on Aug. 10 Humbert with the French III. Army attacked and secured the German positions on the *massif* of Lassigny, while a few days later Mangin on Aug. 17 advanced with the French X. Army northeast of Compiègne and in a series of attacks penetrated to the valley of the Ailette and secured the heights north of Soissons. Thus, as the result of Haig's intervention, the scope of the first two operations had been greatly extended, the German lines had given way on a front of 70 m. and the Allies by Sept. 2 held the chord of the great salient which had run from near Arras, by Albert, just southeast of Amiens to Soissons. That chord now ran in a general north and south line from the Scarpe 10 m. east of Arras, by Péronne and Noyon to Soissons.

German Retreat Commences.—Ludendorff had not at first been much perturbed by the initial success of Foch's counter-attack of July 18 and he had gone to Flanders to hasten the preparations for Rupprecht's offensive. When there he learned the full extent of the disaster which had befallen German armies and cancelling that offensive he began to withdraw troops from Flanders to ease the situation on the Marne front. While he was so engaged the battle of Amiens came like a thunderbolt from a clear sky and the resulting situation was felt to be so grave that a crown council was held at Spa on Aug. 13–14, at which Ludendorff declared that it was no longer possible for Germany to gain her war aims and a peace by arrangement should be sought at the first favourable opportunity, while Germany still held large stretches of Allied territory.

This complete change of front produced a political crisis and resulted in the negotiations which made Prince Max of Baden German Chancellor. The evacuation of the great Lys salient created by Rupprecht in April was decided on and this evacuation was now hastened by a number of local attacks by the British. On Aug. 30 they re-occupied Bailleul and by the end of the first week of Sept. the Germans had recrossed the Lys and were back in the lines from which they had started in the spring. On Sept. 12 Gen. Pershing completed the series of preliminary operations by attacking the St. Mihiel salient with nine American divisions.

With the elimination of that salient the introductory phase in the advance to victory came to a close. Within eight weeks a complete change had taken place in the military situation. No longer were the Allies anxiously anticipating German attacks from positions menacing Paris and the Channel ports; the Germans, who had lost all their territorial gains of the spring, were now anxiously anticipating the next Allied blow and had abandoned all hope of winning the War. Their reserves were depleted, while those of the Allies were steadily increasing. Ludendorff had been compelled to break up 16 of his divisions to provide drafts for the remainder. In May the Americans had three divisions fit for battle, now Pershing could place at Foch's disposal 25 divisions, each double the strength of a German division. At the end of April Haig's strength had fallen to 48 divisions fit for battle, by mid Sept. this number had grown to 61. Thus while in May the Germans had 207 divisions opposed to 153 Allied divisions, after the battle of St. Mihiel they had 191 divisions opposed to 210 Allied divisions, counting one American as the equivalent of two German divisions.

Allied Offensive Plan Outlined.—Success had fired the Allied troops with enthusiasm, while the Americans were fresh and inspired with the zeal of crusaders. Defeat had on the other hand greatly depressed the German ranks and the tanks which the Germans had neglected had become a weapon of terror. In these circumstances Foch and the Allied commanders-in-chief agreed that the time had come to seek victory in 1918 by means of a series of combined attacks to be delivered as soon as possible after the American operations at St. Mihiel were concluded. These were to be made

1. By the Americans west of the Meuse in the direction of Sedan.
2. By the French west of the Argonne in the direction of Mézières.
3. By the British on St. Quentin-Cambrai front in the direction of Maubeuge.
4. By Belgians, British and French in Flanders in the direction of Ghent.

(*See* VICTORY, ADVANCE TO.)

First Overtures for Peace.—On Sept. 28 the Hindenburg system was cracking under Haig's blows and on that day Hindenburg and Ludendorff agreed that the situation of their armies was desperate. The next morning they informed the German Foreign Minister than an immediate request for an armistice was essential and on Oct. 4 the first peace offer was sent to President Wilson. Thus it was the battle of Amiens which decided Ludendorff to tell the Kaiser on Aug. 15 that a German victory was impossible and the battles of the end of Sept. together with the news of the collapse of Bulgaria before Gen. Guillaumat's attacks and of the Turks in front of Allenby, which caused him to appeal for terms. The suggestion, therefore, that the collapse of Germany was due to what is generally known in that country as the "stab in the back," that is to say, internal revolution and not to military defeat, cannot be substantiated, though it is true that the despatch of plenipotentiaries, who crossed the Allied lines on Nov. 8, was hastened by the revolution, as was their readiness to accept on Nov. 11 the terms imposed.

Position on Nov. 11.—The general situation on Nov. 11 was that the Allied front ran northwest from Pont-à-Mousson on the Moselle through Stenay-Sedan-Mézières-Chimay Mons-Ath and Ghent to the Dutch frontier. Thus the Allied right was considerably nearer to the German lines of retreat over the Rhine than were the German forces in Belgium. It has often been held that the Allies should, therefore, instead of imposing terms on Nov. 11, have continued the struggle and ended the War dramatically by compelling a large mass of German troops to surrender.

The decision to impose terms was made by Foch in consultation with the Allied commanders-in-chief because on Nov. 11 the Allied advance to the Meuse had come temporarily to a standstill. The Germans had in their retreat destroyed very completely both roads and railways and until these could be repaired supplies could not be brought up to the front beyond the line reached on Nov. 11. Therefore on the Meuse front a short halt was necessary and this would have given the Germans time to rally behind the Meuse and have entailed further battles. Foch had provided for this contingency and had actually begun to set in motion a new Allied offensive by French and American troops directed into Lorraine on either side of Metz, in order to turn the line of the Meuse. This portion of the front was weakly held by the Germans and against it the Allies could have brought their freshest troops and their largest reserves, for it was in this quarter that the bulk of the American Army was employed.

At the time of the Armistice the number of American divisions in France had increased to 42 and of these 32 were ready for battle. There is therefore no doubt but that an immediate advance into Lorraine would have been successful and have placed the German armies on the Meuse in a position of great embarrassment by the time that the Allied advance against the Meuse could have been resumed. Foch and the Allied Commanders, however, felt that if they could force Germany to accept such terms as would leave her militarily helpless they had no right to call for a further sacrifice of life or to expose the territories of France and Belgium to further devastation. It was in this spirit that the Armistice was signed in Foch's railway carriage in the forest of Compiègne on Nov. 11.

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WESTER WEMYSS, ROSSLYN ERSKINE WEMYSS, 1ST BARON (1864–), British sailor, was born in London April 12 1864, a posthumous son of James Hay Erskine Wemyss of Wemyss Castle, Fife. He entered the navy in 1877, was promoted lieutenant 1887, commander 1898 and captain 1901. Rear-admiral of 2nd Battle Squadron 1912–3 and of the 12th Cruiser Squadron 1914, he was made vice-admiral 1916 and admiral of the fleet 1919. He commanded a squadron during the landing of the British troops in Gallipoli (1915), was commander-in-chief in the East Indies and Egypt (1916–7), deputy first sea lord, and afterwards first sea lord of the Admiralty (1917–9) and a member of the War Cabinet (1918). He was created K.C.B. (1916), G.C.B. (1918) and raised to the peerage in 1919. In 1924 he published *The Navy in the Dardanelles Campaign.*

WEST INDIES, BRITISH (*see* 28.544).—In 1925 the estimated total population of this group was 1,805,436 (Bahamas 55,423; Barbados 159,499; Jamaica 904,405; Turks and Caicos Islands 5,400; Cayman Islands 5,465; Trinidad and Tobago 381,753; Grenada 68,957; St. Lucia 54,304; St. Vincent 47,591; Antigua 29,420; Dominica 38,632; Montserrat 11,890; St. Kitts-Nevis 37,140; and the Virgin Islands 5,557). Emigration from the islands to Cuba and Santo Domingo remained considerable, but the adoption of the quota system in the United States in 1924 almost stopped the exodus to that country.

I. POLITICAL HISTORY

On the outbreak of the World War in August 1914 many West Indians came over to enlist, and a contingent comprising 15,601 officers, non-commissioned officers and men was recruited voluntarily for active service and embodied as the British West Indies Regiment, which served with distinction in France, Flanders, Egypt, Palestine and elsewhere. Private contingents also went over for enlistment in the United Kingdom. The total contributions made by the British West Indies towards the cost of the War, relief funds, etc., amounted to over £3,250,000, the most notable gift being a contribution of £60,000 annually for 40 years voted by the Jamaica Legislature.

While the idea of political federation of the West Indies awoke little enthusiasm the scattered colonies tended increasingly to co-operate in matters of common interest. This is largely attributable to the intercolonial conferences which were held from 1899 onwards to consider such matters as agriculture, legal affairs, quarantine, customs tariffs, etc. All proved eminently successful, the customs conference (1919), for example, having resulted in the adoption of uniformity of definition and arrangement of the West Indian tariffs, whilst the conference on legal affairs (1916) led to the establishment of a West Indian court of appeal. A further step in the direction of closer union was the foundation in 1917 of the West Indian Associated Chambers of Commerce, which holds triennial conferences that serve to focus opinion on commercial matters affecting the group. In 1926 a conference, at which all the West Indian colonies as well as British Guiana and British Honduras were represented by official and unofficial delegates, was held in London to discuss the desirability of setting up a permanent conference or council to discuss periodically West Indian affairs. In 1920–21 Grenada, St. Lucia and St. Vincent petitioned the King for the substitution of representative government for the Crown Colony system. While the request of Grenada was granted, those of St. Lucia and St. Vincent were rejected on the grounds that the signatories were not sufficiently representative.

In 1921–2 a Colonial Office mission, comprising the Hon. Edward Wood, M.P., Under-Secretary for the Colonies, the Hon. W. Ormsby-Gore, M.P. and Mr. R. A. Wiseman visited the West Indies and British Guiana with the object of promoting closer touch between the Colonial office and those colonies and of studying the constitutional question. They visited in succession all the islands and British Guiana. In his report (Cmd. 1,679) Mr. Wood advocated the reintroduction of the elective system into the constitutions of Grenada, St. Lucia and St. Vincent and its adoption in Trinidad and Tobago. He recommended an increase in the tariff preference granted by Great Britain on Empire sugar from one-sixth to one-third, and in the event of the duties being reduced its stabilisation on the basis of not less than £3 15s. 0d. per ton on 96° sugar, and the adoption of the proposals for establishing an " all red " telegraphic system in the British West Indies. Most of his recommendations were adopted. Trinidad, which had been since its cession in 1797 a Crown Colony, with its ward Tobago, was granted a measure of representative government, and the elective element was reintroduced into the constitutions of Grenada, St. Lucia, St. Vincent and Dominica. The result of the British Empire Exhibitions of 1924 and 1925 was to attract much tourist traffic to these colonies, and to increase the interest taken in their affairs in Great Britain. Delegations of Members of Parliament visited parts of this area in 1924 and 1925; the Prince of Wales had already toured them in 1920.

II. ECONOMIC HISTORY

Trade.—The World War and the boom which followed brought about a remarkable revival of prosperity to the British West Indies, their total trade rising from £20,993,559 in 1913 to £54,691,648 in 1920. In 1923 the total was £30,674,367. The chief staples, sugar, rum, molasses, cacao, cotton and arrowroot, all commanded greatly enhanced prices, the only industry, indeed, that reaped no benefit being that of the production of lime and lime products in Dominica, which was adversely affected by the lack of shipping facilities and by import restrictions in the United States. More recently it suffered from the outbreak of withertip disease, which necessitated Imperial assistance of £22,000 (loan £13,400; grant £8,600).

Some anxiety was caused in 1912 by the decision of the Imperial Government to withdraw from the international convention for the suppression of sugar bounties and cartels, but the remaining high contracting Powers having decided to adhere to that agreement no ill effects resulted. Though Great Britain withdrew from the convention, she decided to adhere to its principles and not to give a preference to sugar produced within the Empire or to cane over beet. In Aug. 1918 she gave to the signatories of the convention six months' notice of her intention to resume complete liberty of action in respect of her policy with regard to sugar, and the Finance Act of 1918 provided for the granting of a preference of one-sixth off the duties on sugar, molasses, tobacco, coffee, cacao and other products imported from within the Empire into the United Kingdom, and a preference of 2s. 6d. per gallon on rum. The preference on sugar was increased in 1925 from 1s. 8·3d. per cwt. on sugar polarising 96° (to which it had fallen consequent upon a reduction in the sugar duty in the preceding year) to 3s. 8·75d., and stabilised for 10 years at that figure by clause 7 of the Finance Act of 1925.

Following an inquiry in 1909 by a Royal Commission, a conference was held at Ottawa in 1912 between representatives of the Dominion and the British West Indian colonies, the Bahamas, British Honduras and Jamaica excepted, to consider the question of closer trade. On April 9 1912 a reciprocal trade agreement was signed, the basis of which was a mutual preference of 20% on the chief products of the countries concerned, with a minimum preference on flour in favour of Canada of 12 cents per 100 lb. and 15 cents on 96° test sugar not over No. 16 Dutch standard in colour in favour of the British West Indies. Certain concessions which the Canadian refiners had enjoyed of importing foreign sugar at the British preferential rates were withdrawn. The agreement came into force on June 2 1913. Grenada gave her adhesion in the same year.

In 1920 a second conference was held at Ottawa at which all the West Indian colonies, and also the Imperial Government, were represented. A new agreement was signed on June 18 1920, and brought into force in May 1921, under which Canada agreed to give to British West Indian products a tariff preference of 50%, whilst the British West Indies similarly agreed to extend to Canadian products tariff preference of 50% in the case of Barbados, British Guiana and Trinidad, 33⅓% in that of British Honduras, the Leeward Islands and the Windward Islands, 25% in Jamaica and 10% in Bahamas, the legislature of which colony afterwards voluntarily increased the preference to one of 25%. Certain products were again specifically dealt with, the preference on Canadian flour entering the West Indies being not less than 1s. per 196 lb., and that on West Indian sugar being not less than 83·712 cents per 100 lb. on 96° test.

The Government of Canada further agreed to endeavour to arrange for a weekly freight, mail and passenger service, with steamers of 5,000 to 6,000 tons burden, capable of steaming 12

knots, between St. John (New Brunswick) or Halifax (Nova Scotia) down the islands lying to windward, British Guiana and back, the colonies contributing £27,000 per annum; also a service of freight, mail and passenger steamers of 3,500 tons burden, capable of steaming 10 knots, from Canada to Nassau (Bahamas), Jamaica, Belize (British Honduras) and back, fortnightly, the colonies concerned contributing at the rate of £13,000 per annum toward any loss involved should the service prove unremunerative. The Canada-British Honduras service was inaugurated in Jan. 1921, but the western service was withheld. A declaration appended to the agreement favoured the laying of British-owned and British-controlled cables as soon as possible, to connect Bermuda with Barbados, Trinidad, British Guiana, the Windward Islands, the Leeward Islands and Turk's Islands or Jamaica.

In 1925 a new and more comprehensive agreement was signed under which West Indian produce (other than tobacco, cigars and alcohol) was to enjoy a preference of 50% off the full duty on entering the Dominion. Canada was to withdraw the benefit of the British preferential tariff from any British colony producing cacao beans which did not extend to her a satisfactory reciprocal preference. She was to admit, free of duty, bananas produced in British colonies and impose a duty of 50 cents per bunch on foreign bananas.

Canada also undertook to provide for the western group a fortnightly freight passenger and mail service from Canadian ocean ports calling at all the islands both ways and at British Guiana, and alternating with a fortnightly freight service from river ports in summer and ocean ports in winter calling at St. Kitts, Antigua, Barbados, Trinidad and British Guiana. Towards the cost the colonies visited were to contribute £29,000 annually. For the western group Canada was to provide a fortnightly passenger freight and mail service with refrigeration for 70,000 bunches of bananas alternating with a fortnightly freight service to carry 50,000 bunches of bananas. The West Indies on their part were to give increased tariff preferences, namely 2s. per barrel or bag of 196 lb. of Canadian flour, and in the case of Jamaica, the Bahamas and British Honduras a preference not less than 30% on dairy products, meat and apples, and in the other colonies a preferential duty of not less than one-third of the general rate.

Industries.—Sugar remains the principal staple. Under the central factory system canes from the surrounding estates or farms are dealt with at a central base, at which the most efficient extracting machinery can be installed. The cocoa industry suffers from competition with the rapidly increasing production of cacao in West Africa. The banana industry is making headway in Jamaica after a setback due to a succession of hurricanes in 1915, 1916 and 1917. A considerable acreage has been planted under bananas in St. Lucia, and much interest in this crop is being shown also in Grenada and Trinidad, it being believed that arrangements will shortly be made for the provision of a fruit steamer service.

The Sea Island cotton industry, which owed its development in the West Indies to the ravages of the boll-weevil in the United States, received a check in 1920, through the appearance of the still more dreaded boll-worm in St. Kitts and Montserrat, to which it was brought by a Brazilian vessel. A comparatively new industry, which made rapid progress, was that of rice. At one time British Guiana had imported large quantities of rice for the Eastern immigrants, but in 1905 this colony was already able to cover her requirements and export 45,223 lb. and in 1925 15,495,727 pounds.

Almost as rapid has been the development of the petroleum industry in Trinidad. The existence of petroleum deposits in Trinidad has long been recognised. As far back as 1864 oil was struck, but it proved impossible to make a financial success of the enterprises concerned. About 1900 Mr. Randolph Rust, a local resident (mayor of Port of Spain in 1921), imported modern oil-boring machinery and successfully struck oil at Aripero in 1901. Other prospectors came on the scene, and in 1910 followed the successful flotation of the Trinidad oilfields, and Trinidad enjoyed an extraordinary boom. The new industry, which, was officially inaugurated in 1911, developed rapidly. With many new wells being drilled it was certain that the production of oil, which in 1925 amounted to 126,233,293 gal., would undergo material expansion.

College of Tropical Agriculture.—As the outcome of the report of a committee appointed by Lord Milner in 1919, the Imperial College of Tropical Agriculture was founded in 1921, with headquarters at St. Augustine, about seven m. east of Port of Spain, Trinidad. Its objects are to provide training in the science and practice of tropical agriculture to students intending to become tropical planters, agricultural administrators or officers or specialists in different branches of agricultural science and technology, and to offer facilities for the study of tropical agriculture to graduates of other colleges and universities. An important feature of the college is the provision for research and investigation work which its laboratories and fields afford. The site was given by the Govt. of Trinidad and Tobago, whose planters furnished £50,000 towards the erection of the college building, the first wing of which was opened by the governor, Sir Horace Byatt, in the presence of Lord Peel and the other members of a parliamentary delegation which was visiting the island. Maintenance is provided for by Imperial grants and contributions from the Govts. of certain of the West Indian and West African colonies. Attached to the college is an instructional sugar factory, towards which the British sugar machinery firms contributed plant to the value of £20,000.

Communications.—In 1915 the Royal Mail Steam Packet Co. terminated the transatlantic contract steamer service on the ground that they had been precluded from using their terminal port at Southampton. In the same year the fortnightly intercolonial contract service was also terminated by mutual agreement between the company and the colonies concerned. For some time thereafter the company continued to berth small passenger steamers for the West Indies at irregular intervals; but this service was also brought to an end in 1920, and passengers between the West Indies and Great Britain were compelled to travel by foreign steamers, cargo boats or via Canada or the United States. In 1920 T. & J. Harrison, who had acquired Scrutton Sons & Co.'s cargo service, entered the transatlantic passenger business. They now send passenger steamers every few weeks to Barbados, Trinidad and British Guiana. Later, Elders and Fyffes Ltd. included Barbados and Trinidad in the itinerary of certain of their steamers. It is consequently only in and in connection with the smaller islands that the need for better steamship communication is seriously felt, though throughout the colonies there is a demand for a regular line of steamers to carry fruit to Great Britain.

New cables were laid in 1924 from Grand Turk to Barbados, with spurs from Barbados to British Guiana and Trinidad, and wireless stations established at Barbados, Grenada, St. Lucia, St. Vincent, St. Kitts, Antigua and Dominica. The new system is conducted by the Pacific Cable Board on behalf of the Govts. of Great Britain, Canada, British Guiana and the West Indian colonies concerned. (A. E. A.)

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WESTINGHOUSE, GEORGE (1846–1914), American inventor and manufacturer, was born at Central Bridge, N.Y., Oct. 6 1846. He entered the Union Army in the Civil War in 1863, but in 1864 was appointed third assistant engineer in the navy. At the close of the Civil War he resigned and entered Union College, but on the advice of the president, withdrew to devote his time to mechanical invention. In 1865 he invented a device for replacing derailed cars and also a reversible steel railway frog. In 1869 he patented his air-brake and organised the Westinghouse Air Brake Company. In 1872 he invented the automatic air-brake (*see* 4.414). This brake was quickly adopted by railways in America and gradually in Europe. He also developed a system of railway signals, operated by compressed air with the assistance of electrical contrivances. In June 1912, he received the Edison Gold Medal for "meritorious achievement in connection with the development of the alternating current system for light and power." In 1893 this system was installed at the Chicago Exposition. Later his Pittsburgh establishment built dynamos for the power plants at Niagara Falls, for the rapid transit systems of New York City, and for the London Metropolitan Railway. Westinghouse also devised a method for conveying gas through long-distance pipes, thus making it a practicable fuel. He died in New York March 12 1914.

WEST POINT (*see* 28.558).—The administration building, east academic building, riding hall, two new cadet barracks, cadet chapel and chaplain's quarters, artillery barracks and stable, cavalry barracks and stable, eight sets of officers' quarters, two apartment buildings each containing eight sets of officers' quarters, a cadet laundry and a concrete athletic stadium with a capacity of 20,000 were completed after 1910. By Act of May 4 1916, the number of cadetships authorised at the academy was increased to 1,332. By authority of the War Department, April 1915, candidates were permitted, in lieu of passing the regular entrance examination, to qualify for admission upon the presentation of satisfactory certificate of previous academic work in accredited institutions. By Acts of 1919 and 1920, the pay of cadets was fixed at $780 per annum and one ration per day or commutation thereof at the rate of $1.08 per day.

The War and the demand for officers led the War Department to direct the graduation of the First or Upper Class April 20 1917, and of the Second Class Aug. 30 1917. The next year the need for officers resulted in the graduation of three classes, the first, June 12 1918, and the second and third together, Nov. 1 1918. A class of new cadets was admitted at an irregular time, Nov. 2

1918, and provision was made for a temporary one-year course. After the Armistice the War Department directed, May 12 1919, that the course of instruction be fixed for three years, but the following year Congress specified that the course should be four years. The academic authorities thereupon reorganised the curriculum in the light of the most recent military and educational experience.—

The schedule contains the following features:—

(1) The upper classes on duty undergo military training June 15 to Aug. 30, at West Point; (2) the new Fourth Class enter the academy July 1 and receive at West Point preliminary military training until Aug. 30; (3) during the academic year, extending from Sept. 1 to June 4, tactical drills and supervised athletics alternate daily for all cadets; (4) academic instruction is given in the following subjects—*Fourth Class*, mathematics, English, French and surveying; *Third Class*, mathematics, English, French, political history, drawing and theoretical tactics; *Second Class*, natural and experimental philosophy, chemistry and electricity, Spanish and drawing; *First Class*, military engineering, law, military art and history, ordnance and gunnery, economics and government and military hygiene. Training in riding and equitation is given to the upper three classes.

The number of graduates of the academy 1910 to 1925 inclusive was 2,993. The superintendents since 1910 have been T. H. Barry, 1910–2; C. P. Townsley, 1912–5; John Biddle, 1916–7; S. E. Tillman, 1917–9; Douglas McArthur, 1919–22; Fred W. Sladen, 1922–.

(F. W. S.)

WEST VIRGINIA (*see* 28.560), a State of the United States of America. In the decade before 1920 the population increased from 1,221,119 to 1,463,701 (19·9%), the urban population from 18·7% to 25·2%, and the density of population from 50·8 to 60·9 per square mile. The five largest cities in 1920 were Wheeling (56,208), Huntingdon (50,177), Charleston (39,608), Clarksburg (27,869) and Parkersburg (20,050).

Agriculture.—In 1920, 62·2% of the land area of West Virginia was in farms, and 57·7 was improved. The total number of farms was 87,289, and the total farm acreage was 9,569,720. In the preceding decade the total value of all farm property increased from $314,738,540 to $496,439,617 (57·7%), and the value of farm lands and buildings from $264,390,954 to $410,783,406, the value of implements and machinery from $7,011,513 to $18,395,058, and livestock from $43,336,073 to $67,261,153. The number of farms reported mortgaged grew from 9,525 in 1910 to 10,274 in 1920. The average debt per mortgaged farm was $1,241 in 1920. Of the 87,289 farms in the State in 1920, 86,785 were operated by white farmers, of whom only 752 were foreign-born, and there were only 504 coloured farmers, compared with 708 in 1910. Of the native white farmers 71,181 were owners, 1,071 managers and 13,781 tenants.

Domestic Animals.—The following table shows the number of domestic animals in 1910, 1920 and 1925:—

	1910	1920	1925
Horses	176,530	169,148	157,000
Mules	11,577	14,981	15,000
Milch cows	560,770	587,462	224,000
Other cattle	..	..	343,000
Sheep	556,952	509,831	514,000
Swine	..	..	261,000

The value of all crops for West Virginia in 1919 was $96,537,459, compared with $36,167,014 in 1909. The 1919 value of the corn crop was $29,768,131; oats, $3,054,668; wheat, $8,395,097; hay and forage, $23,746,574; potatoes, $6,461,619; tobacco, $2,731,338; apples, $7,540,491; peaches, $1,518,784. The variations in production of the chief crops in 1909, 1919, and 1923 is shown in the following table:—

	1909	1919	1923
	Bu.	Bu.	Bu.
Corn	17,119,097	17,010,357	20,536,000
Oats	1,728,806	3,054,668	4,600,000
Wheat	2,575,996	3,747,812	2,760,000
Buckwheat	533,670	537,883	693,000
Potatoes	4,077,066	2,809,398	4,851,000

In 1920 4,080,000 lb. of tobacco were produced. Fruit-raising has recently become more important, especially in the eastern panhandle and South Branch. In 1922 the production of apples was 5,600,000 bu. and peaches 715,000 bushels. The extension of agricultural teaching, which was established at the West Virginia University in 1913, has been an important factor in the development of scientific agricultural methods.

Mining.—Next to agriculture, mining is the chief occupation. In mineral production West Virginia ranks second among the States of the Union. The total annual mineral output is valued at over $300,000,000. Oil production in 1920 was 8,173,000 bbl., valued at about $20,000,000. The yield in 1922 was 7,026,000 bbl. and in 1924 was 5,924,000. Gas production, which in 1919 was approximately 201,500,000,000 cu. ft. (valued at $40,304,500), decreased to 192,960,989,000 cu. ft. in 1924. Coal production, which had reached 61,671,019 short (net) tons in 1910, continued to increase steadily, reaching in 1914 71,707,626 short tons, valued at $71,391,408 and furnishing employment to 78,363 persons. The industry became especially active when the United States entered the World War. In 1916 the production increased to 86,460,127 short tons, valued at $102,366,092. In 1919 it was 75,500,000 short tons, and, together with coke production of 1,454,000 short tons, gave employment to 91,566 persons. In 1920 it was 87,500,000 tons. The production of coke, which steadily increased until 1910, when it reached 14,217,380 short tons, valued at $7,525,922, diminished in 1919 to 1,454,000 short tons. The total output of coal in 1922 was 81,000,000 tons, that of 1923 was 97,475,177 tons, valued at $276,759,877, and that of 1924 was 103,325,960 tons, valued at $206,651,920. The determination of the United Mine Workers in 1912 to unionise the mines of West Virginia led to a bitter and prolonged labour war.

Manufactures.—In 1914 West Virginia was the 28th State in importance of manufactures. The number of establishments was 2,749, with an invested capital of $175,995,011 and a production valued at $193,511,782. The number of persons employed was 79,353 (11% more than 1909), earning $51,377,760. The leading industries were lumber and timber, steelworks, rolling-mills, tinplate and terneplate, glass, leather, railway cars and shop construction, flour-milling, and the manufacturing of clay products. The State ranked second in the production of glass, and also in the production of tinplate and terneplate, and eighth in the value of clay products. By 1923 the number of manufacturing establishments was approximately 3,000 with a total capital of $225,000,000, employing 110,000 labourers and producing goods valued at over $228,000,000.

Water-power.—One of the most prominent features is electrical production by water-power, which has largely transformed mine operation. Large projects have been planned on New Gaulay and Cheat rivers. The latest activity of this kind is on Cheat river at the Pennsylvania line, where a large dam was finally completed in 1926. A revision of the restrictions of the state Water-Power Act with a view to co-operation with the Federal Water-Power Act and to encourage water-power development was recommended by Gov. Cornwell in 1921. A Senate joint resolution, adopted April 29 1921, authorised the governor to appoint a commission to consider suitable water-power legislation suitable for development and proper control of natural water-power sites.

Banks and Banking.—Banking resources increased more than 100% in the years 1916–25. From 1920 to 1923 the total deposits in West Virginia state banks rose from $154,440,268 to $186,802,607 (which, however, decreased to $183,922,397 in 1924) and in West Virginia National banks from $136,717,000 to $156,676,000. The condition of the banks in West Virginia in 1924 was as follows:—

	National Banks	State Banks
Number	125	225
Capital	$13,126,000	$20,339,043
Surplus	10,529,000	13,805,900
Loans	131,320,000	71,729,992
Deposits	134,429,000	183,922,397

Finance.—The long impending dispute known as the Virginia debt question, which arose from the formation of West Virginia

as a separate State in 1863, was partly settled by a U.S. Supreme Court decision of 1911 and a later judgment of 1915 fixing the obligation of West Virginia at $12,393,929.50 (including interest since 1861). It was finally settled in 1919 when the West Virginia Legislature, facing a threat of compulsion, arranged to pay $1,062,287.16 in cash and the balance by an issue of "listable" 3½% bonds in favour of Virginia, payable in 1939 or earlier. The state fund revenue for the year ending June 30 1924 was $10,416,699 and the disbursements were $9,193,997. On June 30 1924 the total bonded indebtedness of the State was $39,100,000, of which $9,100,000 were Virginia debt bonds and $30,000,000 were road bonds. Before 1914 West Virginia obtained its revenue for state purposes from a small direct levy on assessed valuations, a charter or licence tax on corporations, and from liquor or other licence. An Act of 1915 imposed a business tax which in 1921 produced $1,400,000. The legislature in 1919 imposed a privilege tax on pipe-lines carrying oil and gas. This law, which was expected to yield about $1,500,000, was declared unconstitutional by the U.S. Supreme Court in 1921. Anticipating the failure of the law the Legislature of 1921 passed an Act which repealed the laws of 1915 and 1919 and substituted therefor a gross sales tax designed to reach every person, firm, association or corporation, doing a business of $10,000 or more in the State, and also declaring a tax on persons practising professions on the excess of their annual gross income above $10,000. In 1925 the gross sales tax and the gasolene tax were increased. From 1918 to 1923 direct taxes increased $24,694,311 (120%). In 1918 the aggregate assessed valuation of all property was $1,449,451,754, in 1923 it was $2,109,813,186 and in 1924 it was $2,122,919,846 (real estate, $1,236,516,283; personal, $430,789,236, and public utility, $455,514,327).

Education.—In 1924 the total school population was 479,766, the total school enrolment 401,344, the average daily attendance 316,510, the *per capita* cost of education $37.33 based on enumeration and $44.20 based on enrolment. The total number of teachers was 13,632. The total number of school houses was 7,196. The expenditure for all public schools (elementary and high) was $21,446,542, and the total for higher state institutions was $1,860,814. The value of public-school property was estimated at $49,981,335. A compulsory school law of 1920 has steadily become more effective. The development of the high schools has been a prominent feature of recent educational growth. In 1924 the State had 218 classified high schools with 1,733 teachers and an enrolment of 32,075, with 5,317 graduates during the year. The high school property was valued at $16,277,253. The total cost of maintenance in 1923–4 was $3,402,730, or $105.08 *per capita*. Under the Act of 1919 the control of all educational affairs of the State, from the lowest school to the university, was vested in a State Board of Education. The Board has an advisory council of three coloured citizens.

Public Health.—In 1914 a hygiene laboratory was established. In 1915 a State Department of Health was created; two new divisions, vital statistics and child welfare, were added by an Act of 1919. In 1925 general laws relating to health and medicine included provisions for examination and registration of midwives and nurses, for regulation of the practice of pharmacy and of chiropractic, for prevention of the sale of fraudulent diplomas by medical schools, for regulating the sale of caustic poisons and for legal action against places of prostitution.

State Government.—An amendment proposed in 1917 and ratified in Nov. 1918 provided that an itemised and classified budget should be prepared by the Board of Public Works and presented to the legislature for its guidance in determining appropriations. The governor urged the necessity of a modification which would place upon the executive the duty and the authority of preparing the budget, as the original draft of the amendment (before mutilation by the legislature) had provided, and in 1925 the legislature submitted a budget amendment placing large responsibility and power in the hands of the executive in the preparation of the budget. Another amendment ratified in Nov. 1920, provided for two periods of every regular session of the Legislature—one of 15 days in January, primarily for presentation of bills, and another of 45 days in March–April, primarily for consideration and action on bills. An amendment in 1920 increased the salaries of members of the Legislature to $500. By an Act of 1915 the membership of the House of Delegates (previously 86) was increased to 94. Following 1913 the salaries of elective state officers and supreme judges were increased. By an Act of 1919 the salary of the governor was increased to $10,000, effective March 4 1921.

By an Act of 1919 a Dept. of Public Safety (state police) was established to relieve the military arm of the State and to aid in abolishing the system of private peace officers. Its need was demonstrated by a serious condition resulting from a strike of steel workers at Benwood and Weirton in the upper panhandle. Among the most important acts of the Legislature of 1923 were those providing for instruction in American history and civics in all public and private schools, for organisation of co-operative marketing associations to facilitate the sale of agricultural products, for increasing compensation paid to injured employees and for the appointment of factory inspectors. Among the most important general laws enacted in 1925 was one authorising a bond issue of an additional $20,000,000 for further extension of state highways, one providing a better system of deposits of state funds, one creating a state forest and conservation commission, several relating to public health and medicine, and several relating to banking and taxation. The State continued Republican in politics, although party division resulted in the election of a Democrat, John J. Cornwell, to the governor's office in 1916 to succeed Gov. H. D. Hatfield. In the elections of 1920 and 1924, the Republicans elected the entire state ticket headed by Ephraim F. Morgan in 1920 and by Howard Gore in 1924.

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WEYGAND, MAX (1867–), French soldier, was born at Brussels Jan. 21 1867. Having entered the military college at St. Cyr in 1885, as a foreigner, he proceeded to the cavalry school at Saumur. He was appointed sub-lieutenant in 1888 and after successive promotions commanded the 5th Hussars in 1912. On Sept. 21 1914, as a temporary colonel, he was appointed chief of the general staff of an army, and in Aug. 1916 he was made a general of brigade. From the outset of the World War he was the immediate assistant of Marshal Foch, whom he succeeded as the French representative on the Inter-Allied General Staff in 1917. In April 1918 he resumed his work as Chief of the General Staff under Marshal Foch, which post he held during the remainder of the War; and in this capacity he was considered by many to be what Berthier was to Napoleon.

But, and here the balance was in his favour, he proved himself capable of personally directing operations on a very large scale in Poland. In Aug. 1920, when Warsaw was surrounded and threatened by a Soviet army, at a distance of only 20 km., Gen. Weygand arrived, and speedily reconstituting the disorganised Polish army, launched an offensive against the Bolsheviks' vulnerable points. In Dec. the enemy was in retreat. When the people of Warsaw acclaimed him, he said: "My rôle was merely to fill up the gaps; it was the heroic Polish nation itself which won the victory."

Weygand became a member of the *Conseil Supérieur de la Guerre*, and was made a grand officer of the Legion of Honour on Sept. 1 1920. In Nov. and Dec. 1922 he served as military expert on the French delegation to the Lausanne Conference, and in Jan. 1923, he was sent to the Rhine to inspect the Allied troops, The same year he succeeded Gen. Gouraud as high commissioner in Syria, where he proved himself to be a remarkable organiser. He was recalled to Paris on Nov. 29 1924, and placed in charge of the *Centre des Hautes Études Militaires.* (M. Gu.)

WHALES AND WHALING (28.570).—The last two decades of the 19th century which witnessed, at many European and American ports, the decay almost to extinction of whaling by the use of sailing ships and harpoons thrown from their boats, saw also the beginnings of the new whaling which was to replace

it. The Svend Foyn gun (*see* 28.571) was first employed for the capture of whales near the Norwegian coast; it was carried on small steamers and the whales being taken near shore were towed back to harbour for flensing and the extraction of oil. These three features—the use of the harpoon gun and harpoon with explosive head, of steamers capable of manoeuvring quickly and towing the whales, and of shore stations at which efficient plant could be installed for economic utilisation of the catch—are the essentials of modern whaling, an industry which has spread to practically every ocean coast of the world.

Methods.—No material change has been made in the harpoon, which has four 12-in. barbs which open out on entering the whale. Whale catchers and factories, however, have been developed greatly. A modern catcher is of 150 tons, with a crew of 11 men: she may reach 130 ft. in length, and can develop a speed of 12 to 15 knots. Similarly a shore station, with its accommodation, engine-houses, boilers and machines, is a small settlement and gives employment to about 150 men. Latterly, to enable whaling to be carried out in regions in which the maintenance of shore factories is difficult or impracticable, large ships equipped with boilers and other plant and capable of carrying 5,000 to 7,000 tons of whale oil are used. These floating factories do not operate in the open sea, but take up their position in such sheltered coves as they can find, where the attendant catchers (generally three in number) feed them with whales. The floating factory taken by Capt. Larsen to the Ross Sea was a 7,000-ton ship and was accompanied by five catchers. Although utilising a far greater proportion of the whale than was possible in the early days of whaling, floating factories are less efficient in economy than the shore stations.

Factory Processes.—On arrival at the factory, the whale is drawn up a sloping stage by means of a steam winch, power being used also in stripping the blubber, dividing blubber and carcass and transporting them to the boilers. The blubber is tried down in open boilers, the flesh and bones in pressure boilers, steam being the heating agent. The oil is graded into five qualities, of which grades 0 and 1 are obtained from blubber alone, 2 and 3 from carcass and bones and 4 from refuse. The finer qualities, after hydrogenation, are used in soap-making (*see* Oils, Fats and Soap). The oil was of great importance during the War as a source of glycerin; it is also used in the manufacture of margarine, and in dressing leather and fibre. The meat, especially that of certain species, is much used for food in Japan and has been used on the Pacific coast of the United States; for modern use, however, it must be eaten or tinned when very fresh. Whale meal and guano are made for cattle feeding and fertiliser respectively. Whalebone has much declined in importance in recent years. Ambergris is still employed in making perfumes. The value of the oil, however, enormously preponderates.

Present Conditions.—The new methods spread rapidly over the North Atlantic seaboard reaching Iceland and the Faeroes before 1900 and Great Britain shortly after, and after more than one exploratory voyage Antarctic whaling was resumed early in this century. The whaling in this region centres about the dependencies of the Falkland Is., whose waters are now by far the most productive whaling field. In 1906 Norwegian companies took 47,200 bbl. of oil from the Northern and 4,200 bbl. from the Southern Hemisphere; in 1911 they took 38,000 from the former and 306,000 from the latter. It may be added that the technical success of the Norwegians has led to whaling being very largely in their hands. According to expert evidence given before an Inter-departmental Committee on the Falkland Is. Dependencies, 72% of the world's supply of whale oil in 1917 was contributed by Norwegian companies; even in companies whose capital is in British or other hands the expert labour is almost entirely Norwegian.

Types of Whale.—The whales of the Falkland Is. Dependencies are chiefly the Blue whale (*Balaenoptera musculus*) which may reach 100 ft. in length and yields on an average 12 tons of oil, the Fin whale (*B. physalus*) giving 7 tons, the Humpback (*Megaptera nodosa*) with 5 tons, together with Right whales, Sei and other species in far smaller numbers. During the years 1909–18 the mean annual numbers of all kinds taken was 8,197 and in some years the catch exceeded 10,000, while in the same period the total value of products rose from just over £250,000 to over £1,500,000.

Danger of Over-Fishing.—Unfortunately the very success of whaling brings its own dangers. One catcher has been known to bring to her station (Vancouver) 325 whales in seven months, and six whales in one short voyage. Thus the destructive effect of modern whaling exceeds immensely that prevailing in the Arctic or South Sea whaling of former times. In the Antarctic whaling mentioned the fishery has shown a tendency for the Humpback whales to figure less largely in the catch, and for the Fin whales which succeeded them to give place to Blue whales; and though, perhaps, this may be explained in part by the increasing facility with which improvement in ships and gear permits larger and more valuable species to be attacked, when coupled with the known history of several other whale fisheries it constitutes a *prima facie* case for inquiring whether, notwithstanding the rigid regulations of the fishery by limitation of catching power, the region is not being fished to the detriment of future supply.

Scientific Investigations.—Such fears have led to the launching of a comprehensive investigation into the whales, and the oceanic conditions affecting their growth, movements and abundance. Capt. Scott's " Discovery " has been practically rebuilt and as the royal research ship " Discovery," commissioned for the work, which is financed by the Falkland Is. Govt. and directed by a special committee appointed by the Colonial Office. It is impossible here to detail the wide field of investigation undertaken. The danger of exhausting the whale stock of (for instance) South Georgia clearly depends largely on whether the catch is drawn from a separate local race or from the fringe of a great circumpolar stock. An important part of the investigations consists in marking whales by discharging at them numbered discs, resembling drawing pins in shape, which fasten into the whale's hide. These marks when returned by the whaler on the ultimate capture of the whale will cast light on the creature's migrations and thus on the question referred to, and if sufficiently numerous on the rate of destruction. A vessel of whale-catcher type appropriately named " William Scoresby," will be employed in this work but will co-operate with " Discovery " in other ways. A laboratory has been placed on South Georgia for the use of the staff. The investigations, which will keep close touch with other expeditions, can hardly fail to yield results of great economic and scientific importance.

Pelagic whaling, in which the whales are treated at sea after being drawn up on a slipway let into the stern of a large floating factory, has been inaugurated. It is too early to learn whether this method, which can hardly approach existing methods in efficient use of materials, will be a financial success: but if successful and permitted unrestricted development it will clearly increase the danger of depletion.

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WHARTON, EDITH (1862–), American novelist, the daughter of George Frederick Jones, was born in New York City, but spent most of her later life in Italy and France. In 1885 she married Edward Wharton, a Boston banker, and in 1891 she began her literary career by contributing to *Scribner's Magazine* a story entitled *Mrs. Manstey's View*. Her first long novel, *The Valley of Decision*, a not very interesting essay in historical romance, was published in 1902. *The House of Mirth* (1905) definitely established her reputation as inferior to Henry James' alone in the field which she and James together ploughed.

Her splendid sense of character, her ineluctable wit would have secured her a still higher place in literature if, owing to long residence abroad, she had not too often set her characters amid the frivolity of cosmopolitan society.

The best known of her later publications are: *The Fruit of the Tree* (1907); *Tales of Men and Ghosts* (1910); *Ethan Frome* (1911); *The Custom of the Country* (1913); *The Age of Innocence* (1920); *Old New York* (1924), and *The Mother's Recompense* (1925).

WHEAT: *see* GRAIN.

WHEATLEY, JOHN (1869–), British politician, was born on May 18 1869. Educated in village schools in Lanarkshire, he worked in the coal mines till 1891. After serving two years on the Lanarkshire county council, he was elected to the Glasgow city council in 1912, becoming a bailie, and acting as leader of the Labour group. He was also chairman of the Scottish National Housing Council. In 1922 he was elected M.P. for the Shettleston division of Glasgow. A member of the Independent Labour party from 1908, he was on its administrative council in 1923 and 1924. As Minister of Health in the Labour Govt. he was responsible for the Housing Act of 1924, which provided for a continuous building programme over a period of 15 years, designed to secure the erection of 2,500,000 houses to be let at rents within the means of the working class. In a large number of pamphlets, and through journalistic articles, Mr. Wheatley set out what is known as a left wing view of British Labour policy.

WHITE, ANDREW DICKSON (1832–1918), American educationalist (*see* 28.599), died at Ithaca, N.Y., Nov. 4 1918. His later works included *Seven Great Statesmen in the Warfare of Humanity With Unreason* (1910) and *The Work of Benjamin Hale* (1911). In 1913 he published a new edition of *The Warfare of Science and Theology in Christendom.*

WHITE, EDWARD DOUGLASS (1845–1921), American jurist, was born on a plantation in the parish of Lafourche, La., Nov. 3 1845, his father being 7th Governor of Louisiana. He was educated at Mount St. Mary's, Md., Georgetown (D.C.) College, and, after the outbreak of the Civil War, at the Jesuit College in New Orleans. During the latter part of the year he served as a private in the Confederate army. He studied law in the office of Edward Bermudez, later Chief Justice of Louisiana, was admitted to the Bar in 1868, and practised law in New Orleans. In 1874 he was elected to the state Senate, and four years later was appointed associate justice of the Louisiana Supreme Court. In 1891 he was elected to the U.S. Senate, and before completing his term was appointed, in 1894, associate justice of the U.S. Supreme Court by President Cleveland. In 1910 he was appointed Chief Justice by President Taft. Many of his notable opinions were delivered in connection with the Sherman anti-trust law. Of special importance were his opinions requiring the dissolution of the Standard Oil Co. and the American Tobacco Co. in 1911. As Chief Justice he administered the oath of office to President Wilson in 1913 and 1917, and to President Harding in 1921. He died at Washington, D.C., May 19 1921.

WHITE, SIR GEORGE STUART (1835–1912), British soldier (*see* 28.599), died in London June 24 1912.

WHITE, SIR WILLIAM HENRY (1845–1913), British naval architect (*see* 28.602), died in London Feb. 27 1913.

WHITEAVES, JOSEPH FREDERICK (1835–1909), British palaeontologist (*see* 28.602), died at Ottawa, Canada, Aug. 9 1909.

WHITE RUSSIA (*see* RUSSIA 23.869).—The White Russian Socialist Soviet Republic was established by a decree of the All-Russian Central Executive Committee on Feb. 5 1919, and its relations with the Russian Socialist Federated Soviet Republic were regulated by a treaty signed on Jan. 16 1921 until the adoption of the constitution of the Union of Socialist Soviet Republics in 1923, when the White Russian Republic became a constituent State in the Union. Its territory lies in the centre of the Western frontier of the Union opposite Poland (*see* RUSSIA).

The Republic covers 52,398 sq. versts, and has a population of 1,730,846, of whom 274,970 are classified as urban. The average density is just over 30 persons to the square verst. The capital is Minsk (population 105,834). The country is to a large extent composed of forest and marsh, and is not productive. The timber trade is being developed, and although a certain amount of grain is grown it is insufficient for home needs. There are practically no industries. The main Moscow-Warsaw line passes through the republic with an important station at Minsk, from which branch lines go to Vilna and Bobruisk. A main road from Brest-Litovsk to Moscow also passes through Bobruisk. There are two institutions of quasi-university standing at Minsk.

WHITE SLAVE TRAFFIC (*see* PROSTITUTION, 22.457).—The movement for the suppression of the international traffic in women and children for immoral purposes may be said to some extent to date from the attempt, in the middle of the 19th century, to introduce what may be described as a system of State regulation of vice into England. This system owed its introduction to the remarkably high incidence of venereal disease at that period among soldiers and sailors, and as a result, in 1864, the first of the Contagious Diseases Acts was passed (*see* 22.462).

Steps Taken Before 1920.—At that time in Europe there appear to have been, as there still are, two bodies of opinion; in some countries the State recognised prostitution as a necessity which could not be overlooked, but which called for control by registration and sanitary supervision; in other countries a strong body of opinion favoured no such recognition. In 1875 a meeting was called by Josephine Butler in Geneva to consider white slave traffic from its international aspect and in its relation to state regulation, and as a result the International Federation for the Abolition of State Regulation of Vice was formed. In 1898 and 1899 William Alexander Coote, the Secretary of the National Vigilance Association of Great Britain, visited Germany, Holland, Belgium, France, Russia, Switzerland, Spain, Austria and the Scandinavian countries, and in the capital of each organised a national committee for the suppression of white slave traffic. An international congress was therefore held in London in June 1913, and at that congress the International Bureau for the Suppression of White Slave Traffic was constituted to co-ordinate the work of the national committees. The French Government had called an official conference in Paris in 1904, and an international agreement was drafted, under which the signatory Powers undertook to appoint a central authority in each country charged with the co-ordination of all information relative to the traffic. The signatories undertook to ensure vigilance at ports and railway stations, to notify the arrival in each country of suspected persons, to take declarations from alien prostitutes, to protect and maintain the victims of the traffic pending repatriation (for which they also took the responsibility) and to supervise registry offices or agencies engaged in finding employment for women and girls abroad.

In 1910 a second governmental conference was called in Paris. A convention drawn up after this conference provided for the punishment of procurers for immoral purposes of girls and women, either minors or of full age, in whatever country the various acts constituting the offence might be committed. It provided also for the enactment, in those countries where needed, of the necessary legislation. In addition to the official conferences mentioned, the International Bureau was instrumental in calling together conferences and congresses in various parts of Europe, and it is greatly due to the enterprise of this body and the national committees affiliated to it, that so much has been done to limit the extent of the traffic.

THE WORK OF THE LEAGUE OF NATIONS

Such was the preliminary work done before the League of Nations came into existence on Jan. 10 1920. Article 23 (3) of the Covenant states that Members "will entrust the League with the general supervision over the execution of agreements with regard to the traffic in women and children." On the decision of the First Assembly of the League, a questionnaire was sent to all Governments to ascertain the measures taken or proposed in the various countries to put an end to the traffic. The Council of the League was also invited to convene an international conference. Thirty-four States were represented at this conference, which was held in Geneva from June 30 to July 5 1921. To it were invited, not only States parties to the previous international engagements, but all States willing to take part, and the meetings were open to the public. The conference examined the replies to the questionnaire, and a Final Act was adopted containing a number of recommendations requiring action by Governments. This Final Act was approved by the Council and, in Sept. 1921 the Assembly invited all Governments to authorise their delegates to sign forthwith a Convention submitted by the British Govt. in which many

provisions of the Final Act were given conventional form. This Convention was open for signature on Sept. 30 1921; it has been signed by 33 States, 27 of which (including the British Empire, the Dominions of Australia, Canada, New Zealand and South Africa and India) have up to the present time ratified the Convention. Twenty-five British colonies and dependencies and the territory of 'Iraq (British mandated territory) have adhered.

The new Convention was not intended to replace the earlier instruments, but to supplement only, and it is for that reason that the first Article prescribes that the High Contracting Parties, if not already parties to the Agreement of 1904 and the Convention of 1910, shall ratify or adhere to them without delay. Other new provisions in the Convention are that the punishments prescribed under the Convention of 1910 for those who traffic in women and girls are made applicable to those who engage in the traffic of children of either sex. The punishment is required not only of those guilty of offences committed, but of attempts to commit the offence and, within legal limits, of acts preparatory to the committing of such offence. The minimum age under which it is an offence to procure a woman for immoral purposes, even with her consent, previously fixed at 20, is raised to 21. In addition, the provisions of the Convention of 1921 relating to extradition go further than those of the Convention of 1910, the Parties agreeing that in cases where no extradition convention exists between two countries, they will take all measures in their power to extradite or provide for the extradition of persons accused or convicted of certain offences specified under the Convention of 1910. They also undertook to prescribe such regulations as are required for the protection of women and children seeking employment in another country, if they had not already done so.

The Advisory Committee.—Another outcome of the Conference of 1921 was the setting up of an advisory committee to the Council on all matters relating to the traffic in women and children. This committee sat for the first time in June 1922. It was composed of delegates of Governments, and of assessors appointed by international voluntary organisations. During its four meetings it had under special consideration the questions of employment of women abroad by theatrical, variety, concert and cinema agents; the moral welfare of women and children on emigrant ships; the consideration of the system of licensed houses; the employment of women police, and the consideration of the laws and regulations in force in the various countries for the suppression of the traffic.

Of these questions, one which has been given much importance is that of the system of the licensed house. Though it may be maintained that the regulation of vice in any country is purely an internal and national question, it was the opinion of a large number of members on the advisory committee that the licensed house stimulates immorality and encourages an international trade to supply a certain market. The committee gave special attention to the subject, and as a result of its investigations, the Council " recognising the connection which may exist between a system of licensed houses and the traffic in women and children," invited States which had abandoned the system to explain the motives of their decision in abandoning it, in so far as they concern the traffic; and States which still maintain the system to indicate whether their experience leads them to believe that the system encourages the international traffic or otherwise.

The majority of answers received appear to indicate a strong movement for the abolition of the licensed house system, which some of the new States created by the Treaty of Versailles adopted and subsequently abandoned. The reasons given by these States and others for this abolition are various. It is said, for example, by some that the system has not justified expectation, and has tended to disseminate rather than diminish venereal disease. It is the opinion given by more than one State that the licensed brothel has proved itself to be a permanent factor in the traffic in women and children, in fact that the traffic owes its very life to the existence of the licensed brothel. The Dutch Govt., in stating the reasons for the abolition of the system of regulation in that country, state that experience has shown that the traffic depends on the existence of the licensed brothel and that its abolition has almost killed the traffic. On the other hand certain countries, in replying, say that they maintain the system in the interests of public health. This is sometimes qualified by the statement that there is an obvious contradiction existing between the system of tolerance and the higher end of the State, or that the State has decided to give the matter serious attention in view of the growing public opinion in favour of abolition, and in other reports it is said that although the system is maintained, a scheme is in course of preparation for its suppression. The evidence, however, is far from complete.

An Expert Investigation.—In order to ascertain the extent of the world traffic, the routes which it follows and the individuals or organisations connected with it, a small body of experts was nominated to make a world investigation on the spot with the consent of and in conjunction with the Governments concerned. During 1924 and 1925, between 30 and 40 countries were visited.

BIBLIOGRAPHY.—*Reports of the International Conference on Traffic in Women and Children* (Geneva, 1921); the *Reports* of the League of Nations Advisory Committee on Traffic in Women and Children (5 sessions, 1922, 1923, 1924, 1925, 1926). (R. CR.)

WHITLEY COUNCILS: *see* INDUSTRIAL RELATIONS.

WHITLOCK, BRAND (1869–), American diplomat and writer, was born at Urbana, Ohio, March 4 1869. He was elected mayor of Toledo in 1905 and was re-elected for three succeeding terms, but in 1911 declined the nomination for a fifth term. In 1913 he was appointed U.S. minister (later ambassador) to Belgium. Before he had been in Belgium a year the World War broke out and the German invasion took place. Although the other diplomatic bodies followed the Belgian Court to Havre, Whitlock insisted on remaining in Brussels. It was largely due to his urgent advice that Brussels did not resist and thus escaped devastation. In the early days of the War he gave protection to many German residents who had been unable to leave the country. By his firm attitude toward the German military officials he saved many innocent Belgians from death; but his activities on behalf of Edith Cavell were unavailing as he was misled at the last moment through false promises by the Germans. After the formation of the Commission for Relief in Belgium, its operations were placed wholly under his direction. His ceaseless work on their behalf won the gratitude of all the Belgians. He resigned Feb. 1 1922. An account of the German occupation is given in his *Memories of Belgium under the German Occupation*, 2 vol. (1918).

Whitlock's other writings include *The 13th District: a Story of a Candidate* (1902); *Her Infinite Variety* (1904); *The Turn of the Balance* (1907); *Abraham Lincoln* (1909, in the *Beacon Biographies*); *The Gold Brick* (1910); *The Fall Guy* (1912); *Forty Years of It* (1914); *J. Hardin and Son* (1923), and *Uprooted* (1926).

WHOOPING COUGH: *see* INFECTIOUS FEVERS.

WHYMPER, EDWARD (1840–1911), British artist, explorer and mountaineer (*see* 28.617), died at Chamonix Sept. 16 1911.

WHYTE, ALEXANDER (1837–1921).—Scottish divine (*see* 28.617), died at Hampstead, London, Jan. 6 1921. In 1915 he published *Thirteen Appreciations*.

WIEN, WILHELM (1864–), German physicist, was born on Jan. 13 1864, at Gaffken (East Prussia). He studied at the universities of Königsberg, Freiburg and Berlin, and in 1890 entered the Physico-Technical Institute as assistant. In 1896 he was appointed professor at the technical high school, Aix-la-Chapelle; in 1899 he went to Giessen, and in 1900 to Würzburg. Wien's researches covered almost the whole sphere of physics. He wrote on optical problems; on radiation, especially the radiation of heat, for which in 1911 he was awarded the Nobel prize; on water and air currents; and on the transmission of radiation in rarefied gases (Cathode and Röntgen rays), which brought him in touch with modern high frequency technology. In 1913 he lectured at Columbia University in New York on problems of modern theoretical physics.

Wien was editor of the *Annalen der Physik from* vol. 21 (1906); His chief works are: *Lehrbuch der Hydrodynamik* (1900); *Neuere Probleme der theoretischen Physik* (1913); *Die Relativitäts-theorie vom Standpunkte der Physik und Erkenntnislehre* (1921).

WIGGIN, KATE DOUGLAS (1857–1923), American novelist (*see* 28.626), died in London Aug. 24 1923. In accordance with her wishes her body was cremated, and the ashes scattered on the waters of the Saco river at Hollis, Me., Sept. 12 1923.

WILAMOWITZ-MÖLLENDORFF, ULRICH VON (1848–), German philologist, was born on Dec. 22 1848 at Markowitz in Posen. He studied at Bonn and Berlin, and afterwards travelled in Italy and Greece 1872–4. In the latter year he took a post as lecturer in Berlin, and afterwards became a professor in Greifswald and Göttingen. In 1897 he was appointed professor of ancient philology in the university of Berlin. Wilamowitz proved himself not only an excellent editor and witty commentator on the Greek tragedies of Aeschylus, Euripides and Aristotle, but also a brilliant translator of Greek verse. Sharply attacked by Friedrich Nietzsche in his youth, Wilamowitz became one of the first authorities of modern times in the field of Greek philology.

Among his numerous works are: *Aeschyli Tragoediae* (Greek and German 1914); *Euripides' Herakles*, with an introduction to the Greek tragedy and German annotations (1889); *Die Textgeschichte der griechischen Lyriker* (1900); *Bucolici Graeci* (Oxford, 1905); *Die Ilias und Homer* (1916); *Platon*, (1919); *Hellenistische Dichtung* (1924); *Griechische Verskunst* (1921); *Pindaros* (1922).

WILBERFORCE, ALBERT BASIL ORME (1841–1916), English divine (*see* 28.630), died May 13 1916.

WILBRANDT, ADOLF (1837–1911), German novelist and dramatist (*see* 28.631), died at Rostock June 10 1911. *See* E. Scharrer-Santen, *Adolf Wilbrandt als Dramatiker* (1912), and *Jahrbuch und Deutscher Nekrolog*, XVI., p. 84 (Totenliste 1911).

WILBUR, RAY LYMAN (1875–), American educationalist, was born at Boonesboro, Ia., April 13 1875. He graduated at Stanford University in 1896, proceeding thence to Cooper Medical College, San Francisco (M.D. 1899), and later continuing his studies at London, Frankfurt and Munich. In 1909 he was appointed professor of medicine at Stanford University, becoming dean in 1911. In 1915 he was appointed president. He was chief of the division of conservation of the U.S. Food Commission, and a member of the California State Council of Defence 1917.

WILEY, HARVEY WASHINGTON (1844–), American chemist, was born in Kent, Ind., Oct. 18 1844. He was educated at Hanover (Ind.) College (A.B., 1867; A.M., 1870), Indiana Medical College (M.D., 1871) and Harvard (B.S., 1873). He was professor of Greek and Latin at Butler College, Indianapolis (1868–70); state chemist of Indiana and professor of chemistry at Purdue University (1874–83); and chief chemist of the U.S. Dept. of Agriculture (1883–1912). From 1899 he was professor of agricultural chemistry at the George Washington University. He was specially interested in preventing food adulteration, and antagonised many food packers, who in 1911 unsuccessfully exercised political pressure to obtain his dismissal from the Dept. of Agriculture on the technical charge that an expert in his department had received recompense exceeding the legal rate. President Taft wholly exonerated him. Dr. Wiley resigned in 1912, thereafter devoting himself largely to the cause of pure food by lecturing and writing.

His numerous publications include *The Sugar Industry of the United States* (1885); *Principles and Practice of Agricultural Analysis* (1894–7; revised edition, 1906–14); *Foods and Their Adulterations* (1907, third edition, 1917); *The Lure of the Land* (1915), and *Beverages and Their Adulteration* (1919). He also edited a series of *Health Readers for Schools* in 1919.

WILLARD, DANIEL (1861–), American railway official, was born at North Hartland, Vt., Jan. 28 1861. He studied for a year at the Mass. Agricultural College, Amherst, and in 1879 began his railway career as a track labourer in Vermont. He rose to fireman, then to engineer, and for years held various positions on the Minneapolis, St. Paul and Sault Ste. Marie; Baltimore and Ohio; Erie; Chicago, Burlington and Quincy; Colorado Midland and Colorado and Southern railroads. In 1910 he was elected president of the Baltimore and Ohio. In Oct. 1916, he became a member of the advisory commission of the council of national defence, and the following March chairman of the commission. He was appointed in July 1917, a member of the special committee of the council of national defence to secure mediation in case of strikes on war contracts. In Nov. 1917, he was appointed by President Wilson chairman of the War Industries Board. In Jan. 1918, he resigned in order to devote his personal attention to the Baltimore and Ohio Railroad. After the Government had taken over the railways as a War measure he was displaced as operating head of his road, but remained president in charge of its corporate affairs, in which position he continued when the U.S. Govt. gave up control of the railways.

WILLCOCKS, SIR WILLIAM (1852–), British engineer, was born in India and educated at Roorkee College, India. From 1872 to 1897 he was engaged successively in the Indian and Egyptian Public Works Departments. He designed and carried through the Aswan Dam in 1898, and for this work the C.M.G. was conferred upon him, followed by the K.C.M.G. in 1902. His most important undertaking, however, was the irrigation of Mesopotamia, begun in 1911 at an estimated cost of £26,195,000. The scheme provided for the irrigation of 3,500,000 acres. His published works include *Egyptian Irrigation* (1889); *The Irrigation of Mesopotamia* (1905) and *From the Garden of Eden to the Crossing of the Jordan* (1918). In March 1921 he was found guilty by the supreme consular court of Egypt of sedition and criminal libel in respect of statements concerning the data in connection with the Nile irrigation scheme, and was bound over to be of good behaviour for one year.

WILLETT, WILLIAM (1856–1915), British builder, was born at Farnham, Surrey, in Sept. 1856. He made a name for himself in London as a designer of beautiful houses; but his chief claim to fame was his conception and promotion of the system of "daylight saving." Though scoffed at in his lifetime, his idea was taken up and put into practice in 1916, and honour has been paid to Willett's memory, which was denied to him in life. He died at Chislehurst, Kent, March 4 1915. (*See* DAYLIGHT SAVING.)

WILLIAM (1882–), late Crown Prince of Germany, eldest child of William II. of Germany, was born at the Marble Palace, Potsdam, on May 6 1882. He began his military career by serving in the 1st Foot Guards, and accompanied the Kaiser to England (Jan. 19–Feb. 5 1901) on the occasion of the funeral of Queen Victoria. On June 6 1903 he married the Duchess Cecilia, sister of the Grand Duke of Mecklenburg-Schwerin. There were five children, four sons and one daughter, of the marriage. His political and personal interventions in public affairs gave some trouble in the years preceding the War. He was credited with pan-German sympathies, and on one occasion (Nov. 9 1911) he appeared in the royal box in the Reichstag during the debate on the Morocco settlement and demonstratively applauded speakers who were attacking Great Britain and the Imperial Chancellor, Bethmann-Hollweg. He was afterward compelled by the Emperor to make amends to the Chancellor. On the occasion of the conflict in Dec. 1913 at Zabern in Alsace between officers of the garrison and the civilian population, he dispatched telegrams encouraging the officers in their truculent attitude. In 1910–1 he paid a visit to Ceylon, India and Egypt, and he published some account of his experiences in his *Jagdtagebuch*.

On the outbreak of the World War the Crown Prince was appointed to the command of the V. Army in the west. In Sept. 1915 he received the command of an army group, and he was nominally in charge of the German operations against Verdun. His flight to Holland speedily followed that of the Emperor in Nov. 1918, and he went to Wieringen, an island in the Zuider Zee. He formally renounced on Dec. 1 1918 his rights of succession to the crowns of Prussia and the German Empire. The ex-Crown Princess and her children, however, continued to reside at Potsdam. Although credited with remaining in touch with the Monarchists in Germany, the ex-Crown Prince took little active part in this movement. His father was the national object of the strict legitimist sympathies while William was too closely involved in his father's fate and unpopularity to be able to head a rival movement of his own. On Nov. 10 1923 he suddenly returned to his estate at Oels in Silesia. There was strong feeling in France that the German Govt. should be com-

pelled to surrender him, but the matter was settled by a German note which stated the act of renunciation of the ex-Crown Prince and declared that it would not permit the return of the Kaiser. The Allied Powers declared that they would hold Germany responsible for any consequences which might arise, but the ex-Crown Prince himself declared that he would take no part in politics. His memoirs, *Ich suche die Wahrheit* were published in 1922.

WILLIAM II. (1859–), until 1918 German Emperor, was born at Berlin on Jan. 27 1850, the eldest son of Prince Frederick of Prussia, afterwards Crown Prince and second German Emperor, and of Victoria, Princess Royal of Great Britain and Ireland.

At the time of his birth William received an injury to his head and left side that rendered his left arm permanently useless, an event that was to have an important effect upon his character and thereby upon the future of Germany and the world. As a Hohenzollern prince, and still more as heir to the throne, he was destined for a military career. Yet in this career his useless arm would more patently handicap him than in any other. Hence there entered into his personality what would now be termed an "inferiority complex," to overcome which he asserted himself to the uttermost, so that in the event he became arrogant and self-assertive even when he had no occasion to be so. Because he seemed manifestly unfitted for the army, he determined all the more to make himself an efficient soldier. With the exception of three years spent at the gymnasium at Cassel and two more at the University of Bonn his early years were entirely occupied in military training and duties—he became a second-lieutenant in the First Regiment of the Guards at the early age of 10 years. Hence when he ascended the throne on June 15 1888 he did so thoroughly imbued with militaristic ideas, and in the belief that "the soldier and the army, not parliamentary majorities, have welded together the German Empire. My confidence is placed in the army."

Prior to his accession he had made two friendships that were destined to affect profoundly his future career, and that serve to illustrate in their divergency his dual personality. Amidst army circles he had learnt to know General Count Waldersee, a bitter opponent of Bismarck and Bismarck's pro-Russian policy, from whose enmity with the great Chancellor may well have sprung the Emperor's own enmity with him. A Prussian prince and soldier, he found in Waldersee the prototype of the *alt-preussische* officer for whom there was but one loyalty—that of his oath to his king; and one path to national greatness—military victory. There was, however, another and very different side to William's nature—a side that sought expression in his dramatic journeyings over Europe; in his highly rhetorical speeches; in his very sincere love of music and art. Inherited from his Coburg grandfather, Albert the Prince Consort, the young Kaiser's strongly developed artistic and theatrical temperament demanded a more sympathetic *milieu* in which to expand than the society of Waldersee and the officers of the Potsdam garrison. And this is found in the Kaiser's friendship, which lasted more than 30 years, with Philip, Count (later Prince) zu Eulenburg-Hertefeld. In the diaries and letters of this remarkable man is to be found the fullest, most intimate portrayal of his Imperial friend's personality.

On ascending the throne William II. speedily found that Germany was not wide enough to contain two such spirits as his and Bismarck's. In theory the aged Chancellor conceded the supremacy in the government to the Emperor; in practice he had himself been the real ruler. But now there sat on the throne a ruler who was not content to rule merely in name. After a struggle that left behind it bitternesses that poisoned German political life for more than a generation, the Chancellor was dismissed and the young Emperor grasped with his own hands the helm of the ship of state. Despite gloomy forebodings, especially in Bismarckian circles, no disaster overtook the ship; on the contrary, she went forward prosperously for the first decade of the reign.

In the 'nineties, however, the Emperor made the discovery that the future of Germany lay on the high seas; a discovery that led to the long rivalry in naval armaments between the Empire and Great Britain and that was an important factor in bringing about the World War. For once an idea had taken possession of the Emperor he was tenacious to the last degree in endeavouring to give practical expression to it. Hence he placed himself at the head of the Navy party, gave his support to von Tirpitz, and telegraphed to Prince Henry of Prussia: "I will not rest until I have brought my navy to the same height at which my army stands." This policy of naval and also of colonial expansion inevitably brought Germany into conflict with the British Empire; but the Emperor's outbursts of ill-humour against this country are chiefly to be ascribed to his dislike to having his desires frustrated rather than to any inherent personal animus against the English. From his earliest years he had been brought up to have his slightest wish regarded as a command, to be instantly obeyed; and as years passed by his position as ruler over a greatly prospering nation did nothing to eradicate his egotism.

In foreign policy the Emperor pursued a less spectacular path in the first decade of his reign than had been anticipated. He was conciliatory towards France; he courted Russia, whose rapidly growing intimacy with France gave cause for alarm to the Wilhelmstrasse; and he paid a theatrical, yet in its practical results eminently valuable, visit to the Sultan of Turkey in 1889. The East, indeed, made a strong appeal to his temperament, and he did much to intensify the "Drang nach Osten" by which Germany shortly afterwards became animated. Until the dispatch of the celebrated telegram to President Kruger on Jan. 3 1896, after the failure of the Jameson Raid, Anglo-German relations had been friendly, even cordial, since the Emperor's accession; and at one time the basis of a possible *entente* was under discussion. But after the episode of the telegram a change took place; the two countries gradually drifted apart until, with the growth of the German Navy, rivalry began to spring up between them.

In the second decade of his reign events occurred presaging the coming of the catastrophe that was to mark its final days. There was the episode of the Björkö Treaty, July 23–4 1905, in which the Emperor sought to detach the Tsar from his French alliance by pledging him to give, if necessary, his armed support to Germany—an attempt that ended in failure because Prince Bülow was willing to regard the treaty, which the Tsar had actually signed without consulting Count Lamsdorff, the Russian Foreign Minister, as being *non avenu*.

Two years later came the famous incident of *The Daily Telegraph* interview (Oct. 28 1908), in which the Emperor inveighed against the Anglo-Japanese alliance and declared that Germany "must be prepared for any eventualities in the East"; a declaration that was promptly disavowed by Prince Bülow, who forced his Imperial master to promise publicly that in future he would refrain from such intrusions into the realm of foreign policy. The storm raised in Germany by the publication of this interview nearly cost the Emperor his throne; for some weeks talk of his abdication was rife, and he became the sport of every caricaturist in Germany. Eventually the storm blew over, leaving the Kaiser unchanged in his autocratic disposition: "If another such opportunity comes, then I will no longer act in a constitutional manner."[1] If it left the Kaiser unchanged, except in his people's regard for him, the storm destroyed Bülow, whose resignation followed in 1909. With his departure the last controlling influence over the Kaiser was removed, and that ill-balanced, if gifted, monarch was left to fall a victim to the counsels of militaristic advisers. As Holstein, who died in 1908, had said when entreating Bülow to remain in office: "If you resign, war will be inevitable."[2]

The year 1908 was indeed a decisive year in the Emperor's life. For 20 years he had ruled over an empire that had steadily waxed materially more prosperous. For 20 years he had been the central, though by no means the most important figure, in the political life of Europe. Now in the space of a year all was changed. For a second time the work he had sought to accomplish at Björkö was destroyed when the Tsar and King Edward VII.

[1] Graf Robert von Zedlitz-Trützschler, *Zwölf Jahre am deutschen Kaiserhof*, 1923, p. 239.
[2] Emil Ludwig, *Wilhelm Der Zweite*, 1926, p. 381.

met at Reval in June. As a politician he had been proved no match for his uncle, for whom he now entertained a very hearty dislike. As a ruler he had made himself ridiculous in the eyes of his own people because of the flagrant contrast between his professions and his deeds. For the first time in his reign, perhaps for the first time in his life, the Emperor experienced the chilling sensation of unpopularity. The way in which he met it was but a prelude to the days of Nov. 1918; he went hunting with the ill-fated Archduke Francis Ferdinand, and wired to Bülow from Vienna at a time when the Reichsrat was debating his conduct: "The two days here passed very harmoniously and happily . . . the hunt went splendidly. I laid 65 deer low. . . . I remember you always in my prayers morning and evening. They lift us above all human hatred and envy! *There is a silver lining* (sic) *to every cloud*. God be with you! In old friendship. William I.R."[1]

Between 1908 and 1914 the storm clouds overhanging Europe frequently threatened to break. At times it seemed as if the German Emperor were bent on provoking the catastrophe; at other times he seemed to be doing his utmost to avert it. Aehrenthal's *coup* in the annexation of Bosnia-Hercegovina in Oct. 1908 aroused the Kaiser's fury no less than that of Izvolsky. "Vienna will be accused of duplicity," he wrote on the margin of the dispatch in which he learnt of the annexation, "and with reason. It has duped us shockingly. . . I have been cut to the heart in my feelings as ally . . . simply a felony . . . the thanks of the House of Habsburg."[2]

The Turkish revolution followed speedily on the annexation crisis. With amazing inconsistency the autocratic Emperor welcomed this latest achievement of democracy. On the margin of a dispatch in which Marschall von Bieberstein, writing from Constantinople, commented on the conduct of the Sultan's courtiers who, owing all to him, nevertheless deserted him in the hour of crisis, the Kaiser in words prophetic of the circumstances attending his downfall wrote: "Thus do creatures of the court always behave! Not only among the Turks but also among us Christians."[3] With the fall of Bülow the influence of the military party, and especially of von Tirpitz, grew from day to day. The competition between England and Germany in naval armaments became keener and keener. Repeatedly urged by Bülow to come to an understanding with England on the naval question, the Kaiser invariably replied in words he used to King Edward: "It (the naval programme) will be adhered to and exactly carried out, without any restrictions."[4]

In 1912 Lord Haldane visited Berlin in the hope that even at that late hour some *modus vivendi* might be found as between the two countries, but without result, though the Kaiser, perhaps to impress his visitor, played the part of a constitutional monarch in the discussions that ensued. By now, however, it was too late to undo the work accomplished in the previous 20 years. Already, as Sir Edward (later Viscount) Grey observed to Count Metternich, Europe was divided into two camps. The responsibility for the existence of that division must in part fall upon the Kaiser's shoulders.

The years 1912–4 were filled with wars in the Balkans and rumours of wars elsewhere. Perhaps at last some vision of what lay ahead of Germany were she to pursue her present path became apparent to the Emperor, for he constantly in these years reiterated his desire for peace. Constantly he warned Bethmann Hollweg against the dangers into which Germany might be led by a warlike Austria, "which might be the ruin of Germany—all because of Albania and Durazzo."[5]

When, however, he was at last confronted with the imminent outbreak of that World War to which events had been leading up for a quarter of a century the Kaiser lost his nerve. On first learning of the murder of the Austrian Archduke and his wife at Sarajevo he was filled with fury against Serbia, which he declared was not "a State in the European sense, but a robber band."[6] The sanctity of the monarchical principle had been violated, and true to his conception of kingship as a divine institution the Emperor called for vengeance upon the murderers and the nation to which they belonged. Nor did the imminence of a European war at first appall him. On the margin of a dispatch in which Grey was reported as speaking of the danger of a European war he wrote: "That will certainly come."[7] Indeed, during that fateful July preceding the outbreak of War the Emperor found himself caught between the horns of a dilemma from which it might well have puzzled an abler man than he—and he was an able man—to escape. For years he had played the war-lord before the eyes not only of all Europe but before those of the German nation and the military clique. Now that war had become imminent, could he dare risk playing the peacemaker? Might not his throne, if not his life, be endangered were he to seek to oppose the militarists whose plans he had long encouraged at the very moment when the long-awaited opportunity for putting them into execution had arrived? As he thus hesitated, there came the news of the Serbian reply to the Austrian ultimatum, and as he read it the Emperor was quick to see a possible way of escape from his difficulties. "A brilliant result for a delay of 48 hours," he declared. "That is more than one could expect. A great moral success for Vienna; but with it every occasion for war disappears."[8] Unhappily, the Kaiser's advisers proved him a false prophet; and indeed before many days had elapsed he was again possessed by a war-frenzy. At the great Crown Council at Potsdam on July 29 the decision was taken in favour of war.

In the War the Kaiser's mercurial temperament was recognised as a danger by the military leaders of Germany. He was gradually but effectively side-tracked, and the real control of affairs passed into the hands of men like Ludendorff, Hindenburg and Falkenhayn. In 1918 as the end approached it became obvious that a revolution was imminent. Hindenburg, who treated the Emperor with scant respect, informed him that even the troops could not be relied upon in event of a civil war, and urged him to abdicate. At first the Emperor protested his duty to Germany, but finally gave way, abdicating as German Emperor but not as King of Prussia. The Berlin Government had anticipated such a move and had already announced his abdication of both thrones. After some hesitation he agreed to seek safety in Holland, and he crossed the frontier on Nov. 10, the day after the revolution broke out in Berlin. At first he was the guest of Count Bentinck at Amerongen; subsequently he purchased for himself a property at Doorn. The Empress (Augusta Victoria), who joined him at Amerongen, died at Doorn on April 11 1921. She was a daughter of Frederick, duke of Augustenburg and was married Feb. 27 1881. They had issue, six sons and one daughter. On Nov. 5 1922 the ex-Emperor married Princess Hermine of Reuss, widow of a German prince. (*See* also GERMANY: HISTORY.)

BIBLIOGRAPHY.—For an understanding of William II.'s character no book exceeds in interest or importance Johannes Haller's *Aus dem Leben des Fürsten Philipp zu Eulenburg-Hertefeld* (Berlin, 1924); Emil Ludwig's *Wilhelm II.* (1926), besides being a brilliantly written account of the Emperor's life, has done more than any other single volume to destroy the respect for monarchy entertained by the German people: it is, however, highly coloured and exaggerated. Among other books may be mentioned Bismarck's *Reflections and Reminiscences*, 3 vol. (1898 and 1921); Prince Hohenlohe's *Memoirs* (1906); Otto Hammann's *Um den Kaiser* (1919), *Der Neue Kurs* (1918); Graf Robert von Zedlitz-Trützschler, *Zwölf Jahre am deutschen Kaiserhof* (1924); Lady Norah Bentinck, *The ex-Kaiser in Exile* (1921); Walther Rathenau, *Der Kaiser* (1919); Baron von Eckardstein, *Lebenserinnerungen und politische Denkwürdigkeiten* (1919–20); H. von Moltke, *Erinnerungen, etc.* (1922); A. von Tirpitz, *Erinnerungen* (1919–20); A. von Waldersee, *Denkwürdigkeiten* (1922–3); *Die Grosse Politik der Europäischen Kabinette* (1921–5); *Die Deutschen Dokumente zum Kriegsausbruch* (1919).

(I. F. D. M.)

[1] Ludwig, *op. cit.*, p. 371. Italicised sentence is in English in the original.
[2] Ludwig, *op. cit.*, p. 394.
[3] *Die Grosse Politik*, 13 and 15. 622.
[4] Ludwig, *op. cit*, p. 396.
[5] Ludwig, *op. cit.*, p. 407.
[6] *Die deutschen Dokumente zum Kriegsausbruch* (1919), 157.
[7] *Ibid.*
[8] *Deutschen Dokumente*, 271.

WILLSTÄTTER, RICHARD (1872–), German chemist, was born in Carlsruhe Aug. 13 1872. He studied chemistry in Munich, and in 1896 became a lecturer in that city. In 1905 he was appointed an extraordinary professor in Zürich. In 1912 he went as ordinary professor to Berlin, and there became a member of the Kaiser Wilhelm institute of chemical research. In 1916 he resumed his activities in Munich. Willstätter's chief researches are connected with alkaloids (atropine and cocaine), also with aniline dyes (aniline black) quinones, and with vegetable colouring matters, particularly those of the flower and the leaf. These investigations led him to pursue researches concerning the assimilation of carbonic acid by plants, and also in connection with chlorophyll which he carried out in conjunction with A. Stoll. Latterly he devoted himself to extensive and successful experiments in connection with ferments. In 1915 he was awarded the Nobel Prize for chemistry.

WILMINGTON, Del., U.S.A. (*see* 28.690), with a population of 110,168 in 1920, of whom 10,746 were negroes and 16,307 foreign born, contained almost half (49·4%) of the population of the State; for 1925 the census bureau estimate was 122,049. The output of factories within the city, which do not include the Du Pont works, six miles away, was valued at $38,069,000 in 1909; $121,040,000 in 1919; $54,539,453 in 1921; $80,016,372 in 1923. After the World War the city undertook the construction (cost $3,100,000) of a marine terminal, with ample modern facilities, and 25 ft. of water, ultimately to be increased to 35 ft., which was opened in June 1923. It is connected with the business section of the city by a reinforced concrete highway. A joint city hall and county building was completed in 1914; a civic centre (Rodney square) in the business section, in 1915; a new building for the free library, in 1923. The park area was increased to 702 ac. by 1925, and a zoning ordinance was adopted in 1924.

WILNO: *see* VILNA.

WILSON, SIR HENRY HUGHES (1864–1922), British soldier, was born at Edgeworthstown, County Longford, Ireland, on March 5 1864, and educated at Marlborough and Sandhurst. He joined the Rifle Brigade in 1884 and in 1894 he married a daughter of Mr. G. C. Wray. From the outset he was a serious and an ambitious soldier, and while his natural gaiety of disposition made him a welcome companion everywhere, his industry soon attracted the attention of his superiors. He was indeed, almost from the first, one of those men who could not be overlooked. His earliest experience of active service was in Burma between 1886 and 1888, and when the Boer War broke out in 1899 he had passed through the Staff College and become a brigade major at Aldershot.

Before that war ended Wilson was brought back to the War Office, when in the newly formed staff duties directorate it was his especial task to study and to apply the lessons which were learned in South Africa—of which the chief perhaps was the necessity of organising the British Army on something approaching continental lines and establishing a general staff for the study and application of the principles of war. In the work of reform Henry Wilson played a great, if still subordinate, part and it was no surprise when, in 1906, he was appointed to succeed Rawlinson as commandant of the Staff College at Camberley. Himself an inspiring teacher with the Irishman's birthright of eloquence, he gathered around him a group of young officers upon whom he impressed his own views and his own system. More than all he became himself impressed with an almost overpowering sense of the imminence of war between France and Germany. The Entente was already in existence, and if it were to mean anything, at all must carry with it grave military responsibilities. Wilson, therefore, established close relations with the French Staff College, and particularly a close personal friendship with its commandant, Ferdinand Foch, whose great work *Les Principes de la Guerre* (*The Principles of War*) became a textbook in this country. Under his influence Wilson became more and more convinced of the danger which was threatening Europe, and spent much of his leave in making himself thoroughly acquainted with every detail of the Franco-German frontier.

In 1910 he left the Staff College to succeed Sir W. Robertson as Director of Military Operations, while Robertson took Wilson's place at Camberley. It was one of the minor tragedies of the War that these two outstanding personalities were never quite able to act in unison. In Whitehall, Wilson concentrated the labours of his directorate upon what he believed to be the vital field of operations. Incidentally he was one of Lord Roberts' most ardent supporters in his campaign for national training. Thus, while British statesmen were striving for peace, the director of military operations, acting under the chief of the Imperial General Staff, was step by step perfecting the nation's preparations for war. While the political leaders of France and Britain were unable to enter into an alliance, soldiers were not only at liberty but were compelled, unless they were to neglect their manifest duty, to think out in consultation every detail of mobilisation and strategic concentration. At each step he had the cordial support of the other directors, with the result that in Aug. 1914 the British War Office was in a position to bring off the greatest strategical surprise of the whole war. Mobilisation was rapid and the Expeditionary Force was landed in France without the loss of a man or a horse, complete in every detail.

The World War.—In one important respect, however, there was a miscalculation. In common with almost everyone else Wilson had counted on a short war to be reckoned in months. It was generally accepted that no nation could stand the military and economic strain of modern war for long. Acting on this assumption the War Office was denuded of experienced staff, and when Lord Kitchener took office as Secretary of State for War he found hardly anyone in Whitehall upon whom he could rely. Wilson's own appointment in the field was deputy chief of the general staff under Sir Archibald Murray. Of all those who crossed from England with the British Expeditionary Force he was without doubt the best known in France, so much so that when the numbers of our troops increased the British Army Corps came to be referred to in French confidential documents as *C. d'A.W.* or *Corps d'Armée Wilson.* It was therefore natural that he should be appointed principal liaison officer with the French field headquarters, a post which he held until he took command of the IV. Army Corps towards the end of 1915.

Although deeply interested in the life and welfare of the private soldier, he never really made his mark as a commander. To some extent, no doubt, this was due to lack of opportunity, but still more to temperament and to mental development along other lines. Thus it was that early in 1917 he left the field armies for good and accompanied Lord Milner's mission to Russia. In Nov. 1917 he went to Versailles as British military representative on the newly-established Supreme War Council. Three months later, less than a month before the great German attack of March 1918, he once more succeeded Sir W. Robertson and this time as chief of the Imperial General Staff in London. He was one of those who supported Mr. Lloyd George in his efforts to secure unity of command on the Western front and strongly pressed the claims of his old friend Foch to be appointed commander-in-chief of the Allied forces in France and Flanders. Foch was actually appointed at Doullens, when the German advanced troops were within measurable distance of Amiens.

Wilson had always belonged to what became known as the Eastern school of thought rather than to the Western, and when the German advance had been checked he worked hard to re-establish that Eastern front which had been shaken by the Russian revolution and shattered by "General Hofmann's jackboot," at Brest Litovsk. When the Armistice was declared on Nov. 11 1918 he had attained the rank of general, and in the final honours for the War he was promoted field marshal, was given a baronetcy and received a grant of £10,000.

In his capacity as chief of the General Staff he was the principal military adviser of the Government during the prolonged negotiations at Versailles, and subsequently at numerous conferences. His mastery of language and effective manner of expressing in non-technical terms his views on technical matters no less than his charm of manner made him *persona grata* to ministers of state, and his intimacy with all the French superior commanders enabled him to make smooth many rough places.

Parliamentary Career.—Unfortunately, when the War was over, the troubles in Ireland came to a head and Wilson was a great Irishman. His position as chief of the Imperial General Staff, under a government with whose policy in Ireland he could not agree, became extremely difficult. Cordial relations became strained and old friendships were broken. When, in Feb. 1922, his tenure at the War Office came to an end he entered Parliament as member for North Down and at the same time he placed his military experience at the disposal of the Government of Northern Ireland. Seldom has a new member gone to Westminster better equipped. Debate, and especially criticism, came easily to him, for he was a ready and effective speaker with sufficient restraint to prevent him from discussion of subjects of which he did not possess special knowledge. His maiden speech was delivered on March 15 on the Army estimates and was followed at fairly frequent intervals by others on the Irish question. Here he quickly established himself as the most outspoken critic of those colleagues with whom in his military capacity he had worked so long, and in so doing he drew upon himself the hatred of his fellow countrymen in the 26 counties. On May 31 1922 he concluded a speech with the words:

> I wonder when the moment will come when the Government will have the honesty and truthfulness to say, "We have miscalculated every single element in the Irish problem. We are exceedingly sorry for all the terrible things that have happened owing to our actions. We beg leave to return to private life and never to appear again."

He never spoke again in the House of Commons, for just three weeks later he was shot on his own doorstep in Eaton Place, London, as he returned from Liverpool Street Station after unveiling a memorial to the men of the Great Eastern Railway who had fallen in the War. It was a dastardly crime, as horrible in conception as in the occasion and manner of its execution. He was buried with full military honours in St. Paul's Cathedral.

Sir Henry Wilson's character is difficult to sum up. Essentially a critic, he nevertheless did great constructive work for the British Army and was, as much as any man, in Great Britain, the builder, though not the architect, of the Entente with France. Nevertheless he cannot be ranked with the greatest soldiers for he never held high command; in Parliament he at once achieved distinction, but did not live long enough to prove himself a statesman. Perhaps his greatest achievement was that at the most critical period in history, by his brilliant ability and compelling personality he bridged the gulf between the Government in London and the armies in the field, for he more than any other soldier had the confidence of the Prime Minister.

(N. M.*)

WILSON, JAMES (1835–1920), American administrator (*see* 28.693), died at Traer, Ia., Aug. 26 1920.

WILSON, THOMAS WOODROW (1856–1924), 28th President of the United States, was born in Staunton, Va., Dec. 28 1856. The Scotch strain predominated in his ancestry, for his paternal grandfather came from County Down, in Ulster, and his maternal grandfather, Thomas Woodrow, a graduate of Glasgow, from Scotland. The stern Presbyterianism of his father, a minister of small means but marked capacity as a theologian, early influenced him and left an indelible mark upon his character. His early years were spent in Georgia and South Carolina, where he was deeply affected by the sufferings of the South during the reconstruction period. In 1875 he entered Princeton, graduating four years later. His record for scholarship in college was not remarkable, but he was prominent in debating and literary circles, and became student director of athletic sport. His most notable achievement was an article written in his senior year, and published in the *International Review*, which analysed unfavourably the procedure of Congress and formed the basis of his more mature political principles. After studying law in the university of Virginia and following a brief attempt to practise in Atlanta, he decided to pursue his studies in Government and history at Johns Hopkins University, where he received the degree of Ph.D. in 1886.

Wilson's thesis, entitled *Congressional Government* (1885), was a development of the attack upon Congressional methods, and because of its clear and felicitous expression has been reprinted many times. In that year[1] he began his teaching career at Bryn Mawr College, where he was associate professor of History and Political Econony until 1888; after two years as professor of the same at Wesleyan, he entered the Princeton Faculty in 1890 as professor of jurisprudence and political economy. With slight changes in title he served in this capacity until 1902, when he became president of Princeton. As professor he rapidly achieved distinction. His lectures were remarkable for clarity of presentation and brilliancy of phrasing, and the same qualities characterised both his addresses and his published writings. His gift was for generalisation rather than plodding scholarship, and after the publication of his thesis his happiest literary efforts were in essay form. They display keen critical capacity, but are not remarkable either for erudition or for striking creative power. As president of Princeton, Mr. Wilson devoted himself to serious reforms of the educational and social habits of the undergraduates. In the hope of elevating the standards of scholarship and of increasing the efficiency of instruction, he inaugurated in 1905 the "preceptorial system," designed through small classes to bring teachers and students into the most intimate relationship. In his endeavours to democratise the social life of the university he met determined opposition. Further difficulties developed from a disagreement with the dean of the graduate college. Mr. Wilson's policies aroused warm controversy among alumni, faculty and undergraduates.

While at Princeton, both as professor and as president, Mr. Wilson displayed great interest in political questions of the day, and through his addresses and articles speedily won a national reputation. In Sept. 1910 he was tendered the Democratic nomination for governor of New Jersey. The offer, coming at the moment when the prospects for success of his policy at Princeton seemed most discouraging, secured his ready acceptance. Resigning his academic position he entered upon an active electoral campaign which won him the support of progressive elements throughout the state, despite the fact that his candidacy had been inaugurated largely under the auspices of the conservative Col. George Harvey (afterwards U.S. ambassador to Great Britain) and the Democratic state boss, Senator James Smith.

In Nov. he was elected by a plurality of 49,000 votes. He at once made it plain that he intended, regardless of the protests of machine leaders, to fulfil his liberal pledges and would assume the leadership of the party for this purpose. As governor he successfully carried through a series of reform measures. Of these the most significant were: a Direct Primaries Law, which, supplemented by an effective Corrupt Practices Act, did much to purify the political atmosphere of New Jersey; an Employers' Liability Act; the creation of a Public Utilities Commission; reform in municipal administration, making possible the adoption of the commission form of government. Elections to the state Senate and Assembly in 1911 gave the Republicans a majority in both Houses and the legislative output was curtailed. Nevertheless his final activities as governor were characterised by the impetus which he gave to the passage of a series of bills, known as the Seven Sisters, directed to the protection of the public from exploitation by trusts.

When in June 1912 the Democratic National Convention met at Baltimore to choose a candidate for President, Mr. Wilson's reputation as an effective reformer had brought his name prominently before the delegates. The convention was apparently controlled by conservative elements and there seemed little chance of the nomination of an anti-machine progressive. But as the struggle to secure the necessary two-thirds vote proceeded, with the conservative forces divided between Champ Clark, Harmon and Underwood, Mr. W. J. Bryan, leader of the progressive elements, threw his dominating influence in favour of Mr. Wilson. It proved decisive, and on the 46th ballot he was nominated, July 2 1912. In the campaign that followed he voiced popular discontent with the conservatism of the Republican

[1] In 1885 he married Ellen Louise Axson, of Savannah, Ga., who died in 1914, leaving three daughters. On Dec. 18 1915 he married Edith Bolling Galt, of Washington, D.C.

administration, which he believed to have been too closely allied with the interests of "privileged big business." His campaign speeches, characterised by a striking phraseology, won much applause, but were remarkable for their high moral tone rather than for originality of thought or policy. Like Roosevelt he demanded a national renaissance of ideals. In matters of immediate concern, such as the tariff, trust regulation, currency, the interests of labour, he insisted that the "rule of justice and right" must be set up. As regarded the future, in matters of conservation and trade, he asserted that great opportunities had been lost through the interlacing of privilege and private advantage with the framework of existing laws: "we must effect a great readjustment and get the forces of the whole people once more into play." His radicalism was of a mild sort, and he insisted that "we need no revolution, we need no excited change; we need only a new point of view and a new method and spirit of counsel." The popular temper was responsive to such a tone, but success in large measure could hardly have come to him except for the division of Republican forces through the campaign of Theodore Roosevelt as Progressive candidate. In the Nov. election Mr. Wilson received 435 electoral votes as against 88 for Roosevelt and 8 for Taft; but his popular vote was 1,000,000 less than that of his two chief opponents, and in only 14 states (all in the South) did he receive a clear majority.

Despite the fact that he was the choice of a minority of the whole people, Mr. Wilson's political position when he assumed office on March 4 1913 was one of remarkable strength. He was supported by a Democratic majority in both Houses of Congress, the Republicans were at loggerheads and he might expect support from the Progressives for much of his reforming legislative programme. His Cabinet was not distinguished, but it contained certain elements of political and administrative strength, which proved advantageous for the moment, although later it was to become the mark for bitter criticism. The President soon made it plain that he was determined, as in his governorship of New Jersey, to exercise his personal influence and his position as head of the party to initiate and carry through the legislation he had advocated in his campaign. His ascendancy in Congress was soon established. After convoking both Houses in special session on April 7 1913 he delivered his first message in person, reviving the custom that had lapsed since the administration (1797) of the elder Adams. He intervened constantly during this and later sessions, to further the legislation in which he was especially interested.

The first important piece of legislation that resulted from the special session was the Underwood Tariff Act, which was passed in Sept. and signed by the President Oct. 3 1913. It provided for a notable downward revision, and naturally met strong opposition from varied industrial interests. Such opposition was overcome largely through the personal efforts of Mr. Wilson, who appealed constantly to public sentiment, notably in an attack upon the activities of hostile lobbyists. The Tariff Act, in addition to lower duties and important administrative changes, introduced an income tax—long advocated by Democrats—which was destined in later developments to counterbalance the loss of revenue resulting from the lowering of the tariff; it weighed heavily upon the industrial interests of the North and increased the growing unpopularity of the President in that region. The Tariff Act was followed by a broad measure of currency reform, the Federal Reserve Act, signed Dec. 23 1913; it is generally regarded as the administration's second great legislative triumph. Mr. Wilson's purpose was to supplant the dictatorship of private banking institutions by a reorganisation that should provide funds available to meet extraordinary demands and a currency that would expand and contract automatically. Early in 1914 the President called upon Congress to continue its labours of reform by the regulation of the trusts. After long debate and warm opposition, his appeal was answered by the passing of the Federal Trade Commission Act and the Clayton Anti-trust Act. The latter, besides perfecting anti-trust legislation in several ways, met the demands of labour by declaring that labour was not a commodity, by prohibiting injunctions in labour disputes unless necessary to prevent irreparable injury, and by proclaiming that strikes and boycotts were not violations of Federal law. It further exempted labour associations from the anti-trust laws.

Mr. Wilson's policy of domestic social reform had thus been developed with surprising legislative success during the first year of his administration. His foreign policy was not so clear-cut and aroused little enthusiasm. It was characterised by an evident desire to concede the rights of other nations to the limit and to avoid any stressing of the power of the United States for the material advantage of its citizens. Definite steps were taken to prepare the Filipinos for self-government. Pressure was brought to bear upon the California state Govt. to mitigate the severity of its anti-Japanese legislation. The "dollar diplomacy" of the preceding administration was repudiated and American bankers effectively discouraged from participating in the international Chinese loans. As a result of the President's personal demand, Congress repealed the law exempting American coastwise shipping from Panama Canal tolls. Mr. Wilson, however, failed to secure the Senate's ratification of a treaty with Colombia, which contained a virtual apology on the part of the United States and an offer to pay $25,000,000 as reparation for the alleged grievances of Colombia in connection with the establishment of Panama as an independent country. In the Caribbean, Mr. Wilson's policy differed in principle rather than practice from that of his predecessors; in Nicaragua and Haiti the customs were taken over by U.S. officials. By a treaty signed Sept. 16 1915, a virtual protectorate of Haiti was assumed; in Santo Domingo the precautionary visits of American cruisers were followed in the summer of 1916 by the landing of marines, and in Nov. of that year by the proclamation of a military government under American auspices.

Mr. Wilson's Mexican policy aroused heated criticism. Following the accession of Gen. Huerta to power and the President's failure to arrange a settlement providing for his elimination as dictator, Mr. Wilson resigned himself to what he called a policy of "watchful waiting." Conditions in Mexico were anarchical, and intervention was strongly urged by both American and European commercial interests. To formal intervention the President was definitely opposed, but in April 1914 he was compelled to authorise the occupation of Vera Cruz in retaliation for affronts to American bluejackets. The proffered mediation of Argentina, Brazil and Chile he gladly accepted, but the resulting protocol of Niagara Falls (June 24 1914) did not provide a basis for peace. Although Huerta fled from Mexico in July, the country continued to be torn by rival factions. American troops were withdrawn from Vera Cruz in Nov. 1914, but it was not until Oct. 1915 that the Government of Carranza was recognised by Mr. Wilson, in company with eight South and Central American Governments. Further complications ensued. The raid into American territory of Gen. Villa, March 9 1916, led Mr. Wilson to authorise a punitive expedition, which soon aroused the protests of Carranza. In May and June the President mobilised the National Guard and sent a force of about 100,000 to patrol the Mexican border. The crisis was tided over by a joint Mexican-American commission sitting at New London, Conn., which brought no definite settlement, but at least postponed hasty action on either side. In Jan. 1917 the last American troops were withdrawn from Mexican soil. The President's policy had not led to stable conditions in Mexico, and the sole advantage secured seemed to be the emphasis laid by the U.S. Govt. on the principle that it would not take advantage of the misfortunes of a weak neighbour for its own selfish profit.

Foreign affairs after July 1914 were naturally dominated by the World War. President Wilson insisted upon a policy of strict neutrality. This he emphasised not merely by formal proclamation on Aug. 4, but by an address to the American people on Aug. 18, in which he adjured them, in view of the mixture of nationalities in the United States, to be impartial in thought as well as action. His offer of mediation, made on Aug. 5, remained without response, and further attempts at mediation in early autumn proved fruitless. His determination

to remain absolutely aloof from European quarrels was underlined in several addresses, in which he insisted that the United States was in no way concerned, and was further emphasised by his opposition to any change in its military policy. America's vital interest in the struggle, however, soon became plain and resulted in diplomatic controversies with the belligerents. Great Britain's attempt to control indirect importation of goods into Germany, by an enlargement of contraband schedules and an extension of the doctrine of "continuous voyage" to conditional contraband, was vigourously opposed by President Wilson, who authorised Mr. Bryan, his Secretary of State, to protest in strong terms. A lengthy interchange of notes followed, which led to no settlement.

The diplomatic controversy with Germany proved more serious. The proclamation of a "war zone" about the British Isles, in which German submarines threatened to destroy enemy merchant vessels with consequent danger to the lives and property of neutrals, was met by a note of Feb. 10 1915, which warned Germany that she would be held to "strict accountability" for the lawless acts of submarine commanders. Mr. Wilson further attempted to find a compromise, based upon a relaxation of the British food blockade and an abandonment of the German submarine campaign. The effort failed and was followed by a series of submarine attacks, which culminated in the sinking of the "Lusitania," May 7 1915, with the loss of over 100 American lives. The President, while he disappointed opinion in the eastern states by a speech in which he reaffirmed his pacific determination, stating that a man might be "too proud to fight," at once set out to win from Germany a disavowal and a promise that merchant ships should not be torpedoed without warning and the saving of the lives of passengers.

A lengthy exchange of notes ensued; the pacific Mr. Bryan, Secretary of State, regarding the President's language as too strong, resigned; on the other hand Mr. Wilson's patience with the evasions of the German Govt. and the continued sinking by submarines led to bitter attacks upon the President's policy of conciliation, which was stigmatised as anaemic or even cowardly. Mr. Wilson succeeded, however, in securing from Germany a promise not to sink liners without warning (Sept. 1 1915), and continued his efforts to induce Germany to abandon the submarine campaign completely. He was hampered by an attempted revolt of Congressional leaders, who blurred the issue with Germany by introducing resolutions designed to prevent Americans from travelling upon belligerent ships. The President, through his personal influence, secured the defeat of these resolutions in Feb. 1916, insisting that he would not consent "to any abridgment of the rights of American citizens in any respect." Shortly afterwards the issue with Germany was brought to a head by the sinking of the "Sussex," March 24 1916. Mr. Wilson waited three weeks before sending a formal note of protest to Germany (April 19 1916), but couched it in the form of an ultimatum, stating that unless Germany should immediately declare and effect an abandonment of its present methods of submarine warfare, the United States would be compelled to sever diplomatic relations. The German answer, while attempting to make acceptance conditional upon Great Britain's relaxation of the blockade, was in effect a promise not to sink merchant ships without warning and without saving human lives. The submarine issue now seemed less critical.

The diplomatic victory thus apparently secured by Mr. Wilson was utilised in his behalf during the electoral campaign of 1916, in which he was inevitably the Democratic candidate. It enabled his supporters to declare that he had vindicated the rights of the United States successfully, and at the same time had "kept us out of war." The slogan made a strong appeal, especially in the districts of the Middle West. The Republicans, on the other hand, who had nominated Charles E. Hughes, criticised the whole foreign policy of the President. They insisted that he had failed to take prompt action for the protection of American lives and honour, alike in his dealings with Germany and in his handling of the Mexican crisis. They characterised his domestic policy as demagogic, instancing the Clayton Act and the Adamson Act; the latter had been urged on Congress by Mr. Wilson to avert a railroad strike in Sept. 1916, and many citizens regarded it as an untimely surrender to labour threats. They also criticised his attitude on "preparedness," to which the President had been opposed until the close of 1915, and ridiculed the cautious expansion of military forces provided for in the National Defence Act of 1916. In the east and in most industrial centres of the middle west Mr. Wilson was unpopular, but the election showed his strength in the farming districts west of the Mississippi and on the Pacific coast; in spite of Mr. Roosevelt's return to the Republican fold the President drew largely from the Progressives, and on election day received a slight electoral majority over Mr. Hughes (277 to 254) and a popular plurality of 9,129,606 to 8,538,221.

His re-election enabled Mr. Wilson to proceed with plans for peace proposals to the European belligerents. These he had been preparing since the early summer of 1916, and, regardless of the German peace balloon of Dec. 12 1916, he sent on Dec. 18 identical notes to the belligerents, asking them to state the terms upon which they would consider peace. Informed of the undercurrents of German military circles, he evidently feared that if the War continued the United States would necessarily become involved; he also hoped that a clear definition of war aims would strengthen pacific elements in both belligerent camps. The German reply was evasive; that of the Allies refused to consider peace until Germany should offer "complete restitution, full reparation and effectual guarantees." The replies gave the President opportunity to expound what he had come to believe was the only sure basis of an enduring peace. This he did in a speech of Jan. 22 1917, in which he insisted that the peace must be organised by the major force of mankind, thus emphasising the need of a League of Nations; that no nation should extend its policy over another nation; that no one Power should dominate the land or the sea. There must be a limitation of armaments. As a guarantee of future peace and justice, the ending of the existing war must not be the violation of the rights of one side or the other: it must be "a peace without victory."

Further efforts to secure a peaceful arrangement were frustrated by the determination of the German militarist clique to renew the submarine warfare, regardless of the effect on the United States. On Jan. 31, the German ambassador, Von Bernstorff, delivered a note to this effect, and four days later the President handed him his papers. He still, however, avoided formal war with Germany, and on Feb. 26 asked for a resolution of armed neutrality, which would permit the arming of American merchant ships for entrance into the barred sea zone. The resolution was blocked by a filibuster. Finally, in view of continued sinking of American ships, the President came to Congress on April 2 1917 and asked for a declaration that a state of warfare existed with Germany. The resolution was passed by the Senate on April 4, by the House on April 6.

President Wilson had always abhorred the exercise of force in international relations, and the war which he at last regarded as necessary was, in his mind, a war to ensure peace. Nevertheless he was determined that it should be waged efficiently and that the mistakes of previous wars should not be repeated. Those mistakes, he believed, had resulted chiefly from the intermixture of politics in military affairs, and from the decentralisation of the American military machine. He opposed a coalition war cabinet, as leading to divided responsibility. Military policy was handed over to the military experts. He approved the immediate development of the general staff as the centralising military organ, and it was upon the recommendation of that body that he urged, against the wish of Congressional leaders, the Selective Service Act. On the advice of the general staff he appointed Gen. John J. Pershing commander of the expeditionary force to France, and, also following that advice, he refused to authorise a volunteer force under Mr. Roosevelt. Similarly the plans for the development of a large army in France were inaugurated and translated into fact by the military experts.

As regards conduct of operations the President gave to Gen. Pershing complete authority, and permitted no interference by

politicians. In the building of the new army the President took no direct part, but he used his authority consistently to favour centralisation under the general staff. He followed a similar policy in the mobilisation of the industrial resources of the nation. He encouraged the centralising efforts of the Council of National Defence and its committees, and sought always to secure for them executive rather than the merely advisory powers which they at first possessed. He urged the Lever Act, which in Aug. 1917 created a Food and a Fuel Administration, and advocated the taking over of the railroads by the Government in December. His policy of economic centralisation was ultimately assisted by the many protests against his war policies which were made in the winter, and which centred round the demand for a non-partisan war cabinet or ministry of munitions; for his supporters were able to insist that the more effective handling of war problems demanded not new machinery but greater efficiency of the existing mechanism. The President asked for powers to cut through red tape and rearrange bureaux without reference to Congress. His demands were embodied in the Overman Act, which was passed in May 1918, and which enabled him to grant executive powers to the various boards that had been created. The War Industries Board, released from its dependence upon the Council of National Defence, at once became the centralising organ of the economic activities of the country. In his war appointments Mr. Wilson disregarded party lines, a notable fact since in political appointments he always showed himself strictly a party man. Republicans, such as Hoover, Stettinius, Goethals, Schwab, Vanderlip, were chosen because of their administrative qualities and regardless of political affiliations.

During the War President Wilson consistently developed his ideals of a new international system which should perpetuate peace and assure justice and security to every nation regardless of its material strength. He hoped thus not merely to construct a basis for just peace when the War should end, but to hasten the end of the War by appealing to the peoples of the enemy states against their Governments. The most notable of his speeches was that of Jan. 8 1918, in which he stated 14 points necessary to a just and lasting peace. This, with his later addresses, was ultimately accepted as the basis of the final settlement. Their effect in Germany and Austria-Hungary was not apparent until the military defeat of those empires, but his words acted continually as a corroding factor, weakening the enemy's determination to fight. When in the autumn of 1918 they faced military defeat, they turned to Mr. Wilson, offering to accept his Fourteen Points as the basis of peace.

The President's insistence upon justice as essential to a settlement brought him great prestige in Allied countries, but the chiefs of the Allied Govts. hesitated to accept the Fourteen Points in the fear that the advantages of the victory might be thrown away. They yielded, however, to the persuasive diplomacy of Col. House, who represented the President at Paris, and it was on the understanding that the Fourteen Points (reservation made of " Freedom of the Seas " and inclusion of Germany's promise to make full reparation) should be the basis of the peace that the Armistice was granted to Germany.[1] The President realised, however, that it would be difficult to translate his principles into the actual treaty. Aside from the opposition he might expect from selfish nationalistic interests among the Allies, he lacked unified support at home, where his political opponents called for a " strong peace " that would annihilate Germany; there was little enthusiasm for a League of Nations, which the President regarded as essential to a just and lasting settlement. Furthermore he had weakened his political position at home by a series of tactical mistakes. Of these, the most important was an appeal issued immediately before the Congressional election of Nov. 1918, in which Mr. Wilson asked the voters to cast their ballots for Democratic candidates, on the ground that a Republican Congress would divide the leadership at the moment of international crisis. Such an appeal would have been comprehensible if it had been made by a prime minister in a parliamentary country, but Wilson had proclaimed himself the leader of the nation and could not logically also play the rôle of party leader. The Republicans seemed to have some ground for complaining that although they had submerged partisan quarrels during the War, President Wilson was now attempting to capitalise the War and foreign affairs in order to win a partisan advantage. Many voters were antagonised by the appeal, and the elections went in favour of the Republicans. The President thus lost command of the Senate in the next Congress and its Foreign Relations Committee was to be controlled by his political and personal opponents.

Believing that his presence at the Peace Conference was necessary, if it was not to be dominated by old-style diplomatic practices, Mr. Wilson decided himself to go to Paris, and on Dec. 4 1918 sailed with the other members of the American Commission on the " George Washington." He arrived at Brest on Dec. 13, and was received at Paris, in England and at Rome with tremendous enthusiasm. For the moment he was the popular hero, both in Allied and enemy countries. But his prestige rested on a precarious footing, and must inevitably diminish when he came to oppose the national aspirations of any people. He was anxious, therefore, to strike off a quick general peace, leaving details for later settlement; but this proved impossible, and formal conversations at Paris began only in Jan. 1919. The President succeeded in winning an early victory when he persuaded the conference to accept the principle of the League of Nations as the basis of the peace, and when, on Feb. 14, he won unanimous approval of the preliminary draft of the covenant. On returning to the United States, however, he found Republican opposition to the league strongly manifested in the Senate, although he had the support of Mr. Taft's influence in that party and in the country. Public opinion seemed to be uninstructed and apathetic as to the President's policies. Going back to Paris in March, he was able to secure the insertion in the covenant of certain amendments required by American sentiment, and the approval by the conference of the final draft of the covenant.

But he was confronted by the demands of the French, Italians and Japanese for territorial and economic concessions from the enemy, which he regarded as excessive. Long discussions followed, culminating in Mr. Wilson's acceptance of a portion of the Allied demands, notably the granting of Shantung to the Japanese, of much of the frontier line promised by the Treaty of London to Italy, and the exaction from Germany of what amounted to a blank cheque in the matter of reparations. Such concessions aroused the opposition of liberals in England and America, who insisted that the President had surrendered his principles. Mr. Wilson, on the other hand, acknowledging that certain aspects of the settlement were not ideal, believed that he had won his main contention in securing the League of Nations, which provided the mechanism for eradicating the vices contained in the treaties. In this belief he was supported by another liberal protagonist, Gen. Smuts. On June 29 1919, the day following the signing of the Versailles Treaty, the President sailed for America. His international prestige had suffered from his opposition to national claims, especially that of the Italians to Fiume and of the French to the left bank of the Rhine. Nevertheless, as the bitterness of the moment passed, the magnitude of his accomplishments at Paris became more generally recognised. When the veil of secrecy surrounding the negotiations was gradually lifted, it was seen that the belief that he had been outmanoeuvred by Lloyd George and Clemenceau was hardly justified by the facts. Lacking the negotiating ability of Lloyd George and the political experience of Clemenceau, he refused to enter the diplomatic lists with them, but by his manifest candour and sincerity early disarmed his opponents in argument. He said exactly what was in his mind, and was careful that his statements should be fortified by the documents and statistics furnished by his expert advisers.

The strain of the conference had told upon Mr. Wilson's physical and nervous strength. He was thus not well equipped to wage the struggle with his Republican opponents in the Senate

[1] The Fourteen Points are set forth in full in an article on that subject.

which developed upon his presentation of the treaty. Had the President been willing to compromise and accept reservations to the covenant of the league, it is possible that the two-thirds necessary to ratification might have been secured. This course he refused to follow, and it soon became clear that the Foreign Relations Committee would not recommend ratification without serious reservations or amendments. In the hope of winning popular support, the President set forth upon a tour of the country, and along the Pacific coast aroused enthusiasm in marked contrast to the coldness of the East. The effort, however, overtaxed his strength, and on Sept. 26 at Wichita, Kan., the President was compelled to give over his tour and return to Washington, where he suffered a complete nervous collapse. The exact nature of his illness was not made public and few realised how serious it would prove to be. Many, however, felt that in view of his inevitable abstention from active work it would have been wiser for him to retire at least temporarily. As it was, his system had provided for no understudy and the administration was left without a leader.

Entirely apart from the confusion thus caused in the conduct of public business, Mr. Wilson's illness led directly to the defeat of the treaty. There was no one else capable either of leading the fight for ratification without reservations, or with sufficient authority to arrange a compromise. On Nov. 13 the Senate adopted reservations which Mr. Wilson declared would " nullify " (etc., etc.) the treaty; for this reason he urged the Democrats to refuse to vote for the ratifying resolution, which was accordingly defeated on Nov. 19 1919. During the succeeding weeks efforts were made to arrange a compromise. The Republican leaders agreed to soften the language of certain reservations, and the President intimated that he would accept a mild reservation on Article X. of the covenant, which had aroused the chief opposition. Neither side would yield enough, and when on March 19 1920, the final vote was taken on the ratifying resolution, which contained a strong reservation on Article X., Mr. Wilson again urged Democratic senators not to accept. The resolution thus failed of the necessary two-thirds by a margin of six votes, 57–37. The President appealed to the autumn presidential election in 1920 as the decisive plebiscite. Although he had lost his former control of the party, and the Democratic presidential nominee at San Francisco was not his choice, the Wilsonian policies, including approval of the League of Nations, were inevitably the issue of the elections. In the electioneering campaign, however, the President himself could take no active part, for his physical collapse proved so serious as to confine him to the White House. For the overwhelming victory won by the Republicans, *see* UNITED STATES (*History*). After his defeat Mr. Wilson kept close silence on public matters, and his annual message of Dec. 1920, while it sounded the note of national duty, made no reference to that which lay nearest his heart—the League of Nations. This silence, indeed, he preserved until the close of his administration, March 4 1921. In Dec. 1920 he had been awarded the Nobel Peace prize.

After his retirement from office Mr. Wilson lived quietly in Washington, refraining from all political comment. He appeared to greet his admirers on Armistice Day, 1923, with a short speech from the porch of his house. For months he had been growing weaker, and on Feb. 3 1924 he died in his sleep.

The failure of President Wilson to win the approval of the United States for his peace policies presents one of the most interesting problems of American history. He had led the country through the difficult period of a war unsurpassed in magnitude and culminating in complete victory; in the face of serious obstacles he had forced European statesmen to accept the major item in his programme; he returned home only to be repudiated by his own people. Personal and partisan factors unquestionably contributed to his defeat. In private intercourse Mr. Wilson displayed a personal magnetism, a breadth of culture and a genial cordiality that are amply attested by his intimates. But in public life he proved unable to capitalise such advantages, possibly because of natural shyness, possibly because physical delicacy restricted his social activities. Roosevelt's capacity for " mixing " with all political and human types he totally lacked. In the formation of his policies he isolated himself and was unable to establish close relations with Congressional leaders. This gave rise to the impression that the President disliked advice, was an egocentric autocrat and immediately dispensed with anyone who disagreed with him. Such criticism, by no means a novelty in the case of strong-willed presidents, was utilised by his political opponents and intensified his unpopularity in the industrial centres, especially of the east, an unpopularity which, except for a brief period during the opening months of the War, was an outstanding factor in the political situation. Broadly speaking, the criticism does not seem to be fully justified. In matters of what he regarded as principle he was adamant, and he distrusted the judgment of those whose basic point of view was different from his own; but the evidence of those who worked with him, including that of Republican advisers at Paris, is almost unanimous to the effect that he was anxious to secure advice, was tolerant of opinions, and glad to delegate responsibility. The contrary belief was doubtless fostered by Mr. Wilson's inability to build up an efficient secretarial organisation, and his incapacity, rather than unwillingness, to apportion effectively the details of administrative labour. His handling of war problems shows clearly his desire to delegate responsibility; once an appointment was made he refused to interfere and consistently protected his appointee from the importunities of politicians.

Political responsibility in general, he believed, should rest with the President. From conviction, rather than from egotism, he sought to emancipate the presidential office from the control of Congressional committees, a control which he earnestly deplored in his earliest writings. The President, he felt, should be the real leader of the nation, and not a mere executive superintendent. The Cabinet he looked on as an executive and not as a political council, and it was always strictly subordinated to his policies. So long as the Democrats held the majority in Congress he was able to translate such ideas into fact, and effectively disposed of all attempted Congressional revolts. This attitude naturally did not allay the political resentments which were inevitably aroused and which were intensified by Mr. Wilson's tendency to regard political opposition as tantamount to personal hostility; when the Democratic majority disappeared he faced uncompromising hostility. He was intensely impatient of partisan obstruction of his idealistic plans, and there is much of the Calvinist in his refusal to temporise or deviate from the path which he believed himself appointed to tread. While in matters of detail he showed at times some capacity for compromise, in matters of principle he displayed the unswerving determination characteristic of the prophet, a trait that is not always conducive to success in the exigencies of modern party warfare. Indeed it is as a prophet rather than as a statesman that Mr. Wilson should be regarded. No one has preached more effectively the necessity of introducing a moral standard into international politics.

The following are the most important writings of President Wilson: *Congressional Government, a Study in American Politics* (1885); *The State—Elements of Historical and Practical Politics* (1889); *Division and Reunion, 1829–89* (1893); *An Old Master and Other Political Essays* (1893); *Mere Literature and Other Essays* (1893); *George Washington* (1897); *A History of the American People* (1902); *Constitutional Government in the United States* (1908); *The New Freedom* (1913); *On Being Human* (1916); *International Ideals* (1919). Personal and political biographies of President Wilson have been written by H. J. Ford, *Woodrow Wilson: The Man and His Work* (1916); by H. W. Harris, *President Wilson: His Problems and His Policy* (1918); by W. E. Dodd, *Woodrow Wilson and His Work* (1920); and by his private secretary, Joseph P. Tumulty, *Woodrow Wilson as I Know Him* (1922). All four are eulogistic, especially the two last named. Critically appreciative biographies are: David Lawrence, *The True Story of Woodrow Wilson* (1924), and William Allen White, *Woodrow Wilson, the Man, his Times, and his Task* (1924). A less friendly interpretation, valuable for Wilson's Princeton career, is Robert E. Annin, *Woodrow Wilson; a Character Study* (1924). The chief authority for Wilson's work at the Peace Conference is Ray S. Baker, *Woodrow Wilson and World Settlement* (1923). A documented exposition of Wilson's character and policies is found in *The Intimate Papers of Colonel House*, arranged as a

narrative by Charles Seymour (1926). General surveys of Wilson's foreign policy are to be found in E. E. Robinson and V. J. West's *The Foreign Policy of President Wilson, 1913–7* (1918), and in Charles Seymour's *Woodrow Wilson and the World War* (1920). In *Beacon Lights of History*, 1924, P. W. Wilson gives a close analysis of Wilson's character and career. The authorised edition of President Wilson's state papers and addresses is *The Public Papers of Woodrow Wilson*, edited by Ray S. Baker and William E. Dodd (1925).
(C. Sey.)

WINCHESTER, England (*see* 28.704), had a population of 23,791 in 1921 and an area of 1,930 acres. The city has been included in the parliamentary division of the same name since 1918. A scheme for the division of the large diocese received the royal assent in 1924. Alarming cracks and subsidences having been discovered in the walls and vaulting of the transepts and east end of the cathedral, the work of underpinning the foundations almost throughout, of grouting and bonding the walls and of reconstructing much of the vaulting, was begun in 1906 and finished in 1912, at an expenditure of about £110,000. A recumbent bronze figure of Sir Redvers Buller was placed in the north transept in 1911. The Hampshire, Isle of Wight and city of Winchester War memorial cross was unveiled outside the main west door in 1921; a memorial statue to men of the King's Royal Rifle Corps in the churchyard in 1922; and the Winchester College war memorial, a beautiful cloister in connection with the Boer War memorial gate, in 1924. A site of 100 ac. in the St. Cross district has been developed as a garden city. New county council offices on Castle Hill were opened in 1911. A chamber of commerce was founded in 1919.

WINDMILL: *see* AIRSCREW.

WIND POWER (*see* 28.710).—The development of the windmill for electricity generation is mainly—certainly, at any rate, so far as Great Britain is concerned—a post-War movement. Earlier attempts were mostly crude and unsatisfactory, and the old sweep-sail mill may be said to have vanished completely, at least in this connection. Structures built on gaunt masts or skeleton-like framework towers lack the picturesque attractiveness of the old types, but possess efficiency and compactness.

The windmill was adapted to this new purpose in the hope that the initial outlay (higher perhaps than when supply is by internal combustion engines) would be more than compensated by low running costs and the need of rare personal attention. The only factor preventing widespread use is the fear of discontinuity of supply in calm periods, with its consequent recourse to temporary assistance. Adequate storage will meet this objection.

Experiments.—The windmills used for test experiments conducted by the Institute of Agricultural Engineering, University of Oxford, were of different heights ranging from 10 ft. to 60 ft. from the ground, and the various wind wheels varied from 8 ft. diameter to 29·5 ft. diameter and were fitted with generators rated at from 0·300 kw. to 10·0 kilowatts. The rating is usually given as the maximum output at wind speeds varying from 18 to 25 m.p.h. according to the design, the smallest size mentioned being sufficient to furnish light to a cottage or small house, while the larger sizes are capable of meeting power demands.

Wind Wheels.—The types of wind wheels in use were of three patterns:—

(*a*) Multi-bladed, with concave sheet-metal blades.
(*b*) Five-bladed, with semi-streamlined metal blades.
(*c*) Four-bladed, with fabric-covered streamlined blades.

In the last case the wheels were mounted behind the headpiece and automatically kept their position in the wind stream. The other wheels were mounted in front of their respective structures, and required a tail vane or other auxiliary apparatus to maintain the windwheel in the proper direction. Each wind wheel was governed in such a way that on the wind speed reaching a predetermined value the speed of the wheel was controlled to keep the output of the generator from exceeding the safe limit.

In windmill work the "fuel" used is free and unlimited and there arises the possibility of a large "inefficient" wheel being preferable to a smaller "efficient" one, which is more expensive to manufacture. This is a point of difficulty at the stage of development of purely stream-lined blades. A windmill plant with an approximate aggregate output of 3,650 units shows charges bringing the unit cost to 4d. only, reckoning on available energy apart from battery losses.

Calms and Storage.—As to the question of calms and the planning of adequate storage to tide over the worst period which may be expected from all the figures and records of wind conditions, etc., it may be concluded that, if sufficient storage is provided to cope with the heavy winter load for three days, there is little likelihood of the supply ever being seriously interfered with. If the load is flexible and can be reduced during the critical period, the assurance of continuity of supply is complete.

Selection of Sites.—Observation of wind conditions over several years show that when fixing the site for a windmill plant the greatest care should be taken to ensure freedom from interference from trees, etc., on the sides from which the winds mainly come. The wheel should be as high as possible in order to obtain the utmost use of the winds. At the coast and in exposed hilly districts there should be no hesitation in adopting wind power to supply electricity. Even in ordinary inland parts there are very few districts where a suitable site cannot be found. Thus, for isolated districts wind power may be adopted for generating purposes with every assurance of reliability and economy; and even for communal groupings and for medium power work there are larger sets which will provide the same service.

Bibliography.—P. la Cour's reports *Forsögsmöllen*, vol. 1 (1900), vol. 2 (1903), translated into German by J. Kauffmann; *Die Windkraft und ihre Anwendung* (Leipzig 1905); O. Stertz, *Moderne Windturbinen* (Leipzig 1912); L. Hammel, *Die Ausnutzung der Windkräfte* (1925). See also *The 36th Report of the Danish Government Testing Station* (Copenhagen 1925); *Report on Windmills*, Institute of Agricultural Engineering (Oxford 1926).
(C. A. C. B.)

WINE (*see* 28.716).—The production of wine has not undergone any drastic changes. Since the World War, small motor ploughs have appeared in the vineyards, better machinery has been devised for removing the stalks (a valuable part of the crop), fertilisers and germicides have been improved, and the *chais* and cellars have become more cleanly and orderly under the influence of modern hygiene and factory methods. But the vigneron, while diligently using saccharometers, hydrometers, etc., still trusts primarily in his eye and nose and palate. Chemists and engineers, however, have not slackened in their attempts to find rapid methods of "ageing" wines.

For example, Prof. Charles Henry, of the Sorbonne, claims that he can both "age" young wines and purge them of defects by placing the cask in an electro-static field of 60,000 to 120,000 volts. Other inventors have applied themselves to the familiar problem of maturing and clarifying large quantities of sparkling wine in strengthened vats, wherein the juice is first raised in temperature and then chilled for five or six days. As this process is much quicker and cheaper than the traditional method of mellowing the wine in bottles for years, and then shaking down and disgorging the sediment from one bottle at a time, it is said to be a commercial success in the making of *vins mousseux* for the less fastidious markets; but no champagne house with a reputation to lose has looked with favour upon such mass production.

The Effects of the War.—World politics and economics rather than novelties of viticulture and vinification explain the great changes in the position and prospects of wine. So highly did the French military authorities rate wine as a food and medicine during the War that a full litre became part of every *poilu's* daily ration. By 1918 the daily issue of wine to the French armies amounted to 27,000 hectolitres, or about 3,500,000 ordinary wine-bottles. Beer-drinkers of Picardy and cider-drinkers of Normandy were thus turned into amateurs of wine. At the same time, wine consumption increased in Great Britain, largely because of demands from soldiers who had acquired the taste in France and, as wine imports were severely restricted, the carefully graded stocks of the wine merchants were eagerly bought and consumed long before they could mature. This keen demand absorbed even the *mauvais vins authentiques* (genuine wines from famous vineyards, but of poor vintages) which had been hanging

on the Bordeaux market for decades. In Germany, also, most of the hoarded wines were consumed. Hence, throughout Western Europe, the shrewdly chosen bins by which prescient merchants had hoped to maintain the succession of old-bottled wines were scattered, mostly among undiscriminating purchasers. After the War, the financial needs of War-strained States demanded heavy increases in wine taxes. As such imports are payable in advance, any post-War wine merchant who tried to reconstitute the stately old sequences of wine by accumulating successions of bottlings on the pre-War scale, was faced by the need for a vastly increased cash capital, most of which would have to lie locked up in duty-paid cellars for many years. In most cases this was impracticable, and therefore the public is reconciling itself to wines (especially ports from the wood and French white wines) with little or no bottle-age.

Changes in Consumption.—The lowering of wine standards thus imposed on gastronomy by politics and economics has been intensified by social and ethical revolutions both in the Old World and in the New. Russia's aristocratic patronage of fine wines has ceased. American prohibition further discourages superlative viticulture, because the wine imports of the United States (where more than 50,000,000 gal. of Californian and other national wines used to be annually produced), were mainly *vins de luxe*. British consumption, however, has increased. In 1924, Great Britain and Northern Ireland consumed 15,334,346 gal. as against only 11,367,549 gal. taken by the whole of the United Kingdom in 1913; but even with this increase the annual enjoyment of wine in Great Britain is at the rate of less than three bottles a head, mostly port.

Treaty Provisions.—The Treaty of Versailles explicitly engaged Germany to obey the Conventions of Washington (1913) and Madrid (1891), protecting " regional appellations " of wines. In France, from 1908 onwards, many decrees have delimited famous districts, such as Sauternes; but these decrees are inoperative outside France and one still hears of Spanish burgundy, Algerian chablis and even Rumanian champagne. A notable advance, however, was made by the Anglo-Portuguese Commercial Treaty Acts of 1914 and 1916, whereby true port and madeira are guarded by British law against false descriptions. But delimitation has its drawbacks. It gives prestige and market value to the bad as well as the good wines of a delimited area, and thousands of pipes of low-strength, doctored *consumo* (rough table-wine) are shipped from Oporto every year under the protection of the treaty. But diplomacy and commerce are co-operating to rid the sound principle of delimitation of this defect. The warmly discussed action of Spain (1924) in requiring Iceland either to relax her prohibition of Spanish wines or to lose the Spanish market for her fish at least had the advantage of emphasising wine's international importance.

British Empire Wines.—As Empire wines enjoy a substantial preference in Great Britain, " regional appellations " are of enhanced urgency for the vinedressers of Australasia and the Cape. The sweet Australian dessert wine which is becoming popular with Britons cannot be called Australian port because of the Anglo-Portuguese Treaty above mentioned; but the Commonwealth is still far from " the complete abandonment of European geographical wine names," for which the Australian, Professor Wilkinson, and many others have pleaded. The Wembley Exhibition gave a stimulus to Empire wines, for which there is a bright future provided they cease to put themselves in suicidal rivalry with the historic wines of France, Germany, Portugal and Spain. After a disaster in 1920, through over-production, Cape wines are prospering under a fostering Act passed by General Smuts' Government. A sum of £100,000 was devoted to a South African experiment of maturing. Australian exports are also increasing at a fairly rapid rate (*see* AUSTRALIA; FRANCE; SPAIN; etc.). (E. J. O.)

WINGATE, SIR FRANCIS REGINALD (1861–), British administrator (*see* 28.729). In Dec. 1916 he was appointed high commissioner for Egypt and relinquished the governorship of the Anglo-Egyptian-Sudan, after a successful administration during 16 years. At the beginning of 1919 Sir Reginald Wingate was summoned to London to report on the situation which had arisen in Egypt, and he remained there many months at the disposal of the Government until his resignation on Oct. 1919. He had received the G.B.E. in Jan. 1918, and was created a baronet in June 1920.

WINNINGTON-INGRAM, ARTHUR FOLEY (1858–), Anglican divine, was born in Worcestershire Jan. 26 1858. Educated at Marlborough and at Keble College, Oxford, in 1884 he was ordained and became a curate at St. Mary's, Shrewsbury. In 1885 he became private chaplain to the Bishop of Lichfield, and in 1889 head of Oxford House, Bethnal Green, London. In 1895 he was appointed rector of Bethnal Green and in the following year rural dean of Spitalfields. In 1897 he left Bethnal Green to become Bishop of Stepney and canon of St. Paul's Cathedral. In 1901 he succeeded Dr. Mandell Creighton as Bishop of London, becoming at the same time dean of the Chapels Royal. Dr. Winnington-Ingram achieved great popularity, not only within the confines of his diocese, by the ready sympathy he displayed to all who appealed to him for help and by the tireless energy with which he championed social causes.

Among his published works are *Banners of the Christian Faith* (1899); *The Church in Time of War* (1915); *The Potter and the Clay* (1917); *Rays of Dawn* (1918); *Victory and After* (1919); *The Spirit of Peace* (1921); *Rebuilding the Walls* (1922).

WINNIPEG, (*see* 28.731), the capital of the Canadian province of Manitoba, the third city of the Dominion, the great commercial and wholesale distributing centre for the Middle West, and the largest grain market in the world, had a population in 1921 of 179,087 (283,852 with suburbs), and an area of about 24 square miles. The importance of the city was enhanced after 1911 by the completion of the Grand Trunk Pacific Railway, which became later a part of the Canadian National Railways system.

Winnipeg is now on three trans-continental lines, and has extensive railway shops, and a fine new union station in addition to the large C. P. R. depôt. A large new legislative building has been erected. Winnipeg has also increased in importance as a manufacturing centre, and had 1,200 industrial establishments, including very large flour-mills, in 1922. Fur auctions are held on a large scale. Two extensive hydroelectric systems, both deriving power from the Winnipeg river 100 m. distant, have been installed, one of which is owned and operated by the city. A fine agricultural college with extensive grounds has been erected on the outskirts of the city. St. Boniface, on the opposite bank of the Red river to Winnipeg, is a separate municipality, with a population in 1921 of 12,816, largely French and Roman Catholic. St. Boniface is the Roman Catholic headquarters of the Western provinces, and contains a cathedral, a convent and hospital, an archiepiscopal palace and St. Boniface's College, in addition to large flour-mills and stockyards.

WINTER, JOHN STRANGE (1856–1911), British writer (*see* 28.734), died in London Dec. 13 1911.

WINTER SPORTS.—Since 1910 the development of winter sports has been more marked than during any previous period. Until 1913 winter sports in the Alps were a pastime of the leisured classes chiefly, but after 1919 increasingly large numbers of persons from all grades of society went to Switzerland for periods varying from one week to the whole season, and this development in no way resulted in decreased interest of the leisured classes. Norway and Sweden, also, became increasingly popular on account of good travel services and the first-class sporting facilities afforded.

Sports in Switzerland.—In Switzerland, the post-War development was due in a large measure to the electrification of the Swiss railway system; in 1912 a committee of experts examined the question of electrification as a means of coal economy, and in 1913 electrically propelled trains were introduced on the Engadine express route from Coire onwards. During the years 1914–8 the work was necessarily suspended, but in 1919 the engineers of the Swiss Federal and Rhaetian railways resumed operations, and at an approximate cost of 18,800,000 fr. the whole system was electrified. This opened up a good many small resorts which had been previously inaccessible. In 1910

there were approximately 45 resorts to which people went for organised winter sports, but in 1924 the number had been increased to 89, with an approximate increase of 150% in the number of passengers travelling from Great Britain to Swiss resorts direct.

With the development in the number of resorts, the various snow sports became very highly specialised. Ski-running, skating, curling, bobsleigh riding and skeleton running were all developed. Ski-running, skating, ice hockey and ski-jumping are included in the programme of the Olympic Games—though of necessity held at a time and place distinct from games not dependent on snow conditions. The Alpine Games at the eighth Olympiad were held at Chamonix in Feb. 1924, and it was arranged that those of the ninth Olympiad should be held at St. Moritz, when skeleton running was to be included in the programme. Women began to take part in all winter sports organised at the Swiss resorts, but comparatively few women ride the Cresta run. Skeleton running is generally considered a sport more suited to the physique of a man. On the Cresta run, the total number of riders of both sexes in one season rarely exceeds 30. On the other hand, bobsleighing has become very popular; at most Swiss resorts there is a specially constructed run, the one at St. Moritz and the Schatzalp run at Davos being among the better known. In bobsleighing, the *ventre à terre* position was revived and is now almost universal. The developments in ski-running are largely due to the test system instituted by the ski clubs of Great Britain, and the standard of running has greatly improved in consequence. Ski-jumping among English people is still practically confined to experts, but the performances of the Swiss and Scandinavians at this pastime are gradually inspiring the people of other races to participate; many English people go annually to Oslo, Norway, to witness the Holmenkollen ski-jumping championships, which, indeed, provide a thrilling and wonderful spectacle.

The United States.—Snow and ice sports are popular in the United States. The natural resources of the Adirondack mountains, allied to the enterprise of the American sportsman, have provided winter sports which challenge comparison with those of Switzerland. At Lake Placid, one of the largest American resorts, the season opens early in Dec., and about 1,000 people can be accommodated. The Inter-Vale Ski Jump, which is the principal sporting contest, takes place on the anniversary of Washington's birthday, Feb. 22. Ski-ing is the favourite winter sport, although skating is popular, and skaters are very well provided for. There are special rinks for curling, figure skating and ice hockey. Bobsleighing, ski-öering and tobogganing—on the flat American type of toboggan—are all sports subsidiary to ski-ing at Lake Placid, which is becoming one of the most popular resorts for families during the Christmas holidays.

In New England several resorts are available, such as Picketts, New Hampshire and Toy Town, Winchendon, Massachusetts. Within 30 m. of New York City there are various smaller places, such as Briarcliff Lodge, catering for week-end visitors; an annual ski-jumping contest takes place here on Washington's birthday. In the winter of 1924 snow had to be imported from upper New York State to make this contest possible. In the west, skating is perhaps more popular than in New York State. Chicago, for instance, has skating contests which attract a large number of contestants and visitors. (V. M. C.)

Canada.—In Canada climatic conditions are more favourable to snow and ice sports than those existing in the United States. The season is longer, the temperature much lower and steadier and particularly in Ontario and the Maritime Provinces, the snowfall is greater. Snow-shoeing, tobogganing and skating have been popular winter sports for years, and in Manitoba and Eastern Canada can be enjoyed usually without a break from Nov. to March. Ice hockey enjoys a great vogue with the younger element, and contests between the leading clubs attract enormous crowds. Ski-running and jumping is of comparatively recent introduction, but is becoming increasingly popular. Curling is extensively played, interest in it being periodically stimulated by the visits of representatives of prominent Scottish curling clubs. The centre of winter sport is Montreal with its magnificent physical surroundings, the slopes of Mt. Royal affording every opportunity of indulging in snow-shoeing, tobogganing and ski-ing under ideal conditions. The annual Winter carnival at Montreal offers a unique spectacle, though that held at Quebec is a close competitor in point of attendance. The annual curling Bonspiels held at Montreal, Toronto, Winnipeg and other centres attract competing teams from all parts of Canada and contiguous territory of the United States.

WIRELESS TELEGRAPHY AND TELEPHONY.—This article is arranged with three main divisions, since the three periods—(1) from 1910 to 1914, (2) the War period and (3) the post-War period—each have special features.

I. PERIOD 1910–AUG. 1914

1. *Wireless Shipping Report.*—The first wireless shipping report was published by Lloyd's in 1910, the importance of wireless to the mercantile marine having become well recognised by this date, and shore stations for communicating with shipping were becoming general in all parts of the world.

The ship transmitters of 1910 included induction coil and small generator sets from 150 watt to two kw. plain spark, rotary spark and quench gap sets, direct or inductively coupled to the aerial and tuned to 300 metres or 600 metres.

The receiver comprised an adjustable tuned circuit and a magnetic detector, crystal detector, or a barretter, with, in many cases, an additional circuit or circuits designed specially to minimise interference, particularly from atmospherics.

2. *Post Office Stations.*—By the autumn of the same year the transfer to the British Post Office of all the wireless coast stations in the United Kingdom established by the Marconi Company for shipping communication and others belonging to Lloyd's had been completed, their technical equipment being as set out in the following table:—

Station	Nominal power of station	Transmitter
Caister	1½ Kw.	Rotary converter and plain spark.
North Foreland	3 Kw.	Motor generator and plain spark.
Niton	¼ Kw.	Coil and plain spark.
Lizard	¼ Kw.	Coil and plain spark.
Seaforth	3 Kw.	Motor generator and plain spark.
Bolt Head	3 Kw.	Motor generator and plain spark.
Rosslare	¼ Kw.	Coil and plain spark.
Tobermory	1½ Kw.	Rotary converter and plain spark.
Lochboisdale	1½ Kw.	Rotary converter and plain spark.
Crookhaven	3 Kw.	Motor generator and rotary spark.
Malin Head	¼ Kw.	Coil and plain spark.
Hunstanton	¼ Kw.	Motor generator and plain spark.
Skegness	¼ Kw.	Motor generator and plain spark.
N. Ronaldshay	50 watts	Coil and plain spark.
Sanday	50 watts	Coil and plain spark.

3. *Naval and Other Stations.*—At this date also there were naval stations equipped with 100 kw., 250 cycle rotary spark transmitters at Hornsea, Cleethorpes and Gibraltar; and when in the following year the 14 kw. stations at Aberdeen, Ipswich, Pembroke and finally Whitehall were completed, the power to control the movements of warships in distant or foreign waters direct from the Admiralty became possible.

In 1913 with 30 shore stations and 435 ships fitted with wireless this direct control was an accomplished fact.

The Hornsea 100 kw. arc commenced working in 1912, and in 1913 the two-kw. arc transmitter became standard for naval use on board ship.

In 1912 there were 250 stations in different parts of the world engaged solely in ship-to-shore traffic, and nine high power stations were also available for this work.

4. *Thermionic Valves and Valve Circuits.*—At this period the use of the Fleming thermionic two-electrode valve as a detector was steadily growing, but the possibilities of the modifications introduced by Lee de Forest, consisting of the three-electrode valve patented in 1906, and its amplifying circuit in 1907, were

not fully realised for several years. The 1907 circuit is shown in fig. 1. A filament made incandescent by the battery B1 is indicated at F, a metal plate maintained at a positive potential by the battery B2 is shown at P, and an electron current flows from F to P.

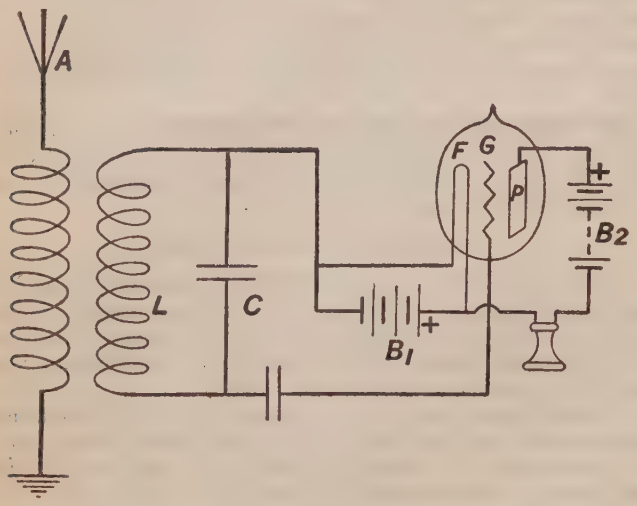


FIG. 1.—The Lee de Forest amplifying circuit.

Between them is interposed a metallic grid G, to which is applied the high-frequency potential of the signal tuned in by the circuit LC. When the grid is made more positive by the signal the electron current flowing through its meshes is increased, and when it is made more negative the current flow is reduced, so that the potential changes due to the signal are thus able to cause variation in the current drawn from the plate circuit battery, and in this way the signal is amplified.

In 1913 C. S. Franklin coupled the plate circuit to the tuned grid circuit of the valve with the object of reducing the decrement in the grid circuit by feeding energy into it from the plate circuit battery, which operation is called " retroaction " or " regeneration, " and the same year A. Meissner, using a Lieben-Reiss three-electrode valve with a lime-coated platinum filament, carried this operation one step further by employing a coupling of such a value that the energy fed back into the grid circuit compensated for all the circuit losses, so that oscillations once started tended to continue until one or other of the battery circuits was broken, and he thus produced the first valve oscillation generator. In the Meissner circuit (fig. 2) the oscillation frequency was controlled by the constants of the circuit Lp_1Lg_1C, but it can be understood that the arrangement may be simplified if necessary by leaving out that circuit altogether and coupling Lg direct to Lp, the oscillation frequency desired then being obtained by connecting a condenser of the necessary capacity across one of these coils.

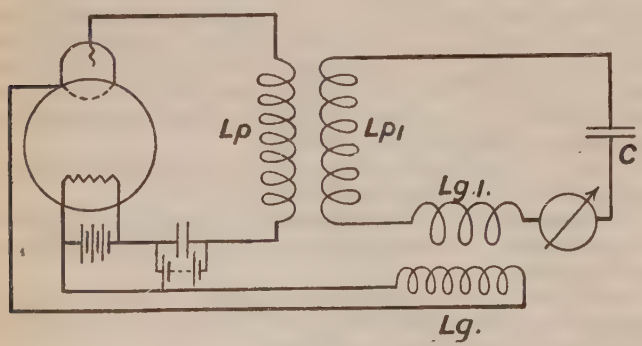


FIG. 2.—The Meissner valve oscillator circuit.

5. *Direction Finding.*—The practical application of the Bellini-Tosi system of wireless direction finding—partly based on researches carried out by A. Artom—now commenced to receive attention. Most systems of direction finding are based on the principle that for maximum signal intensity the plane of the receiving antenna, or pick-up circuit employed, must lie in the direction of the propagation of electromagnetic waves.

Bellini-Tosi in 1907 used two triangular aerials erected in vertical planes at right angles and on the same axis, and with free ends at each apex. In the base of each aerial fixed field coils were introduced, also mounted at right angles, and on the same axis as a search coil. The direction of the resultant field of the signal currents in the two field coils was found by rotating the search coil—to which was attached a pointer moving over a scale—until strongest signals were obtained, when the scale deflection which actually indicated the angle between the axis of the fixed and moving coils also gave the angular direction of the signals relative to the two aerials. The open top antennae confined the utility of the D.F. equipment to short wave lengths and complicated the tuning.

The system was adopted and modified by the Marconi Company in 1912 for ship use, when the antennae were altered to closed loops, each of which was tuned at the base by an adjustable condenser.

6. *Wireless Telephony.*—The employment of the Poulson arc generator from 1906 onwards gave an impetus to the development of wireless telephony, and an appreciable advance was made by the invention by Majorana in 1908 of a heavy current liquid microphone which enabled speech to be transmitted from Rome to Sicily, a distance of 300 miles. In 1909 the Colin-Jeance arc apparatus was in use from Toulon to a French cruiser 100 m. away; in 1910 successful tests were carried out in the United States over a distance of 490 m., and in 1912 the Vanni liquid microphone used with an arc transmitter enabled speech to be carried on from Rome to Tripoli—600 miles.

Development along new and more practical lines followed the invention by Meissner in 1913 of the valve oscillator and its use as a carrier wave generator for communicating between Berlin and Nauen, and the necessity for a heavy current microphone also disappeared with the arrival of the valve amplifier. In 1914 Marconi carried out a number of tests with valve transmitters and receivers on Italian war vessels up to a range of 45 miles.

The outbreak of war brought European long range telephone tests to a temporary standstill, but the American tests were continued, and in Oct. 1915, by employing 300 valves in the oscillator and modulator circuits, speech communication was effected when transmission conditions were favourable from Arlington to Eiffel Tower, Paris, a distance by great circle of 3,080 m.; also during the same series of tests long distance telephony from New York to Arlington by land line and Arlington to Hawaii by wireless was achieved, the total distance being over 5,000 miles.

7. *Wave Propagation Theories.*—To explain the propagation of electromagnetic waves such as are used in wireless telegraphy to great distances round the earth, Oliver Heaviside in 1901—reviving a theory first advanced by G. F. Fitzgerald in 1893—discussed the possibility of the existence in the upper atmosphere of a conducting and reflecting shell of ionised gas, and the name " Heaviside layer " has since been given to this hypothetical region.

Electromagnetic waves are guided by the surface of a conductor, and many attempts were made from 1909 onwards by Poincaré, Nicholson, MacDonald and Love, taking the ideal case of a perfectly conducting earth, to show that diffraction accounted for the intensity of the signals received at a distance. But the calculated results always came out very much too low.

The influence of night effect, first noticed by Marconi in 1902 when, on the S. S. " Philadelphia," he found a daylight range of 900 m. extended to 1,500 and 2,000 m. at night, was further demonstrated by him in 1911 by charts showing the daily variations of signals received at Clifden from Glace Bay over a period of 12 months, an average example being given in fig. 3. W. H. Eccles in 1912 advanced the theory that the presence of free ions of atomic dimensions at some considerable distance above the earth's surface would have the effect of increasing the velocity of those electromagnetic rays in the wave which passed through the region occupied by these ions, with the result that the top of the

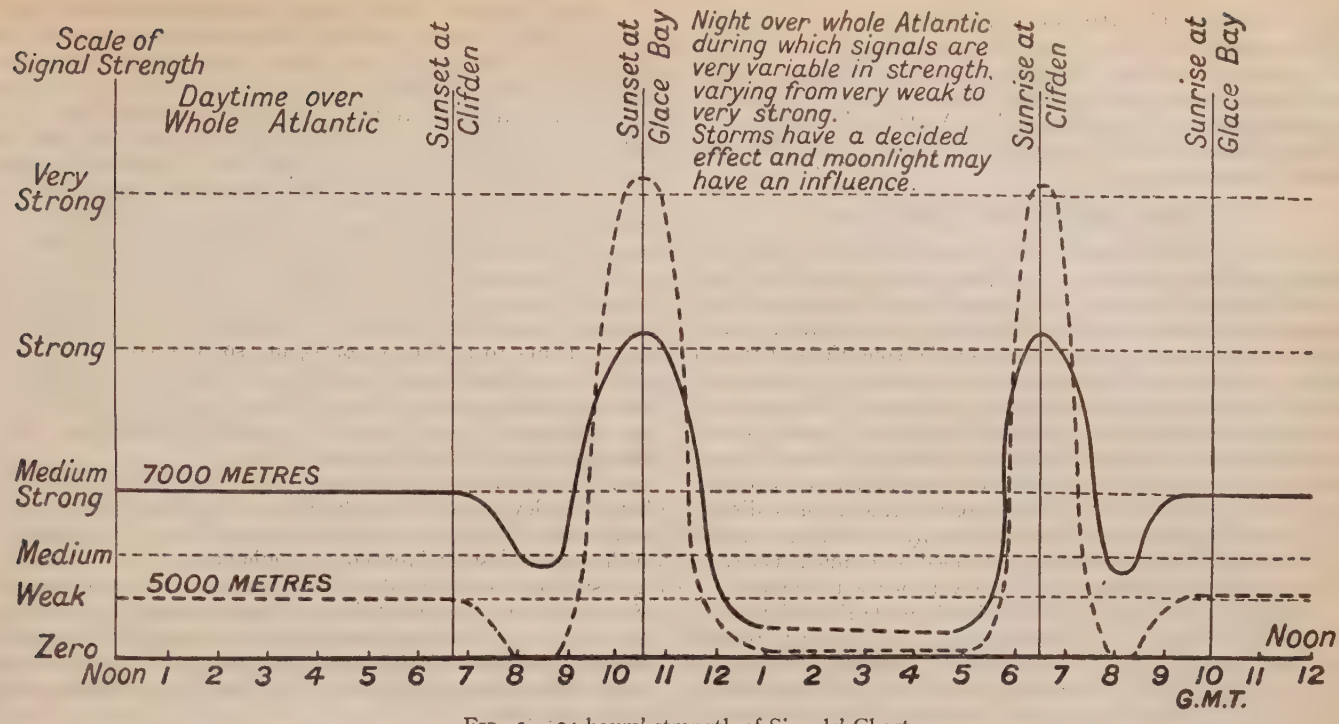

Scale of Signal Strength
Daytime over Whole Atlantic
Sunset at Clifden
Sunset at Glace Bay
Night over whole Atlantic during which signals are very variable in strength, varying from very weak to very strong. Storms have a decided effect and moonlight may have an influence.
Sunrise at Clifden
Sunrise at Glace Bay
Very Strong
Strong
Medium Strong
7000 METRES
Medium
Weak
5000 METRES
Zero
Noon 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 Noon
G.M.T.

FIG. 3.—24 hours' strength of Signals' Chart.

wave front would be given a lean forward, and this would cause the direction of propagation to bend down again towards the earth. As an example, about 16,000 gaseous ions per cubic centimetre would be required for a wave length of 6,000 metres.

It was suggested that this ionised region disappeared during the night, leaving the more clearly defined Heaviside layer above, to act as a reflecting surface.

As a result of tests carried out from 1910 to 1913 by the United States Navy, transmitting from Brant Rock to cruisers out in the Atlantic up to a distance of 1,000 m., the well known Austin-Cohen empirical formula for daylight range was deduced, namely:—

$$I_2 = 4{\cdot}25 I_1 \frac{h_1 h_2}{\lambda d} \cdot e^{-ad/\sqrt{\lambda}}$$

where I_1 and I_2 = transmitting and receiving antenna currents respectively.
h_1 and h_2 = transmitting and receiving antenna heights in km. respectively.
λ = wave length in km.
d = distance between stations in km.
a = dissipation constant = 0·0015 in daylight over sea.

8. *Imperial Wireless* (*I.*).—Proposals for long distance transmission between outlying parts of the British Empire had meanwhile been taking definite shape.

The first scheme for Imperial wireless communications was submitted by the Marconi Company to the British Colonial Office in 1906, and the experience gained in running a Trans-Atlantic service between Clifden, Ireland, and Glace Bay, Canada, which was opened to the general public in Feb. 1908, led this company to ask for powers in 1910 to erect within three years, and subsequently maintain and operate entirely at its own expense, a chain of 19 stations throughout the British Empire. The practicability of the proposal received additional support from the results of the tests made by Marconi in Sept. of that year, when, on a voyage from Italy to the Argentine in the S.S. "Principessa Mafalda," he was able to receive messages from Clifden by day and night up to a range of 4,000 statute m., and night signals up to 6,000 m.; and also by the successful tests carried out towards the close of the same year by the Italian Govt., partly over sea and partly over large stretches of desert between Coltano and Massauna (Italian Eritrea), a distance of 2,400 miles.

In 1911 the question was discussed at the Imperial Conference and in 1912 the Marconi Company entered into a contract to erect six stations in England, Egypt, East Africa, South Africa, India and Singapore for the British and Dominion Governments, the chain to be completed by the Marconi Company's own stations which would be erected in Australia and Canada.

Germany, America and France followed the lead of what was being done in England and Italy, each devising and commencing the constructions of its own national network for world-wide radio communication.

As regards the British scheme various delays ensued. A Government committee under Lord Parker was appointed "to consider and report on the merits of the existing systems of long-distance wireless telegraphy and in particular as to their capacity for continuous communication for the distances required by the Imperial chain."

Poulson arcs were said to be working over long distances in America. R. Goldschmidt in Germany had produced in 1908 a high frequency alternator which was in effect a rotary frequency multiplier, depending largely on the principle of resonance; and E. F. W. Alexanderson in 1909 had made a practical success in the United States in the direct generation of electric waves by means of a high frequency alternator of the inductor type, employing a high rotor speed, an extremely small gap and the maximum possible number of coil elements on the stationary armature, the current generated being suitable for energising an aerial tuned to the same frequency.

The report of the committee was issued on April 30 1913. It stated: "The Marconi system is at present the only system of which it can be said with any certainty that it is capable of fulfilling the requirements of the Imperial chain"; and, although this remark applied to tuned spark or damped wave transmission, the committee also reported that "The only continuous high frequency generator we have yet seen tried with success over long distances is the Marconi continuous high frequency machine to which we have already referred."

This machine produced continuous waves by the "timed spark" method, introduced by Marconi in 1912, and was the first successful commercial attempt at the production of continuous wave impulses of high power in the aerial.

The result was obtained by the successive superimposing, correct in phase, of a number of trains of waves of identical amplitude and damping, which produced the effect of continuous

wave oscillations of a constant amplitude; and this system, having an available power of 300 kw. is still used commercially at Stavanger, Norway, for communication with the United States, and was the one employed during the first transmission of wireless messages from England to Australia in 1918.

The outbreak of the War stopped all further work on the contract in December 1914.

II. WIRELESS DURING THE WAR

9. *Field Army Wireless.*—At the outbreak of the War the British military equipment had its spark transmitter and crystal detector and pack and wagon sets suitable for army purposes; but from Oct. 1914 wireless had to make fresh beginnings in order to adapt itself to the special conditions of trench warfare, which called for efficient short distance services and extremely portable and unobtrusive apparatus. The company or battalion headquarters signalled brigades by power buzzer employing earth currents; brigades signalled divisional headquarters by 50 watt spark set; divisional headquarters signalled corps directing stations by 120 watt spark set, and corps directing stations signalled corps headquarters by $1\frac{1}{2}$ kw. light motor set. Later on the French army developed with much success a small frame aerial set with valve receiver for use in dugouts.

10. *Direction Finding* (*II.*).—British Army D.F. stations were erected at Abbeville and Blendecques, and several British Navy D.F. stations along the east coast of England. Under the charge of Captain H. J. Round, they were used as position finders of German transmitters on board ship, behind the lines and in the air, the position of land and sea stations being ascertained by simultaneous measurements of the angles to the objective transmitter from the base lines of known length between two or more D.F. stations, which allowed the position of enemy stations to be found by triangulation.

The Bellini-Tosi tuned aerial system proved suitable for locating spark stations of fixed wave-lengths, but C.W. arc stations required constant and rapid searching not only for direction but also for wave-length, and an aperiodic aerial system, consisting of two closed loops of wire in vertical planes and at right angles connected to suitable field coils in the radiogoniometer, was introduced for this purpose, the only tuning necessary being in the circuit of the search coil, thereby enabling the D.F. stations to give very satisfactory results during daylight. The removal of wave-length limitations enforced by the tuned aerial system was an important improvement, and the introduction at the same time of an efficient and robust valve and multi-stage amplifier in a metal screening box very greatly increased both the range and utility of the apparatus.

The movement of a well-known German wireless control vessel a few miles to the northward on May 30 1916, detected by D.F., led the Admiralty to the correct deduction that the German Fleet had left Wilhelmshaven for a position in the Jade river ready to put to sea. This decided Admiral Jackson, then first Sea Lord, to send the Grand Fleet out to meet it, and the battle of Jutland the following day was the result.

The traffic handled during the War by the Admiralty D.F. stations and the Marconi stations controlled by the Admiralty amounted to some 80,000,000 words intercepted and some 8,000,000 words transmitted.

11. *Naval and Other Stations* (*II.*).—Within 10 months of war being declared all German colonial wireless stations had either been destroyed or taken over, and by the end of 1915 the Admiralty had 14 additional strategic stations, 11 of 30 kw., 2 of 100 kw. and one of 150 kw. rotary spark type working in different parts of the world.

By the year 1917 arc transmitters were in general use in the Navy, and valve transmitters in the following year.

Wireless was of the greatest value in keeping submarines in touch with their parent ships, and the routine of rising to the surface, erecting mast and aerial, sending code signals, and lowering mast and aerial and then submerging was reduced to a minimum.

A notable achievement was the picking up of signals on a frame aerial by a submarine while submerged in the Baltic.

12. *Royal Air Force.*—The Royal Air Force, working in conjunction with the Royal Artillery, found wireless invaluable for gun-spotting. Thus in a sample month for 1,562 shots fired the calls received from flash-spotting machines were 74,201, while the percentage received to those missed from all causes was 86%; and this in spite of intense activity in the ether, and with as many machines crowded in on the front as possible, undue mutual interference being avoided by a careful selection of wave-lengths and by note tuning. Just before the Armistice there were 600 aeroplanes transmitting one-way from machine to ground by means of spark apparatus, working in conjunction with some 1,000 ground stations, but two-way transmission was employed to assist the work of the long range guns, which necessitated flights to a distance of 15 m., so that communication might be maintained with aeroplanes when over the targets. The transmitting range from machine to ground increased to 100 m. late in 1917, when C.W. valve transmitters were employed by night bombing squadrons.

13. *Aircraft Wireless Telephony* (*II.*).—Aircraft wireless telephony was developed during the War by the Royal Air Force at Brooklands. The first satisfactory aircraft valve transmitter, which required a special form of microphone suitable for responding to speech close to the mouthpiece but insensitive to machine noises, was in use for transmission from aeroplane to ground in 1915, and in 1916 two-way working was obtained by the use of a three-valve receiver in the aeroplane, and an efficient screening system which stopped interference in the receiver from engine ignition impulses.

In 1917 inter-machine wireless was in use for formation control, and at the time of the Armistice the equipping of all squadrons with the new apparatus was well in hand. The working ranges were 20 m. from machine to ground and three m. from machine to machine.

The aeroplane aerial was a single wire with a metal bob at the end which was run out from a winch so that it trailed below the machine, and the fuselage was employed as a counterpoise.

14. *The Armistice.*—The historic message sent out from the Eiffel Tower at 5 A.M. on Nov. 11 1918:—

"Marshal Foch to the Allied Commanders: *Hostilities will cease at 11 a.m.*"—was delivered to more than half the troops by wireless.

III. WIRELESS SINCE THE WAR

15. *Direction Finding* (*III.*).—It had been noticed that position finding at night often proved to be unreliable, particularly at about sunset, and the results obtained by searching with suitable frame aerials led T. L. Eckersley in 1918 to express the view that the error was due to rays reaching the earth from the upper atmosphere.

A vertical aerial picks up signals from all directions. A rectangular or frame aerial gives strongest signals when its plane lies in the line of propagation of signals, but it does not indicate the bearing of the direction; and the search coil of a Bellini-Tosi D.F. in the same way shows direction but not bearing.

By combining a vertical aerial with a Bellini-Tosi system both direction and bearing can be found, the polar diagram of reception having a heart-shape, with one position only for the search coil at which signals vanish, and this is 180° from the true direction of the transmitting station. However much the heart-shape may be distorted by the vertical rays of night effect, it is found that the position where signals vanish remains unchanged, so that it can be used as a reliable indication of bearing.

The heart-shape arrangement came into use after the War, and is now employed on all ships fitted with Marconi apparatus, and also at the receiving stations of the Marconi transatlantic and continental wireless services at Brentwood.

16. *Aircraft Wireless Telephony* (*III.*).—With the advent of commercial flying the power and range of the wireless telephone equipment of R.A.F. type was increased, and in this improved form was given its first air test early in 1919.

The first commercial machine to be fitted was the Handley-Page GEALX which made the journey from Cricklewood to

Paris on March 4 1920, when part of the route was foggy, and the information received by wireless that there was clear weather ahead proved of value. During 1920 and 1921 every British machine regularly flying on the London-Paris route was equipped with Marconi 100 watt air-driven generator, five-valve receiver wireless telephone sets; and the landing at Croydon, the London air terminal port—which gives aeroplanes their bearings en route—is entirely controlled by wireless telephony.

The latest apparatus adopted as standard for commercial airways includes 150-watt air-driven double current generator, one oscillator and two modulator valves and five receiver valves, and works normally on 900 metres.

17. *Wireless and Long Distance Flights.*—The use of wireless for long distance flying was illustrated by the transatlantic voyage of the airship "R34" in 1919 from East Fortune, 20 m. from Edinburgh, to Mineola, Long Island, N.Y., taking four days 12 h. 15 min., and Mineola to Pulham, Norfolk, three days, one h. 56 min., during which she was in touch by spark and C.W. telegraphy with Clifden and Glace Bay and many ship stations for the whole period of her cruise. The transatlantic flight of Commandant Franco from Spain to South America on the Dornier seaplane "Ne Plus Ultra," in Jan. 1926 is another instance. This was an all-metal machine fitted with a Bellini-Tosi D.F. equipment, by which it obtained its bearings to Las Palmas at a distance of 700 km., and navigated with accuracy through mist and cloud solely by this means. At the end of the ocean flight of 1,440 m. the plane, relying on D.F., made the small island of Fernando Noronha with great accuracy. During the Amundsen-Ellsworth polar flight in May 1926 the airship "Norge" was in communication with Europe by wireless when over the Pole, and by the same means obtained its bearings and received meteorological reports from stations round the Polar basin.

18. *Thermionic Valve Development.*—Thermionic valves depend for their operation on (*a*) a free supply of electrons, (*b*) an electron current through the valve drawn from this supply. The first requirement is met by means of an incandescent filament, from the surface of which under suitable conditions the electrons evaporate; or the filament may be used simply as a heater of an alkaline earth material which emits a very plentiful supply of electrons when red hot.

The second requirement is met by removing practically all gas atoms from the valve and by imposing a positive potential on the plate or anode, when, on completing the electric circuit externally from the plate to the incandescent filament which is made the cathode, an electron current flows through the valve.

The filament was first made of carbon, then platinum; later the platinum was coated with lime and barium oxide; tungsten superseded platinum; and now thoriated tungsten is employed by one manufacturer, and lime-coated platinum alloy by another for the filaments of an important group of valves known as dull emitters. The dull emitter allows emission to take place when the filament is only dull red, and therefore calls for only a small current and less filament battery volts than is necessary for a bright filament.

The recognition that stable operation over a wide range of working conditions could only be obtained by removing every particle of gas possible from the valve—as demostrated by the research work of Irving Langmuir in 1915, employing tungsten filaments—brought about improvements in the methods used for obtaining a high vacuum, and the successful maintenance of a high vacuum under load conditions made possible all the later advances in thermionic valve engineering.

A valve containing an appreciable quantity of gas is said to be "soft." As an example, the Lieben-Reiss valve contains mercury vapour at a barometric pressure of 0·01 mm. A "hard" valve should have a lower gas pressure than 0.0001 mm.

The Sprengel and Toepler types of mercury pump originally employed, although efficient and suitable for exhausting to 0·00001 mm., are too slow in operation and require too much attention for commercial use, and it is now the general practice to use a combination consisting of a rough pump and a fine pump. Thus a Geryk piston pump may be employed to reduce the air pressure to 0·25 mm. and a Gaede piston pump to reduce this further to 0·00005 mm. or, the rough pump may reduce the air pressure to 10 mm., and a Gaede rotary mercury pump, or Gaede oil pump, may carry on the exhaustion to 0·00007 mm. With an additional Gaede oil pump in series the pressure can be lowered to 0·000007 millimetres of mercury.

The Gaede molecular pump—which works on the principle that in a partial vacuum gas friction on a moving surface will cause the molecules of gas to travel with the surface—allows a fine pressure of 0·0000003 mm. to be obtained if the rough pump first reduces the pressure to 0·05 mm.; and finally, if a Gaede oil pump is used as a rough pump to reduce the pressure to 0·007 mm., a Langmuir condensation pump can then carry on the exhaustion to any desired extent, a typical value measured by an ionisation gauge being 0·00000007 mm., or 10^{-4} bar.

The gas atoms absorbed or occluded by the various parts of the valve—the lead glass or lime glass employed, the metal of the grid and of the plate—must all be removed if the vacuum is to be retained under working conditions. For this reason the valve and fittings are heated during exhaustion, and by the application of a high potential to the plate and grid these parts are also bombarded by high speed electrons drawn over from the incandescent filament, the gases expelled in this way being water vapour, carbon dioxide, carbon monoxide and hydrogen. The last remnants of gas in certain cases are also removed by chemical absorbents such as calcium, magnesium or red phosphorus, which impart a blackened or silvered or a yellow appearance to the glass bulb.

Platinum, copper, aluminium and nickel have been used at various stages of receiving valve development as the metals for the grid and the plate; and for transmitting valves which in certain cases work with the plate red hot it has been found best to make these parts of nickel or molybdenum.

The grid may be of an open or close mesh of wire, or a wire wound spirally or zigzagged.

If a resistance is connected in the plate circuit of a three-electrode valve, a change in voltage applied to the grid results in a certain change in voltage across this resistance, and the ratio of these two values is called the *voltage magnification* of the valve circuit. This value increases with the plate circuit resistance, but when the resistance is sufficiently large tends to becomes constant, and it is then called the *magnification constant* or M value of that particular design of valve. The receiving valves in use to-day have M values from $2\frac{1}{2}$ to 20, and transmitting valves from 8 to 200; in each case higher M values are obtainable, but they are not called for.

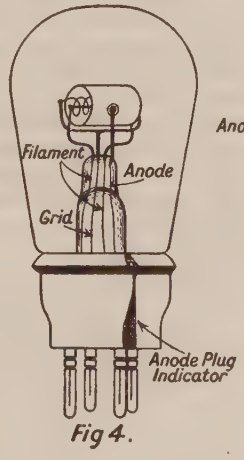


Fig 4.

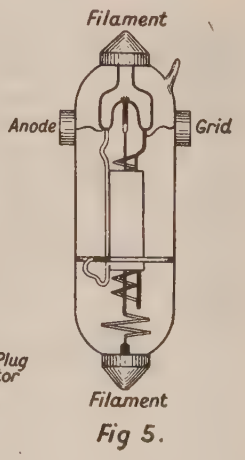


Fig 5.

FIG. 4.—"R" receiving valve. FIG. 5.—"V 24" receiving valve.

The Marconi R (bright filament), (fig. 4,) which can be used as a rectifying or an amplifying valve, has plug-in contacts, is suitable for anode voltages of 30 to 100 and has an M value of 9. It resembles in appearance the French valve used during the War. Except that its filament is a dull emitter, the Marconi D.E.R. valve has the same form and characteristics as the R.

The Marconi V24 (bright filament) (fig. 5) is a compact and robust type of amplifying valve which is held in position by four spring contacts. It is suitable for anode voltages of 20 to 60, and has an M value of 6. This was one of the British valves used during the War. The Marconi D.E.V. has the same form and characteristics but is a dull emitter.

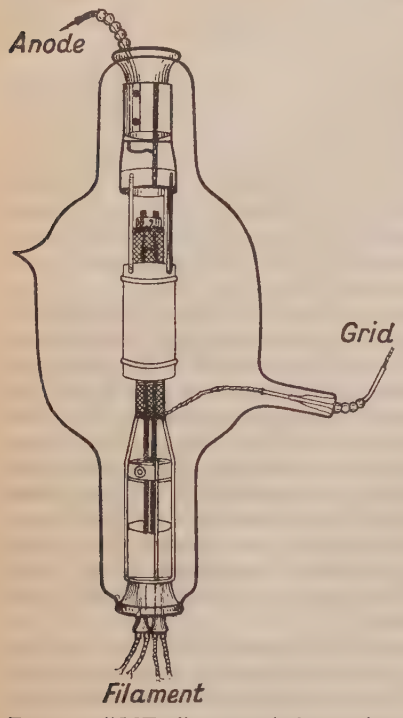


FIG. 6.—"MT9" transmitting valve.

The Marconi MT 9 valve (fig. 6) is suitable for working on a four kw. transmitter with anode voltage up to 12,000. It is able to dissipate up to 1·5 kw. at the anode, and has an M value of 90.

The power valve intensifies the problems connected with sealing metallic connections through glass, the difference in expansion of the materials employed, glass electrolysis and current leakage.

Quartz, which is able to stand high temperatures without fractures, has been used to a considerable extent instead of glass for the bulbs. The quartz valve is more difficult to make and its cost is high, and the necessity for it disappeared with the invention of the water-cooled valve This valve (fig. 7) represents an important new departure in manufacture, as the wall is half of glass and half of metal. The metal part is the anode, and is fitted into a container through which a stream of water flows, taking away with it the heat generated at the anode.

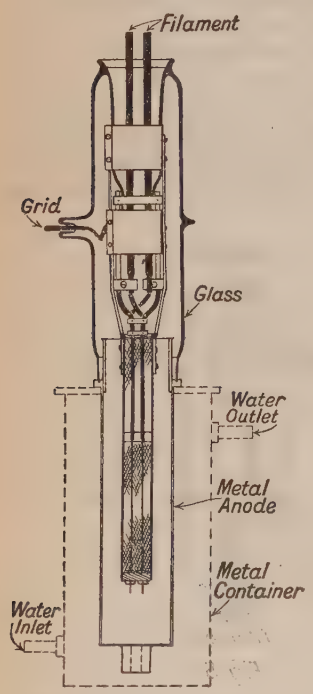


FIG. 7.—Marconi water-cooled transmitter valve.

In one method the anode insulation is maintained by using distilled water—which is a non-conductor—led through a length of rubber hose to and from the valve container; and in another method by employing a spray to break the water circulation into and out of the valve container, the insulation of the spray being such that with 10,000 volts on the anode the current through this channel to earth has the order of a few milliamps only.

Water-cooled valves of 10 kw. and 20 kw. capacity are the sizes in general use, although valves to take up to 100 kw. are also made.

The actual loss in a 10 kw. valve is of the order of 15 to 20%. Where maximum insulation, minimum plate to grid capacity and minimum loss are of first importance, as in short wave work, the transmitting valve may be cooled by an oil circulating instead of a water circulating system.

19. Post Office Stations (III.).—In 1926 there were in Great Britain and Ireland twelve post office stations engaged in ship and shore service. These are Wick, Cullercoats, Grimsby, North Foreland, Niton, Land's End, Fishguard, Seaforth, Port Patrick, Valentia and Malin Head being spark stations of from 1½ kw. to 10 kw. power, keeping watch on 600 metres; while the 12th, Devizes, with its receiving station at Burnham, Somerset, is fitted for long range working to ships installed with continuous wave sets.

In the year 1925 distress calls from 84 ships were received and dealt with, and the total shore station traffic for 1925 amounted to over 4,000,000 words.

Post office stations engaged in point-to-point traffic are Stonehaven, Leafield, near Oxford, Caister in Norfolk, Northolt and Rugby, the control and operating being done at the Central Telegraph Office, London.

20. Commercial Point-to-Point Stations.—Commercial point-to-point high speed duplex radio telegraphic services working at 90 to 150 words per min. were opened by the Marconi Company in 1922 to 1923 between their centralised operating station at Radio House, London, valve transmitting stations at Ongar and Carnarvon, receiving station at Brentwood, and the corresponding continental stations at Paris, Berne, Madrid, Vienna, Barcelona, Belgrade and Moscow on wave-lengths ranging from 2,950 metres to 5,045 metres; the same English stations also working across the Atlantic to Glace Bay, New Brunswick, Marion, Tuckerton, Rocky Point and Coram Hill on wave-lengths from 5,000 metres to 14,000 metres, and receiving on wave-lengths from 7,700 metres to 17,500 metres. A valve telegraph transmitter of 1926 design is shown in Plate fig. 4.

Directional reception is employed at Brentwood, and the tuned-in signals then pass through a high frequency filter of several stages, being afterwards heterodyned as described below to produce a frequency of about 2,500 cycles; they are next rectified and passed through a low frequency filter to a valve bridge circuit, then on by land-line to Radio House.

The operating speed of the Marconi Wheatstone automatic transmitter is adjusted to traffic requirements, and may be anything up to 150 words per minute. The recording apparatus includes (1) a high speed Creed receiver, which makes perforations on a tape identical with those on the tape of the Wheatstone transmitter, and a Creed printer which converts the perforations into printed characters on another tape; and (2) a Marconi undulator or trailing syphon recorder, capable of working up to 200 words per min., which is employed in place of the Creed apparatus when atmospheric conditions cause printed messages to be mutilated. The total traffic of the Marconi services for 1925 exceeded 20,000,000 words.

21. "Heterodyning" Continuous Wave (C.W.) Oscillations.—To detect continuous wave signals the current is "heterodyned," that is, another current is superposed on either the transmitter—or, more usually, the receiver circuit—of almost identical frequency, so that by suitably adjusting the difference of the two frequencies a "beat" note having a pitch within the audible range is produced. Thus if the signal current has a frequency of 10^6 cycles (3,000 metres), to give it an audible frequency of c″-512 the heterodyning current must have a frequency of 10^6 plus or minus 512 = 2,985 metres or 3,015 metres, being a difference of 0·5% or 15 metres plus or minus in wave-length. But if the signal current has a frequency of 10^7 cycles (30 metres), then the heterodyning frequency to give the same audible note of c″-512 would differ from it by only 0·005%, corresponding to wave-length difference of only plus or minus 0·0015 metres. For a note of two octaves higher, namely 2,048, and a signal current frequency of 10^7, the wave-length difference would still only be 0·006 metres.

Such adjustments on short waves would be too critical, and the practice is to use two stages, the first giving a beat note having a frequency well above the audible limit and the second a beat note within the audible limit.

22. Wave-length Allocation and the Number of Channels Possible for Radio Communications.—The ether is becoming congested with radio traffic over a considerable range of wave-lengths, and it becomes necessary to consider the number of possible channels obtainable by the use of different wave-lengths.

Those in use at the present time are:—

Wave-length, Metres	Frequency Kilocycles	Service
5 to 7	60,000 to 42,855	Beam "Lighthouse"
7 to 9	42,855 to 33,333	Short wave military stations
13 to 100	23,077 to 3,000	Beam stations including transoceanic stations on this system
150	2,000	Trawlers, aircraft and other small mobile sets
200	1,500	
220	1,364	
240 to 260	1,250 to 1,154	Lighthouses and lightships
300 to 350	1,000 to 857·1	British broadcasting
300	1,000	
450	666·7	Ships with spark sets
600	500·0	
700	428·6	
800	375·0	
850 to 950	352·9 to 315·8	Aircraft
1,000	300·0	Beacon stations
1,000	300·0	Military fixed stations, aircraft and broadcasting
1,550	193·5	
1,600	187·5	High power British broadcasting
2,100	142·9	Ships using C. W. sets
2,650	113·2	
2,650	113·2	Medium power transcontinental stations
8,000	37·5	High power transoceanic wireless stations
8,000 Upwards	37·5	

The allocation of wave-lengths may be made on the basis of a definite percentage difference between them, or what now promises to become the accepted method, on separations of a definite numbers of cycles. This will give many more short-wave channels than long ones. For instance, if steps of 5,000 cycles are chosen, then 5 metres difference in 100 metres or 3×10^6 cycles, would give 30 channels; whereas 5 metres difference in 1,000 metres or 3×10^5 cycles would only give three channels. The whole working range of wave-lengths for all purposes is likely to extend from 5 metres to 30,000 metres, which gives a possible number of channels on the above basis of 11,998, of which 95% would be on shorter wave-lengths than 100 metres. But as it is possible to work on narrower limits and with greater steadiness on long wave than on short, the tendency will be to limit the band at 5 metres, for instance, to something like 100,000 cycles, or within 0·16%, while at 30,000 metres the width of band may be confined to 200 cycles, or 2%.[1]

23. Wave Propagation Theories (II.)—The influence of diffraction on the propagation of electromagnetic waves to a distance was further examined by G.M. Watson in 1918, and the mathematical solution put forward by him is now accepted as correct.

He showed that the received current in the Austin-Cohen formula should be inversely proportional to $\sqrt{\sin\theta}\,\lambda^{7/6}$—where θ is the angle at the centre of the earth subtended by the distance d—and the index of the exponential factor should be $0{\cdot}00376\frac{d}{\sqrt[3]{\lambda}}$; but as the intensity of signals at distances of 6,000 m. were still found to be much greater than the values calculated on this new basis, Watson in 1919 concluded that refraction and reflection of the rays earthwards were also involved, such as would be obtained if at a height of 100 km. above the earth the specific resistance of the atmosphere per centimetre cube were $6{\cdot}95\times10^5$ ohms.

Larmor in 1924 continued the discussion of the refraction theory, and pointed out that, to account for the bending of electromagnetic rays without extinction, all action by conduction or other dissipation must be excluded, and that the influence at work must be purely dielectric in character.

[1] Recent measurements of the wave-length of light give a value of $2{\cdot}9982\times10^8$ metres per second instead of 3×10^8 metres per second. This figure should therefore be used in effecting conversions where necessary.

Eccles has shown that by postulating the existence of heavy ions in the middle atmosphere caused by incident ultra-violet radiation, which have a limited free path, the bending of the waves can be accounted for; and Larmor extended this theory by showing that the finite free swayings of electrons or light ions without collision in the ultra-rarefied gas of the upper atmosphere must augment the speed of the exciting waves. Such a layer, in which a sheaf of horizontal electric rays, provided they are long enough, will travel without loss by absorptional scattering, must be high up within the auroral domain, concentration in this stratum being due to the potent influence exerted on the velocity of long waves by the free ions of small inertia interacting with them.

By this theory, electric radiation to great distances involves a sheaf of rays whose breadth may be only a fraction of one of its long wave-lengths, which travels along a surface of constant index, while it has to remain concentrated without spreading either by refraction or by diffraction.

24. Wave Propagation Tests.—Measurements made by L. F. Fuller in 1915 between the arc stations at San Francisco and Honolulu, by G. Vallauri in 1919 between Annapolis and Leghorn, and particularly by Lieut. Guierre for the French Govt. in 1919 to 1920 during the cruise of the S.S. "Aldebaran" to the antipodes receiving from Nantes and Lyons, showed that the Austin-Cohen formula ceased to apply for distances exceeding 2,000 miles.

The Marconi Company having devised a portable instrument for accurately measuring in absolute units, micro-volts per metre, the potential gradient of signals, sent out trained observers in 1921–2 to all parts of the world to measure the strength of signals received on wave-lengths from 5,800 metres Clifden to 23,450 metres Bordeaux, on known power from the principal European and American stations, the intensities of atmospherics and the direction and bearing of both signals and atmospherics being also noted; and from the information obtained, much of which has been published, reliable world transmission formulae covering all the requirements of the Imperial stations for working on long waves have been evolved.

The assumption made by Marconi so long ago as 1905, in a lecture before the Royal Institution, that signals would strengthen at the antipodes of the transmitting station, was confirmed, and it was also noticed that they always travel on a great circle round the earth, but that the direction of arrival whether by the shortest or longest path alters according to the wave-length, position of the sun and, in general, the conditions of the upper atmosphere.

25. Imperial Wireless (III.).—The Imperial wireless chain again came up for discussion at the Imperial Conference of 1921. The British and Dominion Govts. were urged to erect the necessary stations. A Government committee reported in 1923 that the Post Office should own and operate directly all wireless stations for communicating with various parts of the Empire. In the case of Canada the present competition between the Post Office and the Marconi Company might be continued. As regards Continental Europe and the rest of the world, it was recommended that private enterprise be given all reasonable facilities to develop wireless communication. The Post Office then acquired a site at Rugby and proceeded with the erection of the first Imperial transmitting station, and this has been completed. The intention was to provide worldwide radio communication throughout the whole of the 24 hours, and the design is an example of the most recent long-wave practice (Plate fig. 3).

The aerial for telegraphic transmission, which has a capacity of 0·032 mfd., is supported by eight 820 ft. towers, while the aerial for telephonic transmission has a capacity of 0·02 mfd. and is supported by six such towers, two of which are shared with the telegraph aerial.

The power amplifier—consisting of three 18-valve units, each valve having an output of 10 kw.—feeds 500 kw. to the aerial valve through a coupled circuit.

The constancy of the wave-length is controlled by a valve-maintained tuning fork vibrating at 1,777 cycles per sec., which

is made to excite continuously a valve circuit tuned to the same frequency, but so constituted that it has a pronounced ninth harmonic, namely 16,000 cycles. This frequency is picked out, amplified, and finally acts as the control current of the power amplifier, and the aerial, therefore, radiates on the equivalent wave-length, namely 18,740 metres.

The total power used in the station for transmitting and auxiliary services is at present (1926) about 1,400 kw. when in operation for both telephony and telegraphy.

26. Marconi Short-Wave Beam Transmission and Imperial Wireless.—In 1916 Marconi returned to the study of short wave transmission as used by him in 1896, employing reflectors and three-metre damped waves on Italian war vessels, and under his direction further exhaustive tests were carried out by C. S. Franklin in 1917, 1919 and 1920, first at Carnarvon and later over 97 m. between Hendon and Birmingham, using reflectors on wave-lengths up to 15 metres, a valve transmitter being introduced in 1919.

A revolving beam spark transmitter 6·3 m. wave-length was fitted at Inchkeith on the Clyde, and demonstrated to the Commissioners of the Northern Lights in 1920, a permanent revolving reflector on the same wave-length being installed at the South Foreland in 1923. In April, May and June 1923 Marconi on the S.Y. " Elettra " at Madeira, and later at St. Vincent, received such strong signals comparatively free from atmospherics from a 97 m. reflector transmitter at Poldhu, working on one kw. to 12 kw. valve input, that he was convinced short waves could give reliable commercial services for the greater proportion of the 24 hours up to 2,300 nautical m. on one kw. power, this being the distance between Poldhu and St. Vincent.

Following the publication of the Government Report on Imperial Wireless, the Marconi Company therefore opened negotiations with the Post Office for the employment of short-wave beam transmitters for the Imperial stations.

Marconi's tests were continued on the same wave-length but with power up to 20 kw. in the autumn and spring of 1923–4, observations of signal strength also being noted at Montreal, New York, Rio de Janeiro, Buenos Aires and Sydney, N.S.W. The first direct message by short-wave wireless telegraphy from Poldhu was received at Sydney on April 30 1924, and the first direct speech by short-wave wireless telephony on May 30 1924.

In July 1924 an agreement was concluded between the Postmaster-General and the Marconi Company for the construction of wireless stations on the beam system, capable of communicating with Canada and of being extended to South Africa, India and Australia, the transmitting station to have an input of at least 20 kw. and the receiving station to have an aerial designed to focus received waves within an angle of 30°, the stations to be worked by remote control from the Central Telegraph Office, London, and to be capable of working at 100 words per min. each way for an average of 18 hours per day.

Following the publication of the agreement, work commenced on the erection of beam stations in South Africa, India, Australia and Canada, which, except for the hours of working—South Africa 11, India 12, Australia seven—are required to be identical in performance with the English beam stations.

The Poldhu transmitter having been modified to work with 15 Rw. on 92 m., 60 m., 47 m. and 32 m., the range trials were resumed in Aug. 1924, when Marconi on board the " Elettra " found the daylight range increased very rapidly as the wave-length was reduced. Also on 32 m. and 12 Rw. input, signals were received at New York, Rio and Buenos Aires when both terminal stations were in daylight, and Sydney, N.S.W., was able to read signals for 23½ out of the 24 hours.

In Oct. 1925, using 200 watts and 15 metres, transmission from Chelmsford to Buenos Aires was of such strength during daylight that a speed of 30 words per min. would be used, reaching a maximum with the sun at its zenith on the great circle track, while during darkness signals disappeared altogether.

Exhaustive tests have since been made by the Marconi Company of the daylight absorption factor of all wave-lengths down to one metre.

The English beam transmitting stations now in process of erection (1926) are Bodmin (Plate fig. 2), to work with Canada and South Africa; Grimsby, to work with India and Australia; and Dorchester, to work with the U.S.A. and South America; the three corresponding receiving stations (Plate fig. 1) being at Bridgewater, Skegness and Somerset.

27. Wireless Telephony (II.).—Transatlantic one-way wireless telephony was carried out in 1919 between the Marconi Ballybunion station, County Kerry and Louisburg, Cape Breton, a distance of 1,800 m.; and in 1920 the first land-line to wireless and wireless to land-line duplex telephone service was opened to the public when the Californian and Santa Catalina Island systems were connected by a wireless link from Los Angeles to Avalon, a distance of 31½ miles.

Further transatlantic one-way transmission tests using 300 Kw. to the aerial and a special valve circuit radiating only " side-band " frequencies from the aerial were carried out in Jan. 1923 between the Rocky Point station, New York, and New Southgate, London, the speech being picked up on a 6 ft. frame aerial connected to special filter amplifier and wave-form correction circuits having the effect of restoring the carrier wave removed at the transmitter.

Transatlantic two-way tests on single side-band working duplex, between the British Post Office station at Rugby sending on 5,769 m. wave-length (52 kilocycles), and the Rocky Point station, New York, sending on 5,263 m. wave-length (57 kilocycles), and the respective receiving stations connected to subscriber lines, were begun in Feb. 1926.

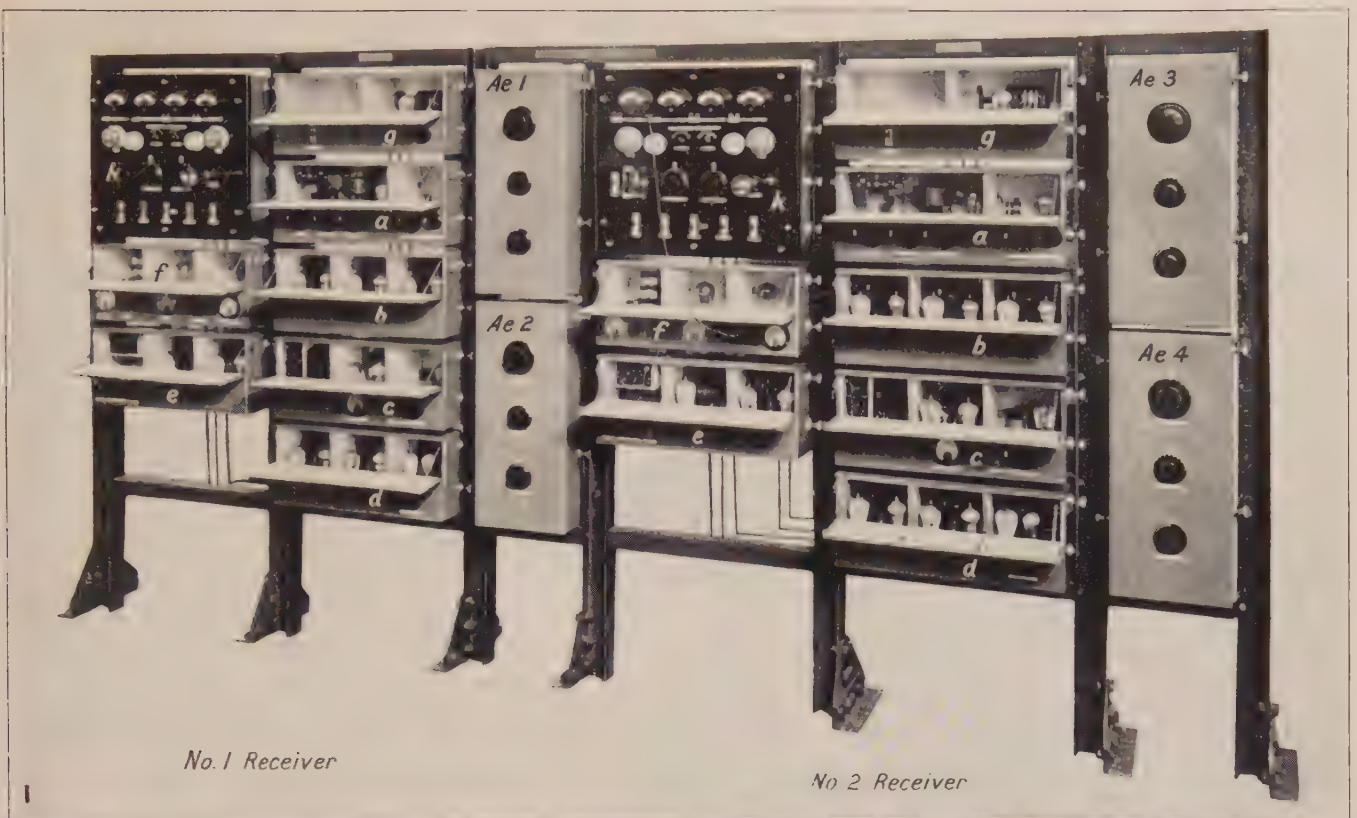
The audible frequencies are comprised between 20 and 10,000 cycles per second. In wireless telephony currents having frequencies between these limits are superposed on the carrier wave frequency x.

If clear speech only is required, and not music, the essential audible frequencies lie between the narrower band of 100 to 3,000 cycles per second.

Then it can be shown that for clear speech the total band of modulated carrier wave frequencies involved lies between the limits $(x-3{,}000)$ and $(x+3{,}000)$; the frequencies below x are classed in one group as a side-band, the frequencies above x are classed in another group as a second side-band, and the speech wave-form is completely outlined by either side-band. If one of them is filtered out before transmission the total width of band employed will be halved and the power transmitted will be halved, and there need be no loss of quality or distinctness if the correct frequencies can be again inserted at the receiver. This is what is done, and a further economy is also obtained by treating the ineffective frequencies between x and $(x \pm 100)$ in the same manner.

28. Broadcasting.—While the technical development of wireless telephony was proceeding with success, its commercial future, apart from its use as a link across water between two land-line systems, appeared to be problematical, as for accuracy, speed and number of channels available for messages it was considered that wireless telegraphy would always have preference.

The general public were led to take an interest in it as a novel form of communication which could be used by anyone able to talk into a telephone, and this interest was fostered by using it as a source of entertainment to transmit songs, musical items and speeches by public personages between recognised stations ashore or afloat which could both transmit and receive. Feb. 23 1920 saw the opening of the first wireless telephone broadcasting service in the world, when a programme of vocal and instrumental music for two half-hourly periods each day for a fortnight was transmitted on a 15 Rw. valve set from Chelmsford on 2,800 metres, the wave-length used by Poldhu for the ship telegraph news service. Amateurs and the shipping companies were advised that this would take place, and many reports of good reception at 1,000 and 1,200 m. distant on crystal sets, and up to 1,400 m. on valve sets, were received. The Hague concerts commenced on April 29 of that year, and in June and July other concerts by well-known artists took place at Chelmsford, which in Northern Europe were received by wireless and put through the telephone



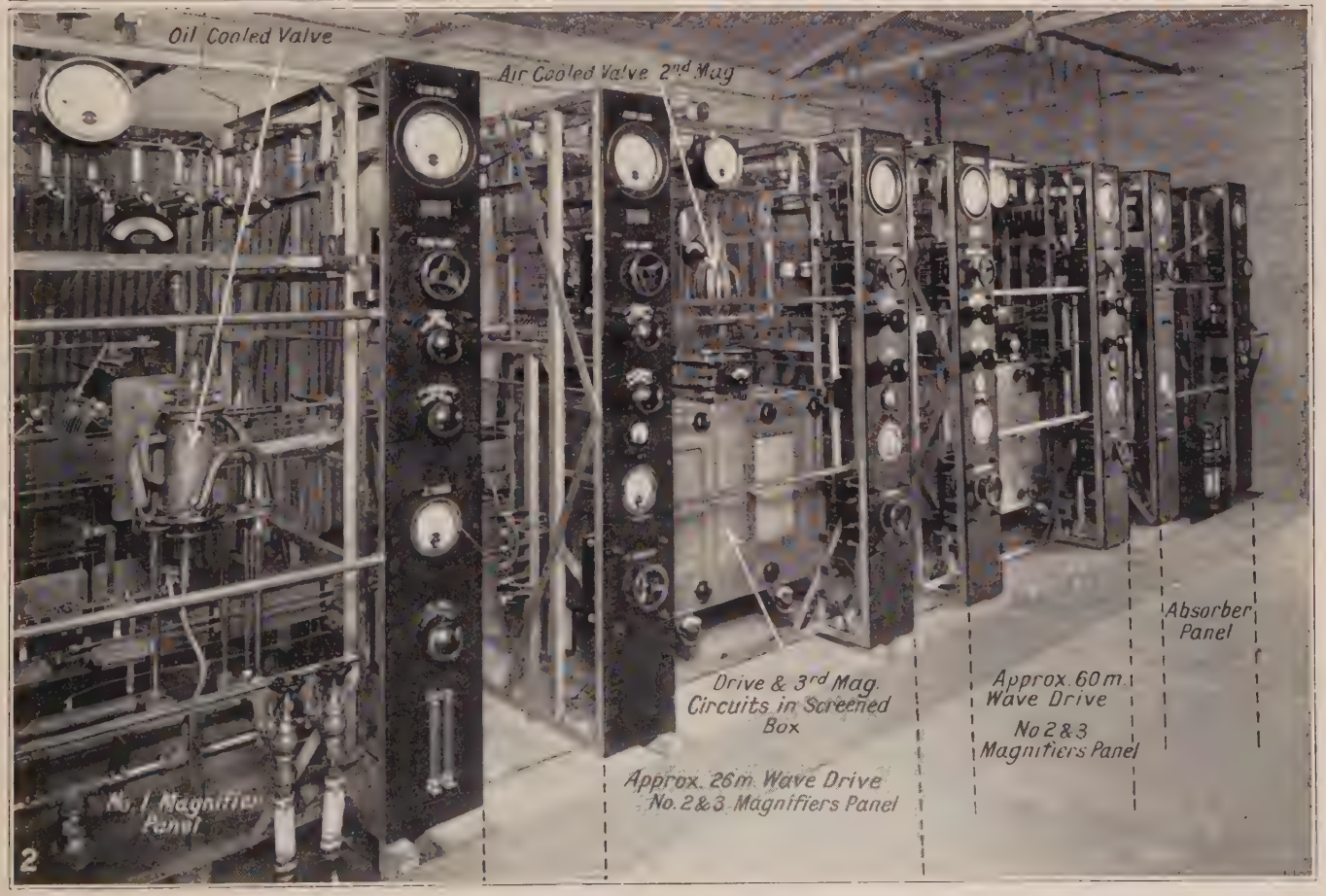
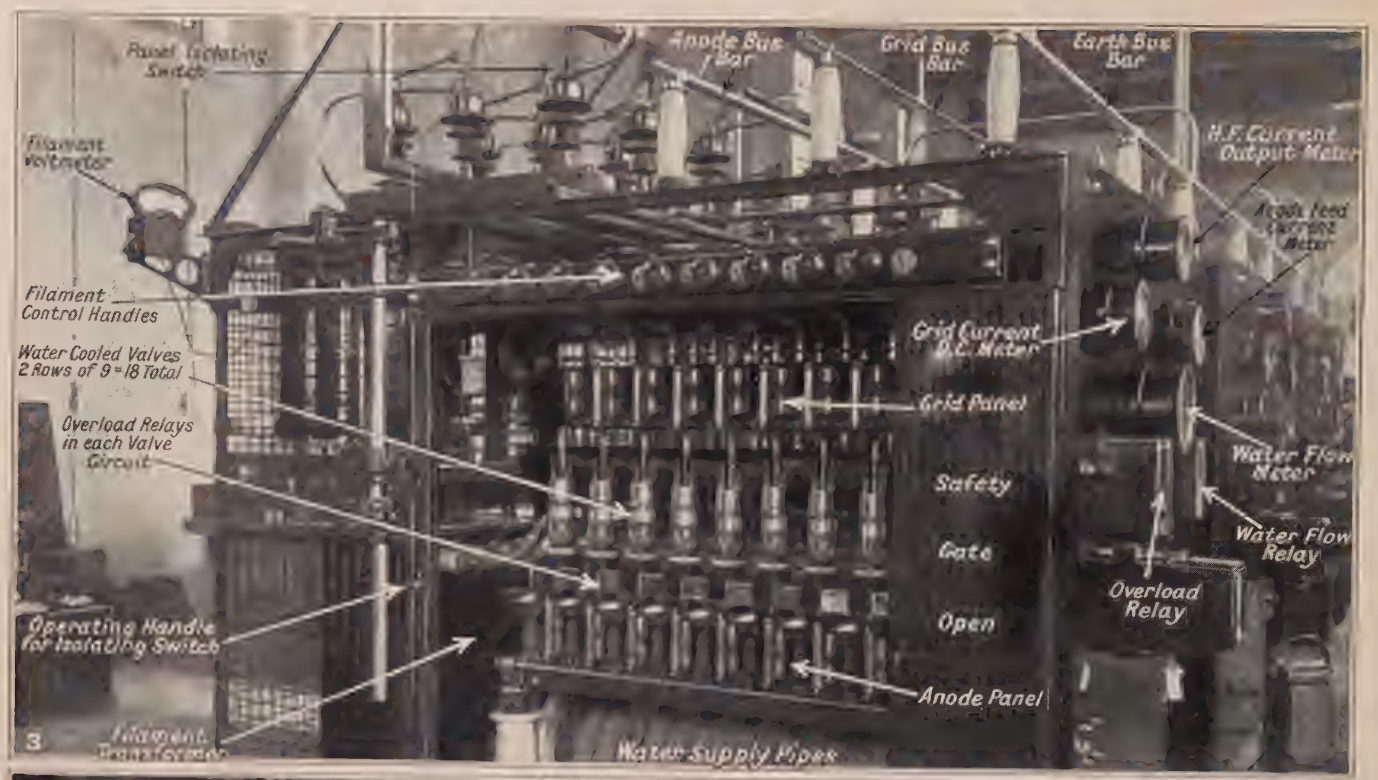

Oil Cooled Valve
Air Cooled Valve 2nd Mag
No. 1 Magnifier Panel
Drive & 3rd Mag. Circuits in Screened Box
Approx. 26m. Wave Drive No. 2 & 3 Magnifiers Panel
Approx. 60m. Wave Drive No 2 & 3 Magnifiers Panel
Absorber Panel
2

FIG. 1. Marconi short wave beam station receiver. Panels *Ae. 1, Ae. 2, Ae. 3, Ae. 4.* Feeder coupling units of 26 m., 60 m., 26 m. and 60 m., waves respectively. Panel *a.* Input tuning circuit: 1st rectifier and 1st oscillator. *b.* 1st filter amplifier. *c.* 2nd rectifier, with listening point, and 2nd oscillator. *d.* 2nd filter amplifier. *e.* Main rectifier and listening point. *f.* Control switchboard. FIG. 2. Marconi short wave beam station transmitter, under test.

(Courtesy of Marconi's Wireless Telegraph Co., Ltd.)



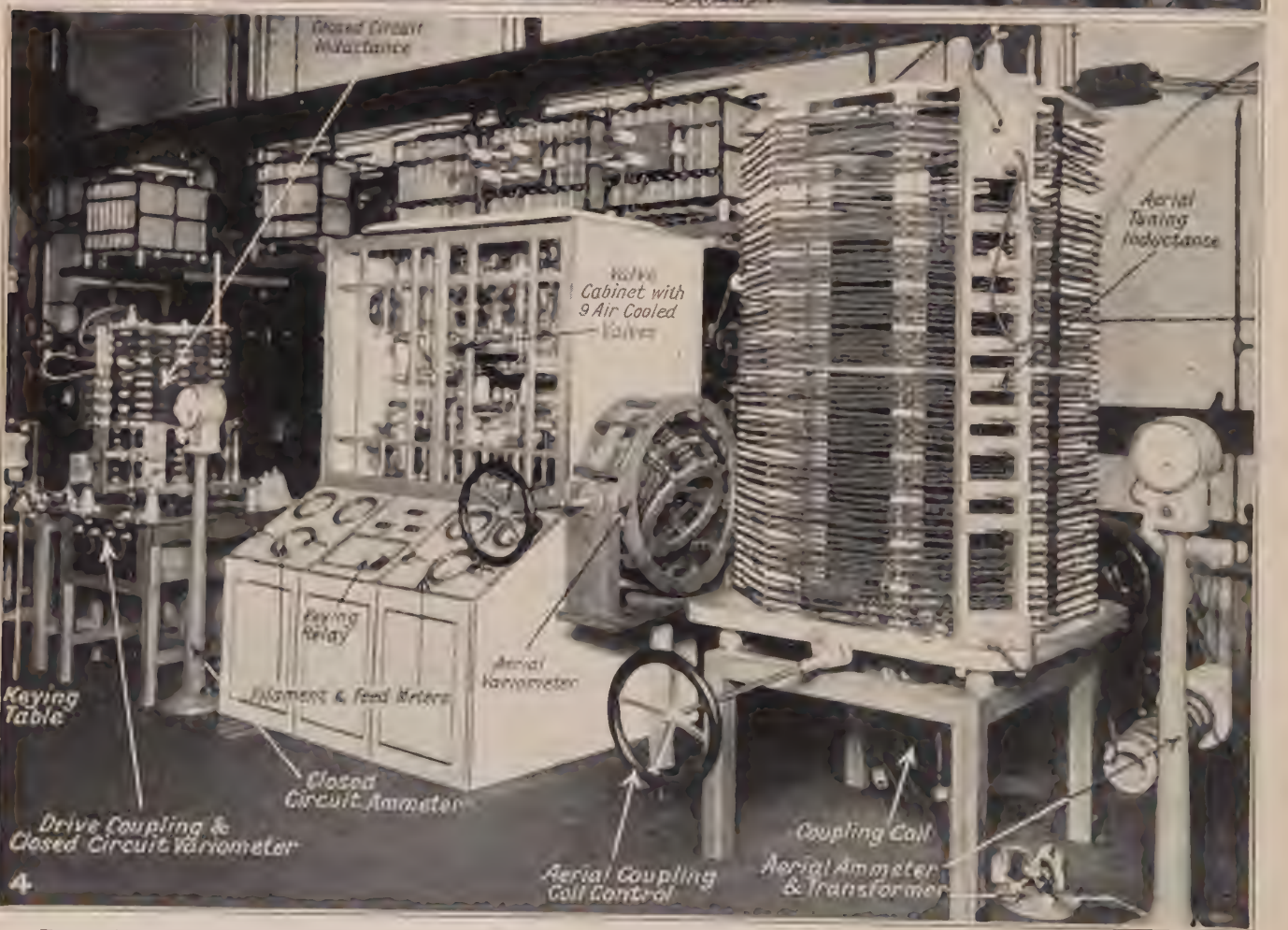


FIG. 3. Post Office long wave valve transmitter. Rugby. FIG. 4. Marconi 15 kw. wireless telegraph transmitter under test.

(Courtesy of Marconi's Wireless Telegraph Company.)

exchanges of the large Scandinavian towns and thence to the subscribers' lines. The musical items encouraged a great deal of unofficial listening-in, the amateur movement grew apace, and manufacturers in the United States discovered that a vast trade in receivers only was springing up, which they proceeded to encourage by the erection of stations solely for transmitting to, and entertainment of, the general public. The publicity afforded and utilised brought an income to the transmitting stations from advertisers, the number of listeners-in officially recognised and catered for rapidly increased, and the United States 1921–2 boom in broadcasting arrived.

Broadcasting, however, developed more slowly in Great Britain. The Postmaster-General finally gave permission for vocal and gramophone selections and calibration signals for amateurs to be broadcast from Writtle, Essex, and the first transmission on 700 metres and 250 watts took place Feb. 14 1922. The first station of the British Broadcasting Company, 2LO, at Marconi House, London, commenced its transmission on 360 metres and 1½ kw. to the aerial on Nov. 14 1922, and, with the issue of a formal licence by the Postmaster-General to the British Broadcasting Company in Jan. 1923, wireless telephonic reception, with all the possibilities it implied now fairly well realised, received every encouragement from the Government, and is now an ineradicable habit of millions.

Broadcasting demands an unvarying frequency for the carrier wave in order that no readjustment of a receiver may be necessary during the course of a programme, and also to allow sharply tuned receivers to be used, so that there may be the minimum interference between broadcasting stations working on slightly different wave-lengths.

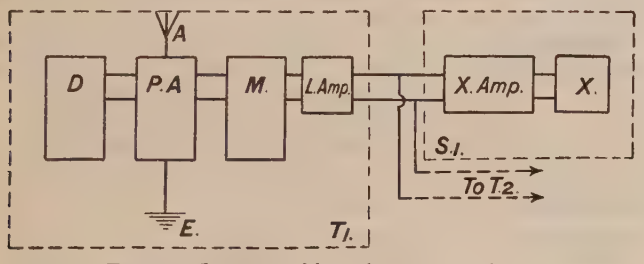


FIG. 8.—Lay-out of broadcast transmitter.

The essential equipment of the transmitter is a circuit P.A., (fig. 8), the power oscillator or magnifier, which is a valve oscillator circuit of carrier wave frequency of which the open aerial forms a part.

D, the drive circuit, a complete self-oscillator having a closed H.F. circuit and, therefore, an invariable oscillation frequency which controls the magnifier and compels it to run at the same invariable frequency.

M, the modulator, which is so connected to the magnifier as to modify the amplitude of the carrier wave according to the speech frequencies to be broadcast.

Sometimes another panel is provided if the H.T. supply is alternating current, in order to rectify it and smooth out the ripples before the rectified current is supplied to the anodes of the valves.

X is the microphone in the studio S_1, which is connected to the input of the microphone amplifier X.Amp., the output of which goes on to the line. On arriving at the transmitting station T_1 the line currents are put through a second or line amplifier L.Amp., the output from which is connected to the input of the modulator panel M, to build them up to the values required to work the first stage of the modulator so that it controls to its full capacity.

The modulator panel may contain the circuits of several stages of amplification, in passing through which the control currents, which originate in the microphone circuit, finally reach such a magnitude that the maximum modulation possible is finally applied to the carrier wave current.

A typical method of modulating the carrier wave, known as "choke control," is illustrated in fig. 9. When speaking into the microphone M, changes in potential take place on the grid of the modulator valve X, as this is connected to the secondary of the microphone transformer T. Owing to the presence of the choke Lx in the modulator plate circuit, corresponding changes in the plate potential of X also take place, and as this plate is connected to the plate of the main oscillator valve O, the fluctuating potentials originated by speech are thus made to control the amplitude of the aerial current.

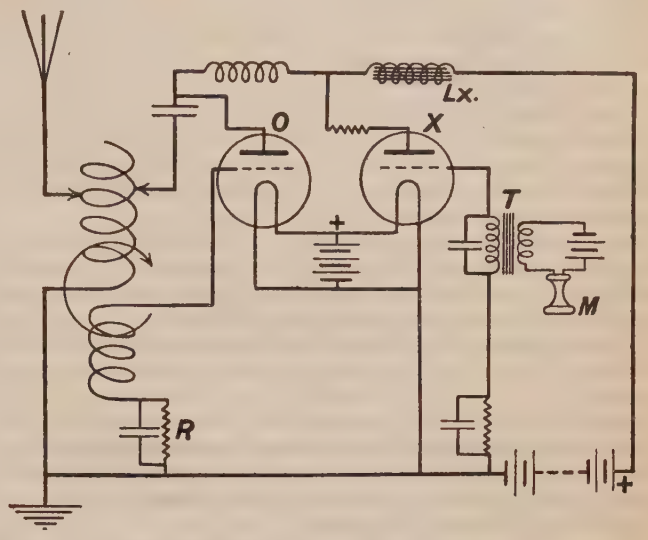


FIG. 9.—Choke control.

By inserting the microphone M, with its circuit and transformer T, in the oscillator grid circuit in place of the resistance R, the modulator valve and choke can be dispensed with, the modulation then being obtained by "grid control," which is a good, but less effective, method.

For simultaneously broadcasting, or "S.B.", the output from the microphone amplifier in the studio S_1 (fig. 8) is connected to the input terminals of two or more land-line amplifiers at two or more transmitting stations, such as T_1 and T_2.

While it is always necessary that the carrier wave should have an unvarying frequency, it is much more vital with short waves than with long.

Short-wave amplification is more difficult than long-wave, as the condensers in the closed tuned circuits are so small that the capacity between the plate and grid of the valve becomes of importance in regard to the capacity coupling between the grid and plate circuit, so that reaction effects tend to take place.

For this reason the incoming short-wave speech-bearing currents are first heterodyned in the receiver to produce long-wave currents well above the audible range; this long wave is then amplified up in the normal manner and finally rectified, thus leaving only the speech frequencies, which are dealt with in the usual way. This is the method usually employed for the relaying of transatlantic short-wave telephony before it is put on to the land-line feeding a B.B.C. transmitter. This is the superheterodyne method which is sometimes used for the "wireless link" between studio and transmitting station in place of the land-line. It cuts out interference, gives greater selectivity to the receiver and permits more amplification to be used than with the original short-wave unheterodyned.

When retroaction is employed in a receiver which is being tuned in to a given transmission, the coupling between the grid and plate circuits may be increased to such a value that the valve circuit becomes an oscillation generator, and its current then heterodynes with that of the carrier wave received, thus causing a variable beat note of diminishing pitch to be heard in the telephones as the resonant point is approached, and of increasing pitch as the adjustment passes the resonance point and puts the circuit more out of tune. This variable note produced when searching for the in-tune adjustment is called "howl."

In many such receivers the self-oscillation involves the aerial circuit. Radiation then takes place and the heterodyne note is

heard on receivers connected to neighbouring aerials. This interference trouble caused by the faulty adjustment of listeners' receivers is known as "oscillation," and spoils the clear reception of many programmes.

29. Future Progress.—An enormous field of development lies ahead. Navigation by sea and air will be aided by the installation of rotating wireless beams which signal a different code for each point of the compass; by special beacon stations automatically transmitting known code signals on reserved wave-lengths for direction-finding purposes; and by the use on board ship of automatic call devices for S.O.S. signals.

Point to point wireless telegraph communications for economic and interference reasons are likely to be established to a rapidly increasing extent by short wave beams, transmission on alternative wave-lengths being provided if propagation absorption conditions make this necessary.

Automatic operating speeds up to 2,000 words per min. if called for can be achieved, and if traffic becomes heavy enough multiplex transmission by applying different modulating frequencies to the same carrier wave may be employed.

It is expected that the British Post Office trans-Atlantic wireless telephone service will be operating commercially within a year or so.

Transmission of line drawings and photographs and whole pages of messages by wireless is already an accomplished fact, and is being adapted for commercial use to trans-Atlantic circuits by the Radio Corporation of America working in conjunction with the Marconi Company.

The invaluable aid that a popular broadcast service, comprising distributed transmitting stations under a centralised control, can render a Government at a time of national emergency, was effectively demonstrated in Great Britain during the General Strike of 1926, and the experience then gained is likely to influence future broadcast regulations.

Finally reference may be made to wireless television, which is still (in 1926) in the laboratory stage, and must take several years to develop; but when mature will prove to be a very useful and popular extension of the art of broadcasting and radio transmission in general.

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(G. MAR.; H. M. D.)

WIRTH, KARL JOSEPH (1879–), German statesman, was born at Freiburg, Baden, Sept. 6 1879. Educated at Freiburg University, in 1908 he was appointed professor of natural science at the technical college in Freiburg, being shortly afterwards elected to the municipal council of that city. In 1913 he obtained a seat in the diet of Baden and the following year became a member of the Reichstag. In 1918 he was appointed Minister of Finance for Baden and in 1919 was elected a member of the Constituent Assembly of the Reich. In March 1920 he was given the portfolio of Finance, which he continued to hold until Feb. 1922. In May 1921 he was called upon to form a new ministry, on the occasion of the Allied ultimatum regarding reparations. In Aug. and Sept. of that year he came into conflict with Von Kahr, the Bavarian Premier, who refused to apply to Bavaria the state of national emergency which Wirth had proclaimed consequent on the murder of Rathenau. Wirth stood his ground, and Von Kahr was compelled to resign, but two months later the decision of the League of Nations on the partition of Upper Silesia between Germany and Poland led to Wirth's own resignation. No one was found capable of taking his place, however, and he resumed office on Oct. 26. In Nov. 1922, owing largely to party dissensions, Wirth again resigned, and Dr. Cuno, manager of the Hamburg-America Line, was entrusted with the formation of a new ministry.

WISCONSIN (*see* 28.740), a State of the United States of America. The population in 1920 was 2,632,067, as compared with 2,333,860 in 1910, an increase of 298,207, or 12%. The density of population in 1920 was 47·6 per sq. m.; in 1910 it was 42·2. The proportion of urban population increased from 43% in 1910 to 47·3% in 1920. The following table shows the population in 1920 of the principal cities.

Milwaukee	457,147	Madison	38,378
Racine	58,593	Oshkosh	33,162
Kenosha	40,472	Green Bay	31,017
Superior	39,671	Sheboygan	30,935

Government.—A constitutional amendment in 1912 regulated the borrowing capacity of cities and incorporated villages; another of the same year gave the State Government power to create a park system. Amendments in 1911 and 1912 regulated the pay of judges; and one of 1922 related to trial by jury. A law of 1915 allowed absentee voting, and one of 1918 voting by soldiers. Commissions play an important part in the government. The following have been created since 1905: accountancy (1913), compensation insurance (1917), conservation (1915), engineering department (1915), grain and warehouse (1905), health (reorganised 1913), highways (1911), industrial (1911), and marketing (1923), besides boards of examination for licences for architects, boxers, barbers, plumbers, etc. and *ex-officio* boards. A workmen's compensation law for the state was passed in 1911. A law of 1917 provided for the sterilisation of defectives, and laws of 1913, 1915 and 1917, for the ante-nuptial physical examination of men.

History.—The progressive policy inaugurated by Governor La Follette was continued by his successors, governors Davidson and McGovern. In 1914 there was a political reaction which resulted in the election of Emanuel Phillip, but the governmental policy underwent but slight change. The State was strongly divided in 1917 on the question of the entry of the United States into the World War; Senator La Follette opposing such action, and Senator Husting favouring it. The death of the latter in 1918 resulted in the election of Irving L. Lenroot (Rep.): he was re-elected in 1920. In 1920 John J. Blaine, supporter of the views of Senator La Follette, was elected governor in succession to Emanuel Phillip. He was re-elected in 1922, and in 1924.

Agriculture.—The total land area in cultivation in 1910 was 21,060,000 ac. of which 11,908,000 was improved; in 1925 it was 21,851,733, of which 13,666,709 was improved. The value of farm property in 1910 was $1,413,118,785, and in 1020 it was $2,677,282,997. The following table shows the quantities and values of the chief crops in 1920 and 1925:—

	1920		1925	
	Quantity Bu.	Value	Quantity Bu.	Value
Corn	44,547,398	$64,593,729	99,556,000	$71,680,000
Oats	68,296,223	58,051,788	126,246,000	47,973,000
Wheat	7,328,444	16,489,016	5,196,000	3,284,000
Barley	12,191,861	16,459,014	16,965,000	11,197,000

The total value of cereal production in 1910 was $73,141,919; in 1920 it was $170,196,910. Livestock on farms in 1925 consisted of 626,000 horses and mules, 5,050,000 cattle, 351,000 sheep and 1,580,000 swine.

Manufactures.—Manufactures and agriculture are closely balanced in their importance to the state. In 1920, 308,038 persons were listed as engaged in agriculture, and 339,578 in manufacturing. The value added to materials by manufacturing in 1914 was estimated at $277,756,928; in 1921, at $486,919,679. The greatest increase in the output of manufactured products was in the region of Lake Michigan. Water-power resources have been partially developed, and are used chiefly for lighting and transportation purposes. The most important manufactures are of farm products.

The following tables give details of the manufacturing industries of the State:—

	1909	1919	1923
Total No. industrial establishments	9,721	10,393	7,832
Wage earners, average number	182,583	263,949	247,851
Wages	$93,904,808	$290,440,561	$297,160,064
Cost of material	346,356,583	1,127,274,961	1,001,501,870
Total value of products	590,305,538	1,846,984,307	1,720,198,349

Butter, Cheese, Condensed milk	$56,642,000	
Cheese	91,463,000	$221,447,000
Condensed milk	73,342,000	
Foundry and machine shop products		198,644,000
Automobiles, including bodies and parts		119,381,000
Slaughtering and meat packing		104,201,000
Leather		94,762,000
Lumber and timber products		88,883,000
Paper and wood pulp		80,328,000
Flour mill aud grist mill products		58,304,000
Boots, shoes and shoe findings		45,699,000
Ship and boat building		44,164,000
Agricultural implements		43,623,000
Furniture and refrigerators		43,522,000
Hosiery and knit goods		40,778,000
Car construction and repairing		36,791,000
Copper, tin and sheet iron products		32,443,000
Iron and steel, steel works and rolling mills		28,393,000
Printing and publishing		26,097,000
Confectionery		24,389,000
Electrical machinery and supplies		23,636,000

Natural Resources.—The following table shows the development in the value of mineral production from 1909–19:—

	1909	1919
Iron ore	$2,972,584	$3,826,872
Lead and zinc	1,989,907	3,816,911
Granite	1,433,105	1,484,979
Lime stone	842,116	1,107,790
Sand stone	200,236	231,078
All other	21,456	113,203

In 1904 Wisconsin stood first among the States in lumber products; in 1922, fourteenth. In 1925 the development of forest reserves and fire protection were helping to stabilise the lumber industry. The earliest Wisconsin industry, the fur trade, produced goods to a value of $669,005.20 in 1918. The development of the fisheries included the establishment of new hatcheries at Spooner for pike, at Sturgeon Bay for white fish, and at Sheboygan for blue fin. The commercial fishing was mostly in the Great Lakes, but this was less important than the sport fishing under licence in the rivers and streams.

Transportation and Commerce.—The steam railway mileage in 1924 was 7,657, and the mileage for electric railways, 989. An interurban electric system covers the southeastern portion of the state. The highway system has been widely developed with the assistance of Federal and State aid, and in 1925 the State trunk highways totalled 10,257 m. in length. This has been followed by an extensive development of lines laid to carry busses and trucks.

Finance.—State finance is managed under a budget system with certain continuing appropriations, and an *ex-officio* commission has power to make emergency grants. In 1922, $19,784,872 was raised for State purposes. In 1922, $22,265,693 was raised for county purposes, and $43,506,660 for local purposes. This included proceeds from the state income tax, $12,661,352 in 1921, most of which is turned over to localities in lieu of a personal property tax.

Education.—A state board created in 1915, with powers modified in 1917, correlates the educational undertakings of the state. In 1915 a board was created to provide vocational instruction; in 1920, 32 cities provided for continuation schools. The total expenditure for public schools in 1921 was $50,385,853, of which over $30,000,000 was raised by school taxes.

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WISTER, OWEN (1860–), American writer, was born in Philadelphia July 14 1860. On graduating from Harvard in 1882 he intended to devote himself to music. He went abroad for study; but family reasons forced him to return, and he spent several years in Arizona and New Mexico. He then entered the Harvard law school, graduating in 1888, was admitted to the Bar in 1889 and for two years practised in Philadelphia. Thereafter he devoted his time to literary work. His novels, *The Virginian* (1920) and *Lady Baltimore* (1906) in particular, established his position as one of the foremost American writers of his generation and won for him a wide popularity.

Wister's other publications include the *Modern Swiss Family Robinson* (1883); *The Dragon of Wantley: His Tail* (1892); *Lin McLean* (1898); *U. S. Grant, a Biography* (1900); *Philosophy 4: a Story of Harvard University* (1903); *The Seven Ages of Washington: a Biography* (1907); *Members of the Family* (1911); *The Pentecost of Calamity* (1915); *A Straight Deal: or the Ancient Grudge* (1920); *Neighbours Henceforth* (1922); and *Watch Your Thirst* (1923).

WOLSELEY, GARNET JOSEPH WOLSELEY, VISCOUNT (1833–1913), British soldier (*see* 28.777), died at Mentone March 25 1913, the title going by special remainder to his only daughter, Frances. He was buried in St. Paul's Cathedral, and an equestrian statue of him on the Horse Guards' Parade, Whitehall, London, was unveiled in 1920.

WOLVERHAMPTON, HENRY HARTLEY FOWLER, 1ST VISCOUNT (1830–1911), British statesman (*see* 28.781), died at Woodthorne, Wolverhampton, Feb. 25 1911.

WOMEN, DISEASES OF (*see* GYNAECOLOGY, 12.764).—During recent years gynaecology has advanced chiefly in the direction of greatly improved operative technique, and in the application of radiological methods. Papers have been published on various points, particularly on the functions of the ovary and the ductless glands, but no experimental work of outstanding importance has appeared and most of the publications are clinical.

At puberty the uterus and ovaries begin to undergo each month a complex and correlated series of changes, which continues throughout the whole reproductive period of a woman's life, normally is arrested only by pregnancy and lactation and ends at the menopause. Its double purpose is to liberate an ovum from

the ovary and prepare the endometrium for its reception if fertilised. The cycle of change in the endometrium is concerned with the renewal of the so-called menstrual decidua. If fertilisation occurs, the ovum becomes embedded in the prepared endometrium where it develops into a child, and further menstruation is arrested. If fertilisation does not occur, the menstrual decidua is cast off and the cycle of changes in the uterus and ovaries is repeated. The menstrual flow recurs about every 28 days, lasts about five days, and consists of a discharge from the uterus of 4 to 6 ounces of non-coagulate blood with fragments of decidua and mucus from the cervical glands. The complete cycle in the endometrium thus consists of alternate phases of building up and breaking down initiated by ovulation, for if the ovaries are removed the endometrium remains permanently in the resting phase. During ovulation an ovarian follicle ripens and ruptures, liberating an ovum; at the site of rupture a temporary yellow body (*corpus luteum*) forms, and recent work has shown that the internal secretion of this body provides the chemical stimulus to the uterine cycle. The time-relationship between the events in the ovarian and uterine cycles is as follows: the ovarian follicle ruptures about 14 days before the onset of the menstrual flow, the *corpus luteum* reaches its full development about seven days before the flow, and begins to decline after the flow has begun.

Common Disorders.—The usual disorders of menstruation are: (1) amenorrhoea (absence of flow), (2) menorrhagia (excessive flow), (3) too frequent, irregular or scanty flow, (4) dysmenorrhoea (painful flow). Amenorrhoea may be physiological (pregnancy, lactation, menopause). Delay in initial onset may depend upon developmental error in the uterus or vagina. Pathological amenorrhoea may be due to error in growth or development or to constitutional disease. Thus menstruation may occur, but escape of the fluid be prevented by presence of a membrane obstructing the vaginal orifice (" imperforate hymen ") or by the absence of the vagina or imperforation of the cervix uteri (concealed menstruation)—or the uterus may fail to develop beyond the infantile state or may be completely absent and in the latter case the amenorrhoea is permanent. Amongst constitutional causes are chlorosis, secondary anaemia, tuberculosis, mental shock and strain, acute illness and defective function of the thyroid or pituitary glands; in most of these the amenorrhoea is usually temporary.

Menorrhagia.—This signifies excessive bleeding at the time of the menstrual flow, but no irregular bleeding during the interval. Amongst uterine causes are fibromyoma, polypi, excessive thickness of the endometrium, fibrosis and chronic sub-involution and inflammation of the Fallopian tubes; general causes are, (*a*) diseases associated with plethora, *e.g.*, chronic cardio-vascular disease, chronic renal disease, (*b*) primary blood diseases, *e.g.*, pernicious anaemia, leukaemia, purpura and haemophilia, (*c*) endocrinous diseases, especially hyperthyroidism, (*d*) at puberty and menopause there may be, for a time, excessive menstrual haemorrhage; but haemorrhage at the menopause is often associated with a new growth of the uterus. Irregular haemorrhage independent of menstruation always indicates uterine disease. After the age of 30, and especially after the menopause, it suggests cancer of the uterus. Irregular haemorrhage during early pregnancy usually means either threatened abortion or extra-uterine gestation. Treatment demands careful diagnosis. Amongst drugs which relieve certain forms of haemorrhage are ergot, pituitary extract, calcium salts and parathyroid gland. Too frequent or irregular menstruation is common and, if not profuse, is unimportant; since the ovary is the " pacemaker " of the uterus in menstruation, the cause probably lies in irregular ovulation.

Dysmenorrhoea.—The varieties of dysmenorrhoea are (*a*) spasmodic, (*b*) congestive. *Spasmodic dysmenorrhoea* is due to painful contractions of the uterus beginning with onset of the flow and lasting a few hours or a day; the pain is believed to be associated with the shedding of the menstrual decidua and the entire membrane can often be discovered in the discharge. Usually no uterine abnormality can be detected. The treatment consists of rest, hot baths and such anti-spasmodic drugs as phenazone, phenacetin, aspirin, atropine. If this fails dilatation of the cervix often cures. Cases which arise in later life are usually due to a submucous fibromyoma of the uterus.

Congestive Dysmenorrhoea.—This condition is a severe aching which begins about a week before, and is relieved by, the flow; it is due to chronic inflammatory disease of the Fallopian tubes or of the uterus, or to uterine fibromyoma.

Infections of the Reproductive Organs

About 60% of infections are puerperal, about 20% are gonorrhoeal, and the remainder are fortuitous infections, often secondary to a primary focus elsewhere, such as in the bowel (appendicitis, diverticulitis), the tonsils or the teeth; about two per cent are due to the tubercle bacillus. In most puerperal infections, and in all gonorrhoeal, the infection ascends from the vulva, vagina or cervix uteri to the uterus, Fallopian tubes and peritoneum. In other cases the bacteria are carried to the organs by the blood stream (*haematogenous* infection). The infection may remain localised to the various parts of the generative system or invade the blood stream, producing the very grave condition of septicaemia. Usually, especially in puerperal and gonorrhoeal infections, the condition is widespread. Syphilitic infection of the reproductive organs is considered elsewhere.

Diseases of the External Genital Organs

The vulva comprises several structures grouped together for convenience of description.

Types of Affections.—(1) Injuries occurring during parturition, or accidental; the commonest is rupture of the perineum. (2) Inflammation (*vulvitus*). Simple vulvitis is due to want of cleanliness or to irritating discharges, and in children may result from threadworms. Severe infective vulvitis is usually due to gonorrhoea. The symptoms are heat, itching and throbbing, and the parts are red, swollen and bathed with discharge. In the gonorrhoeal variety local inflammation is very severe, the discharge profuse and purulent and there is scalding pain on micturition. The treatment of simple vulvitis is rest in bed, cleanliness and bathing the vulva with warm, antiseptic lotions. Gonorrhoeal vulvitis is almost invariably associated with infection of the urethra, vagina and cervix; the treatment, which is prolonged and requires an expert, consists chiefly in the precise application of a special antiseptic, such as two per cent acriflavine, to the sites of infection. (3) Cutaneous infections, the most important of which are eczema, erythema, herpes, furunculosis, tubercle, elephantiasis, leucoplakia and kraurosis. These affections present the same characters as in other parts of the body. In leucoplakia the surface of the vulva becomes thickened and covered with white patches, and later cracks and ulcers appear; the disease is important because it is often the forerunner of cancer. (4) Tumours. Any part of the vulva may be the seat of new growths, simple or malignant; cysts of Bartholin's gland and vascular *caruncles* of the urethral orifice are the commonest. *Pruritus* of the vulva (persistent itching) is a symptom more than a disease, and accompanies vulvitis and most of the conditions given above under (4), as well as diabetes and cancer.

Diseases of the Vagina

The vaginal walls are kept moist by a thin, acid, opalescent fluid containing desquamated epithelium and cervical mucus; when excessive the condition of *leucorrhoea* results.

Malformation.—The vagina may be absent in whole or in part, or may present a longitudinal septum. Occlusion of the lower end by a membrane prevents escape of the menses and leads to gradual distension of the vagina with blood (" haematocolpos ").

Prolapse.—This is a hernial protrusion of the pelvic contents, *e.g.*, bladder, rectum, through the opening in the pelvic floor muscles, the vaginal walls forming the covering of the protrusion; there is usually concomitant prolapse of the uterus. Vaginal prolapse can be permanently cured by operation; the palliative treatment is by vaginal pessaries.

Fistulae.—These may form between the vagina and bladder, or vagina and rectum. They are usually the result of parturition or malignant disease.

Vaginitis.—(*a*) Simple catarrhal vaginitis is due to the same causes as simple vulvitis; occasionally in children it is important from a medico-legal aspect. (*b*) In gonorrhoea the vagina is infected together with the vulva, urethra and cervix; the vaginal walls are intensely red and covered with profuse yellow discharge. (*c*) Chronic vaginitis may follow the acute variety and may persist for a long time. The vagina is rarely the seat of tumours, but cysts are not uncommon.

Diseases of the Uterus

Errors in Growth and Development.—The organ may be congenitally absent, may remain in the infantile state, or may fail to reach full maturity; these conditions cause amenorrhoea, scanty menstruation, dysmenorrhoea or sterility. It may also be completely or partially double.

Displacements.—Normally the uterus is bent forwards (anteflexion) and turned forwards (anteversion). The chief displacements are prolapse and retroflexion. In early prolapse the uterus remains within the vagina; later the cervix lies outside the vulva and the vagina is completely inverted (procidentia). The symptoms are a " bearing down " feeling, great discomfort and fatigue on walking and interference with micturition and defaecation. Prolapse is very rarely met with in nulliparae, and its essential cause is stretching and injury of the fasciae and muscles of the pelvic floor owing to parturition; an inborn tendency doubtless exists in some women, but in many cases too hasty delivery of the child by midwifery forceps is blameable. The palliative treatment is by vaginal pessaries; but cure by operation is far preferable. The modern operation consists of a plastic repair of the pelvic floor, vaginal vault and perineum. Retroflexion is always combined with retroversion (rotation backwards through a transverse axis); it may be congenital, but is nearly always acquired as the result of childbirth or abortion or of pelvic inflammation. There is much difference of opinion concerning the symptoms and effects of retroflexion and the indications and methods of treatment. If the displaced uterus is healthy, and not fixed by adhesions, it is, with the occasional exceptions of dyspareunia and sterility, symptomless and harmless, and requires no treatment. But when it is the subject of chronic inflammation or subinvolution and is fixed by adhesions, it requires treatment for the relief of associated symptoms. Palliative treatment is by replacement and the insertion of a pessary, which is only possible when the uterus is not fixed. Curative treatment consists in suspending the body of the uterus to the anterior abdominal wall.

Inversion.—Inversion of the uterus is possible only when the cavity is dilated, either after pregnancy or by a tumour. Most cases are acute, follow immediately on delivery and are accompanied by much shock and haemorrhage and a very high mortality. Chronic inversion either results from the acute variety in untreated patients who have survived, or is due to the gradual traction of a fundal intrauterine tumour (usually a fibroid polypus). The symptoms of chronic inversion are haemorrhage and bladder troubles, and on examination a swelling is found in the vagina. Reduction of the condition is often difficult, particularly when it has lasted for a long time.

Inflammation.—This may affect the cervix or the body of the uterus, and may be acute or chronic. Most cases are due to infection at labour or to gonorrhoea. A secondary infection by the bloodstream, especially by streptococci, may occur from a primary focus elsewhere. Pessaries in the vagina may cause infection, especially if not kept clean by douching and removed at intervals. Chronic inflammation of the cervix (cervicitis) is predisposed to by unhealed tears resulting from labour, is commonly associated with a red congested annular patch of glandular mucous membrane (erosion) and has a muco-purulent discharge as its chief symptom. In acute cervicitis the part is red and swollen, and a discharge of pus, in which the infecting germ may be discovered, pours from the cervical canal. Its danger is upward spread of the infection to the uterus, Fallopian tubes and peritoneum. The treatment of acute infection is rest in bed, vaginal douches and the application of strong antiseptics to the cervical canal. Chronic infections may be cured by the direct application of antiseptics and in cases associated with unhealed tears and erosion, by excision of the diseased portion. Inflammation of the body of the uterus, usually the result of puerperal or of gonorrhoeal infection, affects chiefly the lining membrane or endometrium (*endometritis*). Acute puerperal endometritis is a very serious condition, due usually to streptococcal infection, and liable to spread to the tubes, peritoneum or blood stream (septicaemia). Gonorrhoeal endometritis is always secondary to infection of the cervix; it is serious as infection of the Fallopian tubes may follow.

Chronic endometritis may be either interstitial or glandular, and results from bacterial infection. The chief types of interstitial endometritis are senile and tuberculous. Senile endometritis affects women after the menopause and causes a foul-smelling discharge, sometimes blood-stained; if the discharge cannot escape the uterus becomes distended with pus (*pyometra*). Tuberculous endometritis is extremely rare and is usually due to spread from the tubes. Chronic glandular endometritis is characterised by very great thickening of the endometrium due to proliferation of the glands; the symptom is profuse menorrhagia, and relief can be obtained only by curetting. Inflammation of the whole uterus (metritis) if acute, is nearly always the result of puerperal infection, and the symptoms and complications are similar to those of acute puerperal endometritis. Chronic metritis is the sequel to the acute variety or to puerperal subinvolution; the uterus is enlarged and fibrous, and the chief symptom is menorrhagia. The menorrhagia, in this case, cannot be cured by curetting, because the endometrium is not thickened; the intrauterine application of radium, however, acts like a charm.

New Growths

Non-Malignant.—The uterus is the commonest seat of new growths. The innocent new growths comprise adenoma, fibromyoma, adenomyoma and polypi of various kinds; the malignant are carcinoma, sarcoma and chorionepithelioma. Adenomata usually become polypoid, and occur both in the body and cervix; their symptom is uterine haemorrhage and their treatment is surgical. Fibromyomata or " fibroids " occur especially in women between the ages of 35 and 50. They are believed to affect about 25% of women over 35 years of age, but commonly are small and cause no symptoms. It is doubtful if they ever originate after the menopause. They are solid, round or ovoid tumours, usually multiple, sometimes becoming enormous, and composed of a mixture of fibrous and muscular tissue. According to their position in the uterine wall they are divided into intramural, subperitoneal and submucous. The two latter may assume a polypoid form. Submucous fibroids and, to a less extent, intramural fibroids, give rise to severe menorrhagia and may lead to dangerous anaemia. At the menopause they share in the general atrophy of the uterus and may almost disappear. Secondary changes are common and include calcification, mucoid degeneration, cyst-formation, fatty changes, necrobiosis (red degeneration), septic infection (sloughing fibroid), and sarcomatous change.

The modes in which fibroids imperil life are haemorrhage, septic infection, impaction, twisting of the pedicle by rotation and intestinal and urethral obstruction. During pregnancy they share in the growth of the uterus; but interference with pregnancy, such as abortion, is not common. If growing from the cervix or lower part of the uterus they may obstruct labour and necessitate Caesarean Section. Small symptomless fibromyomata, often discovered by accident, require no treatment, but should be watched. Fibromyomata of a certain size, or causing symptoms, require either hysterectomy (removal of the uterus) or myomectomy (removing the tumour and leaving the uterus). Hysterectomy is the easier, and usually the safer, operation; myomectomy is preferable when the patient is young and it is desired to preserve the function of child bearing. Treatment by drugs or by electrical currents is, rightly, a thing of the past, but X-rays and radium have an important place. The insertion of radium into the uterus is the ideal treatment for menorrhagia due to *small* submucous

fibroids, but is not suitable for tumours of any size. Haemorrhage from fibroids often ceases after several applications of X-rays; but this treatment is too uncertain in its action seriously to compete with surgery.

Malignant New Growths.—The varieties of malignant disease met with in the uterus are carcinoma, sarcoma and chorion-epithelioma malignum. The age at which women are most subject to carcinoma of the uterus is towards the decline of sexual life. Of 3,385 collected cases of cancer of the uterus 1,169 occurred between 40 and 50, and 856 between 50 and 60. In contradistinction to fibroid tumours it frequently arises after the menopause. It may be divided into cancer of the body and cancer of the neck (cervix). Cancer of the cervix is almost exclusively confined to women who have been pregnant. Predisposing causes are tears of the cervix, erosion and chronic cervicitis. The symptoms which induce women to seek medical aid are haemorrhage, foetid discharge and, later, pain and cachexia. An unfortunate belief amongst the public that the menopause is associated with irregular bleeding and offensive discharges has prevented many women from seeking medical advice until too late. It cannot be too widely understood that cancer of the cervix is in its early stages a purely local disease, and that removal in this stage usually results in cure. The modern operation is that perfected by the late Professor Wertheim of Vienna, and consists in removal of the whole uterus, upper third of the vagina and as much of the surrounding tissues as possible. The operation is severe, but freedom from recurrence may be expected in 30% of early cases.

Preoperative treatment by radium is usually advisable. In advanced cases treatment by radium and X-rays may be relied upon to palliate, if not to cure. Cancer of the body of the uterus is rare before the 45th year and is most frequent subsequent to the menopause. The majority of the patients are nulliparae and may be the subjects of fibroids. Hysterectomy is the only treatment. Chorion-epithelioma is a malignant disease presenting microscopic characters resembling the cells of the chorionic epithelium. It occurs in connection with recent pregnancy and particularly with the variety of abortion termed hydatidiform mole. It quickly ulcerates and infiltrates the uterine tissues, forming metastatic growths in the lung and vagina. In many cases it destroys life with a rapidity unequalled by any other type of growth. Clinically it is recognised by the occurrence after pregnancy of violent haemorrhages and progressive cachexia. The growth is usually primary in the uterus but may be so in the Fallopian tubes and in the vagina. A few cases have been recorded unconnected with pregnancy. Immediate and wide removal of the affected organ is the only treatment. Sarcoma of the uterus may occur in the body and in the cervix, occurs at an earlier age than carcinoma and may originate either in the wall or endometrium of the healthy uterus, or as a secondary change in a fibromyoma. Uterine enlargement and haemorrhage are the symptoms. The differential diagnosis is microscopic. Hysterectomy is the only chance of prolonging life.

Diseases of the Fallopian Tubes

The Fallopian tubes or oviducts are liable to septic infection (acute and chronic *salpingitis*), tuberculosis, innocent and malignant new growths and tubal pregnancy. Salpingitis is nearly always secondary to septic infection of the genital tract following labour or abortion, gonorrhoea, infected fibromyoma and cancer of the uterus. The right tube may be affected by appendicitis. In some cases the infection of the tubes appears to be accidental, probably the result of an infective focus elsewhere, such as the tonsils or respiratory tract. When the pus escapes from the tubes into the peritoneal cavity it sets up local or general peritonitis. Even mild cases of salpingitis result in gluing together of the fimbriae and sealing of the ostium (the abdominal opening or mouth of the tube) and matting together of the tube and ovary by peritoneal adhesions. If the inflammation continues after the ostium is sealed, fluid accumulates in the tube (*pyosalpinx*, *hydrosalpinx*). Distension of the tube with blood (*haematosalpinx*) is nearly always due to tubal pregnancy. Acute salpingitis is a very severe illness, and is accompanied by high temperature, abdominal pain and tenderness and much constitutional disturbance. The symptoms may become merged in those of general peritonitis. In chronic salpingitis there is a history of puerperal infection or gonorrhoea, followed by chronic pelvic pain, profuse menstruation and sterility; on examination the enlarged tubes may be felt. Acute salpingitis requires rest in bed in a propped up posture, sedatives, hot fomentations and skilled nursing. Urgent symptoms and signs of spreading peritonitis may call for operative interference, chiefly for the purpose of peritoneal drainage. Chronic salpingitis, or pyosalpinx, renders a woman an invalid and permanent relief can only be afforded by surgery. Tuberculous salpingitis is usually secondary to tuberculous infection in other parts, such as the lungs or peritoneum. The Fallopian tubes may be the seat of malignant disease; this is rarely primary but usually an extension of cancer of the uterus or ovaries.

In *tubal pregnancy* the fertilised ovum becomes embedded in the tube instead of in the uterus. The chief cause of this abnormality is kinking and adhesion of the tube is the result of former salpingitis, and this state of the tube is found in 75% of cases of tubal pregnancy. The tubal ovum has a precarious existence, because of the eroding action of the villi surrounding it upon the thin tubal wall. Either the ovum becomes separated and surrounded by blood, and in consequence dies, forming a *tubal mole;* or, the eroding villi perforate the tubal wall, resulting in rupture of the tube and profuse intraperitoneal haemorrhage.

After the formation of a tubal mole the tube undergoes spasmodic contractions and attempts to expel the mole through the ostium; this process (*tubal abortion*) is accompanied by violent attacks of pain and the escape of blood into the peritoneal cavity. The bleeding is usually localised by adhesions and forms beside the tube a swelling of varying size (*pelvic haematocele*). Tubal pregnancy usually comes to an end at about the 6th week. Rarely the ovum continues to develop after rupture of the tube and may even continue to full-term, the placenta gaining attachment to the pelvic or abdominal structures. The uterus undergoes slight enlargement and always develops a decidua which is expelled when the pregnancy is disturbed. The signs of tubal pregnancy before rupture are amenorrhoea, pelvic pain and the presence of an enlarged tube. When rupture occurs there is sudden and severe pain with great shock and collapse, and the haemorrhage is usually so severe as to imperil life. The more common event is, fortunately, mole formation with tubal abortion and production of a haematocele; the symptoms of this are spasmodic attacks of severe pain and irregular uterine haemorrhage and, sometimes, the passage of a decidual cast from the uterus; on examination the haematocele is felt as a swelling in the pelvis. In all forms the only treatment is abdominal section and removal of the affected tube. In those rare cases in which the placenta and foetus continue to develop until full-term, the child may be removed alive by abdominal section but is often deformed and rarely survives for long. If the foetus die it may become the seat of calcification (*lithopaedion*) and be retained within the abdomen indefinitely.

Diseases of the Ovaries and Parovarium

Congenital absence of the ovaries, except in association with some foetal monstrosity, is unknown. Prolapse or descent from its normal position into the pouch of Douglas, is usually associated with backward displacement of the uterus or salpingitis and pyosalpinx but it may occur from elongation of the utero-ovarian ligament. A prolapsed ovary is tender and painful and is one cause of dyspareunia. Inflammation (oöphoritis) is commonly dependent on infection of the tubes or peritoneum or, on the right side, on appendicitis; but the tuberculous variety may be primary. The causes of oöphoritis are the same as those of salpingitis. If the condition becomes chronic the capsule is thickened, the follicles cannot rupture and the ovary becomes converted into a collection of tiny follicular cysts (*small cystic or cirrhotic ovary*); ovarian tumours (generally cystic) are common. The two commonest are the multilocular *pseudomucinous adenomatous cyst*, which may arise at almost any age and attain an enormous size, and the unilocular *epoöphoric cyst* which arises

from the tubules in the hilum of the ovary; both are innocent and occasionally bilateral. The so-called *dermoid cyst*, really a teratoma, along with sebaceous material, may contain bone, teeth, hairs, skin and many other tissues. The *papillomatous cyst* may be semi-malignant and often gives rise to secondary implantations on the peritoneum; it is usually bilateral. *Broad ligament cysts* are unilocular and may reach a large size; they originate from the rudimentary Wolffian tubules. "Chocolate" or "tarry cysts" arise from implanted endometrium (endometrioma); they are usually bilateral and are associated with dysmenorrhoea and sterility. Ovarian cysts seldom cause pronounced symptoms but are liable to such grave complications as torsion of the pedicle, rupture and suppuration; they are all liable to undergo malignant change. *Fibroma* is the commonest innocent solid tumour. Malignant disease (carcinoma and sarcoma) may be primary, or more commonly, secondary to cancer of the gastro-intestinal tract or breast. The treatment of all varieties of ovarian tumour is removal by operation as soon as possible.

Diseases of the Pelvic Peritoneum

Nearly all of these infections result from childbirth or abortion or from gonorrhoea and become localised to the pelvic part of the peritoneal cavity. Pelvic peritonitis or perimetritis may proceed to abscess formation, the most common situation being the pouch of Douglas; from thence the abscess may either burst into the rectum or the bladder. Even if pelvic peritonitis resolves without abscess-formation it always leaves adhesions, of greater or less extent, between the uterus, tubes, ovaries and adjacent coils of intestine, resulting in abnormal position of the pelvic organs, sterility, dysmenorrhoea and other pelvic pain. General peritonitis of genital origin is comparatively rare; it may follow puerperal infection, but seldom, if ever, is the result of gonorrhoea. *Hydroperitoneum*, a collection of free fluid in the peritoneal cavity, may be due to many general causes but also to papillomatous or cancerous ovarian tumours.

Connective Tissues.—Pelvic cellulitis or *parametritis*, a septic inflammation of the pelvic cellular tissue, chiefly at the bases of the broad ligaments, is usually preceded by labour, especially if difficult or instrumental and accompanied by tears of the cervix uteri. The symptoms are rigours, rise of pulse-rate and intrapelvic pain, with tenderness and swelling on one or both sides of the pelvis beside the uterus, which becomes fixed in the exudate as if embedded in plaster of Paris. The inflammation may undergo resolution if appropriately treated or may go on to suppuration, forming an extraperitoneal abscess which may point in the vagina, rectum or bladder and occasionally in the groin. If the pus can be localised an incision should be made and the abscess drained.

References.—T. W. Eden and C. Lockyer, *New System of Gynaecology* (1917); F. H. Garrison, *An Introduction to the History of Medicine* (1921). (E. Hd.)

WOMEN, EDUCATION OF.—"The growing demand for higher education" referred to in the article on Education (*q.v.*) has been most marked in the sphere of women's education. On both sides of the Atlantic this movement has caused a great deal of pressure on the existing schools for girls and colleges for women.

I. IN GREAT BRITAIN

As regards England and Wales the report of the Board of Education for 1923–4 states that in grant-aided secondary schools there were in 1910 72,447 girls; in 1924 171,176. Schools generally are larger than they were. In 1909 361 girls went to the universities; in 1921 the corresponding figure was 1,214.

The reform movement in women's education began about 1850. Colleges came first, then high schools, and between 1875 and 1900 these developed, though under financial stress and many limitations. The local education authorities, under the Act of 1902, established new schools and took over, transformed or aided existing ones. The Board of Education grant and regulations from 1904 unified and encouraged growth, while the foundation of the civic universities widened opportunity for women more even than for men. All this reform justified itself during the War; it had made possible the extraordinary contribution of women to national service.

Simultaneously women, hitherto supported by their families, became self-supporting, owing either to choice or to need; parents, who had never desired secondary or university education for their daughters, learnt its value. Hence the pressure felt most seriously at the colleges for women at Oxford and Cambridge. Hostels at civic universities are thronged also. No demand appears for any general change in the existing plans of work or of life, though greater freedom and variety for individuals is urgently claimed, and the competition and overpressure to enter are strongly deprecated.

The outstanding characteristics of the movement since 1911 are unity and standardisation among schools, and the development of boarding schools. Two forces caused the former. The first is the action of the Board of Education, which acts, not only through grants, regulations and inspections, but through examination schemes. The state has never made any difference between boys and girls in education; the same grants are paid, the same state scholarships offered, the same standards required. Women appreciate this equality, but they demand freedom for the individual, a longer time of preparation for examinations, and the wider recognition of music and art.

The second force, more vague but as effective, is the spread of the tradition formed in the older schools into the new council schools. That tradition was itself derived from the best ideals of English colleges and public schools. The new secondary schools for girls were staffed by women themselves true to such traditions. Head mistresses often fought hard to establish and maintain this tradition against that derived from earlier and meaner forms of public elementary education and they generally succeeded. Today there are council schools with fine buildings, good tone, and high intellectual standards of which the country may be proud.

The free place system has made little difference to the high schools for girls. Free and fee-paying pupils blend and share social life and self-government. The system may be responsible for the increased popularity of the new boarding school. The boarding school has always suited certain English families who send their boys to the public schools. This new type has attractions; games, college women as mistresses, marked physical care and comfort, kindly methods of discipline, intellectual standards of work. The initiative for this type was made at St. Andrews by Miss Lumsden and Miss Dove in 1885. New boarding schools have been opened, and older ones extended, but women have kept together in one professional body the heads of schools of every social type. The association of headmistresses, founded in 1874 by Miss Buss and seven other heads, now contains 510 members, representing probably 120,000 girl pupils.

(S. A. B.)

II. IN THE UNITED STATES

The movement to supply facilities for the higher education of women in the United States developed rapidly in the latter half of the 19th century through the action on the part of a number of the state universities in opening their doors to women students. It was realised that the theory of free public instruction prevailing in the schools should be extended to collegiate institutions, and by 1875 14 state universities, in addition to Antioch, Cornell and Boston, had admitted women to their membership. Doubts had been expressed as to the intellectual capacity of women to undertake curricula which had been formulated solely for men, but such doubts were at once dissipated by the women students themselves. The year 1861 witnessed the foundation of Vassar College, the first privately endowed college for women, and by 1900 a number of institutions had grown up, such as Smith (1871), Wellesley (1875), Bryn Mawr (1880) and Barnard (1889), all independent of state aid. The success of these colleges warranted the president of Bryn Mawr in 1900 in pointing with pride to what had been accomplished up to that time in respect to the higher education of women. The average standing of the women, it was demonstrated, was better than

that of the men students, and the thought that a course of study, modified especially for women, might supplant the men's curriculum had proved unwarranted. The best academic traditions of men's education had become thoroughly accepted as the standard in women's colleges.

There is evidence that the movement has lost something of its brilliance, and the satisfaction resulting from things achieved is not so complete as formerly. There are indications that a modification of curricula in the interest of women may be near. Vassar, in July 1926, opened a course in euthenics, which it defines as the science of home making, rearing of children and bettering of the community. Smith College, with the financial aid of the Laura Spelman Rockefeller memorial fund, founded, in 1925, the Institution for the Co-ordination of Women's Interests, which seeks to relieve the dissatisfaction among college graduates caused by a lack of harmony between their college education and their home life. There were other indications of this tendency in spasmodic attempts at substitutions for, or additions to, established courses. The teaching of technique in music and art has in some cases been added to that of theory. Experience, however, seems to show that the older courses tend to reassert themselves.

At the close of the first quarter of the 20th century the outstanding feature of the women's educational movement was the amazing increase in the number of women students. The following table shows the progress of the movement since 1890:—

Women Enrolled in Universities, Colleges and Professional Schools:

	1890	1900	1910	1920	1924
Preparatory	22,219	21,471	23,426	20,915	23,033
Collegiate	20,624	36,051	61,139	128,677	196,482
Graduate	409	1,719	2,866	5,775	10,355
Professional	977	2,144	5,688	3,836	5,651
Total	44,229	61,385	93,119	159,203	235,521
Degrees Conferred (A.B.)		9,547	15,267	23,272	36,258

In 1926 it was stated over one-third of the total number of students enrolled in the colleges and universities of the United States were women.

WOMEN, LEGAL POSITION OF (*see* 28.782).—During the years 1911–26, and especially after the World War, there was a general movement throughout the civilised world towards the emancipation of women from legal disabilities. It was particularly strong in Great Britain, where legal discrimination between men and women has, broadly speaking, ceased to exist, and where women not only exercise the franchise, both parliamentary and municipal, but sit in the House of Commons, where one or two have even attained ministerial rank.

I. GREAT BRITAIN

Civil Rights.—By the Representation of the People Act 1918, which swept away all the old franchises, the parliamentary suffrage was granted to all women, whether single, married or widows, not being less than 30 years of age (*see* WOMAN SUFFRAGE). There are three qualifications for women as parliamentary electors under the Act—residential, university and as the wife of a local government elector. In her own right a woman may qualify by residence in the electoral area and may in addition have one or more university votes. As the wife of a local government elector she may also have a parliamentary vote, but she may not vote more than once in the same election nor for more than one ordinary constituency in a general election. In addition she may have one university vote at a general election. To qualify as a local government elector she must have (*a*) attained the age of 21, be resident in the area on the last day of the qualifying period (Jan. 15 or July 15), have occupied some land or premises in the area for the whole of the qualifying period, or, in the alternative, (*b*) must have attained the age of 30 and be the wife of a man who is entitled to be registered as a local government elector in respect of the premises in which they both reside. To qualify as a parliamentary elector she must have attained the age of 30 and must be entitled to be registered as a local government elector in respect of the occupation in the electoral area of land or premises of the yearly value of not less than £5, or of a dwelling house, however small the value, or be the wife of a husband entitled to be so registered. This means that the husband must own land or premises in the area of the yearly value of not less than £5.

A peeress in her own right can be an elector, and so can a peeress by marriage. There are certain offices, chiefly in Scotland, which if conferred on a woman would incapacitate her as a voter. The wife of a person serving in military or naval forces of the Crown who would, if he were not so serving, be entitled to be registered as an elector is not disqualified. In the case of a university vote the woman elector must be 30 years of age and must have fulfilled the same academic conditions as a man elector.

Within a year of being admitted to the franchise women were declared capable of holding any public office not being ecclesiastical or military offices. The Sex Disqualification (Removal) Act 1919, which applies to the whole of Great Britain and Ireland, provides that no person shall be disqualified by sex or marriage from the exercise of any public function, or from being appointed to or holding any civil or judicial office or post or from entering or assuming or carrying on any civil profession or vocation or for admission to any incorporated society (whether incorporated by Royal Charter or otherwise), and a person shall not be exempted by sex or marriage from liability to serve as a juror. The Act further provides (*a*) that His Majesty may by order in Council authorise the admission of women to the civil service, and reserve to men any branch of, or posts in, the civil service in H.M. possessions overseas or in any foreign country; (*b*) that any judge or other person before whom a case is heard may in his discretion on application (in both civil and criminal cases) by either party or at his own instance make an order that the jury be composed of men or women only, or may on her application exempt a woman from service on a jury by reason of the nature of the evidence or issues to be tried. Section 2 provides for the admission of women as solicitors. Section 3 enables any university to admit women to membership or any degree notwithstanding any statute or charter of such university.

The Act overrides all previous statutes, orders in council, royal charters or other provisions inconsistent with it. In *The Viscountess Rhondda's Claim* (1922, 2 A.C.339), however, it was held by the Committee for Privileges of the House of Lords that the Act did not affect existing patents so as to entitle women to sit in the House of Lords. A peeress in her own right, therefore, is under a double disability: her sex excludes her from the House of Lords and her rank from the House of Commons. Attempts to remedy this anomaly by legislation have so far (1926) been unsuccessful.

Property.—The principle of equal rights for both sexes was embodied in the new English law of property which came into force on Jan. 1 1926 (*see* PROPERTY, LAW OF). Since then in England and Wales a woman, whether married or unmarried, may hold and dispose of property, both real and personal, on the same terms as a man. As regards unmarried women this was little more than a consequence of the assimilation of the law of realty to that of personalty, but the legislative scheme went further: so far as the law of property is concerned the old doctrine of the legal personality of a married woman being merged in that of her husband has disappeared entirely. Under any disposition operating after 1925 husband and wife take as separate persons. Formerly upon intestacy real estate was subject to dower and courtesy and a widower was entitled to the whole of his wife's personal estate, whereas a widow was entitled only to £500 and a third of the remainder of her husband's personalty (or a half if there were no issue). Under the new law dower and courtesy have been abolished and widower and widow are placed on the same footing, *i.e.*, the surviving spouse takes £1,000 absolutely and, as to the remainder of the estate real, and personal,

a life interest in one-half where there is issue, or in the whole where there is no issue.

Marriage.—The doctrine of the subordination of the wife and her identity in law with her husband remains operative to some extent in matrimonial law (*see* MARRIAGE LAWS). A married woman's domicile is that of her husband, and she cannot acquire a domicile of choice even when living apart from him under a decree of judicial separation (*Attorney-General for Alberta v. Cook* [1926] 42 T.L.R. 317). The husband is legally entitled to the wife's obedience, though the extent to which the courts will aid him in enforcing his right is extremely limited. On the other hand, even in the marriage laws, the modifications have been made in the direction of sex equality. Thus, as a corollary to the Sex Disqualification (Removal) Act, the Guardianship of Infants Act 1924 was passed, whereby the guardianship of infant children, which formerly belonged to the father alone, has been vested in the parents jointly, and, in event of the death of either, in the survivor. If the parents disagree, either may apply to the Court, and the Court in making an order is to be guided solely by consideration of the infant's interest.

Another important change in the English law of husband and wife was made by the Matrimonial Causes Act 1923, which relieved a wife petitioner for divorce of the necessity of proving cruelty, desertion, etc., in addition to adultery. (No change was necessary in the law of Scotland, which has always recognised a husband's adultery as in itself a sufficient ground for divorce.) A wife can obtain a maintenance order from a magistrate if she separates from her husband on the ground of his assault on her, or his desertion. Orders made abroad can now be enforced in England, and, if made in England, can be enforced against the husband abroad. Maintenance of the children can also be obtained up to 10s. per child.

The sentiment in favour of sex equality has also resulted in amendments of the English criminal law, but here the modifications have deprived women of some legal privileges that they formerly enjoyed. Thus at common law a married woman living with her husband was deemed incapable of stealing from him, but that immunity was taken away by the Larceny Act 1920. Again, the common law presumption that a woman who commits a crime (other than treason or murder) in her husband's presence does so by reason of his coercion was abolished by sec. 47 of the Criminal Justice Act 1925, though coercion by the husband remains a good defence—that is to say, the burden of proof has been shifted from the prosecution to the defence. (D. CA.)

II. THE UNITED STATES

With the progressive breaking down of the legal conception of the household as an entity ruled from within by a head, and as an agency of social control, it becomes necessary to give legal recognition and protection to individual interests of women in the domestic relations, which at common law were supposed to be secure through the internal economy of the household, or were left unsecured in view of a paramount social interest in the household as a social institution. Summarily, these may be put as *parental* interests—interests of women in the relation of parent and child, and *marital* interests—interests of women in the relation of husband and wife.

Parent and Child.—At common law the father was entitled to the custody of his minor child and the mother had a right to custody only after the father's death. In form this still stands in the books as law, but in substance there has been a complete change within a generation. Equity long ago refused to give effect to the father's common law right of custody as against the interest of the child, and by taking the equitable doctrine of regard for the interest of the child over into the law, the courts have been able to put father and mother upon an equality for practical purposes in almost all jurisdictions. Yet the common law doctrine remains theoretically in force in the absence of legislation, and legislation halts. One decision, as late as 1905, holds that as between father and mother the former has a legal right to control the religious training of the children (Hernandez *v.* Thomas, 50 *Florida Reports*, 522, 536).

Husband and Wife.—Marital interests of women include claims against the world at large growing out of the relation of husband and wife, and claims of wives against husbands because of that relation. As interests of personality a wife has claims to the society of her husband, quite apart from any economic advantage; to the affection of her husband, analogous to the legally recognised claim of the husband to the society and affection of the wife; and to the chastity and constancy of the husband as involving her self-respect and honour. These interests, however, are not yet recognised to their full extent and are not fully secured even in legal theory. The first and second are now protected by an action for alienating the husband's affections, which has come to be allowed by the overwhelming weight of American authority (Turner *v.* Heavrin, 182 *Kentucky Reports*, 65, 1918). The third was recognised recently in New York (Oppenheim *v.* Kridel, 236 *New York Reports*, 156). Generally it is at most but partially recognised and indirectly secured; but it should be said that the obvious inutility of the husband's means of redress, which should be applied by analogy to make the law logically complete, has had much to do with the apparent backwardness of the law on this subject.

As an interest of substance the wife may claim to be secured in the marriage relation as an economically advantageous relation, providing her with support and shelter. Where the husband is enticed or induced to abandon his wife or to divert earnings which should be devoted to her support, the courts are coming to recognise this interest directly. (The wife's action was allowed in Flandermeyer *v.* Cooper, 85 *Ohio State Reports*, 327, 1912; it was denied in Brown *v.* Kistleman, 177 *Indiana Reports*, 692, 1912.) On the other hand, in case of physical injury to, or abduction of, the husband, the wife is still usually denied an action, although the husband may recover in the converse case for "loss of service." The claim of the wife to support was recognised fully and secured adequately at common law. Legislation setting up domestic relations courts and providing for criminal prosecution in case of non-support has only put more effective administrative machinery behind existing legal duties of the husband.

The most serious inequalities in this connection were in the procedural difficulties encountered in enforcing the wife's legal rights. Domestic relations courts, which have had a considerable development in the United States, are adapted especially to removing these obstacles (see Smith, *Justice and the Poor*, chap. II.). Modern legislation, although taking away from the husband all control over the wife's property and earnings and committing it solely to the wife, has left untouched the common law duty of the husband to support the wife even if she has property and he has none. Some courts go so far as to allow a wife possessed of means who has supported herself out of her separate estate to sue the husband and obtain restitution of the amount thus contributed. (De Bauwere *v.* De Bauwere, 203 *New York Reports*, 460, 1911). A few Western States, however, now impose upon a wife of means and ability a duty of supporting an indigent and infirm husband, and allow an action by the husband to enforce this duty (Hagert *v.* Hagert, 22 *North Dakota Reports*, 290, 1911). American courts now recognise the separate domicile of the wife substantially to the full extent of her individual interest in free self-assertion (Williamson *v.* Osenton, 232 *U.S. Reports*, 619, 1914).

So also with respect to actions by the wife against the husband. The older Married Women's Acts, which in form merely removed disabilities as to property and contract, were long construed as not allowing such actions since they did not do so expressly, and a policy against aggravation of domestic troubles by dragging them into court was taken to be in the way. This sacrifice of the individual interests of the wife to the supposed exigencies of a social interest has now definitely given way, and conservative courts are allowing such actions even under statutes in terms dealing with property rights only (Brown *v.* Brown, 88 *Connecticut Reports*, 42, 1914). The more recent type of statute, providing that a married woman shall have the same legal existence and personality after marriage as before marriage, necessarily

permits such litigation (Fielder *v.* Fielder, 42 *Oklahoma Reports*, 124, 1914). As to capacity to own, acquire, use and enjoy property, little remains of the old law, and there are but few jurisdictions where legislation might still accomplish anything.

In one respect, however, improvement by judicial decision is still going forward. A number of States, by derivation directly or indirectly from Spanish law, have the institution of "community property," in which with respect to certain property, and especially property acquired after marriage, husband and wife are treated legally as a sort of property-owning entity. The older view was that the husband was the administering agent of this collectivity during their joint lives, and hence could dispose of it, alter its form, and charge it with his personal debts; and that it could even be taken in execution for his wrongful acts. Recent decisions in some of these jurisdictions, recognising the individual interest of the wife, hold that the community property is not liable for acts done by the husband outside of the reasonable scope of his authority as agent of the community (Schramm *v.* Steele, 97 *Washington Reports*, 309, 1917). Yet even there a claim for an injury to the wife, being an acquisition after marriage and community property, she is not allowed to sue therefore if her husband refuses to join (Hynes *v.* Colman Dock Co., 108 *Washington Reports*, 642, 1919).

Protection of Women in Industry.—American courts have been reluctant to give over, or to construct, legislation as abrogating common law privileges or disabilities which protected married women to uphold legislation restricting freedom of contract on the part of women in industry with respect to hours and conditions of labour and minimum wage. When such statutes were first enacted, they were held unconstitutional as being arbitrary and unreasonable interferences with liberty of contract by a court which had had no hesitation in keeping alive common law disabilities that had long ceased to secure any individual or social interest. That decision has been overruled (Ritchie *v.* Wayman, 244 *Illinois Reports*, 509, 1910), and it seems to be settled that legislation may take account of the facts of women's physical make-up and secure the social interest in a healthy womanhood by regulating the hours of labour of adult females (Muller *v.* Oregon, 208 *U.S. Reports*, 412, 1908; Bunting *v.* Oregon, 243 *U.S. Reports*, 416, 1917). But it is now held that this may not be carried to the extent of fixing a minimum wage for women employees (Adkins *v.* Children's Hospital, 261 *United States Reports*, 525). The political and legal emancipation of women is urged as a reason against such legislation, as if the removal of political and legal disabilities had any relation to, or effect upon, the physical handicaps upon women in industry which are the occasion of these statutes.

Women on Juries.—In 1917 California provided for the drawing of women upon juries (*Laws of 1917*, p. 1283). Since the adoption of the Nineteenth Amendment of the Federal Constitution providing for women suffrage, 1920, it has been assumed that women are to sit upon juries everywhere. But in some jurisdictions, out of caution, it is felt that the courts should await express legislation, and in other courts have felt compelled to wait until courthouses and jury-rooms could be adjusted to the novel situation presented by juries of men and women.

(R. Po.*)

WOMEN, PROFESSIONAL.—The period 1910–26 was marked, both in the British Empire and in the United States, and to a lesser degree in other countries, by a general opening of the learned professions to women. The article herewith deals with this aspect of the movement towards sex equality, firstly in Great Britain, and secondly in the United States.

I. IN GREAT BRITAIN

Medicine.—In Oct. 1925 women in the medical profession celebrated the fiftieth anniversary of its opening to their sex. Honours granted to medical women include that of O.B.E. to a woman doctor and a surgeon. Four important medical works were published by qualified women in 1925. About 200 medical women hold honorary hospital appointments in Great Britain, of whom 75 are stationed in London. The major appointments held include the following: Professor (University of London) of anatomy; associate examiner in obstetric medicine for M.B. and M.S. examination; the representative appointed by the Ministry of Health to the Central Midwives' Board; honorary gynaecologist to the Plymouth Infirmary; surgeon to the Royal Edinburgh Hospital for Sick Children and Edinburgh University; lecturer on the diseases of Children; and honorary physician to the British Hospital for Mental Disorders and Nervous Diseases.

The academic successes gained by women in medicine are too numerous to individualise, but the Brunton Memorial Prize, the highest award Glasgow University faculty of medicine can offer, was gained in 1925 by a woman. Many medical women serve on the various committees and sub-committees of the British Medical Association. There is a Medical Women's Federation for Great Britain, which has voiced the corporate opinion of medical women upon a number of public and professional topics, including the defence of married medical women; regulated prostitution in the Crown Colonies; the reversal of the policy of co-education of students at St. Mary's Hospital, London, and unequal salaries as between men and women employed as officers of health.

Inequality between the sexes is almost as rampant in the professional as in the industrial world. In 1921 there was a recrudescence of the policy of dismissing married medical women begun by the metropolitan borough of St. Pancras dismissing, upon her marriage and unashamedly because of her marriage, its woman assistant medical officer of health, regardless of the fact that her work largely consisted in child welfare and maternity work. The example of St. Pancras was widey followed and the position of the married women in the public health service is at present (1926) most precarious. Lower salaries are constantly offered to women health officers than to men by the municipal authorities—fortunately many medical women are public-spirited enough to refuse them—and the unfair principle of unequal payment is embedded in the Government system where, because unequal pay prevails as between men and women in all grades of the Post Office, exception is not made with regard to women working for it. A good proportion of medical women do really well in private practice. Two women doctors have stood for Parliament and several serve upon local government bodies.

The Legal Profession.—The Sex Disqualification (Removal) Act admitted women (*inter alia*) to the legal profession on Dec. 23 1919 and on Dec. 24 1919 the Middle Temple enrolled the first woman bar student in England. Early in 1921 Ivy Williams, LL.D., became the first woman barrister and in Nov. 1921 ten other women were called. As Dr. Williams does not practice, the senior in precedence in date of studentship of these ten, Helena Normanton, B.A., became the senior practising woman barrister in England, in accordance with the bar council regulations then in force regulating seniority. Four women barristers have passed with first-class honours. Several have gained prizes and studentships. Four have had written legal work published. About 12 are in actual practice, out of some 50 who have been called. The number of women students is well on to 100. Several barristers have made really creditable appearances in courts, where judges take no apparent notice of the sex of the advocates before them. Three at least have been highly commended by judges for their conduct of cases.

The senior practising woman was the first of her sex to appear in the High Court (both divorce and chancery divisions), the Central Criminal Court, London sessions, and, in 1925, was briefed to appear before the U.S. Secretary of State at Washington. The early appearances of women barristers in practice has caused more press comment than was at all desirable; this led to a certain degree of male resentment, and a little friction which now appears to be lessening. However, at least two bar messes have refused election to candidates ostensibly upon this ground. Most circuits now admit women but many male barristers still refuse to share chambers with women barristers or to take women pupils. Men solicitors have not yet got into the habit of briefing women, other than a few, and an enormous prejudice still remains to be overcome. The newcomer, if a

woman, cannot yet, at the English bar, reckon on a safe livelihood. Aspirants should have at least £1,000 to live upon after call whilst building up practice.

The majority of women with a legal vocation should carefully consider the greater opportunities open to them in becoming solicitors. Direct contact with the lay client should ensure a livelihood to a capable woman solicitor. By the end of 1925 there were 134 women articled clerks, and 34 women had been admitted as solicitors, of whom 24 had taken out practising certificates. Eight women had passed with honours and 2 had won important prizes. Miss Carrie Morrison is the senior woman solicitor in England. The training and examinations for women barristers and solicitors are respectively identical with those of men. Marriage is an asset in ordinary professional practice, but it is a bar to the employment of the woman lawyer in the Government service.

The Church.—In the Church of England the order of women deacons has been canonically restored by the joint action of the convocations of Canterbury and York, following the proposal of the Lambeth Conference of 1920. This diaconate is on the model of the primitive diaconate rather than on the lines of the present diaconate, which for men is regarded almost entirely as a stepping stone to the priesthood. Women deacons do not at present officiate precisely as the men; neither have they the same sphere of service. Convocation has recently authorised a service for the making and ordering of deaconesses. Marriage is permitted to deaconesses.

There is no specific place for deacon or deacons in the National Assembly of the Church of England, neither in the House of Clergy nor the House of Laity. Women can sit for the B.D. degree at most universities and for the archbishop's diploma—the S.Th. To the National Assembly 49 lay women have been elected. Admission to the priesthood and episcopate of the Church of England does not seem to be within very easy distance, owing to the effect of Lambeth Conference (1920) resolution No. 5. The established Church of Scotland has not yet opened its ministry to women. The ministry of most of the Free Churches is now open to women and the only remaining difficulty is for women to obtain calls to pastorates of responsibility and dignity with adequate remuneration.

Politics and Diplomacy.—Perhaps representation of one's fellow citizens is a vocation rather than a profession, but the technical side of political work is now practically a new profession. Speakers and organisers are the principal types of workers. The speakers are graded according to merit. The organisers are divided into missioners and organisers. The former go round from door to door explaining the party's policy, and for this they must have a wide knowledge of the political questions of the day; the second weld the units into a whole, create and maintain an organisation. The higher posts are those of central office district agents who are placed in charge of areas varying from about 30 to 75 constituencies, and who are responsible, not only for the organisation of women throughout the area, but act in an advisory capacity for other positions. Above these again comes the central office staff, controlling and directing the women's activities throughout the country, and finally the post of chief of the staff.

Diplomacy, a profession opened in 1925 to women in both France and the U.S.A., remains closed to British women by an Order in Council under the Sex Disqualification (Removal) Act 1919. Miss Gertrude Bell, however, did outstandingly good work in Mesopotamia in a quasidiplomatic position and drafted a remarkable state paper upon political matters associated with that district. The consulate is expressly closed to women under the above-mentioned Act of Parliament.

Other Professions.—Miss Harris Smith in 1918 was elected an honorary member of the incorporated Society of Accountants. In 1920 the Institute of Chartered Accountants opened its doors to her. The Society of Incorporated Accountants and Auditors admitted women in 1919. There is now a small batch of women accountants in actual practice, some of whom are reported to be doing very well. Miss Ethel Watts, B.A., was the first woman who passed the final examination of the Institute of Chartered Accountants (1924).

In 1918 Miss L. Charles was admitted A.R.I.B.A. and in 1900 Miss B. Charles. The school of the Society of Architects has been training women since 1918 and there are now several other women architects. Miss Irene Martin is the first woman member of the Surveyor's Institution. The Auctioneers and Estate Agents' Institute and the Land Agents Society have both admitted several women. In Dec. 1922 Miss Aileen Cust became the first fully qualified member of the Royal College of Veterinary Surgeons.

Journalism.—The profession of lobby correspondent in the House of Commons was opened to women by the appointment of Miss Stella Wolfe Murray in 1924. Equal minimum pay is at any rate the rule now in Fleet street, but opportunities for women journalists of getting upon the more serious sides of their papers are still very restricted. The editorships of weekly and monthly magazines are the most lucrative spheres for women.

Engineering.—In this profession women are making considerable headway. Miss V. Holmes, B.Sc., A.M.I.M.E., was the first woman to be admitted to the Institute of Mechanical Engineers. The Institution of Civil Engineers has one member, that of Automobile Engineers two, of Electrical Engineers eleven, of Marine Engineers two; whilst the Institute of Metals has about twelve members and the Society of Engineers has one. A large Manchester Electrical engineering firm has two women as college apprentices, this being the first occasion in which women have been allowed to serve an apprenticeship in the same way as collegiate men students.

A decision of the International Aerial Navigation Commission forbidding women pilots to be employed by commercial aircraft firms, or even by their own private enterprise to take up passengers for hire, was rescinded early in 1926 by international agreement. (H. Nor.)

II. IN THE UNITED STATES

The ratification of woman suffrage in 1920 following the spirited discussion of the rights of women and the widespread utilisation of the service of women in the World War, stimulated the entrance of women into all kinds of professional service. This is noticeable, not so much in the increase in the total number of professional women, which grew from about 734,000 in 1910 to 1,016,498 in 1920 (11·9% of all gainfully employed women), but rather in the increases in the newer types of work such as chemists, draftsmen and designers, social workers, college professors, and especially positions in the government service.

The Federal Women's Bureau in Bulletin No. 27, of *The Occupational Progress of Women*, has pointed out that the two groups making the largest gains during the decade 1910–20 were teachers and nurses, although the number of men in these fields declined both actually and relatively. Librarians, both male and female, showed a considerable increase, the women's group more than doubling. These was a decrease in the numbers gainfully employed in the following groups: artists, sculptors and teachers of art; musicians and teachers of music; and physicians, surgeons and osteopaths (both sexes).

Of the more unusual professions the following showed great increases: chemists, assayers and metallurgists; clergymen; lawyers, judges and justices; college presidents and professors; osteopaths, theatrical owners, managers and officials; charity and welfare workers; teachers of athletics and dancing; and draftsmen and designers. On the border line between the professions and the "trades" should be noted increased numbers of bankers and bank officials; insurance agents, real estate dealers and agents; accountants and auditors; dentists and assistants; and telegraph and telephone operators.

Out of the thousands of women in the various professions, 1,582 were listed in Who's Who in America for 1920–1. Of these, as compiled by Prof. S. S. Visher, 714 were writers, 244 educators, 127 social workers, 117 artists, 63 actresses, 46 singers, 34 editors, and 28 were physicians. Other professions listed included lawyers, scientists, musicians, explorers and politicians. The great

majority of these lived in or near large cities, one-third residing in New York State. Of the 88% who attended college or university one-half reported training in women's colleges, and 53% of all those listed were married. With the exception of the large groups of teachers and nurses this picture is possibly fairly descriptive of the entire body of professional women. In several of these professions women have won highest honours, including four of the leading prizes for novels offered in 1925, three of the four prizes offered by Harpers Magazine for short stories, and a notable prize in poetry. Women have also done outstanding literary work in biography, criticism and social politics.

In painting and sculpture, fewer women have reached leading positions, although two or three artists have won highest honours in sculpture. In architecture, landscape gardening and interior decoration there has been a great influx of women workers, and the rapidly increasing development of suburban villages offers to the woman with a combination of artistic and business ability an excellent opportunity.

Probably the most notable development of professional service among women has taken place in the fields of political and social welfare. In federal employment, although women were technically given equal opportunity with men in civil service examinations, there still exists discrimination against them in the matter of appointments and entrance salaries. However, the number of women holding public office either as expert, as administrator or as politician has greatly increased. The outstanding positions held by women in the federal service include a third secretary in the legation at Switzerland, a vice-consul in Holland, an assistant United States attorney general, members of the U.S. Civil Service and of the Workmen's Compensation Commission, heads of the Women's and the Children's Bureaux, and many positions as experts and administrators in the various government bureaux. Congress has had one woman senator (temporary appointment) and seven members in the House.

In the state service women are found in practically every branch from sheriff to governor, Texas and Wyoming being the two states claiming the latter distinction. There are nearly 150 women in the various state legislatures; several state superintendents of public education; and hundreds in city and county offices, including the important position of secretary of state in New York. The highest paid women in state service is the registrar in New York county who receives $12,000 a year, and one of the most honored positions is that held by the woman member of the Ohio State Supreme Court. Municipal or district courts have opened their doors to women jurists much more frequently during the decade (1915–25) and the number of women with a private law practice has been a notable development.

The more intelligent treatment of delinquent children and erring girls has developed in the last decade an almost new profession. Juvenile courts have been established with women officers to study the child and its home condition and make recommendations to the judge. Also in connection with municipal police departments, women's divisions have been established in about 120 cities and villages and a national organisation of policewomen has been formed. In the 1910 census this occupation was not listed but in 1920, 236 were so recorded. Religious, charity and social workers, according to the 1920 census more than trebled, and keepers of charitable and penal institutions more than doubled. (I. A.*)

The League of Nations.—The charter of the League of Nations contains a clause rendering women eligible for all its appointments, including those on the secretariat. This clause did not remain a dead letter. Besides a large number of women in less responsible positions, Dame Rachel Crowdy was made director of the section dealing with the white-slave and opium traffic, with the care of women and children. At the first assembly of the League (Geneva, Nov.–Dec. 1920) Sweden appointed Mrs. Wicksell and Norway Dr. Kristine Bonnevie as alternate representatives of their respective countries; and in Sept. 1922 Great Britain appointed Mrs. Coombe Tennant as Substitute Delegate, Mrs. Swannick received the same appointment under the Labour Govt., and Mrs. Alfred Lyttelton under the Conservative Govt. of 1924 and the Duchess of Athol in 1925. Miss Forchhammer, of Denmark, brought forward in the full assembly the subject of the white-slave traffic, and was successful in carrying her proposal to appoint a commission of three persons, one of whom must be a woman, to prosecute a special inquiry on the subject in the Near East. Miss Sophie Sanger was made head of the Legal Section of the International Labour Bureau.

WOMEN, WAR WORK OF.—It is impossible here to attempt to describe the special work done by women of all the belligerent countries in 1914–8; this article, therefore, is confined to an outline of women's war-work as organized in the United Kingdom and the United States.

I. IN GREAT BRITAIN

On Aug. 3, before the official declaration of war, the executive committee of the National Union of Women's Suffrage Societies decided to suspend political action and devote the organising capacity of the Union to meet the changed conditions. The London branch started a free bureau under the name of "Women's Service" to direct the efforts of the thousands of non-professional women eagerly desirous of finding useful work. Many young women began at once to prepare themselves for nursing, joined Voluntary Aid Detachments and worked in auxiliary hospitals. The raising of funds and making of comforts for the units of the original Expeditionary Force absorbed others, and the arrival of the Belgian refugees in England before the end of Aug. caused the formation of 2,500 local Belgian relief committees, of whom the members were mostly women. Clubs to help the wives of soldiers and sailors were started. The Women's United Services League co-ordinated and registered the work done by war clubs throughout the kingdom. A large number of women devoted themselves to the work of the Soldiers' and Sailors' Families Associations, and to the work of the Officers' Families Fund.

In the early months of the war it became evident that the abnormal conditions arising from the quartering of large numbers of soldiers in barracks and camps, and of convalescents in hospitals, would give rise to social dangers, and that steps should be taken to deal with the situation. A militant suffrage society, the Women's Freedom League, formed the Women's Police Volunteers in Sept. 1914. This corps was reorganised shortly afterward as the Women Police Service. To cope with the same evil the National Union of Women Workers called an emergency meeting and as a result a corps of "Women Patrols" was formed to work under the official sanction of the commissioner of police in the metropolitan district, and of the chief constables in the provinces.

Voluntary Organisations and Corps.—A corps of women called into existence to meet war conditions was the Women's Emergency Corps. In addition to relief workrooms, and the registration of voluntary offers of service, schemes were started under its auspices which developed independently, after the parent corps had met the "emergency" conditions of dislocation of labour and refugee relief. The collection of surplus food from the London markets for the unemployed and for Belgian refugees developed into the National Food Fund, which raised £163,615 in gifts of food and money before the end of the war. The Women's Volunteer Reserve, founded in 1914 as a branch of the Women's Emergency Corps, "to provide a trained and disciplined body of women ready to assist the state in any capacity," did military drill, wore khaki uniform and saluted their officers. The founders' idea that, as signallers, despatch riders, telegraphists and motorists, they might set free men for the firing line, was premature in 1914, but anticipated the need actually met later by the women of the Army Service Corps and Q.M.A.A.C.

By the spring of 1915, when the country began to feel the drain on its man-power, the Marchioness of Londonderry founded the Women's Legion, which from the first was intended to be a corps of paid women replacing paid men. A khaki uniform was worn and the women were subject to regulations and discipline. Ultimately over 40,000 were enrolled. This corps was the link

between the independent voluntary associations of women, such as the Emergency Corps, formed on the outbreak of the war, and the official women's services, two of which were sections of the Women's Legion.

Work on Land.—Throughout 1915 and 1916 efforts were made by voluntary organisations, such as the Women's Legion and the Women's Defence Relief Corps, as well as by the Government, through the War Agricultural Committees of the Board of Trade, to induce women to offer their services on the land and to persuade farmers to accept them. The Women's Farm and Garden Union, the most important of the bodies which had dealt with women's work on the land before the war, started a system of training farms in the autumn of 1915. Early in 1916 the Government provided a grant, and the Women's National Land Service Corps was launched as a war off-shoot of the Farm and Garden Union. By the end of the year the demand for women had become greater than could be met by a small voluntary association, and the Women's Land Army was instituted early in 1917 as a Women's Branch of the Ministry of Agriculture. The corps continued to act as the agent of the Land Army for organising the supply of women as seasonal workers.

Munition Making.—By the spring of 1915 shell work for women was beginning; in March women tram conductors started work at Glasgow, and girls were employed as telegraph operators in Liverpool. But women were impatient at the slowness of the progress of industrial substitution and at the uselessness of the women's war service register compiled by the Board of Trade in March 1915. In connection with the demand for skilled workers, the London Society for Women's Suffrage, which promoted the introduction of women into occupations hitherto reserved for men, started a munitions and aircraft department in July 1915, and arranged the first training classes in oxy-acetylene welding. The pupils were the first women welders to enter the engineering trade, and after two years the Ministry of Munitions assumed financial responsibility for the school. Messrs. Beardmore in Glasgow and Messrs. Vickers at Barrow-in-Furness and at Erith employed women on shell-making in the spring of 1915. In order to ease the strain due to Sunday work, a band of women relief munition workers, educated women of the leisured class, were trained in the rough turning and boring of 4·5 shells and 18-lb. shrapnel at Erith; they bound themselves after training to undertake week-end shifts for six months.

Enrolled and Non-enrolled Women.—The Women's Services were of two types. First came those composed of enrolled women in the legal sense, who were in the direct employment of the War Departments, and whose contracts brought them within the regulations of the Defence of the Realm Act. The women could be enrolled as mobile workers for home service only, or for service at home and abroad; or as immobile workers, recruited for local employment, who could not be required to move away from the district. Secondly came those composed of non-enrolled women in the legal sense, who did not render themselves liable to penalties under the Defence of the Realm Act and might be engaged on an annual or weekly contract. Some services enrolled their women for a year only; others for the duration of the War.

The enrolled women consisted of the various army nursing services, the Military Massage Service, which started its career in Aug. 1914, under the name of the Almeric Paget Massage Corps; the Women's Forage Corps; Queen Mary's Army Auxiliary Corps; the Women's Royal Naval Service, commonly known as the "Wrens"; and the Women's Royal Air Force. (*See* NURSING.)

In Queen Mary's Army Auxiliary Corps which was at first the Women's Army Auxiliary Corps or familiarly the Waacs, the women were enrolled as mobiles for home service only, or for home or foreign service, and for the duration of the War; they received a special rate of pay, not civilian or military, and were not enlisted under the Army Act. At first substitution overseas only had been contemplated, but by March the number of women recruited by the Department of National Service was so great that home commands were included in the scheme. Recruiting was afterwards carried on through the Employment Department of the Ministry of Labour. In Dec. 1917, owing to the shrinkage of available woman power, an immobile branch was formed. Women employed in the Ordnance Army Pay Department and Record offices at home were not made to join the Corps. A khaki uniform with distinguishing badges was worn. In all there were 1,200 officials and 56,000 women, of whom 9,500 were the outside number employed in France at any one time. This figure was made up of women working in the Calais, Boulogne, Etaples, St. Omer, Abbéville, Dieppe, Rouen and Havre areas and on the lines of communication, chiefly at army schools, and in certain offices at G.H.Q.

In the Women's Royal Naval Service the officers, other than those engaged in the organisation, welfare and discipline of the women, replaced naval officers for the following work: coding and decoding, intelligence work, confidential books, secretaries, telephone exchange, paymasters, accountants, gas mask work and observation station. The ratings were employed as ledger clerks, clerks, shorthand typists, victualling store assistants, telephone operators, postal sorters, stewards, cooks, general domestic workers, orderlies and messengers, porters and storewomen, bakers, tailoresses, gas mask workers, gardeners, fitters, turners, boiler cleaners, boot cleaners and painters, wiring hands, net mine workers.

As regards the Women's Royal Air Force, 566 officers and 31,764 other ranks passed through the service, the strength at the time of the Armistice being rather over 25,000. The Service consisted of mobiles and immobiles in approximately equal proportions. In addition to the administrative, clerical and domestic work common to all the Services, the women were employed on meteorological work and as despatch riders, dopers, painters, acetylene welders, carpenters, magneto repairers, photographers and drivers. Fabric workers did duties of all kinds from the covering of aeroplane wings to the mending of the finest balloon silk.

Non-enrolled women included the Anti-Gas Department, the Army Pay Corps, the Army Remount Department, and the Navy and Army Canteen Board. Practically the whole of the work on gas-mask manufacture was performed by women. There were 34 factories employing 12,000 under the immediate control of the Anti-Gas Department and 160 contractors employed a further 90,000 on work for the Department. In Aug. 1917 a number of educated women were trained for inspection work on the mask of the respirator and drafted out to the factories. They wore an indoor uniform of scarlet and were called "red-coats." Ultimately 800 to 1,000 of these were appointed, and 100 were promoted to the duties of check inspecting, formerly performed by sergeants of the Anti-Gas Department. They were also known as sergeants, and, as regards their duties, were interchangeable with the men.

Army Pay Corps.—The Army Pay Department was one of the earliest in the army to substitute female clerks. In July 1915, 479 were working and by Jan. 1 1916 there were 4,556 female clerks and 13 lady superintendents. The engagement was a weekly one and there was no form of contract till Aug. 1917. By that time the demands made for women by the W.A.A.C. and other organisations were so insistent that a form of agreement to serve for the duration of the war and three months afterwards was signed by the superintendents and a portion of the women doing skilled and semi-skilled work. These wore a badge but no uniform, and by March 1918 there were 5,171 of them out of a total of 17,500.

Navy and Army Canteen Board.—When the Navy and Army Canteen Board (then called the Army Canteen Committee) started operations in April 1916, only 20 women clerks were employed. During 1917 the Board's activities were enormously expanded to include catering for the Imperial Overseas Forces and for the American and Allied Troops. It was decided in March 1917 to institute a N.A.C.B. Women's Corps in mobile and immobile sections, and by the date of the Armistice the women employed in connection with canteen organisation in the mobile corps numbered 10,000 and the clerical staff in the immobile corps, 2,000.

Another branch of women's work was concerned with providing supplies for the fighting forces.

II. IN THE UNITED STATES

When the United States entered the World War in April 1917, but one organisation depending mainly on the efforts of women was officially recognised by the Government, the Red Cross. On May 6 1917 the Red Cross had 562 chapters with a membership of 486,194. At the signing of the Armistice, it had more than 3,500 chapters and upwards of 8,000,000 regular volunteer women workers. These women produced in 20 months over 371,000,000 relief articles, including surgical dressings, garments for the wounded and the refugees, and a variety of comforts and conveniences for soldiers and sailors. The value of their output was about $94,000,000. The Red Cross enrolled during the War 23,822 women as nurses. They served in the military and naval hospitals in the United States, Europe and the Near East, as well as in convalescent homes for soldiers and sailors and in relief work for adults and children both in the United States and overseas. They worked in 700 Red Cross canteens in the United States and 130 in France, serving refreshments to moving troops, giving them medical care and transferring them when sick.

When War was declared many large national organisations of women applied to the Government for instructions. The Council of National Defense appointed, at the end of April 1917, a committee of nine women (afterwards increased to eleven), to form a plan by which the women of the country could be utilised. This committee selected a woman in each state as a temporary chairman, requesting her to call together the heads of all national organisations of women in her territory to elect permanent officers for a state division. This state division was in turn to organise county committees and each county was to form a division in each city and town. This work of organisation was carried on so rapidly that by Dec. 1917 the county organisation was complete in no less than 23 states, and a year later there were county chairmen in more than 80% of all the counties in the country.

The plan of work which the women's committee laid out included the following departments: (1) registration for service, (2) food production and home economics, (3) food administration, (4) women in industry, (5) child welfare, (6) maintenance of existing social service agencies, (7) health and recreation, (8) educational propaganda, (9) Liberty Loan work, (10) home and foreign relief. The specific tasks for these departments originated either in requests or suggestions of the Government or in plans made by the committee itself and approved by the Government. Two months after the women's committee was created the Government requested it to enrol the women of the country in a league to support such plans for food conservation as the food administration might present. In a few weeks 5,223,850 pledge cards were signed. The signers were the nucleus of a women's food army which, throughout the War, responded to every request for the conservation, substitution or production of foods made by the food administration. Throughout the War, the women's committee continued to serve the Government in similar drives.

The National League for Women's Service, an organisation formed after a study of the activities of Englishwomen, some weeks before the United States went into the War, developed an extensive motor corps, carried on a variety of services to soldiers and sailors, and effectively supported all drives. The Y.W.C.A. organised in June 1917 a war council, under which it developed a variety of service clubs, both in the United States and overseas, particularly France. The hostess houses of the association at the home camps of both white and coloured soldiers looked after women visitors, a service which proved of such value that the War Department at the close of the War took the work under its educational and recreational branch. Some 50 buildings were turned over to the Government by the war works council of the Y.W.C.A. Overseas the association conducted service clubs which served Red Cross nurses and other women workers. Both in France and in the United States this organisation carried on industrial service clubs near a number of large manufacturing centres.

WOMEN'S SUFFRAGE (*see* WOMEN, 28.786).—The period 1910–25 was marked by the extension of the franchise to women in Great Britain and in a number of other countries and, partly as a consequence of the World War, by a general recognition of the right of women to the privileges of citizenship.

I. IN GREAT BRITAIN

In the later years of the agitation for woman suffrage in Great Britain the constitutional suffragists, led by the National Union of Women's Suffrage Societies (N.U.W.S.S.), concentrated their efforts on the formation of public opinion. They secured a majority of members pledged to their support in each House of Commons after 1886; and in that year, and also in 1897, 1908, 1909, 1910 and 1911, woman suffrage bills passed their second reading, but each successive Government declined to give the necessary further facilities. The constitutional movement received valuable support from platform, press and pulpit, and from the theatre in plays by leading dramatists of the day. The suffrage party, led by the Pankhursts sought to promote the cause first by sensational actions and even by violence.

"*Militancy.*"—The question of "militancy" was from the first a problem for the Liberal Governments of 1906 and 1910. They were responsible for order and as they were backed by the physical force at the command of the state the contest was unequal. Anti-suffragists had believed that "militancy" would kill the suffrage movement: therefore the greatest publicity was given to every act of violence and to every intemperate speech by the "militants." But so far from killing the suffrage movement, the all-pervading discussions stimulated it as nothing else had done. It was a difficult time for the law-abiding suffragists, who objected to "militancy" because they believed the use of physical force as political propaganda was invariably mischievous. The N.U.W.S.S. issued strong protests against militancy, and they excluded militants from membership. They deprecated the use of "frightfulness" on either side, and urged that the real cure for violence was the redress of grievances.

Serious differences thus arose between the two branches of the suffrage movement. The militants bitterly resented criticism, and made organised efforts to prevent its expression by trying to break up the meetings of the law-abiding suffragists. For the first time since 1886 woman suffrage bills were defeated in the House of Commons, once in 1912 and once in 1913. But other circumstances had contributed to these defeats. At the two general elections in Jan. and Dec. 1910, Mr. Asquith and his party emerged victorious, but in the second his majority fell from 334 to 124. He had promised at a public meeting in Dec. 1909, if returned to power, to bring in a Reform bill and to allow a woman suffrage amendment to be an open question for the House to decide. Just before the Dec. election, he said that, if his Government remained in power, they "would give facilities for proceeding effectively with a woman suffrage bill, if so framed as to admit of free amendment." Both in July 1910 and in May 1911 the House of Commons carried by immense majorities second readings of the measure known as the Conciliation bill.

Electoral Reform.—This bill was of a very limited character, proposing to enfranchise only about 1,000,000 women householders, and was opposed. The second reading in 1910 was, however, carried, though opposed by Mr. Lloyd George on the ground that it was not sufficiently democratic. In 1911 after the general election, suffrage prospects seemed particularly bright; militancy had been suspended in order to give the Conciliation bill a chance; all the suffrage societies were working harmoniously together, when a statement by Mr. Asquith affected these favourable prospects. He announced on Nov. 2 1911 his intention of introducing during the session of 1912 the Electoral Reform bill he had foreshadowed in 1908. This bill would sweep away all existing franchises; the new franchise would be based on citizenship, and votes were to be given to "citizens of full age and competent understanding," but no mention was made of women. On being asked what his bill would do for them, Mr. Asquith dismissed the inquiry with

the statement that his opinions on the subject were well known and had suffered no change: but he reiterated his promise of "facilities" for the Conciliation bill in the session of 1912. It cannot be pretended that the suffragists were satisfied with this procedure.

A violent outbreak at once took place. Windows were smashed in the principal shopping streets of London, and personal assaults were made on members of the Government. The constitutional suffragists were as angry as the militants. Many strong suffragists in the Women's Liberal Federation broke from their party, and gave all their energies to the suffrage cause. On Nov. 18 Mr. Asquith received a deputation representative of the whole woman suffrage movement, militant and non-militant. In the course of his reply to the deputation he said

> that, if the House of Commons on its responsibility is prepared to transform or extend a measure which we are agreed in thinking necessary—a measure for the franchise as regards men—and to confer the franchise on women, we shall not only acquiesce in that proposal, but we shall treat it as the considered judgment of Parliament and shall make ourselves responsible for carrying it out.

Twenty-six days after this Mr. Asquith received a deputation of anti-suffragists to whom he declared that he regarded "the grant of the parliamentary franchise to women as a political mistake of a very disastrous kind." This pronouncement gave direct encouragement to those who desired the defeat of the Conciliation bill. One of the devices employed was to induce the Irish Nationalist party to withdraw their support. They were persuaded that the grant of woman suffrage would break up the Government and thus prevent the third ratification by the Commons of the Home Rule bill necessary to secure (under the Parliament Act) its passage into law notwithstanding its rejection by the House of Lords. These tactics, aided by a coal strike which caused the absence of 13 Labour members in their constituencies, were successful, and the Conciliation bill, which had been carried on second reading on May 5 1911 by 255 to 88, was defeated on March 28 1912 by 222 to 208.

The Reform Bill of 1912.—When the Government Reform bill was produced it was called a Franchise and Registration bill. It came on for second reading on July 12 1912. In his speech Mr. Asquith said: "This bill does not propose to confer the franchise on women; whatever extensions of the franchise it makes are to male persons only." He then referred to the defeat of woman suffrage in March as the "considered judgment of the House," and he dismissed as "an altogether improbable hypothesis the possibility that the House would stultify itself by reversing this judgment during the same session." Notwithstanding this ominous warning Mr. Lloyd George and Sir Edward (Viscount) Grey advised that amendments to the Government bill gave suffragists the best chance they had ever had of parliamentary victory.

The bill itself, however, made no further progress during 1912; the protracted session lasted all through that year and overflowed into 1913; it was officially announced that the committee stage would be taken on Jan. 24. Three days from Jan. 24 had been allotted for the discussion of the woman suffrage amendments. This stage was, however, never reached. On Jan. 23 Mr. Bonar Law asked the Speaker to give a ruling on the point whether the Government's own amendments, regarding the occupation franchise for men, did not so far alter the bill, which had received a second reading in July, as to make it a new measure and necessitate its withdrawal and reintroduction in its new form. In his reply the Speaker intimated that this was his view, and added that there were "other amendments regarding female suffrage which of course would make a huge difference to the bill if they were inserted." The bill was killed by this ruling. Mr. Asquith refused to receive the suffragists in deputation, and merely offered parliamentary time for the discussion of yet another private member's bill. All the suffrage societies repudiated this offer, and did nothing to support the bill, which was brought forward in May 1913 and defeated by 266 votes to 219.

These events convinced the N.U.W.S.S. that nothing would now be of any use but a government bill with the whole weight of the party in power behind it. Their executive therefore resolved "that in judging which of two pro-suffrage candidates should be supported in an election, the official attitude of the party to which the candidate belongs should be taken into consideration." As Labour was the only party which had definitely made suffrage part of its programme, this change threw the influence of the N.U.W.S.S. in the elections definitely on the side of Labour; and a special fund, called the election fighting fund, was formed for the support of Labour candidates. N.U.W.S.S. support undoubtedly contributed substantially to the defeat of six government candidates in by-elections. Public opinion moved rapidly and strongly in the suffrage direction, the general view being that suffragists had received less than fair play at the hands of Mr. Asquith and his Government. The societies were preparing for the electoral campaign expected in 1915, when on Aug. 4 1914 the World War broke out, not only destroying all opportunity of suffrage work but jeopardising the very existence of representative institutions in Europe.

The Cause and the War.—Suffragists, whether militant or non-militant, quickly saw where their duty lay. The militants instantly abandoned every sort of violence and organised themselves for public service. They formed a Women's Emergency Corps, ready to undertake all kinds of national work which the exigencies of the time required. Others, both militant and non-militant, in spite of official discouragement, undertook the organisation of hospital units entirely officered by women (*see* WOMEN'S WAR WORK). The N.U.W.S.S. committee on Aug. 3 resolved to suspend immediately all political propaganda and to use their staff and organising power in mitigating the distress caused by the War. Their societies, numbering over 500, were consulted by post, and all but two approved this course.

The part which women played in industry and in the professions in helping to win the War gradually won recognition and gratitude from the entire nation. An agreement was made between the Treasury and the trade unions to suspend the trade union rules which excluded women from most of the skilled trades. The courage of the women in the dangerous trades was as marked as their efficiency. On one occasion 26 women were killed and 30 injured by an explosion; those who remained uninjured displayed the greatest coolness and discipline, and were prompt both in helping the wounded and in continuing the work of the factory. The legend of the innate timidity of women was thus undermined. The tide in this direction rose so high that even Mr. Asquith was floated by it, and in speaking in Oct. 1915, in the House of the heroic death of Edith Cavell, he said: "She has taught the bravest man among us a supreme lesson of courage; yes, and there are thousands of such women, but a year ago we did not know it." There is no doubt that by 1915–6 the country was by a great majority favourable to the enfranchisement of women. Nevertheless it would have been impossible to induce Parliament to pass a great Reform bill during the War if it had not been that the electoral position of millions of soldiers, sailors and munitions workers was so anomalous as to amount to a public scandal. The parliamentary register, by the direct orders of the Government, had not been revised since 1913, the position was intolerable, but it was not at first clear how best to amend it.

The Conference.—Mr. Walter (later Lord) Long suggested the appointment of a non-party conference, consisting of members of both Houses, selected and presided over by the Speaker, to consider the whole subject of electoral reform including woman suffrage. Mr. Asquith concurred and the House agreed. The conference began its sitting in Oct. 1916, and reported on Jan. 28 1917. In the interval Mr. Lloyd George had succeeded Mr. Asquith as Prime Minister, a change very favourable to immediate action in the direction of woman suffrage. The Speaker's Conference unanimously recommended a new franchise for men amounting practically to manhood suffrage; for women it recommended, but not unanimously, household suffrage, including wives of householders, a higher age limit for women, and their admission to the university franchise. This was the scheme

subsequently adopted by Parliament. The object of the high age limit (30) for women was to produce a constituency in which male voters were in a substantial majority. It was believed by suffrage members of the conference that the acceptance of this was essential to success. The anticipated proportion of women to men in the new electorate was as 2 to 3. This expectation proved practically correct. The new register published in 1919 showed: men 12,913,160: women 8,479,156.

The Vote Granted.—Within a fortnight of his becoming Prime Minister, and a month before the Speaker's Conference reported, Mr. Lloyd George intimated to the leaders of the N.U.W.S.S. that he intended to proceed with women's enfranchisement. The object was to get an agreed measure supported by every party in the House. This was achieved. When on March 28 1917 Mr. Asquith moved a resolution in Parliament calling on the Government to introduce a Representation of the People bill based on the recommendations of the Speaker's conference, the leader of every party supported the enfranchisement of women, and the motion was carried by 341 to 62. Under pressure from the women's societies the local government franchise for women was amended on the same principle which the House had already accepted for the parliamentary franchise—namely, to include not only householders but wives of householders.

The anti-suffragists in the Lords were a more formidable group than in the Commons. Lord Curzon, president of the Anti-Suffrage Society, was the leader of the House and chief representative of the Government. The inclusion of women in the bill was vigorously resisted in the early stages by Lord Bryce and Lord Balfour of Burleigh; but there was no real fight upon it until the committee stage was reached and the women's clauses came on. But at the end of the Speech with which Lord Curzon concluded the debate he reminded the peers that the House of Commons was the sole constitutional representative of the feelings of the country; that in the Commons woman suffrage had been supported by large majorities of every party "including the one to which most of your lordships belong." He declined to be responsible for a conflict with the House of Commons and announced his intention of not voting either for or against the amendment. The division was: for the clause, 134; against 71. Thus ended the 50 years' struggle of British women for political liberty. Royal assent was given to the bill on Feb. 6 1918.

II. IN THE BRITISH DOMINIONS

The granting of woman suffrage in Canada was almost simultaneous with its victory in England. It was first adopted in the provinces (except Quebec) in 1916, and by the Dominion in 1917. Canada was well in front of the mother country in the matter of the eligibility of women. Miss MacAdams was elected to the Legislature of Alberta by the votes of soldiers on duty in England and France in July 1917. The first Woman Suffrage Act for the Dominion limited the vote to women who had near relatives serving overseas. Full suffrage followed, the first woman to sit in Parliament at Ottawa being Miss Agnes MacPhail in March 1918.

New Zealand had enfranchised its women in 1893, and enfranchisement followed in the Commonwealth of Australia in 1902; therefore, South Africa is the only self-governing overseas dominion of Britain which has not given political freedom to women. In March 1921 Mrs. Cowan was elected to the Parliament of West Australia, the first woman M.P. to be elected in Australia. Jamaica, South Rhodesia and British East Africa gave votes to women in 1919 and 1920.

A strong effort was made by Indian women, supported by the Begum of Bhopal, to induce Parliament to incorporate in the Govt. of India Act the principle of woman suffrage, and the Act, as finally passed, specifically left the question of woman suffrage to be decided, province by province, by the elected Legislatures of India herself. Up to Oct. 1925 this power had been used to enfranchise women in Bombay, Madras, United Provinces, Assam and Bengal. Burma also adopted woman suffrage when it became a province of India.

III. IN THE UNITED STATES

American women had been the earliest to make a definite organised struggle for political freedom, having started in 1848, but they were among the last to win. This was in part due to the U.S. Constitution, which can only be amended by a two-thirds majority in both Houses of Congress, and even then the amendment does not become operative until it has been ratified by three-fourths of the 48 states. The suffragists worked state by state until there were some 20 suffrage states. The turning-point in the struggle was the victory gained in the State of New York in 1917, after America had joined in the War.

The necessary two-thirds majority was secured in the House of Representatives in Jan. 1918, but there was not a single vote to spare, and the narrow margin weakened the position, especially as the Senate had yet to be won; but in May 1919 the amendment was again brought up in the House and was carried by 304 to 48; and victory in the Senate followed almost immediately. Then came the battle for ratification in 36 states. The first stages were easy and rapid, 11 states giving a unanimous vote in both Houses, and 7 more in one or other of their chambers. After this the victories came more slowly until, in May 1920, 35 states had ratified and only one more was needed. The issue was much obscured by the impending presidential election. Both candidates were, as in 1916, suffragists. Both parties probably believed they would gain an advantage if they could plausibly claim that their effort had given the final victory to women. Tennessee, a Democratic state, voted for the amendment by the necessary majorities in Aug. 1920; legal objections to its validity were, however, raised, but not in time to prevent the proclamation by the Secretary of State in Washington that the 19th Amendment to the U.S. Constitution had been carried.

The legal points, however, awaited decision in the High Court. This gave an opportunity for a Republican state, Connecticut, to come to the rescue; a special session was called and the 19th Amendment was ratified on Sept. 21 1920. This made the Tennessee objections negligible for, valid or invalid, the 36th state had now ratified and the following article was added to the Constitution: "The right of citizens of the United States shall not be denied or abridged by the United States or by any state on account of sex." The first woman to enter Congress was Miss Jeannette Rankin of Montana.

IV. IN OTHER COUNTRIES

Before the World War there were only four countries in the world where women exercised the political franchise; by the end of 1920 there were 28—namely, the United Kingdom, Canada, Australia, New Zealand, British East Africa, Rhodesia, Jamaica, Denmark, Norway, Sweden, Finland, Iceland, Holland, Rumania, Servia, Luxembourg, Germany, Austria, Hungary, the United States; and, among the states newly formed by the peace treaties of 1919, Poland, Estonia, Lithuania, Latvia, Czechoslovakia, the Ukraine. In Germany 117 women sit in the state legislatures, and women form 8% of the membership of the Reichstag.

In Sweden Mrs. Anna Wicksell is a member of Parliament, and since 1921 she has represented her country on the Permanent Mandates Commission of the League of Nations.

V. CONCLUSION

In seeking a cause for so great a development of principles for which comparatively small groups of women, without any direct political power, had worked in some countries for more than half a century, it may probably be found in one circumstance common to them all. In each country a national crisis had arisen, on the issue of which the whole fate of the nation depended. National feeling in each had been stirred to its utmost depths. Under its pressure class feeling was minimised; all sorts and conditions of men and women had worked and suffered together for what each felt to be a cause of supreme importance. Men and women acted as friends and comrades when the issue was uncertain, and when the end came the men

did not forget the work and the sacrifices of the women. In all countries, whether victors or vanquished, it was universally acknowledged that all through the anguish of the War the women had not been backward either in self-sacrifice, courage or capacity. It was this feeling which broke down the opposition to women's votes and to the participation of women in all the professions and in all walks of public life, in nearly all the warring nations. It was felt also that men by themselves, as a well-known journalist expressed it, had made a mess of the world and needed helpers; men and women together being generally more successful than either men or women by themselves.

Bibliography.—E. S. Pankhurst, *The Suffragette* (1911); M. G. Fawcett, *Women's Suffrage* (1912); J. P. Lichtenberger, ed., *Women in Public Life* (1914); Lady C. Lytton, *Prison and Prisoners* (1914); F. E. Björkman and A. G. Pratt, ed., "*The Blue Book:*" *Woman Suffrage—History, Arguments and Results* (1917); M. G. Fawcett, *The Woman's Victory and After* (1920); I. H. Irwin, *The Story of the Woman's Party* (1921); Carrie Chapman Catt and N. R. Shuler, *Woman Suffrage and Politics* (1923); *The Woman's Year Book* (1923–4); M. G. Fawcett, *What I Remember* (1924); A. Kenney, *Memories of a Militant* (1924); Lady Betty Balfour, ed., *Letters of Constance Lytton* (1925). (M. G. F.)

WOOD, SIR HENRY EVELYN (1838–1919), British soldier (*see* 28.789), died at his home in Essex Dec. 2 1919.

WOOD, LEONARD (1860–), American soldier, was born at Winchester, N.H., Oct. 9 1860. He graduated from the Harvard medical school in 1884, was appointed acting assistant surgeon, U.S.A., in 1885, becoming assistant surgeon with the rank of first-lieutenant in 1886, when he was assigned to Capt. Lawton's expedition against the Apaches in the Southwest, resulting in the capture of Geronimo. For distinguished services he was awarded the Congressional Medal of Honour. In 1891 he was promoted captain and full surgeon, and later, while stationed in Washington, D.C., became the close friend of Theodore Roosevelt, then Assistant-Secretary of the Navy. On the outbreak of the Spanish-American War in 1898 Wood was commissioned colonel 1st U.S. Volunteer Cavalry (the famous Rough Riders) with Roosevelt as lieutenant-colonel. For conduct at Las Guasimas and San Juan Hill, Wood was promoted brigadier-general, July 1898, and in Dec. major-general of volunteers. He was military governor of Cuba from 1899 to 1902, when the Cuban Republic was established. He was appointed brigadier-general U.S.A. Feb. 1901. In March 1903 he was sent to the Philippines and appointed governor of the Moro province, being promoted major-general in Aug. of that year. From 1906 to 1908 he was commander of the Philippine Division. In 1908 he returned to America as commander of the Eastern Department. In 1910 he was special U.S. ambassador to the centenary celebration of Argentine independence. On his return he was appointed chief of staff, U.S. Army, serving until 1914, when he was again given command of the Eastern Department.

General Wood often had disapproved the policies of the War Department, and as early as 1908 had urged preparedness. To him was largely due the establishment of a summer camp at Plattsburg for training civilian officers, which was taken as a model for other camps of the kind after America's entrance into the World War. In 1915 he gave unofficial endorsement to the proposed formation of the American Legion whose purpose was to establish a body of some 300,000 men ready for immediate service, but his action was disapproved by the Secretary of War. Just before America's entrance into the World War in 1917 it was announced that the Eastern Div., then under Gen. Wood's command, had been divided into three divisions, and Gen. Wood was assigned to the Southeastern Div., with the alternative of choosing either Hawaii or the Philippines. As a soldier desiring active service he naturally chose the American post. He was later transferred to Camp Funston, where he trained the 89th Div., N.A. In Jan. 1918 he was sent to France on a tour of observation, in the course of which he was wounded by the explosion of a French mortar.

After his return to America, General Wood was on the point of embarking with the 89th Div., when he was suddenly assigned to the Western Department, no reason being given. It was generally understood that his name was not on the list of officers submitted by Gen. Pershing as acceptable for duty overseas. By change of orders he was returned to Camp Funston, where he trained the 10th Div. of the regular army and other troops. In 1919 he was put in command of the Central Department, with headquarters at Chicago. In 1920 he was a prominent candidate for the presidential nomination at the Republican National Convention. He led on the first four ballots and never fell below second place. Harding, a "dark horse," was nominated on the 10th ballot, with 692½ votes to 156 for Gen. Wood. In 1921 Gen. Wood was sent at the head of the Wood-Forbes mission to the Philippine Islands to report on conditions there. Prior to leaving he was appointed head of the University of Pennsylvania, but was unable to assume charge owing to the President's desire that he should remain in the Philippines as governor-general, a position to which he was appointed in Oct. 1921. He was the author of *The Military Obligation of Citizenship*, lectures at Princeton and elsewhere (1915); *Our Military History, Its Facts and Fallacies* (1916), and *Universal Military Training* (1917).

See I. F. Marcosson, *Leonard Wood, Prophet of Preparedness* (1917); Joseph H. Sears, *The Career of Leonard Wood* (1919); and *Leonard Wood on National Issues* (1920), compiled by Evan J. David.

WOODWARD, HENRY (1843–1921), British geologist (*see* 28.804), died at Bushey, Herts., Sept. 6 1921.

WOODWARD, HORACE BOLINGBROKE (1848–1914), British geologist (*see* 28.804), died Feb. 5 1914.

WOOL.—The period under review (1910–26) witnessed very great upheavals in the wool textile trade of the world, resulting mainly from the economic and political changes produced by the World War. The trade has in essentials changed very little, if at all, in spite of the remarkable fluctuations in wool movements and in price levels, and even of the temporary reorganisation of the industries, both in wool-producing and in manufacturing countries, to meet abnormal circumstances resulting from the necessities of the World War. The tendencies discernible in pre-War years are isolating themselves from the temporary effects and dislocations of the War.

Wool Statistics.—The statistics of the wool trade, and more especially their inevitable limitations, the violent price fluctuations of the War and especially of the post-War periods, have caused almost impassioned controversy. Raw wool is not a "straight" article and its standardisation has not been found in general to be a practical proposition owing to the nature of the War material itself. Estimates of production in terms of actual fibre content are, at the best, rough estimates only. The wool production of the world, especially in those countries from which wool is exported, is, however, sufficiently accurately known and interpreted by the trade for all practical purposes. The incalculable factor is that of consumption, in regard to which all statistics are practically valueless, owing not so much to the expense and difficulty of collecting the statistics of world spindle consumption as to the enormous variations possible in the spinning of different counts of yarn, dependent upon fashion, and to the extent to which substitutes can take the place of virgin wool, dependent mainly upon price. These two factors of price and fashion react in a wholly incalculable manner upon the weight of new wool passing during any given period through machinery. To these factors should be added that of the machine capacity employed, dependent mainly upon the general prosperity of trade and the purchasing power expended upon clothing. Past figures of consumption, then, are, to a large extent, valueless as a guide to the future. Further, the returns of different countries differ so seriously as often to make it difficult to check imports into one country with exports from another. All statistical information must, therefore, be treated as suspect and subject to wide interpretation and inference. The tables on p. 1064 gives details about sheep and wool production, pre-War and in 1925.

Production.—As compared with 1911 there are now over 70,000,000 fewer sheep in the world, but this does not necessarily imply that wool production has decreased to the same extent—

Sheep and Wool Production of the World

Sheep	Pre-War	1925
North America	59,047,000	42,356,000
South America	112,791,000	74,273,000
Europe	179,432,000	164,236,000
Asia	110,058,000	110,915,000
South Africa	35,710,000	30,053,000
Rest of Africa	40,030,000	44,737,000
Australia	85,097,000	83,083,000
New Zealand	24,595,000	24,002,000
	646,760,000 lb.	573,655,000 lb.
Wool		
North America	332,320,000	282,429,000
South America	588,350,000	443,773,000
Europe	673,532,000	696,124,000
Asia	273,146,000	250,320,000
South Africa	165,888,000	185,000,000
Rest of Africa	53,806,000	62,265,000
Australia	705,146,000	672,483,000
New Zealand	198,474,000	208,269,000
	2,990,662,000	2,800,663,000

e.g., in South Africa, where the number of sheep has declined, wool production has increased by 20,000,000 pounds. The world's raw wool production is now about 2,800 million lb., and before the War was about 3,100 million lb., three-quarters of which was suitable for clothing and the remainder for carpets, felts and very coarse materials. That proportion has now changed slightly in favour of wool suitable for clothing, owing mainly to the decrease in the wool production of Russia, a large part of which was of a coarse description. Of the wool used for clothing, about one-third is consumed in countries where it is produced, and the remaining two-thirds is the exportable surplus, which is the production considered hereafter and in most references to the subject. Of this wool the following estimate can be given:—

	Pre-war (In Pounds)	1925 (In Pounds)
British Empire	1,069,508,000	1,065,752,000
Australia	705,146,000	672,483,000
New Zealand	198,474,000	208,269,000
South Africa	165,888,000	185,000,000
South America	558,350,000	443,773,000
	1,627,858,000	1,509,525,000

Production has varied somewhat during the period in question owing mainly to drought in Australia. The post-War figures include a particularly heavy Australian clip for the season 1924–5. In all probability drought in Australia and New Zealand may in 1926 reduce not only the number of sheep but the weight and condition of the fleeces, which will be lighter and less well grown, resulting in 1927 in a reduction of wool grown by about one pound per sheep, or say over 100,000,000 lb. in all. The decline in production in South America still continues and is more permanent, arising as it does from the competition especially of cattle and also of wheat.

Of this exported wool slightly more than half consists of crossbred wool, and the remainder of the finer merino product, but this proportion is shifting more in favour of crossbred, owing largely to the fact that the crossbred sheep is grown for mutton while the merino sheep is not, and to the effects of closer land settlement in Australia, where the proportion of crossbred wool is about 37% compared with about 15% in 1916. We must expect, as a result, relatively higher prices for the finer merino wool than for the medium crossbred article, although this tendency may be counteracted by the greater attention given to the breeding and care of sheep in South Africa, where the weight and quality of the merino fleece is greatly improving. The French are also achieving success in sheep breeding in their North African colonies, whilst Japan is also establishing flocks to meet in part the increasing requirements of her growing manufacture. Appreciable success has also attended efforts to establish the merino sheep on the high tablelands of Peru.

Distribution.—The ultimate distribution of exported wool is an extremely complex matter to follow through, especially as its weight and form is often greatly changed before it reaches the spinner and weaver. Consumption varies from year to year, and importations by no means coincide with machine consumption. Consumption in Great Britain has remained fairly steady round

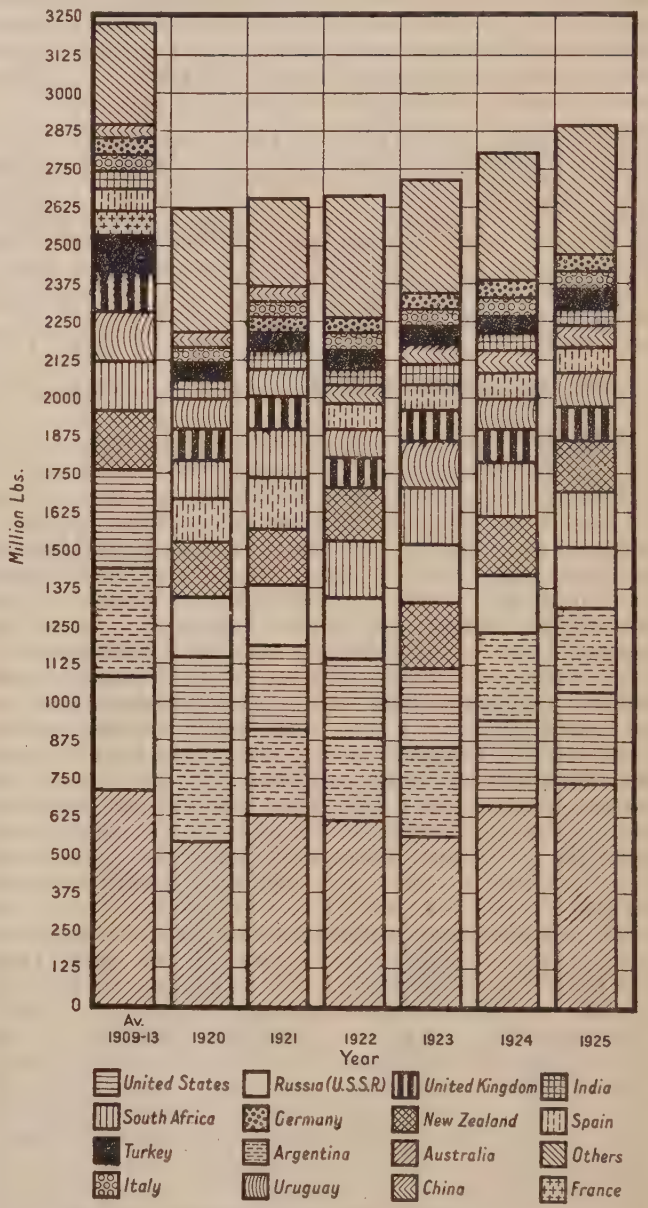

FIG. 1.—Diagram showing the world production of wool and the production in each of the principal producing countries for the annual average 1909–13, and for each year from 1920–5. The diagram is based on figures given in the weekly Commerce Report of the U.S. Department of Commerce, published by the Bureau of Foreign and Domestic Commerce. Every effort is made to obtain reliable figures, but in certain cases, particularly China, India, Turkey and Russia, only an approximate figure can be given, as no official figures are available. The section "Others" represents the production of all countries except those separately shown.

about 28% to 30% of the exportable surplus, whilst Europe, where France and Germany are the principal consumers, which before the War took about double the British consumption, is now consuming at least 10% less (excluding Russia), or say 54% instead of 60% on a somewhat lower supply basis. Both America and Japan are steadily increasing their imports of raw wool. Owing to financial stringency, European manufacturers' raw wool stocks have been below normal.

The relative decline in continental consumption is undoubtedly temporary, for every country, with the exception of Russia, has

increased, since the War, the capacity of her wool textile machinery. The industry of Alsace is of course now French instead of German. Italy in particular has increased her spindles considerably, and is extending her export of manufactures especially to Near Eastern markets. Japan shows great expansion not only in raw wool imports but particularly in wool cloth importations, this country being now the greatest wool cloth market of Great Britain. Japan and China have compensated in this respect for the temporary diminution in other markets, especially Europe and India. Most American wool import figures show extraordinary variations from year to year—*e.g.*, in 1923 her imports of Australasian and South American wool were 334,000,000 lb., compared with about 80,000,000 lb. before the War. In the next year, 1924, the total fell to 122,000,000 pounds. At any time the incidence and extent of American demand may completely upset all forecasts concerning wool consumption. In the meantime, however, the growing expenditure on motor-cars has hit the textile industry in America very seriously.

The War Period

During the period of the World War the military demand of the Allied countries (the blockade effectually preventing Germany and her allies from obtaining any appreciable quantities of overseas wool) was more than balanced, until the last year of the War, by the extent of the cessation of continental demand. Even before the Allied Governments effected their various wool controls, merino wool, required almost exclusively by the civil populations of Allied and neutral countries, increased in price in a far greater ratio than did crossbred wool required for military clothing and other War equipment.

Shipping was gradually withdrawn from the long Australian route in favour of the short Atlantic passage. Large quantities of wool, amounting by the end of the War to almost 1,000 million lb., equal to one and a quarter Australian and New Zealand clips, accumulated at the ports in the Antipodes. The demand for finished goods for civilians had far outstripped the supply, and prices had risen sometimes to as much as 10 times the pre-War level. On the Continent of Europe supplies of finished goods had been absorbed and manufacturers operating reserves of wool for their machinery no longer existed. In the Central Empires the clothing of the military forces was well and efficiently carried out. By 1917 the new clothing issues were made almost entirely of old uniforms torn up into shoddy, and this was repeated and could have been repeated year after year. Meanwhile the German and its allied civil populations existed upon substitutes of every conceivable description, from fibres made from nettles and from seaweeds to jute and paper fabrics for both outer and under clothing (*see* Fibres; Paper Making).

The Allied Armies, and especially those of the British Empire, were exceptionally well clothed in wool, whilst later in the War the provision for the American Army was on a still more extravagant scale.

Government Controls.—All Governments involved in the War instituted some form of wool control. Early in 1915 the French Govt. had requisitioned its domestic wool clip on a basis of prices 25% over the pre-War level. In 1916 the British Govt. requisitioned the British domestic clip on a level of 35% over pre-War prices, whilst in Oct. arrangements were made by the Imperial Govt. with the Australian and New Zealand Govts. whereby their clips were purchased at 55% over the pre-War level. In 1917 the price paid to the British farmer was raised to 50% over the pre-War prices, and in 1918 to 60%. The original proposal had been to purchase merely the crossbred wool of the Empire, comprising practically the whole of the New Zealand clip of about 200,000,000 lb. and 15% of the Australian clip comprising less than 100,000,000 lb., but in the final negotiations the Prime Minister of Australia, fearing the possible financial peril for Australia as a result of untransportable and, therefore, unmarketable Australian products piling up at her ports, pleaded that the Imperial Govt. should purchase the whole of the clip and pay for it whether it was shipped or not. This was done on the basis of 55% over pre-War prices, with the stipulation that this price basis should be maintained for all military and other Government requirements both of Great Britain and of her Allies, but that in respect of civilian demands the fullest price possible should be obtained, and any net profit resulting should be divided equally between the Treasuries of the Imperial Govt. and the Governments of the Commonwealth and the Dominion.

During the first year of the purchase the Imperial Govt. paid out to the Commonwealth and Dominion Govts. about £25,000,000 and received for sales £330,000. By June 1918 it had paid out over £100,000,000 and received not much more than £50,000,000. Up to the end of 1919 the Imperial Govt. had expended many millions sterling more in the purchase of wool than it had received. The Australian brokers and wool growers reorganised the collection and distribution of wool on the new system of appraisement in Australia in a most remarkable and rapid manner. A large part of the South African clip was also purchased, as well as the production of the Falkland Islands and of Iceland. Numerous schemes were considered for acquiring the wool of South America, but all were vetoed by the Treasury, mainly owing to exchange complications. In England an organisation was rapidly improvised by the War Office, which, in co-ordination with the trade, dealt with all this wool, and by a progressive control of the industry not only met the whole of the requirements of the Army, of the Navy and of the Air Force, but in addition a large proportion of the requirements of the Allied Armies, including, later in the War, the total equipment in Europe of the forces of America, to say nothing of hundreds of semi-official organisations, such as the Red Cross, Relief Organisations, Post Office, Police, Prisoners of War, Women's Organisations, etc., as well as the Indian and Egyptian services and the initiation and control of standard clothing schemes for the civil population and for demobilisation after the War.

The reason for the colossal wool purchase, of 9,895,000 bales, which included the period of the War and one clear wool season after the War, and on which almost £300,000,000 sterling was spent and a net profit of £70,000,000 sterling made, was to ensure military supplies. In fact, the first consideration was the securing of supplies for all purposes *at a known price* no matter how long the War continued, and, secondly, securing control in Imperial hands and the means of bargaining which the ownership of such a commodity gave in times of war. In its main objectives the purchase proved to be very successful, and provided a basis of raw material costs on which all subsequent costs and prices paid were based, resulting in more rapid production and the saving of many millions sterling to the Exchequers of the Allied Governments. The aggregate sales of British wool amounted to £40,000,000, on which a profit of £5,000,000 was made.

The Period After the War

In 1919 the state of uncertainty resulted in a temporary cessation of buying and a fall in prices. The British Govt., which at that time was issuing wool at fixed prices, based on a good quality 64's top at 69d. per lb., guaranteed to continue this issue till Nov. 1919. In fact fixed issue was discontinued some months earlier. Manufacturers were, however, anxious to regain their old trade connections, and preferred to resume, as far as possible, their pre-War wool connections and to buy untrammelled by any Government formalities or restrictions, with the result that they bought at even higher prices in the open market in order to secure a greater freedom of action and of contracts.

The wool textile machinery of the Allied countries was, as it happened, situated near frontiers, and had been largely destroyed, notably in the Nord department of France, in Northern Italy and in Poland, with the result that the production of the Allied textile industry outside Great Britain was very largely reduced for a period of two years after the War. The War-time control of the textile industry was speedily liquidated (March 1919). During the first 18 months after the War trade boomed as never before, and Europe poured in orders at any price. Whereas in 1913 Great Britain had exported about 40,000,000 yd. of wool cloth to Europe, at a value of about £6,500,000, in 1919 the exports to the Continent amounted to 120,000,000 yd. of a value over £50,000,000. To the rest of the world Great Britain exported 40,000,000 yd. only, as compared with 120,000,000 yd. before the War. The position had therefore been exactly reversed, and during the first few months of 1920 the extraordinary diversion of export and increase of price was accelerated.

The boom which was experienced was due to many causes. The censuses taken during the War by the British Wool Textile Department revealed large unsuspected stocks held by the industry as its normal reserve, the effect of which before the War was undoubtedly to minimise price fluctuations. The War destroyed that reserve in Europe and in most other parts of the world, in whatever form it then existed. From every quarter, therefore, an insistent demand arose. The whole world, impoverished as it was, over-bought and over-traded, and an edifice of trade was built up which collapsed before another 18 months, the sudden and wholly unprecedented slump in prices corresponding to the unprecedented and abnormal rise. Lack of finance dominated the situation.

Prices.—A comparison of prices of a commodity over a period of years is a fair indication of the position of the trade concerned. The highest price for 64's merino wool tops in the Boer War boom was 33d.; during the boom following the World War the price

reached, by April 1920, the record of 161d. per pound. Within a month of this peak price, and without warning, a financial crisis started in Japan, and, travelling via America to Europe, overwhelmed the trade, which did not recover for two years at least. Recovery was materially assisted by the fact that the bulk of colonial wool supplies was held by the Imperial Government. All their efforts, however, could not stem the tide of declining values.

In 1921 a company, called the British Australian Wool Realisation Association (B.A.W.R.A.), was formed to realise the huge stocks of Government wool without the restrictions and international complications which direct Government control involves, and especially without the political interference which had been absent during the War but asserted itself in time of peace. By this time the initial cost of the clips had been practically met, and the cash realisations constituted very largely the profits made on the whole transaction jointly by the Imperial and Dominion Governments. No wool was sold save at reserved prices, and gradually the surplus in the hands of B.A.W.R.A. was released, having regard to the power of absorption of the trade and the new supplies coming forward from growers. Undoubtedly the policy pursued maintained prices on a level which would otherwise not have been possible and to this extent the organisation was the saviour of the trade. Many failed to recognise that ultimately the financial resources of the world to absorb wool and to purchase woollen clothes were limited by price.

Many proposals to perpetuate the B.A.W.R.A. form of organisation for the wool trade in the hope of maintaining prices for growers on a high level have been made. The general sense of those concerned was, however, against these proposals, and as the market was absorbing supplies satisfactorily little was heard of them. Prices advanced gradually until, by the end of 1924, they were between two and three times the pre-War price, heavy buying taking place on the prediction that the statistical position revealed an undoubted shortage of wool. The vacuum in the world demand for wool textiles had, however, largely been filled, and at the new level of prices consumption decreased. Demand for wool withered away, and substitutes were obtainable at a cheaper price.

During the first six months of 1925 prices fell by 50%, and another minor slump disturbed the equilibrium of the trade. Raw wool was now on a price level even lower than the general cost of living, and as a result demand increased and a healthy consumption of wool was resumed. The Far Eastern demand was dislocated as a result of serious earthquakes and devastation in Japan and of civil war and foreign boycott in China, the American market was quiescent and the main incidence of demand was concentrated in Europe, where, in spite of financial stringency and low purchasing capacity, the wool of the world is being absorbed at a steady rate. As world trade increases and the general economic and financial conditions improve, the main problem of the trade will be to obtain adequate supplies of raw wool at a reasonable price. (*see* AUSTRALIA; INDUSTRY, CONTROL OF; NEW ZEALAND.) (E. F. H.)

WOOLLEY, MARY EMMA (1863–), American educationist, was born at South Norwalk, Conn., July 13 1863. She became a teacher, and was instructor in Wheaton Seminary, Norton, Mass., 1886–91, before going to Brown University where she graduated (A.B., 1894; A.M., 1895). She was teacher of Biblical history in Wellesley College, 1895–8, becoming in the latter year professor and head of the department of Biblical history and literature. She was appointed president of Mount Holyoke College in 1900 and in that capacity became one of the most influential women educationists in the United States. She was the author of several monographs, including one on the *Early History of the Colonial Post Office* (1893).

WOOLWORTH, FRANK WINFIELD (1852–1919), American merchant, was born near Rodman, N.Y., April 13 1852. He studied in the public schools, and graduated from a business college at Watertown, N.Y., in 1872. He began his career as a clerk in Watertown. In 1879 he opened at Utica, N.Y., his first "five cent" store which, however, was a failure. Later in the same year he established a "five and ten cent" store at Lancaster, Pa., followed by another at Harrisburg. The chain was extended till it covered, in 1924, 1,356 "five and ten cent" stores in the United States, Canada and England. When the F. W. Woolworth Co. was incorporated in New York in Dec. 1911, he became president. In 1912 the Woolworth building in New York City, costing $13,000,000, was completed from the designs of Cass Gilbert. It is 760 ft. high, has 57 storeys, and, excepting the Eiffel Tower in Paris, is the tallest building in the world. The gross sales of the company in 1924 amounted to $243,203,459 and the net income $24,601,764, as compared with $119,496,107 and $10,361,557 respectively in 1919. Woolworth died at Glen Cove, L.I., April 8 1919, leaving an estate appraised at $27,000,000.

WORCESTER, Mass., U.S.A. (*see* 28.822), increased by 13·1% in the 10 years after 1910, reaching a population of 179,754 in 1920, of whom 53,527 were foreign born; in 1925 according to the state census it was 192,242. The output of its diversified industries was valued at $77,148,000 in 1909; $208,706,000 in 1919; about two-thirds as much in 1921; and $212,043,158 in 1923, when there were 544 establishments within the city limits, employing a force of 36,449 wage earners. The combined resources of the five savings banks, two national banks, two trust companies and four co-operative banks was $206,526,000. Worcester has never had a bank failure. By 1925 over $10,000,000 had been spent on the waterworks, which included both a high and a low service system; about $8,000,000 on the sewer system, including a sewage purification plant which cost $1,284,208; the equipment of the police department and of the fire department had been motorised; a comprehensive city plan had been prepared; zoning ordinances had been adopted; a beautiful new bridge had been built across Lake Quinsigamond. A trade school for boys was founded in 1909 and one for girls in 1911.

WORKERS, EDUCATION OF.—Since 1910, in spite of the intervention of the World War, this movement has developed with rapidity especially perhaps in Great Britian and the United States. In many countries the old movements persist, such as the Danish People's High School Movement and the English Workers' Educational Association. The former, in its democratic aspect at least, was inspired by Bishop Grundtvig (1783–1872) and demonstrated practically by Kristen Kold, shoemaker (1816–70), whilst the latter was the result of a fusion of English 19th century effort and experience. Both derived their power from their recognition of education as a fundamental force in life which must permeate and illumine every activity of man, as a continuous correspondence with a law of life, not a means to the achievement of any ulterior, though legitimate, purpose. Their ideal was the increase of thinking men of action in all the institutions of a truly democratic community. "Field, factory and workshop," cathedral, town hall, parliament and university were alike to be the beneficiaries of their activity and so they proved to be.

In all countries their effect on "Workers' Education" can be traced. Each country must, however, create its own institutions, yet the post-War Volkshochschule movement of Germany, the Arbetarnes Bildninghsförbund (Workers' Educational Association) of Sweden and the Workers' Education Bureau of United States of America have assumed their characteristic shapes partly at least as the result of their influence.

General Importance.—As a direct result of the demand of working men and women, adult education has become a living issue, particularly in Japan, many European countries, England and the United States of America. In England the rise of specific adult educational movements is the immediate consequence of a post-War limitation of aim on the part of the Workers' Educational Assn., and the rise of a partisan National Council of Labour Colleges which directs its efforts towards intellectual preparation for the final victory of the proletariat in an unrelenting class war. In 1925 a joint agreement was made by these two bodies with the Trades Union Congress, but they operate on different planes, and are only alike in their adoption of the terminology of educational method.

The W. E. A.—The Workers' Educational Assn. (2,500 affiliated bodies and 23,000 independent members) organises its classes in co-operation with universities, the state and local authorities. The maintenance of this alliance is indeed its *raison d'être*. The chief result of its effort is the system of University Tutorial Classes which operating throughout Great Britain and the Dominions and, to a less degree in the United States of America and elsewhere, has made it possible for many workers to participate in the highest form of university extra-mural effort and in the internal work of universities and colleges.

Political Basis.—There is a marked tendency for the various institutions and movements scattered throughout the world to be organised on the basis of political bodies and to serve their ends. The International Conference on Workers' Education held in 1922 at Brussels in the Belgian Labour College, and, in 1924, at Oxford, in Ruskin College, reveal this tendency, yet there is obvious anxiety not to exclude such bodies as are organised for purely educational purposes, provided they admit the theory of " workers' control " into their constitutions.

The area of workers' education, when all is said and done, is still largely unoccupied. It has not invaded the technical and industrial field. There are those who argue, as apart from politics and pure culture, that its business is, in the first place, to develop men and women who can construct and control industrial processes and direct commercial expansion. Then, again, certain occupations segregate their workers, notably in the case of workers on ships, but in England a Seafarers' Education Service has been established which operates largely through the efficient provision of books and advice (*see* LIBRARIES).

Situation in U.S.A.—Some 50 trade union and Labour colleges are dotted about the United States. The Rand School of Social Science (1906) and the Boston Trade Union College (1921) are among the earliest and most notable examples. The Brookwood Workers' College (1921) is the pioneer residential institution. Ten Colleges were represented at the Third National Convention of the Workers' Education Bureau in 1924. Certain colleges have summer schools for workers. Bryn Mawr (1920) for women workers has been a consistent success.

Situation in England.—There are several residential workers' colleges in England. Ruskin (1899), Fircroft (1909), Avoncroft (1925) for agricultural workers and Beckenham (1920) for working women, whilst the Conservatives have Stott College, the Socialists the Labour College. Moreover, there is talk of a Labour university at Easton Lodge under the direction of the Trades Union Congress. The co-operative movement, which has undertaken educational work since 1842, has established a college in Manchester. Most of the universities organise summer schools (*q.v.*) for workers. The majority of the other experiments merge into the general adult education movement.

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WORKMEN'S COMPENSATION: *see* INSURANCE, SOCIAL.

WORKS COUNCILS.—In all industrial countries political democracy has been accompanied by a movement towards democracy in the relations between labour and capital. Historically the trade unions were the first to appear in this field and they have been followed by representative organs of the employees in the individual establishments. Statutory representative bodies existed in many countries before the World War in the mines, where they co-operated in the prevention of accidents. During the War the bargaining strength of labour was greatly increased, and in a number of the belligerent countries, especially in Germany and Austria, the mobilisation of the civilian population for work in the munitions industries led to the creation of statutory works committees, and provision was made for the settlement of disputes between these bodies and their employers by the setting up of conciliation tribunals composed of equal numbers of employers and employees with an impartial chairman.

The revolutions in Russia and in Central Europe brought with them the idea of making works councils the basis of a political organisation of the state. While in Russia this idea was to some extent realised and the councils were at the outset given the control of businesses as a step towards socialisation, the new Central European republics (Germany, Austria and Czechoslovakia) rejected both the political attributes of the councils and the Russian method of socialisation through individual businesses. In these countries the War-time legislation was extended on the following lines: firstly, co-operation of the employees, on equal terms with the employers, in the regulation of working conditions by means of elected representatives, subject to the priority of collective agreements; secondly, the councils to have advisory functions in regard to problems of management, with the aid of certain rights as to information, and other matters.

I. THE GERMAN WORKS COUNCILS ACT

Legal Provisions.—The German Works Councils Act prescribes the erection of works representative bodies in all establishments with 5 or more employees; in establishments with 5 to 19 employees representation is by single individuals (the works steward), and above 19 employees by works councils with a minimum of 3 members, but rising with an increasing number of employees to a maximum of 30 members where 15,000 or more persons are employed. Following the distinction already existing in the trade-union movement and in social insurance, the works council is divided into two sectional councils of wage-earners and of salaried employees, the membership of which is proportional to the number of employees in each section, though with a certain minimum representation of the minority section. These two sectional councils are each exclusively competent to deal with matters affecting the interests of its own section, and it is only when they come together that they constitute the works council representing the general interests of the whole body of employees. The type of establishment is immaterial—all private, state and municipal establishments, commerce, industry, banks, agriculture, etc., come under the Act.

In general, every establishment must have its own works council, and there is no provision for a common works council for undertakings which have establishments in more than one district, *e.g.*, the Deutsche Bank or the firm of Siemens. But in the case, for instance, of the Berlin branches of the Deutsche Bank, or the municipal establishments of the town of Berlin, the individual works councils can in each case elect from their numbers a central works council (*Gesamtbetriebsrat*) to represent their joint interests. The only exception to this local restriction of the statutory association of works councils (which was imposed in the interests of the trade unions in order to prevent the growth of an independent organisation of works councils) is provided by the large undertakings of the Reich and the provinces. In the railways and the post office each local establishment has its own representative body; the whole of the employees in each administrative district then elect a district works council, and, finally, all the employees in the whole of the railways (or the post office) elect a central works council. The election to each of these bodies takes place on the same day throughout the country.

The election of the works steward takes place by the majority vote of all employees with voting rights and that of the works council by the method of proportional representation with secret ballot (those entitled to vote must be not less than 18 years of age; those eligible for election must be not less than 24 years of age, have been in the establishment for six months and in the occupation for three years). The period of office is one year. The council must have a chairman and vice-chairman, and if it has more than eight members it must elect a committee of five, in which certain confidential matters enumerated in the Act must be discussed. Under the Act the council must hold its meetings as a rule out of working hours. The employer can only attend if he has been specially invited or if he has himself summoned the meeting. The necessary free time required

and expenses incurred by the council (rooms, writing materials, texts of the Act, etc.) must be provided by the employer at his cost. The office of works councillor is honorary and unpaid but out-of-pocket expenses and any working time unavoidably lost must be paid for by the employer. The works council is not allowed to make any levy on the employees (this is not so in Austria).

There is no legal obligation to accept the office of works councillor, and it can at any time be resigned. In the case of gross abuse of office a councillor can be compelled to retire, or the whole council can be dissolved, by order of the local Labour Court (composed of an equal number of employers and employees with an impartial chairman). The works assembly consists of the whole body of employees, which can be convened by the employer, or one-fourth of the employees, or in general at the discretion of the works council. It can only present requests and proposals to the council; in particular it has no right of "recall," though this was strongly demanded by some sections of Labour when the Act was under discussion. In the inflation period the works assemblies played a great rôle, but their importance has diminished since the stabilisation of the currency.

On the resolution of one-fourth of the members of the council representatives of the trade unions represented on the council can take part in an advisory capacity in its meetings and also, without such a resolution, in the works assembly.

The functions of the works councils are indicated in the first paragraph of the Act. They are: (*a*) "to safeguard the common economic interests of the employees in relation to the employer," and (*b*) "to support the employer in carrying out the aims of the business."

(*a*) The function of safeguarding the interests of all employees of both sections is entrusted to the works council, while those matters which concern only one section fall within the competence of the sectional councils of wage-earners or of salaried employees—a distinction which is very important because collective agreements between trade-unions and employers are normally concluded separately for wage-earners and for salaried employees. This function consists chiefly in the supervision of collective agreements and in the regulation, together with the employer, of working conditions in the individual establishments which are not settled by the collective agreements. In the event of infringement of a collective agreement the works council (or steward) has not independent power of intervention; if negotiation with the employer is fruitless it can apply to the trade union which has concluded the agreement. Alternatively, it can advise the individual employee to bring an action against his employer in the Labour Court.

The so-called "works agreement" (*Betriebsvereinbarung*) dealing with matters not regulated by the collective agreement (*Tarifvertrag*) is of considerable legal and social importance. Akin to the collective agreement in that it is also chiefly concerned with defining the context of the individual labour contract, it is distinguished from the former because it is concluded, not between trade-union and employers' organisations but between the works council or steward on the one side and the individual employer on the other. The works agreement has no legal status, a fact which has given rise to much controversy in recent years. The employers in general are in favour of giving legal effect to works agreements (as is already the case with collective agreements) but the trade-unions are against it because they see in the proposal a danger to the collective agreement. In practice this danger has so far not materialised. The most important sphere of the works agreement lies in the drawing up of working rules (Arbeitsordnung) which are legally compulsory in the larger industrial establishments and which, prior to the Works Councils Act, had been issued by the employer alone. These working rules (which deal with such matters as the division of working time, the method of wage payment, fines for late arrival, etc.) must now be drawn up jointly with the works council and the signature of both parties appended. If an agreement cannot be arrived at by negotiation, either party can appeal to the Conciliation Board (referred to above in connection with War-time legislation). If the mediation of the board is unsuccessful it is empowered to establish definitive working rules which are binding on both parties. This constitutes perhaps the most important democratic transformation of the old autocratic conditions of employment in works. It is further the duty of the councils and stewards to protect the disabled, to work for good relations amongst the employees and between them and the employer, to safeguard the freedom of association of the employees, and to co-operate in the administration of works welfare institutions. The employer must notify the councils as early as possible of his intention either to take on or to dismiss relatively large numbers of employees in order that unnecessary hardship may be avoided.

The right of the council to co-operate in the protection of individual employees against dismissals which are socially undesirable is of great importance in practice. The legal period of notice of dismissal for the wage-earner varies from one day to two weeks, while the salaried employee as a rule is given monthly or quarterly notice. An employee to whom notice is thus given can, through the works council, in whose hands a great deal of power is thus put, appeal against dismissal on the grounds, amongst others, that he has been dismissed because of his trade-union adherence, or because "the dismissal constitutes an unjust hardship which neither the conduct of the employee nor the circumstances of the business can justify." The decision rests with the Labour Court referred to above. If it allows the appeal the employer can choose whether he will re-engage the employee or will pay him a sum in compensation, which is fixed by the Court in accordance with the number of years during which the employee has been in the business, up to a maximum, for six years or more of employment, of one-half of his total earnings during the preceding year. In 1924 45,000 disputes over dismissal came before the Labour Courts. It is proposed later to grant protection against dismissal to all employees and not merely to those in businesses with a works council.

Works councillors receive a greater degree of protection against notice of dismissal, which only becomes valid in their case if a majority of the works council vote in favour of it (in the case of works stewards a majority of all the electing employees is necessary). If consent is then refused the employer must appeal to the Labour Court, whose decision is final. The consent of the Court is practically withheld, not merely if it considers that the grounds adduced would not justify the dismissal of an ordinary employee but if it holds that the interest of the employees in retaining the councillor is greater than that of the employer in dismissing him. In practice the protection afforded to the councillors has proved thoroughly effective. The protection given by the Act applies to individual dismissals and not to mass dismissals rendered necessary by trade depression. Finally, the works council are called upon to co-operate with the factory inspectors and other officials in the prevention of accidents and the promotion of works hygiene. This opens a wide field of activities to the councils in which they are increasingly making their influence felt.

(*b*) The advisory functions of the works councils are designed to stimulate the feeling of responsibility and the pride of work of the employees. The councils are required by the Act to do their utmost to increase the efficiency of management, and it is their duty also to assist in the introduction of new labour methods. For this purpose they are granted access to the wages lists of the concern in which they are employed and to other information in the possession of the employer which concerns labour conditions. The employer must make a quarterly report on the economic position of the undertaking and of the industry and on the anticipated labour demand. Further, in all establishments employing upwards of 300 wage-earners or 50 salaried employees the employer must lay before the council a balance sheet and profit and loss account in respect of the business, and must explain the different items. Strict secrecy must be observed by the council in regard to any confidential disclosures made by the employer.

The Act goes even farther in empowering the works council in every company to elect two of its members to sit on the Control Board (Aufsichtsrat) of the company with full voting rights. In practice the intention of the Act has been largely evaded by the action of the Control Boards in transferring most of their functions to the management of the company, and confining their activities to the legal minimum of supervision, auditing etc., laid down by the Commercial Code.

II. THE OPERATION OF THE ACT

It is still extraordinarily difficult to form a comprehensive judgment on the operation of the Works Councils Act. In small businesses representative bodies are often not elected, but in the medium-size and still more in large undertakings works councils certainly exist, though in many cases no salaried employees' council is elected owing to lack of interest. The distinctions between large and small towns and between town and country and the strength of trade-union organisation, also influence the extent to which the legal rights under the Act are exercised. In the absence of official statistics certain trade unions give figures of the numbers of works councillors. Thus in 1922 there were 32,565 wage-earning and 5,615 salaried employees who were members of workers' representative bodies in 11,557 establishments in the metal industries. In the same year there were 25,239 works councillors in 7,219 establishments in the textile industries. In the whole German mining industry there were in 1925 5,428 works councillors, of whom 2,944 were in the Ruhr district.

Neither the exaggerated hopes with which the workers regarded the passing of the new Act nor the equally exaggerated fears of the employers have turned out to be justified. At the

outset there was a great deal of friction and an enormous number of appeals to labour tribunals, often over very insignificant matters. But in the course of time things have settled down and the procedure, etc., is now fairly well established. The employers, especially in the stormy inflation years, have learned to appreciate and make use of the councils as a valuable intermediary between the management and the employees; the councils have more and more assumed the necessary, though at the moment thankless, rôle of joint responsibility with the employers. Many a works councillor at the end of his term of office has refused to stand again for so thorny a post or has not been re-elected by his dissatisfied fellow workers, but many have continued in office for more than six years, and have learned how to defend effectively the interests of the employees, and have gained an insight into economic conditions such as was quite foreign to the earlier generation of trade unionists. It is agreed by most German observers that the works councils have justified themselves not merely as representative of the interests of their class but also as valuable organs of social peace in factories and businesses. On the other hand, it must also be recognised that their activities in an advisory capacity and their influence on management are still very slight, partly owing to the opposition of the employers, partly to the insufficient capacity and experience of the works councillors, and partly to the abnormal conditions due to the inflation and subsequent stabilisation of the currency. It will only be after years of normal economic conditions, when the wage question is no longer the chief concern of the councils, that an objective judgment on their economic functions will be possible.

The relations between the works councils and the trade unions deserve special mention. During the first years of the Act there was a vehement conflict between the two forms of organisation for the leadership of the labour movement—a fight which was finally decided in favour of the unions which have succeeded in incorporating the councils within their organisation. The elections to the councils are in practice completely controlled by the trade unions. While the danger of a split in the trade-union movement can be definitely regarded as past, the councils have undoubtedly strengthened the tendency towards the formation of industrial as opposed to craft unions and have increased the solidarity of wage-earning and salaried employees. Finally, the works councils have had an important influence on the growth of workers' education. Several state institutions such as the Academy of Labour at Frankfurt and the School for Economics and Administration at Düsseldorf owe their origin to the Works Councils Act. A great stimulus has also been given to trade-union schools and classes, and by special newspapers and supplements to trade-union organs an active educational work is being carried on.

III. THE MOVEMENT IN OTHER COUNTRIES

Both in Austria and Czechoslovakia Works Councils Acts have been passed; in the former on May 15 1919, and in the latter on Feb. 25 1920 (for mines) and on Aug. 12 1921 (for other establishments). The Austrian Act served in large measure as a model for the German Act and the latter as a model for Czechoslovakia. The experience of the working of these Acts is similar to that of Germany. It is noteworthy that the Czechoslovakian Act for mines contains a profit-sharing scheme for the workers.

In Norway a provisional Act was passed in 1920, but both the scope and the functions of the representative bodies created by it are far less extensive than is the case in central Europe.

In Russia the Labour Code of Nov. 15 1922 pushed the works councils very much into the background and subordinated them completely to the trade unions. Setting aside the divergent economic structure of Russia it appears that their functions are less important than those of the works councils in central Europe.

In France, apart from certain War measures, the movement has not gone beyond an exchange of views between the employers' organisations and the trade unions in the metal industries.

The occupation by the workers of a number of engineering factories in north Italy in 1920 led to proposals by the Govt. to establish statutory representation in the works, but this development was brought to an abrupt end by the success of the Fascist movement.

In England, joint works committees, composed of representatives of the employers and the employees, have been set up in some industries under the Whitley scheme, but only to a relatively small extent. Works councils have also been set up voluntarily with considerable success in a number of large undertakings such as Messrs. Cadbury, Hans Renolds, etc.

In the United States and Canada works councils of various sorts have been established by the employers in a good many undertakings, mostly with the intention apparently of counteracting trade union influence. Their effects on relations between the employers and employees are very favourably regarded, at least by the employers. (*Cf.* esp. Leitch, *Man to Man.*)

The most comprehensive investigation into conditions outside Germany is to be found in the book by the Dutch writer, Van den Bergh, which is referred to in the bibliography.

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(G. F.)

WORKSHOP LAW: *see* FACTORY AND WORKSHOP LAW.

WORLD COURT: *see* PERMANENT COURT OF INTERNATIONAL JUSTICE.

WORLD RECOVERY.—He who would serve his generation, must be in advance of it, and although life has proved that "the executioner is always waiting for the forerunner," the present writer still holds that he who would help his fellow men can only do so in a real sense if, when he sees clouds rising in the distance, he points out untiringly and at no matter what cost to himself how they may be dispersed. It is a thankless and dangerous rôle. Mankind has always hated the prophets of disaster. And they were prophets of disaster who cried in the years before 1914 that there was danger of a world-conflict, and that Europe ran the risk of perishing in the tempest.

I. THE FAILURE OF THE OLD WORLD

Was it, however, so hard to see clearly? Was it so hard to see that capitalism, which has been and is such a wonderful instrument of material progress, but, up to the present, has been little more, had wrought a change in the civilisation which grew out of the Renaissance? The preoccupation with gain and the craving for pleasure have come to be first in men's minds, relegating to the second place the desire for freedom and high thinking which was so deeply imprinted on the great movement of the 16th century. This waning of an ideal would have been partly compensated and would at all events have been but temporary, if the economic transformation brought about by the great inventions had found their corollary in a wise organisation of the production and distribution of wealth. But nothing of the kind took place. Owing, perhaps, to its excessive rapidity, the evolution of industry only led to a feverish haste in production—men striving with all their might to produce goods in order to increase and heap up profits, buying up raw materials, and seizing every opening, ready to make war against all rivals! Such was the spectacle presented by a disorganised economic world at the beginning of the 20th century.

Not that there had not been some efforts to reduce it to order; but the efforts were usually brief, often wrongly directed, and always inadequate. In most countries the larger industries had endeavoured to amalgamate, and to this end their representatives had demanded, and in nearly every country on the continent of Europe had obtained, measures of protective legislation. Entrenched behind tariff walls, they had succeeded fairly well,

though in degrees varying with local conditions, in co-ordinating their internal activities. But practically nothing had been done in the matter of external competition. Nay, protection, by shifting the ground of economic struggles, had also altered their character and increased their intensity; it lessened the rivalry between the scattered producers of the same nation, but led to collective conflicts which increasingly took on the character of national conflicts between the industrialists of different countries, who draped themselves in their national flags.

War between the nations whose interests were mutually threatened and threatening thus became inevitable for want of a forcible imposition of order and method, which would have been strongly resented by the business world, lulled on the comfortable cushion of the *status quo*. This state of inane optimism, moreover, prevented any belief in the words of those who foretold the coming of a terrible cataclysm. The business world replied complacently that the war would not last long, and that as it would provide an opportunity for liquidating stocks it should inaugurate a new era of prosperity. This narrowness of outlook, which was the main attribute of most of the politicians as well as of the great majority of the industrial leaders of the period before 1914, persisted while the conflict raged. The voices of those who urged that events should be utilised to ring down the curtain on the War, or at least to make the attempt, were simply stifled. At times it seemed as if men, seized with giddiness, did not even see the gulf into which Europe was plunging.

Salvation came from the New World. The old continent was rescued by its former colonies. The entry of the United States into the War had, almost at once, a considerable and infinitely beneficial effect, which more than compensated for the inconveniences arising from the intrusion of a young nation which had grown up overseas into the old civilisation from which she was descended. America put an end to the War which, but for her intervention, would have been prolonged for months, perhaps for years. The misfortune was that when the bugles sounded the " Cease fire " peace was not made: papers were signed, and that was all.

Yet how could it have been otherwise? Everywhere in greater or less degree governments had fanned the spirit of destruction in their peoples, had been at pains to propagate and foster it instead of striving to curb and modify it. The hysterical mentality which they had helped to create could not cease with hostilities. It was bound to survive them and to be reflected in the treaties. Thus, at a time when complete unanimity of effort was urgently needed for reparation and reconstruction, the enactments made at Versailles and elsewhere kept alive—nay, multiplied—causes of economic friction, aroused rather than ended financial dissensions, and brought no political relief except by decreeing the cessation of slaughter.

II. THE RUSSIAN CATASTROPHE

Before considering the situation of Central and Western Europe let us look at the great wound inflicted by the Russian Revolution and the dangers involved in it.

How stands the former empire of the Tsars? It abandoned, indeed, the ill-considered communism which, whether or not the discovery pleased them, the men who seized the reins in 1917 soon found was not merely harmful but also ridiculous; but it evolved slowly but surely in the direction of a state socialism which, so far as could be gathered from the confused and contradictory reports that reached the West, daily approached nearer to capitalism. An economic rapprochement between Russia and the West remained, however, far off, and indeed, could not take place until the Soviet Republic consented to adapt itself to the political conditions of Europe.

Moscow became the scene of a struggle between what may be called " Europeanism " and what is known there as " Scythism." Scythism, which achieved the miracle of rallying to the Bolshevik standard the Russian reactionaries who were most violently opposed to it, inculcates scorn and hatred of western civilisation, and aims at nothing less than Asia's vengeance on Europe. The triumph of Scythism, if it were to come about, would be big with consequences. One portion of Europe would be welded to Asia and would revert to the mediaeval methods of production and distribution which have become stereotyped in China or Mongolia. On the political plane the danger would be even greater. The path would be clear for a future collision between East and West, and though it is more than probable that the West would conquer—the days of Genghiz Khan and Tamerlane are over—it is greatly to be feared that a new upheaval would sound the final knell of our civilisation. In order to avoid this immense disaster—the defeat of the Moscow extremists lessened the danger but did not remove it, for words are cheap and aggressive nationalism is tenacious and lasting—the European nations which control parts of Asia must be told again that it is necessary to adopt a conciliatory policy, modifying the laws in favour of the natives and gradually introducing measures of autonomy. Above all it is important that Europe should recover the full economic and political strength which enabled her in the past to make the first attempts to introduce order and progress into Asia, that strange continent which is at once somnolent and anarchic.

III. CENTRAL AND WESTERN EUROPE

But what is the condition of Europe? We must see things as they are. Central Europe is unstable politically, and is only beginning to recover economically, while the victorious States of Western Europe are suffering from the same evils as the vanquished, their sole advantage being that the degree of the suffering is less.

Take first the economic situation. It is a curious one, and shows surprising contrasts in the respective conditions of Great Britain and France. Great Britain's financial health is magnificent, but she is suffering from economic diseases—(the word is used deliberately, disease being transient). She is (1926) suffering cruelly from unemployment, and some of her chief industries are in a perilous state. France confronts her, economically prosperous, justly proud of her splendid agriculture, on the highway (or apparently on the highway) to become a great industrial power, but alas! in a state of extreme financial " poverty." What is the reason of this violent contrast in the position of two nations which are such near neighbours and are similar in so many respects?

The post-War history of Central Europe, and particularly of Germany, which is in the main a story of successive financial and economic crises, makes it possible to realise more fully, and to analyse more accurately, the present condition of France. In 1919 and 1920 the Minotaur of war had devoured the produce and reserves of provisions and wares in the Central Empires, while the blockade prevented any re-provisioning from without. When external communications were restored, they were utilised not so much for the re-equipment of Central Europe as to transfer by means of investment abroad the wealth which its German possessors feared might be laid under forced contribution as a result of their country's defeat. Nevertheless, a year or two later, in 1921 and 1922, the German factories were humming again; the forges, blast furnaces and steel works of the Rhineland were working at full capacity; the textile manufacturers were overwhelmed with orders and the number of unemployed fell to an insignificant figure. And the press of Western Europe declared that Germany's economic condition was most prosperous, that under the direction of a handful of economic dictators she was on the way to becoming a " giant " (this was the expression of a British newspaper). Those who fed the public with these hasty conclusions scarcely condescended to note the fall of the exchanges and the disastrous effect of the monetary depreciation on people with fixed incomes.

A new reel of the economic film was then unrolled, and is still (1926) in process of unfolding. The rulers of the Reich, being forced to put a stop to the downward rush of the mark, which would soon have made existence impossible—resolved to wipe out the internal debt, whether represented by bonds or in kind, at a stroke. They set up a new monetary system on the gold basis.

And thereupon furnaces were extinguished, looms ceased work, unemployment multiplied, and ruin overtook the industrial dictators whose insolent fortunes had sprung up like poisonous fungi. The financial crisis gave place to an economic one.

The explanation, people will say, is simple; ebb and flow were alike due to the upsetting of the exchange. It is easy to maintain this argument by showing that when the exchange of a country falls there is a longer or shorter period during which wages do not rise in the same proportion as the value of money falls. During this period the manufacturers reap the benefit of the premium on exports which increases in proportion as the value of the paper currency falls. This results in a frenzy of production, and the extension and the creation, even, of factitious industries among the nations with ruined currencies. Naturally the nations with healthy currencies are much injured by the species of aggression which is in fact a new kind of "dumping," "dumping by exchanges." Their finances are stable but their economic life is shackled.

Abnormal conditions, however, cannot last very long. There is an inevitable limit to a falling exchange. It is reached when whole classes of the nation are on the verge of abject ruin and a social catastrophe in sight. There is then no choice but to pull up suddenly. Either the currency must be demonetised as it was in Germany, or it must be stabilised as it was in Belgium. In either event, the bonus on exports which was sustaining the factitious or swollen industries disappears forthwith and a crisis occurs, more or less serious according as whether wise measures have been taken to meet it or not, so that the nation has escaped a financial slough only to be engulfed in industrial penury, the completeness of which varies with the economic and political organisation of the country.

The above is a true picture we believe of the economic and financial phenomena which we are now able to observe at leisure; but although they are registered, expressed and proclaimed aloud by the movements of the exchanges these movements do not cause them, as is the popular belief. Monetary depreciation is merely the symptom of the disease in the organism; it is an effect and not a cause.

IV. THE CAUSES OF EUROPEAN DISORDER

What then is the nature of the disease? What are the causes of the European disorder? There are three chief and essential causes—disorganised production; overwhelming public debts; the transference of wealth from one nation to another. The three may be discussed briefly.

First disorganised production. It is obvious to any intelligent observer that the mania for all-round production, which was developing before the War, sheltered behind the customs frontiers, is spreading ruin to-day. During the War nations which were obliged to organise home production of goods formerly obtained from their enemies, were forced into "omniproduction" and now find great difficulty in abandoning it. The result is an incalculable loss of labour and extreme difficulty in co-ordinating the production of the different nations. In a word, abundant waste at a time when every scrap of human labour ought to be utilised to the full.

Simultaneously, the burden of the War is demanding an immense toll from human labour—human labour again. A vast tribute is required to provide the interest on the national debts, debts which are simply a dead weight. The living are toiling for the dead; or, if another figure of speech is preferred, behind the producer as he creates wealth stands an invisible being who diverts part of it and casts it into the abyss—deeper here, shallower there—of the State's debit account.

When the debt is held internally, the evil is only half an evil; but when the money is required for the service of an external debt, the general damage to economic life is immeasurable. Nothing is more complicated in its essence than the transference of wealth from one nation to another. It can only be effected by exporting commodities or rendering services, processes which are extremely difficult on a large scale, even in a time of economic tranquillity. In a time of universal instability, when Europe is split into pieces which only the most delicate handling can ever bring together again, to attempt to transfer large amounts of wealth from one country to another is simply tempting fate.

V. THE REMEDY

Are we then to despair? By no means. There is one remedy—not two, but one—European solidarity.

Let no one be deceived. The causes of the economic disaster, some of which have been indicated, are bound up with a general state of mind, which, in a greater or less degree, is the origin of them all. The nations of Europe have been slow to rid themselves of the hatred which had entwined them during the War, in a fashion unparalleled in the history of the civilised world, yet at last have painfully raised themselves to a higher level. The new mentality, however, is not high enough in view of the vastness of the problems to be solved. The mass of the people believe that the sole result to be aimed at is a return to pre-War conditions. If any honestly believe this let their eyes now be opened. There was, it is true, a time of padded ease and comfort, the memory of which recalls Talleyrand's words: "Those who did not know French society before 1789 will never know how pleasant life can be." Life was also pleasant before 1914; so pleasant that no one troubled to see that its foundations were secure.

Regrets are useless. The past is past. We must look forward. It must be recognised that since all the normal laws of trade, credit and production have been and are being violated, the great effort at reconstruction cannot succeed as long as it is overshadowed by the politics of measured *rapprochement* between the European States which, while rightly advocated by farseeing men before 1914, is not applicable to the new conditions. We must begin afresh, take large views. First of all each country has work to do at home, to balance and more than balance, its budget, and to close the door against loans in any form whatever. Next, there must be a universal return to the gold standard, with the necessary precautions and by suitable stages. But the operation can only succeed if the banks of issue, which control the note circulation in the various countries, work together in such a way as to be able to aid one another at need. This great step accomplished, Europe will once more possess a healthy currency, and a sane and well balanced economic activity will follow. It must inevitably be so.

It is true that these things are being done but they are being done too timidly, and no more than a beginning has been made. Similarly, attempts are being made to solve the problem of the international debts, but they are not adequate. The European nations have not yet grasped the fact that they must reach full agreement if the burden of their mutual debts is to be lightened. They do not realise that in present day conditions, transfers of wealth from one country to another resolve themselves into one vast transfer from the Old World to the New. Ultimately, it all resolves itself into a tribute paid by Europe, the loser of the economic war, to America. It is essential that the debtors should take counsel together so as to distribute the burden in the least irksome way and to obtain from their creditor, the super-victor of the War, the concessions and conditions which both reason and justice demand.

It is no less essential to inaugurate economic co-operation between the nations of Europe. In this respect also some progress has been made. People are beginning to feel the necessity of curbing the rampancies of protectionism. Commercial treaties are being negotiated in almost every direction, but as they are framed on the old lines they are proving quite inadequate. If economic peace is to become a reality there must be general agreements far broader than those of former days, to lay down understandings between producers for the division of the great exporting industries between the various nations, and for the systematic apportionment of raw materials.

VI. NEW GUIDANCE

The road to be travelled is long, arduous and strewn with obstacles. One stage, however, was passed when the representatives of the chief European powers in a little Swiss town signed

disinterested political agreements and accepted the principle of arbitration. Needless to say, it is far easier to arrive at understandings in the realm of pure politics than to unite in one economic and financial order when interests clash. Nevertheless we must persevere, or the achievement of Locarno is doomed to be barren. Shall we succeed? Yes, if a European public spirit can develop and, *above all*, if Europe is governed.

The words "above all" are here emphasised because if public opinion influences governments, governments form it and mould it, if knowing how to govern when they govern. European opinion is turning towards the conception of mutual help and understanding. As yet, however, it stammers in its speech. It must learn to speak loud enough to frighten narrow nationalisms back to the tomb where they ought to be rotting, but it can do this only if it is supported—nay, capably driven, whipped on.

In *La Puine de la civilisation antique* the eminent historian Guglielmo Ferrero says:—

> If Europe had governments of adequate strength and recognised authority, the work of reconstruction would be easily and swiftly accomplished with the very powerful means which western civilisation can command. But, ruined by the War, plunged in the depths of misery, at grip with all manner of difficulties, political, economic, military and diplomatic, which were engendered by the War, and with no Governments capable of governing, the greater part of Europe will probably fall into prolonged anarchy.

We should do well to ponder these words. The will towards a new grouping in Europe may be paralysed by the weakness of governments. But why are they so weak? Because in the centre of the old Continent parliamentary government, which has taken the place of the ancient monarchies that went down in blood and mud, is as yet an improvisation. It will only achieve authority, the keystone of every social edifice, as representative government grows stronger in Western Europe, on whose institutions it is necessarily modelled.

Now, it is useless to deny that in Western Europe parliamentary government is being severely tested. This is scarcely matter for surprise. In many countries no steps have been taken to make its position secure. Things have been allowed to drift; the mania for words—that plague of the Latin peoples and some others—has spread so that chatter has become the order of the day, while legislative disorder and ministerial crises teem and multiply. In the "padded" age—the adjective was apt—before 1914 it was always possible—to float with the tide. There was an immense amount of prosperity. People believed that the line of progress was a continuously ascending curve. To-day we have to sing a different tune, to bid good-bye to our illusions, to realise that a vessel which could make excellent progress on an oily sea cannot keep an even keel on the ocean when the great waves are unloosed.

Let us leave metaphor aside. Only a great renewal can keep post-War Europe alive. And the essential condition of the transformation is that there should be governments which are both authoritative and stable, so that they may be able to make bold and rapid decisions and to take the long view which alone makes it possible to subordinate particular interests to the general interest. The European peoples, who are vaguely conscious of these things, are in an uneasy state. Some of them are drifting into dictatorship—a temporary solution, and an extremely dangerous one unless, as in ancient Rome, it is embedded in the framework of the constitution, unless it provides for the full restoration of responsible government at the expiration of a term fixed by the fundamental laws of the State. In other countries there is hesitation or shirking of the issues. The people must understand that the road to salvation is through the renaissance of the parliamentary system, and through a régime which knows discipline, where there will be a limit to pettifogging, and the chambers will be assisted by the great economic forces, grouped together and taught how to collaborate with the people's representatives.

Before very long the citizens of every nation of the continent will hear these truths and will realise the tragic dilemma which confronts them: "Europe must either organise and unite or perish." "I am in advance perhaps of my time; I am sure I am serving it." (J. Ca.)

WORLD WAR.—The aim of this article is to trace the main strategic currents of the World War, as also the conditions and ideas which guided them. The causes of the War itself are not within our scope[1]. A process of 50 years had gone to make Europe inflammable, and a few days were enough to detonate it. To study the causes of the conflict on the German side we should have to trace the influence of Prussia on the creation of the Reich, the political conceptions of Bismarck, the German philosophical tendencies, her economic situation—a medley of factors which transmuted Germany's natural desire for commercial outlets, unhappily difficult to obtain, into a vision of world-power. We should have to analyse that heterogeneous relic of the Middle Ages known as Austria-Hungary, appreciate her complex racial problems, the artificiality of her governing institutions, the superficial ambitions which overlay a haunting fear of internal disruption and frantically sought to postpone the inevitable end.

On the other side we should have to examine the strange mixture of ambition and idealism which swayed Russian policy; we should have to understand the constant and justifiable fear of fresh aggression which France had suffered since 1870, and follow the regrowth of confidence which fortified her to resist further threats; finally, we should have to trace Britain's gradual movement from a policy of isolation into membership of the European system and her slow awakening to the reality of German ambitions. Beside these fundamental causes the international "incidents" that took place between 1899 and 1914 are but symptoms.

I. INTRODUCTION

The Armed Forces.—The World War may be briefly epitomised as a progress from convention through chaos to co-operation. The nations entered upon the conflict with the conventional outlook and system of the 18th century merely modified by the events of the 19th century. Politically, they conceived of it as a struggle between rival coalitions based on the traditional system of diplomatic alliances, and militarily as between professional armies—swollen, it is true, owing to the continental system of conscription, yet essentially fought out by soldiers while the mass of the people watched, from seats in the amphitheatre, the efforts of their champions. The Germans alone had a glimpse of the truth, but—one or two prophetic minds apart—the "Nation in Arms" theory evolved by them during the 19th century visualised the nation rather as a reservoir to pour its reinforcements into the army than as a mighty river in which are merged many tributary forces, of which the army is but one. Their conception was the "Nation in Arms," hardly the "Nation at War." Even to-day this fundamental truth has yet to be grasped in its entirety and its full implications understood. Progressively throughout the years 1914–8 the warring nations enlisted the research of the scientist, the inventive powers and technical skill of the engineer, the manual labour of industry, and, as potent as any, the pen of the propagandist. For long this fusion of many forces tended to a chaotic maelstrom of forces; the old order had broken down, the new had not yet evolved. Only gradually did a working co-operation emerge, and it is a moot point whether even in the last phase co-operation of forces had attained to the higher level of co-ordination—direction by unity or diversity.

The German Army of 1914 was born in the Napoleonic wars, nursed in infancy by Gneisenau and Scharnhorst, and trained in adolescence by the elder Von Moltke and Von Roon. It reached maturity in the war of 1870, where it emerged triumphantly from a test against the long-service army of France. Every physically able citizen was liable to service, and the State took the number it desired, trained them to arms for a short period of full-time service, and then returned them to civil life. The feature, as also the object, of this system was the production of a huge reserve by which to expand the active army in war. A man

[1] For the political and diplomatic history of the struggle *see* the article EUROPE.

served two or three years full-time, according to his branch of the service, followed by five or four years in the regular reserves. He then went into the Landwehr for 12 years, and finally passed into the Landsturm from 39 till forty-five. Further, an Ersatz reserve was formed of those who were not called on for service with the colours.

In this organisation and the thoroughness of the training lay the secret of the first great surprise of the War, one which almost proved decisive. For instead of regarding their reservists as troops of doubtful quality, fit only for an auxiliary rôle or garrison duty, the Germans during mobilisation were able to duplicate every first line army corps with a reserve corps—and had the courage, justified by events, to use them in the opening clash. This surprise upset the French calculations, as it dislocated their plan.

The Germans have been reproached for many miscalculations; less than justice has been done to the correctness of many of their intuitions. They alone realised what is to-day an axiom —that, given a highly trained cadre of leaders, a military machine can be rapidly manufactured from the levies of the led, like molten liquid poured into a mould. The German mould was a long-service body of officers and n.c.o.s who in their standard of technical knowledge and skill had no equal in the world. But if the machine was manufactured by training, it gained its solidity from another process. The psychological element plays an even greater part in a "national" than in a professional army. Esprit de corps is not enough; the stimulus of a great moral impulse to action is necessary, a deep-rooted belief in the policy for which citizens are called on to fight. The leaders of Germany had worked for generations to inspire their people with a patriotic conviction of the grandeur of their country's destiny. And if their opponents went forth to battle in 1914 with as intense a belief in their country's cause, this flaming patriotism had not the time to consolidate such a disciplined combination as years of steady heat had produced in Germany. The German people had an intimacy with and a pride in their army, notwithstanding its severity of discipline, that was unknown elsewhere.

This unique instrument was handled by a general staff which, by rigour of selection and training, was unmatched for professional knowledge and skill, if subject to the mental "grooves" which characterise all professions. Executive skill is the fruit of practice; and constant practice, or repetition, tends inevitably to deaden originality and elasticity of mind. In a professional body, also, promotion by seniority is a rule difficult to avoid. The Germans, it is true, tended towards a system of staff control, which in practice frequently left the real power in the hands of youthful general staff officers. As war memoirs and documents reveal, the chiefs of staff of the various armies and corps often took momentous decisions with hardly a pretence of consulting their commanders. But such a system had grave objections, for such a happy combination as that of a Hindenburg and Ludendorff is rarely found, and from it came the grit in the wheels which not infrequently marred the otherwise well-oiled working of the German war-machine.

Tactically, the Germans began with two important material advantages. They alone had gauged the potentialities of the machine-gun and of the heavy howitzer, and had provided adequate numbers of these weapons. Strategically, also, the Germans had brought the study and development of railway communications to a higher pitch than any of their rivals.

The Austro-Hungarian Army, if patterned on the German model, was a vastly inferior instrument. Not only had it a tradition of defeat rather than of victory, but its racial mixture prevented the moral homogeneity that distinguished its ally. This being so, the replacement of the old professional army by one based on universal service lowered rather than raised its standard of effectiveness. The troops within the borders of the empire were often racially akin to those beyond, and this compelled her to a politically instead of a militarily based distribution of forces, so that kinsmen should not fight each other. And her human handicap was increased by a geographical one—the vast extent of frontier to be defended. Nor were her leaders, with rare exceptions, the professional equals of the Germans, and if common action was better than with the Entente Powers, Austria did not accept German direction gladly.

Yet despite all its evident weaknesses this loosely knit conglomeration of races withstood the shock and strain of war for four years, in a way that surprised and dismayed her opponents. The explanation is that this complex racial fabric was woven on a stout Germanic and Magyar framework.

From the Central we turn to the Entente Powers. France possessed but 60% of the potential man-power of Germany, and this debit balance had forced her to call on the services of practically every able-bodied male. A man was called up at 20, did three years' full-time service, then 11 in the reserve and finally two periods of seven years each in the Territorial Army and Territorial Reserve. This system gave France an initial war strength of some 4,000,000 men, equal to her German rival, but, in contrast, she placed little reliance on the fighting values of reservists. The French command counted only on the semi-professional troops of the first line, about 1,500,000 men, for the short and decisive campaign which they expected and prepared for. Moreover, they assumed a similar attitude on the part of their enemy—with dire result. But this initial surprise apart, a more profound handicap was the lesser capacity of France for expansion, in case of a long war, due to her smaller population—under 40,000,000 compared with Germany's 65 millions. Colonel Mangin, later to become famous, had advocated tapping the resources in Africa, the raising of a huge native army, but the Government had considered the dangers to outweigh the advantages of such a policy.

The French general staff, if less technically perfect than that of Germany, had produced some of the ablest military thinkers in Europe, and its level of intelligence could well bear comparison. Unfortunately, in recent years a sharp division of thought had arisen, which did not make for combined action. In *matériel*, the French had one great asset in their quick-firing 75 mm. field gun, the best in the world, but its very value had led them to undue confidence in a war of movement and a consequent neglect of equipment and training for the type of warfare which came to pass.

Russia's assets were in the physical sphere, her defects in the mental or moral. If her initial war strength was no greater than that of Germany, her man-power resources were immense and the courage and endurance of her troops was famous. But corruption and incompetence permeated her leadership, her rank and file lacked the intelligence and initiative for scientific warfare—an instrument of great solidity but little flexibility—and her manufacturing resources for equipment and munitions were far below those of the great industrial Powers. This handicap was made worse by her geographical situation, cut off from her allies by ice- or enemy-bound seas, and with immense land frontiers. Another radical defect was the poverty of her rail communications, the more essential as she relied for success on bringing into play the weight of her numbers. In the moral sphere Russia's condition was less clear. Her internal troubles were notorious and must be a brake on her efforts unless the cause was such as to prove a crusade-like appeal to her primitive and incoherent masses.

Between the military systems of Germany, Austria, France and Russia there was a close relation, differences of detail rather than of fundamental, and this similarity threw into greater contrast the system of the other great European Power—Britain. Throughout modern times she had been essentially a sea-power, intervening on land through a traditional policy of diplomatic and financial support to Allies, whose military efforts she reinforced with a leaven from her own professional army. This regular army was primarily maintained for the protection and control of the overseas dependencies—India in particular—and had always been kept down to the minimum strength for this purpose. The reason for the curious contrast between Britain's determination to maintain a supreme navy and her consistent neglect, indeed starvation of the army, lay partly in her insular position, which caused her to regard the sea as her

essential life-line and main defence, and partly in a constitutional distrust of the army, an illogical prejudice, which had its almost forgotten source in the military government of Cromwell. Small as to size, it enjoyed a practical and varied experience of war without parallel among the continental armies. Compared with them, its professional handicap was that the leaders, however skilled in handling small columns in colonial expeditions, had never directed large formations in *la grande guerre.*

Further, the foundations of a general staff had only been laid since the bitter lessons of the South African War, and the interval was too short, the distractions too great, for this to have been developed to the level of Germany and France. For the progress in organisation in the years before 1914, the British Army owed much to Lord Haldane, and to him also was due the creation of a second line of part-trained citizens—the Territorial Force. Lord Roberts had pleaded for compulsory military training, but the voluntary principle was too deeply embedded in the national mind for this course to be adopted, and Haldane wisely sought to develop Britain's military effectiveness within the bounds set by traditional policy. As a result, 1914 found England with an expeditionary force of some 160,000 men, the most highly trained striking force of any country—a rapier among scythes, and to maintain this at strength the old militia had been turned into a special reserve for drafting. Behind this first line stood the Territorial Force, which if only enlisted for home defence had a permanent fighting organisation unlike the amorphous volunteer force which it superseded. The British Army had no special outstanding asset in war armament, but it had developed a standard of rifle-shooting unique among the world's armies.

The reforms by which the army was brought into line with continental models had one defect, which was accentuated by the close relations established between the British and French general staffs since the Entente. It induced a " continental " habit of thought among the general staff, and predisposed them to the rôle, for which their slender strength was unsuited, of fighting alongside an Allied army. This obscured the British Army's traditional employment in amphibious operations through which the mobility given by command of the sea was exploited. A small but highly trained force striking " out of the blue " at a vital spot could produce a strategical effect out of all proportion to its slight numbers.

The last argument brings us to a comparison of the naval situation, which turned on the balance between the fleets of Britain and Germany. Britain's sea supremacy, for long unquestioned, had in recent years been challenged by a Germany which had deduced that a powerful fleet was the key to that colonial empire which she desired as an outlet for her commerce and increasing population. To the spur of naval competition the British people eventually responded, determined at any cost to maintain their " two-power " standard. If this reaction was instinctive rather than reasoned, its subconscious wisdom had a better foundation than the catchwords with which it was justified, or even than the need of defence against invasion. The industrial development of the British Isles had left them dependent on overseas supplies for food, and on the secure flow of seaborne imports and exports for industrial existence. For the navy itself this competition was a refining agency, leading to a concentration on essentials. Gunnery was developed and less value attached to polished brasswork; warship design and armament were transformed—the " Dreadnought " ushering in a new era, of the all big-gun battleship. By 1914 Britain had 29 such capital ships and 13 building, to the 18 built and nine building, of Germany. Further, Britain's naval strength had been soundly distributed, the main concentration being in the North Sea.

More open to criticism, in view of the forecasts of several naval authorities, was her comparative neglect of the potential menace of the submarine. Here German opinion was shown rather by the number building than those already in commission. It is to Germany's credit that though lacking a sea tradition, her fleet an artificial rather than a natural product, the technical skill of the German Navy made it a formidable rival to the British ship for ship, and perhaps its superior in scientific gunnery.

But in the first stage of the struggle the balance of the naval forces would affect the issue far less than the balance on land. For a fleet suffers one inherent limitation—it is tied to the sea, and hence cannot strike direct at the hostile nation. The fundamental purpose of a navy is therefore to protect a nation's sea communications and sever those of the enemy, and, although victory in battle may be a necessary prelude, blockade is the ultimate purpose. And as blockade is a weapon slow to take effect, its influence could only be decisive if the armies failed to secure the speedy decision on land, upon which all counted.

The Economic Forces.—In this idea of a short war lay also the reason for the comparative disregard of economic forces. Few believed that a modern nation could endure for many months the strain of a large-scale conflict. The supply of food, of munitions and their manufacture, of funds, were problems only studied on brief estimates. Of belligerents, all could feed themselves save Britain and Germany, and Germany's deficit of home-grown supplies could only be serious in the event of a struggle of years. But Britain would starve in three months if her outside supplies were cut off.

In munitions and other war material Britain's industrial power was greatest of all, though conversion to war production was a necessary preliminary, and all, again, depended on the security of her sea communications. France was weak, and Russia weaker still, but the former unlike the latter could count on outside supplies so long as Britain held the seas. As Britain was the industrial pivot of the one alliance, so was Germany of the other. A great manufacturing nation, she had also a wealth of raw material, especially since the annexation of the Lorraine iron-fields after the 1870 war. But the stoppage of outside supplies must be a handicap in a long war, increasing with its duration, and serious from the outset in such tropical products as rubber. Moreover, Germany's main coal and iron fields lay dangerously close to her frontier, in Silesia on the east and in Westphalia and Lorraine on the west. Thus for the Central Alliance a quick decision and an offensive war were more vital than for the Entente.

Similarly, the financial resources were calculated on a short war basis, and all the continental Powers relied mainly on large gold reserves accumulated specially for war purposes. Britain alone had no such war chest, but she was to prove that the strength of her banking system and the wealth distributed among a great commercial people furnished the " sinews of war " in a way that few pre-War economists had realised.

The Psychological Forces.—If the economic forces were neglected in the war calculations of the Powers, the psychological forces were an unexplored region, except in their purely military aspect. And even here little study had been devoted to the moral element compared with the physical element. Ardant du Picq, a soldier-philosopher who fell in the 1870 war, had stripped battle of its aura of heroic fictions, portraying the reaction of normal men in the presence of danger. Several German critics had described from experience the reality of battle-morale as shown in 1870, and had deduced how tactics should be based on the ever-present and balancing elements of fear and courage. At the close of the century a French military thinker, Colonel Foch, had demonstrated how great was the influence of the moral element in the higher sphere of command. But only the fringe of the subject had been penetrated. Its civil aspects were untouched, and in the opening weeks of the conflict the general misunderstanding of national psychology was to be shown in the undue muzzling of the Press, followed by the equally stupid practice of issuing communiqués which so veiled the truth that public opinion became distrustful of all official news and rumour was loosed on its infinitely more damaging course. The true value of wisely calculated publicity and the true application of the propaganda weapon was only to be learnt after many blunders.

The Rival Plans.—In this survey the German plan justly takes priority, for not only was it the mainspring which set in motion the hands of the war clock in 1914, but it may even be said to have governed the course of the War thereafter. It is

true that outwardly this course from the autumn of 1914 onwards seemed to be of the nature of a stupendous "siege" of the Central Powers, an idea which is incompatible with the terms we have used. But the conception of the Germanic alliance as a besieged party, although true of the economic sphere, suggests a passivity which their strategy contradicts. Although the initial German plan miscarried, even in its failure it dictated the general trend of operations thereafter. Tactically, most of the fighting resembled siege operations, but the actual strategy on land for long erred rather by its disregard of these tactical conditions than by its conformity with them.

The Germans were faced with the problem that the combined forces of themselves and Austria were decidedly inferior to those of France and Russia. To offset this adverse balance, however, they had a central position and the anticipation that Russia's mobilisation would be too slow to allow her to exert serious pressure in the opening weeks. While this assumption might suggest a decisive blow at Russia before she was ready, it was equally probable that she would concentrate her main forces too far back for such a German blow to reach—and the experience of Napoleon was not an example to encourage an advance deep into the interior of Russia, with its vast distances and poor communications. The plan adopted by Germany was, therefore, a rapid offensive against France while holding the Russian advanced forces at bay, and later, when France was crushed, to deal with the Russian Army. But this plan, in turn, was complicated by the great natural and artificial barriers which the French frontier offered to an invader. It was narrow, only some 150 m. across, and so afforded little room for manoeuvre or even to deploy the masses that Germany planned to launch against her foe. At the southeastern end it abutted on Switzerland, and after a short stretch of flat country known as the Gap of Belfort the frontier ran for 70 m. along the Vosges Mountains. Thence the line was prolonged by an almost continuous fortress system, based on Epinal, Toul, Verdun and just beyond the last-named lay not only the frontiers of Luxembourg and Belgium but the difficult Ardennes country. Apart from the strongly defended avenues of advance by Belfort and Verdun, the only feasible gap in this barrier was the Trouée de Charmes between Epinal and Toul, left open originally as a trap in which the Germans could be crushed by a French counter-stroke.

Faced with such a mental and physical blank wall, the logical military course was to go round it—by a wide manoeuvre through Belgium. Graf von Schlieffen, chief of the German general staff from 1891 to 1906 conceived and developed from 1895 onwards the plan, by which the French armies were to be enveloped and a rapid decision gained, and as finally formulated it came into force in 1905. To attain its object von Schlieffen's plan concentrated the mass of the German forces on the right wing for this gigantic wheel and designedly took risks by reducing the left wing, facing the French frontier, to the slenderest possible size. The swinging mass of five armies, pivoting on the fortified area Metz-Thionville, was to consist of 53 divisions, backed up as rapidly as possible by Landwehr and Ersatz formations, while the two armies of the left wing comprised only nine divisions. Their very weakness promised to aid the main blow in a further way, for if a French offensive pressed them back towards the Rhine, the attack through Belgium on the French flank would be all the more difficult to parry. It would be like a revolving-door—if a man pressed heavily on one side the other side would swing round and strike him in the back. The German enveloping mass was to sweep round through Belgium and northern France and, continuing to traverse a vast arc, would wheel gradually east. With its extreme right passing south of Paris and crossing the Seine near Rouen it would then press the French back towards the Moselle, where they would be hammered in rear on the anvil formed by the Lorraine fortresses and the Swiss frontier.

Schlieffen's plan allowed 10 divisions to hold the Russians in check while the French were being crushed. It is a testimony to the vision of this remarkable man that he counted on the intervention of Britain, and allowed for an expeditionary force of 100,000 "operating in conjunction with the French."[1] To him also was due the scheme for using the Landwehr and Ersatz troops in active operations and fusing the resources of the nation into the army. His dying words were, "It must come to a fight. Only make the right wing strong."

Unhappily for Germany, if happily for the world, the younger Von Moltke, who succeeded him, lacked his moral courage and clear grasp of the principle of concentration. Moltke retained Schlieffen's plan, but he whittled away the essential idea. Of the nine new divisions which became available between 1905 and 1914 Moltke allotted eight to the left wing and only one to the right. True, he added another from the Russian front, but this trivial increase was purchased at a heavy price, for the Russian Army of 1914 was a far more formidable menace than when Schlieffen's plan came into force. The result was to be that two army corps were taken from the French theatre at the crisis of the Aug. campaign, in order to reinforce the Eastern front. Schlieffen's death-bed warning was lost on his successor.

If the fault of the final German plan was a lack of courage, that of the French plan was due to an excess. In their case, also, a miasma of confused thought seemed to creep over the leadership in the years just before the War. Since the disasters of 1870 the French command had planned an initial defensive, based on the frontier fortresses, followed by a decisive counter-stroke. To this end the great fortress system had been created, and gaps like the Trouée de Charmes left to "canalise" the invasion ready for the counter. But in the decade before 1914 a new school of thought had arisen, who argued that the offensive was more in tune with French character and tradition, that the possession of the "75"—unique in mobility and rapidity of fire—made it tactically possible, and that the alliance with Russia and Britain made it strategically possible. Forgetful of the lessons of 1870 they imagined that *élan* was proof against bullets. Napoleon's much-quoted saying that "the moral is to the physical as three to one" has much to answer for; it has led soldiers to think that a division exists between the two, whereas each is dependent on the other. Weapons without courage are ineffective, but so also are the bravest troops without efficient weapons to protect them and their morale. Courage soon oozes when soldiers lose confidence in their weapons.

The outcome was disastrous. The new school found in General Joffre, appointed Chief of the General Staff in 1912, a lever for their designs. Under the cloak of his authority, the advocates of the *offensive à outrance* gained control of the French military machine, and, throwing aside the old doctrine, formulated the now famous, or notorious, Plan XVII. It was based on a double miscalculation. The initial strength of the German Army in the West was estimated at not more than 40–42 infantry divisions, and although the possibility of a German move through Belgium was recognised, the wideness of its sweep was utterly misjudged. The Germans were expected complaisantly to take the difficult route through the Ardennes in order that the French might conveniently smite their communications! Based on the idea of an immediate and general offensive, the plan ordained a main thrust by the I. and II. Armies towards the Saar into Lorraine. On their left were the III. Army opposite Metz and the V. Army facing the Ardennes, which were either to take up the offensive between Metz and Thionville, or, if the Germans came through Luxembourg and Belgium, to strike northeast at their flank. The IV. Army was held in strategic reserve near the centre and two groups of reserve divisions disposed in rear of either flank—relegation to such a passive rôle expressing French opinion on the capacity of reserve formations.

Britain's share in this plan was settled less by calculation than by the "Europeanisation" of her military organisation during the previous decade. This continental influence drew her insensibly into a tacit acceptance of the rôle of acting as an appendix to the French left wing, and away from her historic exploitation of the mobility given by sea-power. At the council of war on the

[1] H. von Kuhl, "Der Deutsche Generalstab," *Vorbereitung und Durchführung des Weltkrieges* (1920); W. Foerster, *Graf Schlieffen und der Weltkrieg* (1921).

outbreak, Lord Roberts, summoned from retirement, advocated the dispatch of the expeditionary force to Belgium—where it would have stiffened the Belgian resistance and threatened the flank of the wheeling German mass. But his was a voice crying in the wilderness, and in any case the British general staff had virtually pledged themselves to act in direct co-operation with the French. When the general staffs of the two countries conducted their informal negotiations between 1905 and 1914 they little realised that they were paving the way for a reversal of England's centuries-old policy for a war effort such as no Englishman had ever conceived.

On the eastern front, the plans of campaign were more fluid, less elaborately worked out and formulated—although they were to be as kaleidoscopic in their changes of fortune as in the western theatre. The calculable condition was geographical; the main incalculable, Russia's rate of concentration. Russian Poland was a vast tongue of country projecting from Russia proper, and flanked on three sides by German or Austrian territory. On its northern flank lay East Prussia with the Baltic Sea beyond. On its southern flank lay the Austrian province of Galicia with the Carpathian mountains beyond, guarding the approaches to the plain of Hungary. On the west lay Silesia. As the Germanic border provinces were provided with a network of strategic railways whilst Poland, as well as Russia itself, had only a sparse system of communications, the Germanic alliance had a vital advantage, in power of concentration, for countering a Russian advance. But if they took the offensive, the further they progressed into Poland or Russia proper the more would they lose this advantage. Hence their most profitable strategy was to lure the Russians on into position for a counter-stroke rather than to inaugurate an offensive themselves. The one drawback was that such a Fabian strategy gave the Russians time to concentrate and set in motion their cumbrous and rusty machine.

From this arose an initial cleavage between German and Austrian opinion. The Germans, intent on a decision against France, wished to leave a minimum force in the east, and only a political dislike of exposing national territory to invasion prevented them evacuating East Prussia and standing on the Vistula line. But the Austrians, under the influence of Conrad von Hötzendorf, Chief of their General Staff, were anxious to throw the Russian machine out of gear by an immediate offensive, and as this promised to keep the Russians fully occupied while the campaign in France was being decided Moltke fell in with this strategy.

On the opposing side, also, the desires of one ally vitally affected the strategy of the other. The Russian command, both for military and for racial motives, wished to concentrate first against Austria, while the latter was unsupported, and leave Germany alone until later, when the full strength of the Russian Army would be mobilised. But the French, anxious to relieve the German pressure against themselves, urged the Russians to deliver a simultaneous attack against Germany, and got the Russians to consent to an extra offensive for which they were neither ready, in numbers, nor organised. Russia, whose proverbial slowness and crude organisation dictated a cautious strategy, was about to break with tradition and launch out on a gamble that only an army of high mobility and organisation could have hoped to bring off.

II. EARLY OPERATIONS

The Detonation.—On June 28 1914 the murder of the Austrian Archduke Francis Ferdinand at Sarajevo set light to a powder trail which within a brief span exploded the European magazine in a series of detonations. Exactly one month later Austria-Hungary declared war against Serbia, whose appeal to her ally and protector led Russia to order a partial mobilisation on her southern front. The same day, July 29, an Imperial council at Potsdam decided on war against Russia, and, as a corollary, against France, although hoping to bargain for Britain's neutrality. While the chancelleries of Europe argued at cross-purposes, the military tide swept them off their feet. On July 31 Russia ordered a general mobilisation and Germany, taking equivalent steps, sent a twelve hours ultimatum. Austria, seeking to temporise, was dragged in the train of her more determined ally. By noon on Aug. 1 a state of war existed between Russia and Germany, and next day German troops entered French territory. At 7 P.M. came Germany's ultimatum to Belgium, demanding an unopposed passage. On Aug. 3 Germany's formal declaration of war on France followed, and on Aug. 4 her troops crossed the Belgian frontier, for the sanctity of which England stood guarantor. At midnight, in reply, England also entered the War—while the Belgian populace, rising to resist the German invaders, sounded the death-knell of gladiatorial wars and inaugurated the new warfare of peoples. And coincidently, by Italy's declaration of her neutrality, her refusal to fulfil the alliance with her hereditary enemy—Austria—the artificiality of the political alliance system broke down before the new wave of national feeling which was to characterise the World War.

The Clash in the West.—The German advance into France was designed as a methodical sweep, so that unexpected checks should not upset its time-table. Confronted with the fact that the Belgians would resist, a detachment was formed under General von Emmich to clear a passage through the Belgian plain north of the Ardennes, ready for the ordered advance of the main armies concentrating behind the German frontier. The ring fortress of Liége commanded this channel of advance, but, after an initial check, a German brigade penetrated between the forts and occupied the town. The interest of this feat is that it was due to the initiative of an attached staff officer, Ludendorff, whose name ere long was to be world-famous. The forts themselves offered a stubborn resistance and forced the Germans to await the arrival of their heavy howitzers, whose destructive power was to be the first tactical surprise of the World War.

The very success of the Belgians' early resistance cloaked the weight of the main German columns and misled the Allies' intelligence. The Belgian field army lay behind the Gette covering Brussels, and even before the Liége forts fell the advanced guards of the German I. and II. Armies were pressing against this line. The Belgians, deprived of support owing to the mistaken French plan and British conformity with it, decided to save their army by falling back on the entrenched camp of Antwerp. The Germans, their passage now clear, entered Brussels on Aug. 20, and on the same day appeared before Namur, the last fortress barring the Meuse route into France. It deserves emphasis that despite the Belgian resistance the German advance was slightly ahead of its time-table.

Meanwhile, away on the other flank, the main French thrust into Lorraine had begun on Aug. 14 and been shattered in the battle of Morhange-Saarburg, Aug. 20, where the French discovered that the material could subdue the moral, and that in their enthusiasm for the offensive they had blinded themselves to the defensive power of modern weapons, a condition which was to throw out of balance the whole mechanism of orthodox warfare. Yet it is but fair to add that this abortive offensive had an indirect effect, although this would hardly have been so if a Schlieffen or a Ludendorff had been in charge at German headquarters instead of the vacillating Moltke. Despite the fact that Moltke had almost doubled the strength of his left, compared with Schlieffen's plan, he had so little moral decision that when the French attack in Lorraine developed he diverted thither many of the newly formed divisions that should have been used to increase the weight of his right wing. When, however, the French were repulsed, he swung to the other extreme and acceded to the pleas of the importunate Crown Prince Rupprecht of Bavaria, who disliked a defensive rôle when others were reaping the personal glory of advance. Similarly, the German Crown Prince, commanding the pivotal V. Army between Metz and Thionville, attacked when he had been ordered to stand on the defensive. The lack of what Colonel Foch had termed "intellectual discipline" was to be a grave factor in Germany's failure, and for this the ambitions of "court" generals were to be largely responsible. Following up the French retreat from Lorraine, Rupprecht's Army entangled itself in a hopeless attempt

to force the French fortified zone between Nancy and the Vosges. Here the Germans in turn learnt the new power of modern defence, and did not even prevent the French drawing off troops to reinforce the other flanks.

But while this "see-saw" campaign in Lorraine was taking place, more decisive events were occurring to the northwest. The attack on Liége awakened Joffre to the reality of a German advance through Belgium, but not to the wideness of the sweep. And the sturdy resistance of Liége confirmed him in the opinion that the German right would pass south of it, through the Ardennes. Plan XVII. had visualised such a move, and prepared a counter. Grasping once more at phantoms, the French command embraced this idea so fervently that they transformed the counter into an imaginary *coup de grâce*. Their III. Army and the reserve IV. Army were to strike northeast through the Ardennes against the rear flank of the Germans advancing through Belgium. The left wing (V.) Army, under Lanrezac, was moved further to the northwest into the angle formed by the Sambre and Meuse between Givet and Charleroi. With the British expeditionary force coming up on its left, it was to deal with the enemy's forces north of the Meuse and to converge on the supposed German main forces in conjunction with the attack through the Ardennes. Here was a pretty picture—of the Allied pincers closing on the unconscious Germans! Curiously, the Germans had the same idea of a pincer-like manoeuvre, with rôles reversed, and with better reason.

The fundamental flaw in the French plan was that the Germans had deployed half as many troops again as they had been credited with, and for a vaster enveloping movement. The French, pushing blindly into the Ardennes against a German centre supposedly denuded of troops, blundered against the German III. and IV. Armies, and were heavily thrown back in encounter-battles around Virton-Neufchâteau. Fortunately the Germans were also too vague as to the situation to exploit their opportunity.

But to the northwest the French V. Army and the British had, under Joffre's orders, put their head almost into the German noose. The German masses of the I. and II. Armies were closing on them from the north, and the III. Army from the east. Lanrezac alone had an inkling of the hidden menace. All along he had suspected the wideness of the German manoeuvre, and it was through his insistence that his army had been permitted to move so far north. It was due to his caution in hesitating to advance across the Sambre, to the arrival of the British on his left unknown to the German intelligence, and to the premature attack of the German II. Army, that the Allied forces fell back in time and escaped from the trap.

At last Joffre realised the truth and the utter collapse of Plan XVII. Resolution was his greatest asset, and with imperturbable coolness he formed a new plan out of the wreckage. He decided to swing back his centre and left, with Verdun at the pivot, while forming a fresh VI. Army to enable the retiring armies to return to the offensive. His optimism might have been again misplaced but for German mistakes. The first was Moltke's folly in detaching seven divisions to invest Maubeuge and Givet and watch Antwerp, instead of using Landwehr and Ersatz troops as Schlieffen had intended. More ominous still was his decision on Aug. 25 to send four divisions to check the Russian advance in East Prussia. All these were taken from the right wing, and the excuse afterwards given for this violation of the principle of concentration was that the German headquarters thought that the decisive victory had already been won! Further, German headquarters lost all touch with the advancing armies and the movements of these became disjointed. The British stand at Le Cateau and Lanrezac's *riposte* at Guise were also factors in checking the German enveloping wing, and each had still greater indirect effects. For Le Cateau apparently convinced the German I. Army commander, Von Kluck, that the British Army could be wiped from the slate, and Guise led Von Bulow (II. Army) to call on the I. Army for help, whereupon Von Kluck wheeled inwards, thinking to roll up the French left. The idea of a Sedan was an obsession with the Germans, and led them to pluck the fruit before it was ripe. This premature wheel before Paris had been reached was an abandonment of the Schlieffen plan, and exposed the German right to a counter-envelopment. One further factor must be mentioned, perhaps the most significant of all: the Germans had advanced so rapidly, out-running their time-table, that their supplies failed to keep pace. Thus, in sum, so much grit had worked into the German machine that a slight jar would suffice to cause its breakdown. This was delivered in the battle of the Marne.

The opportunity was perceived, not by Joffre, who had ordered a continuance of the retreat, but by Galliéni, the Governor of Paris, where the new VI. Army was assembled. On Sept. 3 Galliéni realised the meaning of Von Kluck's wheel inwards, directed Maunoury's VI. Army to be ready to strike at the exposed German right flank, and with some difficulty won Joffre's sanction. Once convinced, Joffre acted with decision. The whole retiring line was ordered to turn about and return to a general offensive from Verdun westwards. The Germans, their advance finally dislocated by this jar, fell back in retreat, and Moltke gave place to Falkenhayn. It was a strategic but not a tactical defeat, and the German forces were able to stand firmly on the line of the Aisne. Here was re-emphasised the preponderant power of defence over attack, primitive as were the trench lines compared with those of later years. Then followed, as the only alternative, the successive attempts of either side to envelop the other's western flank, a phase known as the "race to the sea." This common design brought out what was to be a new and dominating strategical feature—the lateral switching of reserves by railway from one part of the front to another. Before it could reach its logical and lateral conclusion, a new factor intervened. Antwerp, with the Belgian field army, was still a thorn in the German side, and Falkenhayn determined to reduce it while a German cavalry force swept across to the Belgian coast as an extension of the enveloping wing in France.

The menace to Britain, if the Channel ports fell into German hands, was obvious. It is a strange reflection that the British command should have neglected to guard against the danger hitherto, although the First Lord of the Admiralty, Mr. Winston Churchill, had urged the necessity even before the battle of the Marne. When the German guns began the bombardment of Antwerp on Sept. 28 England awakened, and gave belated recognition to Churchill's strategic insight. He was allowed to send a brigade of marines and two newly formed brigades of naval volunteers to reinforce the defenders, while a regular division and cavalry division, under Rawlinson, were landed at Ostend and Zeebrugge for an overland move to raise the siege. Eleven Territorial divisions were available in England, but, in contrast to the German attitude, Kitchener considered them still unfitted for an active rôle. The meagre reinforcement delayed, but could not prevent, the capitulation of Antwerp, Oct. 10, and Rawlinson's relieving force was too late to do more than cover the escape of the Belgian field army down the Flanders coast.

Yet viewed in the perspective of victory, this first and last effort in the west to make use of Britain's amphibious power applied a brake to the German advance down the coast which just stopped their second attempt to gain a decision in the west. It gained time for the arrival of the main British force, transferred from the Aisne to the new left of the Allied line, and if their heroic defence at Ypres, aided by the French and Belgians along the Yser to the sea, was the human barrier to the Germans, it succeeded by so narrow a margin that the Antwerp expedition must be adjudged the saving factor. This defence of Ypres is in a duel sense the supreme memorial to the British Regular Army, for here they showed the inestimable value of the disciplined moral and unique standard of musketry which were the fruit of long training, and here was their tombstone. "From failing hands they threw the torch" to the new national armies rising in England to the call of patriotism. With the continental Powers the merging of conventional armies into national armies was a hardly perceptible process because of their system of

universal service. But with Britain it was clearly stamped as revolution, not evolution. While the little professional army sacrificed itself as the advanced guard of the nation, the truth of the new warfare of peoples was beginning to come home to the civilian population. Lord Kitchener, a national symbol because of his imperial achievements, had been summoned to the post of War Minister, and with a supreme flash of vision had grasped, in contrast to governments and general staffs alike, the probable duration of the struggle. The people of Britain responded to his call to arms, and like an ever-rising flood the " New Armies " came into being. By the end of the year nearly 1,000,000 men had enlisted and the British Empire had altogether some 2,000,000 under arms. Perhaps Kitchener was wrong in not basing this expansion, from a professional to a national scale, on the existing Territorial foundation. It must be remembered, however, that the Territorial Force was enlisted for home defence and that initially its members' acceptance of a wider rôle was voluntary. Perhaps, also, he was tardy in recognising their military value.

The duplication of forces and of organisation was undoubtedly a source of delay and waste of effort. Kitchener has also been reproached with his reluctance to replace the voluntary system by conscription, but this criticism overlooks how deeply rooted was the voluntary system in British institutions, and the slowness with which lasting changes can be effected in them. If Kitchener's method was characteristic of the man, it was characteristic of England. If it was unmethodical, it was calculated to impress most vividly on the British people the gulf between their " gladiatorial " wars of the past and the national war to which they were committed.

While a psychological landmark, the battle of Ypres is also a military landmark. For with the repulse of the German attempt to find an open flank the trench barrier was consolidated from the Swiss frontier to the sea. The power of modern defence had triumphed over attack, and stalemate ensued. The military history of the Entente during the next four years is a story of the attempts to upset this deadlock, either by forcing the barrier or by finding a way round.

The See-saw in the East.—But on the eastern front the greater distances and the greater differences between the equipment of the armies ensured a fluidity which was lacking in the west. Trench lines might form, but they were no more than a hard crust covering a liquid expanse. To break the crust was not difficult, and once broken, mobile operations of the old style became possible. This freedom of action was denied to the Western Powers, but Germany, because of her central position, had an alternative choice, and from Nov. 1914 onwards her command adopted a defensive in France while seeking to cripple the power of Russia in the east. Here, the opening encounters had been marked by rapid changes of fortune rather than by any decisive advantage. The Austrian command, emulating their allies, contrary to the principle of concentration detached part of their strength in an abortive attempt to crush Serbia. And their plan for an initial offensive to cut off the Polish " tongue " was further crippled by the fact that the German part of the pincers did not operate. It was indeed being menaced by a Russian pair of pincers instead, for the Russian commander-in-chief, the Grand Duke Nicholas, had ordered his I. and II. armies to invade East Prussia instantly, in order to ease the pressure on his French allies. As the Russians had more than a two-to-one superiority, a combined attack had every chance of crushing the Germans between the two armies. On Aug. 17, Rennenkampf's I. Army crossed the East Prussian frontier, and on Aug. 19–20 defeated Prittwitz's VIII. Army at Gumbinnen. On Aug. 21 Prittwitz heard that the Russian II. Army under Samsonov had crossed the southern frontier of East Prussia in his rear. In panic Prittwitz momentarily spoke of falling back behind the Vistula, whereupon Moltke superseded him by a retired general, Hindenburg, to whom was appointed as chief of staff Ludendorff, the hero of the Liége attack.

Developing a plan already initiated by Colonel Hoffman of the VIII. Army staff, Ludendorff concentrated some six divisions against Samsonov's left wing. This force, inferior in strength to the Russians, could not have been decisive, but Ludendorff, finding that Rennenkampf was still near Gumbinnen, took the calculated risk of withdrawing the German troops from that front and rushing them back against Samsonov's right wing. This daring move was aided by the absence of communication between the two Russian commanders and the German's ability to decipher Samsonov's wireless orders to his corps. Under the converging blows Samsonov's flanks were crushed and his centre surrounded. The outcome of this military masterpiece afterwards christened the battle of Tannenberg, was the destruction of almost the whole Russian II. Army. Then receiving two fresh army corps from the French front, the German commander turned on the dilatory Rennenkampf and drove him out of East Prussia.

Away on the southern front, however, the scales had tilted against the Central Powers. The offensive of the Austrian I. and IV. armies into Poland was nipped in the bud by a Russian onslaught on the II. and III. armies which were guarding their right flank. These armies were heavily defeated round Lemberg, and before long the whole Austrian line was in retreat, falling back almost to Cracow by the end of September. Austria's plight compelled the Germans to send aid, and the bulk of the force in East Prussia was formed into a new IX. Army and switched south to the southwest corner of Poland, whence it advanced on Warsaw in combination with a renewed Austrian offensive. But the Russians were now approaching the full tide of their mobilised strength; counter-attacking, they drove back the advance and followed it up by a powerful effort to invade Silesia.

The Grand Duke Nicholas formed a huge phalanx of seven armies—three in the van and two protecting either flank. Allied hopes rose high as the much-heralded Russian " steam-roller " began its ponderous advance. To counter it the German eastern front was placed under Hindenburg and Ludendorff, who devised yet another master-stroke, based on the system of lateral railways inside the German frontier. While the Russian advance was slowed down by the thorough destruction of the scanty communications in Poland, Ludendorff switched the German IX. Army back from southwest Poland and thrust it, on Nov. 11, down the Vistula against the joint between the two armies guarding the Russian right flank. The wedge, driven in by Ludendorff's mallet, sundered the two armies, forced the I. back on Warsaw and almost effected another Tannenberg against the II., which was nearly surrounded at Lódź, when the V. Army from the van turned back to its rescue. As a result, part of the German enveloping force almost suffered the fate planned for the Russians, but managed to cut its way through to the main body. If Ludendorff was balked of decisive tactical success, this manoeuvre had been a classic example of how a relatively small force, by using its mobility to strike at a vital point, can paralyse the advance of an enemy several times its strength. The Russian " steam-roller " was thrown out of gear, and never again did it threaten German soil.

Within a week, four new German army corps arrived from the western front, and although too late to clinch the missed chance of a decisive victory, Ludendorff was able to use them in pressing the Russians back by Dec. 15 to the Bzura-Ravka river line in front of Warsaw. This set-back and the drying up of his munition supplies decided the Grand Duke Nicholas to break off the see-saw fighting near Cracow and fall back on winter trench lines along the Nida and Dunajec rivers, leaving the end of the Polish " tongue " in the hands of the enemy. Thus, on the east as on the west, the trench stalemate had settled in, but the crust was less firm and the Russians had drained their stock of munitions to an extent that their poorly industrialised country could not make good.

The Grip on the Seas.—We deal third with the operations at sea, which actually occurred first in chronological order. The reason is that sea-power only came to exert a dominant, perhaps the dominant, influence on the War after the initial plans on land had miscarried. If the quick decision expected by the

military leaders had been reached it is questionable whether sea-power could have affected the issue. How narrowly Germany missed decisive victory, and by what a combination of hardly conceivable blunders, is in the light of history now clear. While it is possible that Britain could, and would have carried on the War unaided, we need to remember that in Aug. 1914 the condition was still that of a professional war with popular backing rather than a truly national war; that British intervention was still regarded as a chivalrous effort to succour violated Belgium and challenged France than as a life and death struggle for Britain's existence. And when a friend lies prone in a tiger's claws it is mistaken friendship to engage in a tug of war for the fragments if there is any chance of enticing the tiger from his prey.

But, fortunately, in 1914, the tiger was held at bay, and with this breathing space gained, Britain had the opportunity to exert her traditional weapon—sea-power. Its effect on the War was akin not to a lightning flash, striking down an opponent suddenly, but to a steady radiation of heat, invigorating to those it was used in aid of, and drying up the resources of the enemy.

But if its effect was extended and cumulative, its application was instantaneous, comparable almost to turning on an electric switch. This simple act, yet perhaps the most decisive of the war, took place before the actual outbreak—on July 29 when at seven o'clock in the morning that greater Armada, the British Grand Fleet sailed from Portland for its war station at Scapa Flow. Few eyes saw its passage, fewer minds knew its destination in those northerly Orkney isles controlling the passage between North Britain and Norway, but from that moment Germany's arteries were subjected to an invisible pressure which never relaxed until on Nov. 21 1918 the German fleet arrived in those same northern waters to hand itself into the custody of a force of whom it had seen no more than a few fleeting glimpses during 4¼ years of intangible struggle.

The fundamental cause of this unprecedented type of conflict lay in the recent development of new weapons, the mine and the submarine, which reproduced in naval warfare that same predominance of defensive over offensive power which was the key factor on land. The immediate cause, however, was the strategy adopted by Germany's naval command, partly through a miscalculation of Britain's probable strategy. Appreciating their own inferiority to the British fleet as well as the impossibility of a surprise blow in face of its preparedness, and believing that their enemy was obsessed with the Nelsonian tradition of seeking battle, the German command adopted a Fabian strategy. They aimed to refuse conflict until their mine-layers and submarines had weakened the strength of the British Navy, until the strain of a close blockade began to tell on the superior fleet and perhaps provided the chance of a surprise stroke, and until the conquest of Britain's allies on land made her position more difficult.

The plan had at least a sound geographical basis, for the nature and configuration of the German coast lent itself to this strategy. The short North Sea coastline was heavily indented, the estuaries a maze of difficult channels, and screened by a fringe of islands—of which Heligoland formed a strongly fortified shield to the naval bases at Wilhelmshaven, Bremerhaven and Cuxhaven. Best of all, from the estuary of the Elbe there was a backdoor into the Baltic Sea, the Kiel Canal. By this the naval forces in the Baltic could be rapidly reinforced, while an enemy advance into that land-locked sea was not only hampered by the neutral possession of its approaches but could be imperilled by submarine and destroyer attack while passing through the narrow channels between the Danish Islands. The natural defensive power of Germany's sea-frontiers made attack almost impossible, and conversely gave her an ideal base for raiding operations. The one obvious defect of this Fabian strategy was that it involved the immediate abandonment of Germany's foreign trade and reduced the possibility of her interference with the sea-borne supplies of Britain and her allies.

Moreover, the German plan of progressive attrition was vitiated by the strategy adopted by the British Admiralty, which abandoned the direct doctrine of seeking out the enemy for the indirect doctrine of "the fleet in being." Realising how the mine and submarine, combined with Germany's natural advantages, had made a close blockade hazardous, the Admiralty adopted a strategy of distant surveillance, keeping the battle fleet in a position which commanded the North Sea and in instant readiness for action if the enemy appeared, and using her light craft for closer, but not close observation. This strategy was not as passive as it seemed to a critical public, eagerly expecting a new Trafalgar. It appreciated that Britain's general command of the sea was the pivot of the Allied cause, and that to hazard it by exposure to uncompensated losses was the negation of this supreme requirement. Therefore, while desiring battle and being ready for it, the Admiralty quietly set about its primary duty of maintaining the security of the ocean-routes, dealing with the sporadic threats to those routes, and thirdly, ensuring the safe passage to France of the British Expeditionary Force.

The idea of economic pressure exercised by sea-power was still in embryo, and not until a later phase did it crystallise into a formal doctrine, and the term "blockade" assume a new and wider definition. The attack on sea-borne commerce was deep-rooted in the tradition of the British Navy, and thus the transition to an indirect attack on the life of the enemy nation—her supplies of food and raw material—was an almost imperceptible progress. When this pressure was exercised against herself in a novel form and by a new weapon—the submarine, it was human if illogical that she should decry it as an atrocity. It was not easy for a conservative mind to realise that with the translation from a war of Governmental policies into a war of peoples, the indefinite code of military chivalry must be submerged by the primitive instincts let loose by a struggle for existence. But in 1914 this "absolute" war was still only a latent conception, and had no influence on the opening operations, great as was to be their influence on it.

The history of the naval struggle must be dated from July 26 1914, when the Admiralty, in view of the clouded international situation, sent orders to the fleet assembled for review at Portland not to disperse. If the review was a happy chance, the use made of it was one of the decisive acts and wisest judgments of the War, for while free from any of the provocation of an army mobilisation, it placed Britain in automatic control of the situation at sea. It was followed on July 29 by the unnoticed sailing of the fleet for its war stations in the North Sea, and warning telegrams to all squadrons abroad. To students of war and politics the lesson should not be lost, for whatever its other limitations, a professional force has this power of unprovocative readiness which a national force inevitably lacks. "Mobilisation" is a threat, creating an atmosphere in which peaceful argument withers and dies. Between negotiations and mobilisation there is a gulf, between mobilisation and war an imperceptible seam, and the act of any irresponsible can draw a nation across it.

Adml. Jellicoe, the new commander of the Grand Fleet, had one initial weakness to contend with; his base at Scapa was without defences against torpedo attack, and the fortified base being prepared at Rosyth was still incomplete. The historic concentration of British sea-power had been on the Channel coast, where lay the best prepared and defended harbours, and the Government had been slow to provide funds for bases on the North Sea to accompany the change in the concentration areas.

The danger compelled him to take his fleet west of the Orkneys, although it came down as far as the Forth during the transport of the expeditionary force to France, which was directly protected by the older battleships of the Channel Fleet, and by a layered system of patrols in the southern waters of the North Sea. This safe passage of the expeditionary force was the first direct achievement of the navy. The next followed on Aug. 29 when Beatty's battle-cruiser squadron and Tyrwhitt's destroyer flotillas made a swoop into the Bight of Heligoland, sank several German light cruisers, and achieved the much greater

indirect effect of confirming the Germans in their strictly defensive strategy—not an unmixed blessing, for it led them to concentrate on the development of submarine attack. Apart from this engagement the story of 1914 in the North Sea is a record of unceasing vigilance on the one side; of minor submarine and mine-laying successes and losses, on the other.

The war in the Mediterranean opened with a mistake that was to have far-reaching political consequences. Two of Germany's fastest ships were there, the battle-cruiser "Goeben" and the light-cruiser "Breslau," and received orders from Berlin to steer for Constantinople. They evaded the British efforts to cut them off, partly owing to inelasticity in applying the Admiralty instructions.

On the high seas the chase was more prolonged. Germany had not been allowed time to send out commerce-destroyers from home waters, but for some months her few cruisers on foreign service were a thorn in the side of the British Navy. It was not easy to reconcile the needs of the North Sea concentration with the duty of patrolling and protecting the tremendous length of sea-routes along which supplies as well as troops were flowing from India and the dominions to the support of the mother-country. By the destruction of the "Emden" on Nov. 9 the Indian Ocean was finally cleared, but this success was offset by disaster in the Pacific, where Cradock's cruiser squadron was crushed by the heavier metal of Von Spee's armoured cruisers, "Scharnhorst" and "Gneisenau." This set-back was, however, promptly redeemed by the Admiralty, who dispatched Sturdee with two battle-cruisers, "Inflexible" and "Invincible" on a lightning dash to the South Atlantic, while another battle-cruiser, "Australia," swept down from Fiji on Von Spee's rear. Trapped on Dec. 8 at the Falkland Isles, by this finely conceived surprise, Von Spee was sunk, and with him the last instrument of German naval power upon the oceans.

From this time onwards the ocean communications of Britain and her Allies were secured for trade, for supplies and for the conveyance of troops. But as to all ocean routes there must be a land terminus, the development of the submarine made this security gradually less effective than it seemed on the morrow of Sturdee's victory.

One result of Britain's early established command of the sea was that it gave her the opportunity to sweep up Germany's oversea colonies with little hindrance or expenditure of force. Their seizure was valuable in that it gave the Allies important assets to bargain with in case of an unfavourable issue to the War. In Aug. a New Zealand expedition took possession of New Guinea and Samoa, and the Australian Navy cleared several important German wireless stations in the Pacific Isles. Japan, entering the War on England's side, sent a fleet and army to besiege the German fortress of Tsing-tau in China, which capitulated after a seventy-six days' siege. In Africa, Togoland was occupied in Aug.; the Cameroons were a sterner obstacle, and not until the end of 1915 were the German forces conquered by joint British and French forces after a prolonged but economically conducted campaign. General Botha, the South African premier, once in arms against England, now for her, organised a force which conquered German South-West Africa. Almost concurrently Botha rendered a still greater service to the British cause by putting down the rebellion of a section of disaffected Boers, which save for the Irish rising of Easter 1916 was the only revolt within the borders of the Empire during these four trying years.

Only German East Africa, the largest and richest of Germany's colonies, remained. And that, owing to the difficulties of the country and the skill of von Lettow-Vorbeck, the German commander, was not to be completely subdued until the end of 1917 An expeditionary force was sent thither in Nov. to support the local British East African forces, and was repulsed at Tanga. Not until late in 1915 could the British Govt., occupied with greater problems, spare either the time or the force to deal with this hornet's nest.

Submarine v. Blockade.—The nature of the War at sea began to undergo definite changes early in 1915. During the first phase Britain had been too busy in clearing the seas and maintaining the security of the sea-routes to devote much attention to the use of her sea command as an economic weapon against Germany. In any case her naval power was fettered by the artificial restrictions on blockade embodied in the Declaration of London of 1909, which the British Govt., with singular blindness, announced on the outbreak of war it would accept as the basis of its maritime practice. Their release from these self-imposed fetters was aided by Germany's action.

On Nov. 2 1914 a German battle-cruiser squadron made a raid on the Norfolk coast, as a reconnaissance to test the scope of Britain's naval defence. Another followed on Dec. 16 against the Yorkshire coast, bombarding Scarborough, Whitby and the Hartlepools. Each time the Germans slipped away safely, but when they attempted a third, on Jan. 24, the English battle cruiser squadron, under Beatty, trapped them off the Dogger Bank, sank "Blücher" and badly damaged "Derfflinger" and "Seydlitz." Although the stroke missed full success, it convinced the Germans of the futility of their attrition strategy, and von Ingenohl, the commander of their High Sea Fleet, was replaced by Von Pohl, who proposed to Falkenhayn an offensive submarine campaign, which for success must be unlimited. As a result, on Feb. 18, Germany proclaimed the waters round the British Isles a war zone where all ships, enemy or neutral, would be sunk at sight. This gave Britain a lever to loosen the Declaration of London, and she replied by claiming the right to intercept all ships suspected of carrying goods to Germany, and bring them into British ports for search. This tightening of the blockade caused serious difficulties with neutrals, America especially, but Germany eased the friction by torpedoing the great liner "Lusitania" May 7 1915. The drowning of 1,100 people, including some Americans, was a spectacular brutality which shocked the conscience of the world, and appealed more forcibly to American opinion even than the desolation of Belgium. This act, succeeded by others, paved the way for the entry of the United States into the War, though it was to be later than seemed likely on the morrow of the tragedy.

The Beginning of Air Attack.—The same period witnessed the dawn of another new form of war which helped to drive home the new reality that the war of armies had become the war of peoples. From Jan. 1915 Zeppelin raids began on the English coast and reached their peak in the following winter, to be succeeded by aeroplane raids. The difficulty of distinguishing from the air between military and civil objectives smoothed the path for a development which, beginning with excuses, ended in a frank avowal that in a war for existence the will of the enemy nation, not merely the bodies of their soldiers, is the inevitable target.

The Psychological Situation.—The first psychological symptom of the World War, as it seemed to many, was an immeasurable sigh of relief. Had the peoples of Europe sat on the safety-valve too long? The war-weary mind of to-day cannot reconstruct the tension and anxiety, the strain and stress of hope and fear of the long years of the peace that was no peace and yet was not war. It may be read as a revolt of the spirit against the monotony and triviality of the every day round, the completion of a psychological cycle when the memories of past war have faded, and paved the way for the emergence and revival of the primal "hunting" instinct in man.

This first phase of enthusiasm was succeeded by one of passion, the natural ferocity of war accentuated by a form of mob spirit which is developed by a "nation in arms." The British Army was immune because of its professional character, whereas in the German Army, the most essentially "citizen," it gained scope because of the cold-blooded logic of the General Staff theory of war. With the coming of the autumn, a third phase became manifest, more particularly among the combatants. This was the momentary growth of a spirit of tolerance, symbolised by the fraternisation which took place on Christmas day, but this in turn was to wane as the strain of the War became felt and the reality of the struggle for existence came home to the warring sides.

III. THE EVENTS OF 1915

The Deadlock on Land.—Well before the end of 1914, the reality of the deadlock on the western front was clear to the Governments and general staffs of the warring countries, and each was seeking a solution. The reaction varied in form and in nature according to the mental power and predisposition of the different authorities. With the Central Powers the opinion of Falkenhayn was the decisive factor, and the impression derived not merely from his critics but from his own account is that neither the opinion nor the direction was really clear as to its object. He was too obsessed with the principle of security at the expense of the principle of concentration, and in his failure to fulfil the second he undermined the foundations of the first.

On his appointment after the Marne reverse, he still adhered to the Schlieffen plan of seeking a decision in the west, but he did not follow the Schlieffen method of weakening his left wing in order to mass on the vital right wing. The Oct.-Nov. attack round Ypres was made largely with raw formations, while war-experienced troops lay almost idle between the Aisne and the Vosges. General Gröner, Chief of the Field Railways, even went so far as to submit a detailed plan to Falkenhayn for transferring six army corps to the right wing, but it was rejected. When we remember how close to breaking point was the Allied line at Ypres, it can only be said that for a second time the German supreme command saved the Allies. At this juncture, too, Ludendorff was pleading for re-inforcements to make his wedge-blow at the Russian flank near Lódź decisive, but Falkenhayn missed the chance by delaying until the Ypres failure had passed from assurance to fact.

Convinced at last of the strength of the Allied trench-barrier, Falkenhayn took the momentous decision to stand on the defensive in the west. But his object in so doing seems to have been vague. His feeling that the war must ultimately be decided in France led him to distrust the value, as he doubted the possibility, of a decision against Russia. Hence while he realised that the eastern front was the only practicable theatre for operations in the near future, he withheld the necessary reinforcements until forced to do so by the threatening situation of the Austro-Hungarian front. And even then he doled out reserves reluctantly and meagrely, enough to secure success but never in the quantity and the time for decisive victory.

It is to his credit, however, that he realised a long war was now inevitable, and that he set to work to develop Germany's resources for such a warfare of attrition. The technique of field entrenchment was carried to a higher pitch than with any other country, the military railways were expanded for the lateral movement of reserves, the supply of munitions and of the raw material for their manufacture was tackled so energetically and comprehensively, that an ample flow was ensured from the spring of 1915 onwards—a time when the British were only awakening to the problem. Here were laid the foundations of that economic organisation and utilisation of resources which was to be the secret of Germany's resisting power to the pressure of the British blockade. For the scientific grasp of the economic sphere in war Germany owed much to Dr. Walter Rathenau, a brilliant captain of industry. She was also a pioneer in the psychological sphere, for as early as the autumn of 1914, she launched a vast scheme of propaganda in Asia, to undermine British prestige and the loyalty of Britain's Mahommedan subjects. The defect of her propaganda, its crudeness, was less apparent when directed to primitive people than when applied to the civilised peoples of Europe and America.

The same period witnessed also the one great success for German diplomacy, the entry of Turkey into the War, although this was fundamentally due to a combination of pre-War causes with military events. Since 1909 the country had been under the control of the Young Turk party, to whom traditions, including that of friendship with Britain, were abhorrent. Germany, filled with her own dream of a Germanic Middle East—of which the Baghdad railway was the symbol, had skilfully exploited the opportunity to gain a dominating influence over the new rulers of Turkey. Their leader, Enver Pasha, had been military attaché in Berlin, German instructors permeated the Turkish Army and fleet, and a definite understanding existed between Germany and the Young Turk leaders as to common military action—urged by the common bond of necessary safeguard against danger from Russia. The arrival of the "Goeben" and "Breslau" reinforced the moral pressure of Von Wangenheim, the German ambassador, and eventually on Oct. 29 the Turks committed definite acts of war, at Odessa against Russia, and in Sinai against Britain.

Falkenhayn has shown "the decisive importance of Turkey joining in the struggle"—first as a barrier across the channel of munition supply to Russia, and secondly as a distraction to the military strength of Britain and Russia. Under German dictation, Turkey struck as early as mid-Dec. against the Russians in the Caucasus, but Enver's over ambitious plan ended in disaster at the battle of Sarikamish. Turkey was no more fortunate in her next venture; to cut Britain's Suez Canal artery with the East. The Sinai desert was a check on an invasion in strength, and the two small detachments which got across were easily repulsed, at Ismailia and El Kantara, although allowed to make good their retreat. But if both these offensives were tactical failures, they were of great strategic value to Germany by fixing large Russian and British forces.

As an offset, perhaps more moral than material, to Turkey joining the Central Powers, Italy definitely threw over the artificial ties of the old Triple Alliance, and joined the Entente. On May 24 she declared war on Austria—her hereditary enemy, although avoiding an open breach with Germany. If her main object was to seize the chance of redeeming her kinsmen in Trieste and the Trentino from Austrian rule, there was also a spiritual desire to reassert her historic traditions. Militarily, however, her aid could not greatly affect the situation, for her army was unready to deliver a prompt blow, and the Austrian frontier was a mountainous obstacle of great natural strength.

On the Entente side the reality of the trench deadlock produced different and diverse reactions. If the desire to hold on to her territorial gains swayed German strategy, the desire to recover her lost territory dominated French strategy. It is true that their mental and material concentration on the western front, where lay the main armed force of the enemy, was justified by military tenets, but without any key to unlock the barrier they were merely knocking themselves to pieces. Winter attacks in Artois, on the Aisne, in Champagne and the Woevre afforded costly proof, and against the Germans' skill in trench-fighting Joffre's "nibbling" was usually attrition on the wrong side of the balance sheet. As for any new key, the French were singularly lacking in fertility of idea.

Britain's trouble was rather an excess of fertility, or rather an absence of concentration in choosing and bringing to fruition these mental seeds. Yet in great measure this failing was due to the obscurantism of professional opinion, whose attitude was that of blank opposition rather than expert guidance.

British-inspired solutions to the deadlock crystallised into two main groups, one tactical, the other strategical. The first was to unlock the trench barrier by producing a machine invulnerable to machine-guns and capable of crossing trenches, which would restore the tactical balance upset by the new preponderance of defensive over offensive power. The idea of such a machine was conceived by Colonel Swinton in Oct. 1914, was nourished and tended in infancy by Mr. Winston Churchill, then First Lord of the Admiralty, and ultimately after months of experiment hampered by official opposition came to maturity in the tank of 1916.

The strategical solution was to go round the trench barrier. Its advocates—who became known as the "eastern," in contrast to the "western" school—argued that the enemy alliance should be viewed as a whole, and that modern developments had so changed conceptions of distance and powers of mobility, that a blow in some other theatre of war would correspond to the historic attack on an enemy's strategic flank. Further, such an operation would be in accordance with the traditional amphibious strategy of Britain, and would enable it to exploit the

advantage of sea-power which had hitherto been neglected. In Oct. 1914 Lord Fisher, recalled to the office of First Sea Lord, had urged a plan for a landing on the German coast. In Jan. 1915, Lord Kitchener advocated another, for severing Turkey's main line of eastward communication by a landing in the Gulf of Alexandretta. The post-War comments of Hindenburg and Enver show how this would have paralysed Turkey. It could not, however, have exercised a wider influence, and it was anticipated by another project—partly the result of Churchill's strategic insight and partly due to the pressure of circumstances.

The Dardanelles Expedition.—This was the Dardanelles expedition, about which controversy has raged so hotly that the term just applied to Churchill may be disputed by some critics. This is answered by the verdict of Falkenhayn himself: "If the Straits between the Mediterranean and the Black Sea were not permanently closed to Entente traffic, all hopes of a successful course of the War would be very considerably diminished. Russia would have been freed from her significant isolation . . . which offered a safer guarantee than military successes . . . that sooner or later a crippling of the forces of this Titan must take place. . . . automatically." The fault was not in the conception, but in the execution. Had the British used at the outset even a fair proportion of the forces they ultimately expended in driblets, it is clear from Turkish accounts that victory would have crowned their undertaking.

On Jan. 2 1915 Kitchener received an appeal from the Grand Duke Nicholas for a diversion which would relieve the Turkish pressure on Russia's army in the Caucasus. Kitchener felt unable to provide troops and suggested a naval demonstration against the Dardanelles, which Churchill, appreciating the wider strategic and economic issues, proposed to convert into an attempt to force the passage. His naval advisers, if not enthusiastic, did not oppose the proposal and in response to a telegram the admiral on the spot, Carden, submitted a plan for a methodical reduction of the forts and clearance of the mine-fields. Fisher, while clinging to his own North Sea project strongly advocated a combined naval and military expedition. On Jan. 13 the War Council decided for a naval expedition to "take the Gallipoli peninsula, with Constantinople as its objective." A naval force, mainly of obsolete vessels was got together with French aid, and after preliminary bombardment, entered the straits on March 18. Drift mines, however, caused the sinking of several ships, and the attempt was abandoned.

It is a moot point whether a prompt renewal of the advances would not have succeeded, for the Turkish ammunition was exhausted, and in such conditions the mine obstacle might have been overcome. But the new naval commander, Admiral de Robeck decided against it, unless military aid was forthcoming. Already, a month before, the War Council had determined on a joint attack, and began the despatch of a military force under Sir Ian Hamilton. But as the authorities had drifted into the new scheme, so were they tardy in releasing the necessary troops, and even when sent, in inadequate numbers, several more weeks delay had to be incurred—at Alexandria—in order to redistribute the force in its transports suitably for tactical action. Worst of all, this fumbling policy had thrown away the chance of surprise, which was vital for a landing on an almost impregnable shore. When the preliminary bombardment took place in Feb., only two Turkish divisions were at the straits, this was increased to four by the date of the naval attack, to six when Hamilton was at last able to attempt his landing. For this he had only four British divisions and one French division—actually inferior in strength to the enemy in a situation where the inherent preponderance of defensive over offensive power was multiplied by the natural difficulties of the terrain. His weakness of numbers and his mission of aiding the passage of the fleet compelled him to choose a landing on the Gallipoli peninsula in preference to one on the mainland or on the Asiatic shore; and the rocky coastline limited his possible landing places.

On April 25 he made his spring, at the southern tip of the peninsula near Cape Hellas and—with Australian and New Zealand troops—near Gaba Tepe, some 15 m. up the Aegean coast; the French, as a diversion, made a temporary landing at Kum Kale on the Asiatic shore. The troops effected the impossible and made good their lodgment on beaches strewn with barbed wire and swept by machine-guns. But the momentary asset of tactical surprise had passed, the difficulties of supply were immense, while the Turks held the commanding heights and were able to bring up their reserves. The invaders managed to hold on to their two precarious footholds, but they could not expand them appreciably, and the stagnation of trench-warfare set in. They could not go on, and national prestige forbade them to go back.

Ultimately, in July, the British Govt. decided to send a further five divisions to reinforce the seven by now on the peninsula. By the time they arrived the Turkish strength in the region had also risen to 15 divisions. Hamilton decided on a double stroke—a reinforced blow from Gaba Tepe and a new landing at Suvla Bay a few miles north—to sever the middle of the peninsula and secure the heights commanding the Narrows. He deceived the Turkish command and achieved surprise (Aug. 6), but the first blow failed and the second lost a splendid chance by the inexperience of the troops and still more the inertia and fumbling of the local commanders. For over 36 hours, before reserves arrived, only one and a half Turkish battalions barred the path. Energetic new commanders, for whom Hamilton had previously asked, were sent out when the opportunity had passed. The British were once more condemned to hang on to tenuous footholds, and with the autumn rains setting in their trials were increased. The Government had lost faith and were anxious to withdraw, but fear of the moral effect delayed their decision. Hamilton was asked for his opinion, however, and when he pronounced in favour of continuing—in which course he still had confidence—he was replaced by Sir Charles Monro, who immediately declared for evacuation. Kitchener was then sent out to investigate, and on his verdict a withdrawal was sanctioned and carried out from Suvla and Anzac on the night of Dec. 18–9 and from Hellas on that of Jan. 8–9. If the bloodless evacuation was an example of masterly organisation and co-operation it was also a proof of the greater ease of such operations in modern warfare. Thus the curtain rang down on a sound and farsighted conception marred by a chain of errors in execution almost unrivalled even in British history.

While the British were striving to unlock the back door to Russia, the Germanic Powers were hammering their Russian allies, whose resistance was collapsing in large measure from a lack of munitions which could only be made good by foreign supplies through that locked entrance, the Dardanelles. On the eastern front, the campaign of 1914 had shown that a German force could count on defeating any larger Russian force, but that when Russians and Austrians met on an equality victory rested with the Russians. Falkenhayn was forced, reluctantly, to despatch German reinforcements as a stiffening to the Austrians, and thus was dragged into an offensive in the East rather than adopting it as a clearly defined plan. Ludendorff, in contrast, had his eyes firmly fixed on the ultimate object, and from now on advocated unceasingly a whole-hearted effort to break Russia. Ludendorff's was a strategy of decision, Falkenhayn's a strategy of attrition.

In the conflict of wills between these two men lies the clue to the resultant strategy of Germany—highly effective, yet not decisive. On the Russian side the plan embodied the lessons of experience and was soundly conceived, but the means were lacking and the instrument defective. The Grand Duke Nicholas aimed to secure both his flanks solidly before attempting a fresh blow towards Silesia. From Jan. until April the Russian forces on the southern flank of the Polish salient strove to gain possession of the Carpathians and the gateways into the Hungarian plain. But the Austrians, with a German infusion, parried their efforts, and the loss was disproportionate to the small gains. The long-besieged fortress of Przemysl, however, at last fell into their hands. In northern Poland the Russians were preparing to strike upwards at East Prussia, when they were forestalled by a fresh Ludendorff stroke eastwards towards the frontier of

Russia proper. The blow was launched on Feb. 7 over snow-buried roads and frozen swamps, and was distinguished by the envelopment of four Russian divisions in the Augustovo forests. Moreover, it extracted the sting from the Russian attack further west.

These moves were, however, merely a "curtain-raiser" to the real drama of 1915. But before turning to this it is necessary to glance at events on the western front, the importance of which is partly as a sign post to the future and partly because of their reaction on the eastern front. While a way round the trench barrier was being sought in Gallipoli and experiments on a novel key were being carried out in England, the Entente commands in France were trying more orthodox solutions. The most significant was the British attack at Neuve Chapelle on March 10. Here a heavy concentration of artillery was secretly assembled, and an intense bombardment of half an hour's duration delivered on the German trenches, after which the artillery lengthened their range and dropped a curtain of fire to prevent the reinforcement of the enemy's battered trenches, which were rapidly overrun by the infantry.

Complete surprise was attained and most of the first positions captured, but control broke down, reserves were late in coming up, and the opportunity of exploiting the initial success vanished. A further factor was that the narrowness of the attack sector made the breach more easy for the defenders to close, although this defect was unavoidable owing to the general shortage of munitions. The British authorities had been slower than the Germans to awaken to the scale of ammunition supply required for this new warfare, and the shortage of shells became so obvious in the spring of 1915 as to lead to a public outcry which culminated in the establishment of a Ministry of Munitions, under Mr. Lloyd George, to co-ordinate and develop both manufacture and the supply of raw materials. Apart from shells, the crudeness and inferiority of all the British trench-warfare weapons compared with the Germans, made such a radical reorganisation overdue, and its urgency was emphasised by the near approach of the time when Britain's new national armies would take the field. If the task was undertaken late, it was carried out with energy and thoroughness, and by 1916 the flow of munitions reached a volume, still expanding, which finally removed any material handicap on the strategy of the British leaders.

The tactical sequel of Neuve Chapelle was less fortunate. It was clear that the small-scale experiment had only missed success by a narrow margin and that there was scope for its development. But the Entente commands missed the true lesson, which was the surprise attainable by a short bombardment that compensated its brevity by its intensity. And only partially did they appreciate that the sector attacked must be sufficiently wide to prevent the defender's artillery commanding, or his reserves closing the breach. Instead, they drew the superficial deduction that mere volume of shell-fire was the key to success. Not until 1917 did they revert to the Neuve Chapelle method. It was left to the Germans to profit by the experience against the Russians in May.

But before that came, the western front was destined to increase the tally of military blunders. In the first, it was the Germans' turn to find and misuse a new key to the trench deadlock. This was the introduction of gas, and, unlike the British introduction of tanks later, the chance, once forfeited, did not return, owing to the relative ease of providing an antidote. In a local attack in Poland on Jan. 31, the Germans had tried the use of gas-shells, but the experiment had been a failure owing to the nullifying effect of the intense cold. At the next attempt it was discharged from cylinders owing to the failure of the authorities to provide the inventor, Haber, with adequate facilities for the manufacture of shells. Further, the initial disappointment led the German command to place little trust in its value. In consequence, when discharged against the French trenches at Ypres on April 22, there were no reserves at hand to pour through the wide breach it created. A strange green vapour, a surging mass of agonised fugitives, a four miles gap without a living defender—such was the sequence of events. But the heroic resistance of the Canadians on the flank of the breach and the prompt arrival of English and Indian reinforcements saved the situation in the absence of German reserves.

The chlorine gas originally used was undeniably cruel, but no worse than the frequent effect of shell or bayonet, and when it was succeeded by improved forms of gas both experience and statistics proved it the least inhumane of modern weapons. But it was novel and therefore labelled an atrocity by a world which condones abuses but detests innovations. Thus Germany incurred the moral odium which inevitably accompanies the use of a novel weapon without any compensating advantage (*see* CHEMICAL WARFARE).

On the Entente side, wisdom would have counselled a period of waiting until their munition supply had grown and the new British armies were ready, but the desire to regain lost territory and the duty of relieving the pressure on Russia, combined with an ill-founded optimism to spur Joffre to premature offensives. The German losses were exaggerated, their skill and power in defence underrated, and a series of diffused and unconnected attacks were made. The chief was by the French between Lens and Arras, under Foch's direction, and the earlier experience of failure to penetrate beyond the first positions was repeated. Even more futile were the British attacks at Festubert early in May.

The effect of these attacks was, however, to convince even the dubious Falkenhayn of the strength of his Western line and of the remoteness of any real menace from the Franco-British forces. His offensive on the eastern front had already opened. Tactically unlimited, its strategical object was at first only the limited one relieving the pressure on the Austrian front and, concurrently, reducing Russia's offensive power. Falkenhayn judged a rupture of the Russian centre to be the best means to this end, and chose the Dunajec sector between the upper Vistula and the Carpathians as offering the least obstacles to an advance and best protection to the flanks of a penetration. The break-through was entrusted to Mackensen, whose force comprised the newly formed German XI. Army—with divisions from the West, and the IV. Austro-Hungarian Army. The Ypres gas attack and a large cavalry raid from East Prussia were initiated to cloak the concentration on the Dunajec, of 10 divisions and 1,500 guns against a front weakly held and lacking rear lines of trenches.

On May 2, after an intense bombardment had flattened the Russian trenches, the attack was launched and swept through with little opposition. The surprise was complete, the exploitation rapid, and despite a gallant stand on the Wisloka river, the whole line along the Carpathians was rolled up, until on May 14 the advance reached the San, 80 m. from its starting point. Defeat almost turned into disaster when this was forced at Jaroslav, but the impetus of the advance had momentarily spent itself and reserves were lacking. A new factor was introduced by Italy's declaration of war against Austria, but Falkenhayn persuaded the Austrian command, with some difficulty, not to move troops from the Russian front, and to maintain a strict defensive on their Italian frontier, which was secured by the mountain barrier. He realised that he had committed himself too far in Galicia to draw back, and that only by bringing more troops from France could he hope to fulfil his object of transferring troops back there, as this could only be possible when Russia's offensive power was crippled and her menace to Austria removed. Strengthened by these reinforcements, Mackensen attacked again in co-operation with the Austrians, retook Przemysl on June 3 and captured Lemberg on June 22, cutting the Russian front into two separated portions.

But the Russians, from their vast man-power resources, had almost made good the loss of 400,000 prisoners, and Falkenhayn's anxiety about the stability of his Austrian allies decided him to continue the offensive, although still with limited objects and with one eye on the situation in France. He changed its direction, however, from eastwards to northwards, between the Bug and Vistula, where lay the main Russian forces. In conjunction,

Hindenburg was ordered to strike southeast from East Prussia, across the Narew and towards the Bug. Ludendorff disliked the plan as being too much of a frontal attack; the Russians might be squeezed by the closing in of the two wings but their retreat would not be cut off. He urged once more his scheme for a wide enveloping manoeuvre through Kovno on Vilna and Minsk, but Falkenhayn rejected it, fearing that it would mean more troops and a deeper commitment. The result justified Ludendorff's expectation—the Grand Duke extricated his troops from the Warsaw salient before the German shears could close on him. Falkenhayn, on the other hand, considered that Ludendorff had not put his full weight into the attack.

Nevertheless, 750,000 prisoners had been taken by the middle of August, Poland had been occupied, and Falkenhayn decided to break off large scale operations on the eastern front. Bulgaria's entry into the War was now arranged and he wished to support the combined attack of Austria and Bulgaria against Serbia, as well as to transfer troops back to meet the French offensive expected in September. Mackensen was sent to the Serbian front and Ludendorff was given a belated permission to carry out his Vilna scheme, with such resources as he had, but as an independent operation.

It began on Sept. 9, Von Below's Army of the Niemen and Eichhorn's X. Army forming two great horns which gored their way into the Russian front, the one east towards Dvinsk and the other southeast towards Vilna. The Russians were driven back in divergent directions and the German cavalry advancing between the horns far overlapped Vilna and drew near the Minsk railway. But the German strength was slender, the Russians free to concentrate against this isolated menace, and in face of the stiffening resistance Ludendorff took the wise course of suspending operations. The crux of the situation was that the Russian armies had been allowed to draw back almost out of the net before the long delayed Vilna manoeuvre was attempted; the degree of success attained with such weak forces was confirmation of its practicability and of Ludendorff's claim that a powerful blow delivered while the Russians were deeply enmeshed in the Polish salient might have annihilated the armed force of Russia. She had been badly lamed, but not destroyed, and although never again a direct menace to Germany, she was able to delay the full concentration of German strength in the West for two years, until 1918. Falkenhayn's cautious strategy was to prove the most hazardous in the long run, and indeed to pave the way for Germany's bankruptcy.

Thus, at the end of Sept., the Russian retreat, after a nerve-wracking series of escapes from the salients which the Germans systematically created and then sought to cut off, came to a definite halt on a straightened line, stretching from Riga on the Baltic to Czernowitz on the Rumanian frontier. But the Russian armies had gained this respite at a ruinous price, and their Western allies had effected little in repayment of Russia's sacrifice on their behalf in 1914. For the Franco-British relief offensive of Sept. 25 had been no more fruitful than its predecessors. The main blow was launched by the French in Champagne, in conjunction with a Franco-British attack on either side of Lens. One fault was that the sectors were too far apart to have a reaction on each other, but a worse was that the command tried to reconcile two irreconcilable factors—they aimed at a break through but preceded it with a prolonged bombardment which gave away any chance of surprise. Both attacks gained the front German positions without difficulty, but then delay in bringing reserves forward allowed the German reserves to close the gaps, a task simplified by the narrowness of the attack frontage. The slight gains of ground in no way compensated for the heavy price paid for them. The British share in this offensive is, however, notable as marking the appearance in strength of the New Armies; at Loos they were "blooded" and if inexperience detracted from their effectiveness, their courage and driving force were an omen of Britain's power to improvise a national effort comparable with the long-created military machines of the Continent.

The direction of this effort inspired less confidence, and Sir John French gave place to Sir Douglas Haig as Commander-in-Chief, just as already in Sept. the Russian command had been transferred from the Grand Duke Nicholas, nominally to the Tsar, as a moral symbol, but actually to Gen. Alexeiev, the new chief of staff.

The Conquest of Serbia, Oct. 1915.—While stalemate, although with marked changes beneath the surface, once more settled in on both the eastern and western fronts, the latter months of 1915 witnessed fluid operations elsewhere which were to have an uncalculated influence on the War.

Austria had proved capable of holding the Italians on the Isonzo, and once the Russian danger began to fade under the pressure of the summer offensive, her command was anxious to deal with Serbia conclusively. Austria's attempted invasions in Aug. and Sept. 1914 and again in Nov., had been brusquely repulsed by Serbian counter-strokes, and it was not pleasant for a great Power, especially one with so many Slav subjects, to swallow such military rebuffs. Her impatience coincided with Falkenhayn's desire to gain direct railway communications with Turkey, hard pressed at the Dardanelles. Throughout the summer the rival coalitions had been bidding for Bulgaria's support, and in this bargaining the Entente suffered the moral handicap of military failure and the material handicap caused by Serbia's unwillingness to give up any part of Macedonia—of which she had despoiled Bulgaria in 1913. As Austria had no objection to offering territory that belonged to her enemy, Bulgaria accepted her bid. This accession of strength enhanced the chance of a decision against Serbia and in Aug. Falkenhayn decided to reinforce Kövess's Austrian III. Army with Gallwitz's German XI. Army from the Russian front. In addition two Bulgarian Armies were available. Mackensen was sent to direct the operations. To meet this new threat Serbia, apart from her own relatively small forces, had only a treaty guarantee of Greek aid and promises from the Entente Powers. The first disappeared with the fall of Veniselos, the pro-Ally Greek premier, and the second, as usual, was too late.

On Oct. 6 1915 the Austro-German Armies attacked southwards across the Danube, with a flanking movement across the Drina on the right. The sturdy resistance of the Serbs in delaying actions, and the natural difficulty of the mountainous country, checked the advance, but before Franco-British reinforcements could arrive, the Bulgarian Armies struck westwards into southern Serbia, across the rear of the main Serbian Armies. This drove a deep wedge between the Serbs and their allies, moving up from Salonika, and automatically loosened the props of the resistance in the north. With their line bent at both ends until it resembled a vast bow, threatened with a double envelopment, and with their retreat to the south cut off, the Serbian Armies decided to retire west through the Albanian mountains. Those who survived the hardships of this mid-winter retreat were conveyed to the island of Corfu, and after being re-equipped and reorganised, joined the Entente force at Salonika in the spring of 1916. The conquest of Serbia, though not as it proved of Serbian military power, relieved Austria of danger on her southern frontier, and gave Germany free communication and control over a huge central belt from the North Sea to the Tigris. For the Entente this campaign dug a military sump-pit, which for three years was to drain their military resources, there to lie idle and ineffective. Yet ultimately that sump-pit was to overflow and wash away one of the props of the Central Alliance.

The Salonika Expedition.—When at the beginning of Oct. the Entente Govts. had awakened to Serbia's danger, British and French divisions had been despatched hurriedly from Gallipoli to Salonika, which was the only channel of aid to Serbia by the railway to Uskub. Under the command of Gen. Sarrail, the advanced guard of this relieving force pressed up the Vardar and over the Serbian frontier, only to find that the Bulgarian wedge had cut them off from the Serbians, and they were forced to fall back on Salonika, pursued by the Bulgarians. On military grounds an evacuation of Salonika was indicated, but political reasons induced the Allies to remain. The Darda-

nelles failure had already diminished their prestige, and by convincing the Balkan states of German invincibility had decided Bulgaria to enter the War and Greece to break her treaty with Serbia. To evacuate Salonika would be a further loss of prestige, whereas by holding on they could check German influence over Greece, and maintain a base of operations from which to aid Rumania if, as expected, she entered the War on their side. To this end the Salonika force was augmented with fresh British and French divisions, as well as contingents from Italy and Russia, and there also the rebuilt Serbian Army was brought. But apart from the capture of Monastir in Nov. 1916 and an abortive attack in April 1917, the Entente force made no serious offensive until the autumn of 1918. Its innocuousness was partly due to the natural difficulties of the country—the chain of mountain ridges which guarded the approach to the Balkans, partly to the feeling of the Allied Govts. that it was a bad debt, and partly to the personality of Sarrail, whose conduct and reputation for political intrigues failed to command the confidence and co-operation essential if such a mixed force was to "pull its weight." On their side the Germans were content to leave it in passivity, under guard of the Bulgarians, while they steadily withdrew their own forces for use elsewhere. With gentle sarcasm they termed Salonika their "largest internment camp," and with half a million allied troops locked up there the jibe had some justification—until 1918.

The Mesopotamia Expedition to the Fall of Kut.—Nor was Salonika the only "drain" opened in 1915. Mesopotamia was the site of a fresh diversion of force from the centre of military gravity, and one which could only be excused on purely political grounds. It was not, like Salonika and the Dardanelles, begun to relieve a hard-pressed ally, nor had it the justification of the Dardanelles expedition of being directed at the vital point of one of the enemy states. The occupation of Mesopotamia might raise British prestige, and it might annoy Turkey, but it could not endanger the power of resistance. Although its origin was sound, its development was another example of "drift," due to the inherent faultiness of Britain's machinery for the conduct of war.

The oil-fields near the Persian Gulf were of essential importance for Britain's oil supply, and thus when war with Turkey was imminent, a small Indian force, of one division, was despatched to safeguard them. To fulfil this mission effectively it was necessary to occupy the Basra vilayet at the head of the Persian Gulf, in order to command the possible lines of approach.

On Nov. 21 1914 Basra was captured, but the rising stream of Turkish reinforcements compelled the Indian Govt. to add a second division. The Turkish attacks in the spring of 1915 were repulsed, and the British commander, Gen. Nixon, judged it wise to expand his footing, for greater security. Townshend's division was pushed up the Tigris to Amara, gaining a brilliant little victory, and the other division up the Euphrates to Nasiriya. Southern Mesopotamia was a vast alluvial plain, roadless and railless, in which there were two great rivers formed the only channels of communication. Thus a hold on Amara and Nasiriya covered the oil-fields; but Nixon and the Indian Govt., inspired by these successes, decided to push forward to Kut-el-'Amara, a move which was 180 m. further into the interior but had a partial military justification in the fact that at Kut the Shatt-el-Hai, issuing from the Tigris, formed a link with the Euphrates by which Turkish reserves could be transferred from one river line to the other.

Townshend was sent forward in Aug., defeated the Turks near Kut, and his cavalry carried the pursuit to Aziziya, half way to Baghdad. Enthusiasm spread to the home government, anxious for a moral counterpoise to their other failures, and Nixon received permission for Townshend to press on to Baghdad. But after an indecisive battle at Ctesiphon, the growing superiority of the Turkish strength, compelled him to retreat to Kut. Here, isolated far from help, he was ordered to remain, as several fresh divisions were being sent to Mesopotamia. Kut was invested by the Turks on Dec. 8 1915, and the relieving forces battered in vain against the Turkish lines covering the approach on either bank of the Tigris. The conditions were bad, the communications worse, the generalship faulty, and at last on April 29 1916 Kut was forced to surrender. However unsound the strategy which despatched Townshend, it is just to emphasise that its actual achievements in face of superior numbers, with inadequate equipment and primitive communications, and utterly isolated in the heart of an enemy country, wrote a glorious page of British history. When these handicaps are compared with the four to one superiority in number, and highly organised supply system of the force which ultimately took Baghdad, the comparison explains the awe in which Townshend and his men were held by the Turks.

The Home Front 1915.—Perhaps one of the most significant landmarks of the transition of the struggle from a "military" to a "national" war was the formation of a National Ministry in Britain, which occurred in May 1915. For the prototype of Parliaments to abandon the deep-rooted party system and pool the direction of the War was proof of the psychological upheaval of traditions. The Liberal Prime Minister, Asquith, remained, but the real lead began to pass insensibly into other hands, notably those of Mr. Lloyd George. Mr. Churchill, whose vision had saved the menace to the Channel ports and made possible the future key to the deadlock, was shelved, as already had been Haldane, the creator of the Expeditionary Force.

Political changes were general in all countries, and were symptomatic of a readjustment of popular outlook. The early fervour had disappeared, and been replaced by a dogged determination which if natural to the British was in strange contradiction to what had been reported of the French temperament.

Economically, the strain had yet to be felt severely by any country. Finance had shown an unexpected power of accommodation, and neither the blockade or the submarine campaign had seriously affected the food supply. If Germany was beginning to suffer some shortage, her people had more tangible omens of success to fortify their resolution than had their enemies.

IV. FROM VERDUN TO THE ENTRY OF AMERICA

Verdun 1916.—In 1914 the centre of gravity of the World War had been on the western front, in 1915 it shifted to the eastern front, and in 1916 once more moved back to France. Although the Entente had dissipated some of their strength in Salonika and Mesopotamia, the rising tide of England's new armies and of her munition supplies promised the power for an effort far larger in scale than before to break the trench deadlock. Measures had also been taken to keep these new divisions up to strength. Although the principle of voluntary enlistment had not yet been abandoned, the method was systematised and based on a National Register. This scheme, launched in Oct. 1915 under the *aegis* of Lord Derby, aimed to reconcile the demands of the army with the needs of industry, calling up men by groups as they were wanted, and taking single men first. But the response among the latter was not adequate to preserve this graduated principle and in Jan. 1916 by the Military Service Act, the voluntary system—system is hardly the correct term—was replaced by conscription.

At the close of 1915 the Entente command adopted the principle of a simultaneous general offensive in 1916 by France, Britain, Russia and Italy. In view of the rawness of the British troops, it was recognised that time must be allowed for training, and that the offensive could not begin before the summer of 1916, although it was hoped to carry out preliminary attacks to wear down the enemy's strength.

But German action was to dislocate this scheme, and only the British share came fully into operation, and not even that into full effect. Falkenhayn was about to fulfil his long-cherished plan for a Western offensive, but with characteristic limitations. Always a believer in the strategy of attrition, he now carried this ruling idea into tactics, and produced the new form of attack by methodical stages, each with a limited objective. In a memorandum to the German Emperor at Christmas 1915 he argued that England was the staple of the enemy alliance. "The history of the English wars against the Netherlands, Spain,

France and Napoleon is being repeated. Germany can expect no mercy from this enemy, so long as he still retains the slightest hope of achieving his object." Save by submarine warfare, however, England and her army were out of reach, for her sector of the front did not lend itself to offensive operations. "In view of our feelings for our arch enemy in the War that is certainly distressing, but it can be endured if we realise that for England the campaign on the Continent . . . is at bottom a side-show. Her real weapons here are the French, Russian and Italian armies." He regarded Russia as already paralysed, and Italy's military achievements as unlikely to affect the situation. "Only France remains." "France has almost arrived at the end of her military effort. If her people can be made to understand clearly that in a military sense they have nothing more to hope for, breaking-point would be reached, and England's best sword knocked out of her hand." He added that a break-through in mass was unnecessary, and that instead the Germans should aim to bleed France to death by choosing a point of attack "for the retention of which the French command would be compelled to throw in every man they have." Such objectives were either Belfort or Verdun, and Verdun was chosen, because it was a menace to the main German communications, because it offered a salient and so cramped the defender, and because of the moral effect if so renowned a place was lost to France.

The keynote of the tactical plan was a continuous series of limited advances which by their menace should draw the French reserves into the mincing-machine of the German artillery. And each of these advances was itself to be secured from loss by an intense artillery bombardment, brief for surprise and making up for its short duration by the number of batteries and their rapidity of fire. By this means the objective would be taken and consolidated before the enemy could move up his reserves for counter-attack. Although the French Intelligence branch at general headquarters gave early warning of the German preparations, the Operations branch were so full of their own offensive schemes that the warning fell on deaf ears. Further, the easy fall of the Belgian and Russian fortresses had led to a commonly held view that fortresses were obsolete, and Joffre, persuading the French Govt. to declass Verdun as a fortress, had denuded it of guns and troops. The forts were only used as shelters and the trench lines which took their place were inadequate and in poor repair. Yet eight months' bombardment was to leave the forts undamaged! At 7:15 A.M. on Feb. 21 the German bombardment began, on a front of 15 m., and progressively trenches and wire were flattened out or upheaved in a chaos of tumbled earth, giving to the countryside a weird resemblance to the surface of the moon. At 4:45 P.M. the German infantry advanced, although the first day only on a 2½ m. front. From then until Feb. 24 the defenders' line east of the Meuse was crumbled away as by the erosion of the tide.

"Operations" still argued that it was only a feint, but Joffre decided to send Castelnau to discover the true situation and with full powers to act. Castelnau swung back the right flank but ordered the line of the forts to be held at all costs and entrusted the defence to Pétain, for whose use a reserve army was assembled. Pétain's first problem was not so much defence as supply—the German heavy guns had closed all avenues into the salient except one light railway and the Bar-le-Duc road. While gangs of territorial troops worked night and day to keep this in repair and widen it, Pétain organised the front into sectors and threw in repeated counter-attacks, which helped by the narrowness of the front at least slowed down the advance. Falkenhayn sought, somewhat late, to widen the front, and on March 6 the Germans extended the attack to the west bank of the Meuse. But the defence was now stiffening, the numbers balanced, and the immediate thrust to Verdun was checked.

A slight lull followed, and during it the Allies of France made efforts to relieve the pressure on her. The British took over the Arras front from the French X. Army, the Italians made their fifth attack, though in vain, on the Isonzo front, and the Russians hurled untrained masses on the German front at Lake Narcocz, near the Vilna, once more gallantly sacrificing themselves to help their Allies. The slight gains were soon lost through a counter-stroke. These efforts did not prevent Falkenhayn pursuing his attrition offensive at Verdun. The advances were slight but they were cumulative in effect, and the balance of loss turned definitely against the defenders. On June 7 Fort Vaux fell, and the German tide crept ever closer to Verdun, seeming to the anxious watchers to resemble the forces of nature rather than of men. And in the Asiago region, Conrad had launched his offensive against Italy's Trentino flank.

Brusilov's Offensive.—Again Russia came to the rescue. Without warning, because without any special concentration of troops, Brusilov, commanding the southwestern Russian front, advanced against the Austrian IV. Army near Luck and the VII. Army in the Bukovina, whose resistance collapsed at the first shock. In three days Brusilov took 200,000 prisoners. This last vital effort of the Russian Army in the War had important consequences. It stopped the Austrian attack on Italy, already impaired by an Italian riposte. It compelled Falkenhayn to withdraw troops from the western front, and so abandon his plan for a counter-stroke against the British offensive preparing on the Somme, as well as the hope of nourishing his Verdun attrition process. It led Rumania to take her fateful decision to enter the War on the Entente side, and caused the supersession of Falkenhayn in the supreme command and his replacement by Hindenburg and Ludendorff. Although Rumania's entry was the ostensible reason, the underlying one was the fact that Falkenhayn's "limited" strategy in 1915 had made possible the Russian recovery which stultified the strategy of 1916. Falkenhayn was history's latest example of the folly of half-measures, the ablest and most scientific general—"penny-wise, pound foolish"—who ever ruined his country by a refusal to take calculated risks. Brusilov's offensive continued for three months with fair success, but reserves were not at hand for immediate exploitation, and before they could be moved down from the north the Germans were patching up the holes. His later efforts were never so dangerous, and his ultimate loss of 1,000,000 casualties completed the virtual ruin of Russia's military power.

The Somme.—Great as was the influence of Brusilov's offensive on German strategy, its effect on the Verdun situation was less immediate, and on June 23 the Germans almost reached the Belleville height, the last outwork of Verdun. Pétain made all ready for an evacuation of the east bank of the Meuse, though to his troops he showed no sign of anxiety, and ever repeated the now immortal phrase, "On les aura!"

But on July 1 the long-planned offensive on the Somme began, and from that day on the Germans at Verdun received no new divisions, and their advance died away from pure inanition. Nevertheless, although the Germans at Verdun had fallen short of their object, moral and material, they had so drained the French Army that it could play but a slender part in the Allied plan for 1916. The British had now to take up the main burden of the struggle, and the consequence was to limit both the scope and effect of the Entente strategy.

On July 1 after a week's prolonged bombardment the British attacked with 15 divisions on a front of 15 m. north of the Somme, and the French with five divisions on a front of eight m., mainly south of the river, where the German defence system was less highly developed. The unconcealed preparations and the long bombardment had given away any chance of surprise, and in face of the German resistance, weak in numbers but strong in organisation, the attack failed along most of the British front. Owing to the dense and rigid wave formations that were adopted the losses were appallingly heavy. Only on the south of the British front, near Fricourt and Montauban, did the attack gain a real footing in the German defences. The French, with slighter opposition, made a deeper advance.

This setback negatived the original idea of a fairly rapid penetration to Bapaume and Cambrai, and the Allied command adopted the attrition method of limited advances aimed to wear down the German strength. The attack was resumed on the southern British flank alone, and on July 14 the capture of the

Germans' second position offered the chance of exploitation, which was not taken. From now onward a methodical but costly advance continued, and although little ground was gained the German resistance was seriously strained when the early onset of winter rains suspended operations in November. The effect, however, can be exaggerated, for it did not prevent the Germans withdrawing troops for the attack on Rumania. But in one respect the Somme shed a significant light on the future, for on Sept. 15 the first tanks appeared. Their early employment before large numbers were ready was a mistake; losing the chance of a great strategic surprise, and owing also to tactical mishandling and minor technical defects they only had a limited success. Although the higher military authorities lost faith in them, and some urged their abandonment, more discerning eyes realised that here was a key which, when properly used, would unlock the trench barrier. The Somme offensive had a further indirect effect, for its relief to the Verdun pressure enabled the French to prepare counter-strokes, on Oct. 24 and Dec. 15, which regained most of the lost ground with small casualties. These economic successes were due to a more elastic use of the limited objective method, and to a high concentration of artillery, with a minimum of infantry, to occupy the defences crushed by the guns.

The Conquest of Rumania.—Rumania, sympathetic to the Entente cause, had been waiting a favourable opportunity to enter the War on their side, and Brusilov's success encouraged her to take the plunge. Her command hoped that this, combined with the Allied pressure on the Somme and at Salonika, would fix the German reserves. But Rumania's situation had many inherent defects. The strategical position of her territory was bad, forming an "L" reversed, with the bottom section sandwiched between Hungary and Bulgaria. Her army, though externally on a modern pattern, had grave weaknesses beneath the surface. Of her allies, only Russia could give her direct aid, and they failed her. And, with all these handicaps, she launched an offensive into Transylvania, which bared her flank to Bulgaria. The Rumanian forces advanced west in three columns, leaving only three divisions to watch the Danube frontier facing Bulgaria.

While the Entente fumbled the Germans acted. The plan was initiated by Falkenhayn and developed by Hindenburg-Ludendorff when they took over the supreme command on Aug. 28. While one force concentrated in Transylvania for a counter-stroke, a Bulgarian Army with German stiffening—under Mackensen—was to strike through Rumania's "back-door" and invade the Dobruja. On Sept. 5 Mackensen forced the Danube crossing at Turtucaia, destroyed three Rumanian divisions and made good his hold on the Dobruja. This automatically halted the Rumanian offensive in Transylvania, and drew away its reserves; at the end of Sept. they were thrown back by the Austro-German counter-offensive, of which Falkenhayn was given executive command. They succeeded in holding the passes of Rumania's mountain border in the west until mid-Nov., but Falkenhayn just broke through before the snows blocked the passes. Mackensen had switched his main forces westwards, and on Nov. 23 crossed the Danube close to Bucharest, on which both armies now converged. It fell on Dec. 6, and, despite belated Russian aid, the Rumanian forces were driven north into the upper section of the Rumanian "L" The brilliantly co-ordinated German strategy crippled their new foe, gained possession of the bulk of Rumania, with its oil and wheat, and gave the Russians another 300 m. of front to hold. Sarrail, at Salonika, had not succeeded in fixing the Bulgarian reserves.

The Capture of Baghdad.—The only territorial success that the Entente could show for their year's campaign was away in Mesopotamia—the capture of Baghdad, and this moral token was seized on with an enthusiasm which, militarily, it hardly warranted. The bitter experience of the past had damped the ardour of the British Govt., and Sir William Robertson, the new Chief of the Imperial General Staff, was opposed to any further commitments which drained the strength available for the western front. But Maude, the new commander on the spot, by subtle if unconscious steps succeeded in changing their defensive policy into one of a fresh offensive. After thorough reorganisation of the Mesopotamian force and its communications, he began on Dec. 12 1916 a progressive right wheel and extension of his front on the west bank of the Tigris, until by Feb. 22 he faced the main Turkish force across the Tigris above and below Kut. These methodical trench-warfare operations had placed him ready for a spring across the Tigris at the Turks' line of retreat, which was thus parallel to his front. But despite his four-to-one superiority of force, the failure of his right to fix the enemy and of his cavalry to cut off their retreat prevented a decisive success. But it led to permission for an advance on Baghdad, and he entered the Mesopotamian capital on March 11 1917. A series of skilfully conducted operations then drove the Turks into divergent lines of retreat and secured the British hold on the province.

The Advance on Palestine.—Ever since the abortive Turkish attempt to invade Egypt early in 1915, the British had kept large forces there, even when the Dardanelles expedition was crying out for troops. When Gallipoli was evacuated, the release of the Turkish forces threatened a fresh move on Egypt. To anticipate this by gaining command of the Sinai Desert, Sir Archibald Murray advanced in the spring of 1916, defeating the Turkish forces, freshly arrived, at Romani, Magdhaba and Rafa. The rate of advance was governed by the time taken in extending a railway and pipe-line (for water) across the desert. This new "Exodus" inspired the British Govt. to an invasion of Palestine, at as cheap a cost in troops as possible. The towns of Gaza, on the coast, and Beersheba, 25 m. inland, guarded the approach to Palestine. Murray attacked Gaza on March 26, but the attempt fell short when on the brink of success. A more deliberate attack on April 17–9 was a costlier failure against defences now strengthened.

The War at Sea 1915–6.—Germany's first submarine campaign—associated by allied opinion with the name of Admiral von Tirpitz, the exponent of ruthlessness—had been a signal failure, both in its meagre results and the disproportionate ethical damage it did to Germany's cause. A series of Notes exchanged between the American and German Govts. culminated in April 1916 in a virtual ultimatum from President Wilson, and Germany abandoned her unrestricted campaign. The deprivation of this weapon spurred the German Navy to its first, and last, attempt to carry out the initial plan on which it had begun the War. On May 30 1916 the British Grand Fleet left its bases on one of its periodical sweeps through the North Sea, but with reason to expect a possible encounter. On May 31, early in the morning, the German High Sea Fleet also put to sea, in the hope of destroying some isolated portion of the British fleet.

For such an encounter the British Admiral, Jellicoe, had formulated an outline plan in the early months of the War. Its basis was the cardinal necessity of maintaining the unimpaired supremacy of the Grand Fleet, which he viewed as an instrument not merely of battle but of grand strategy, the pivot of the Allies' action in all spheres, economic, moral and military. Hence while desirous of bringing to battle under his own conditions he was determined not to be lured into mine and submarine infested waters.

Early in the afternoon of May 31, Beatty, with his battle-cruisers and a squadron of battleships, after a sweep to the south was turning north to rejoin Jellicoe, when he sighted the German battle-cruisers, five in number. In the initial engagement two of Beatty's six battle-cruisers were hit in vital parts, and when thus weakened he came upon the main German fleet under Von Scheer. He turned north to lure them into reach of Jellicoe, 50 m. distant, who raced to support him. To describe the intricate and much debated manoeuvres which followed is neither possible nor would it be just within the limits of this article, a strategical and not a tactical survey. Mist and failing light put an end to an indecisive action, which, however, left the British fleet between the German and its bases. During the night Von Scheer slipped past their guard, which Jellicoe dared not draw

too close in view of his guiding principle and the danger of torpedo attack.

But if the battle of Jutland could be counted a tactical advantage to the Germans, it had no effect on their strategic position. Britain's command of the sea was intact, and the grip of the blockade on Germany unrelaxed. Once more she fell back on submarine warfare, and the first development was an extension of range. In July one of her new large submarine-cruisers appeared off the American coast and sank several neutral ships. In British and Mediterranean waters the pressure began seriously to affect the sea-borne trade and food supplies of the Entente. Various remedies were tried—the most effective being a system of sailing in convoys—but the only truly adequate measure, that of penning the Germans in their bases by close-in minefields, was debarred by Britain's failure to obtain a decisive battle success. But if Britain was feeling the strain of economic pressure, so also was Germany, and her leaders feared that the race between decisive success on land and economic collapse would end against her. The naval authorities declared that a renewal of the "unlimited" submarine campaign, which with her increased numbers could now be far more intense, would bring the Entente to their knees. Accepting this opinion, Ludendorff consented to a step which he had hitherto opposed, and on Feb. 1 1917 it was inaugurated—with the full realisation that it involved the weight of America being thrown into the scales against them.

V. THE PENULTIMATE YEAR

Despite incessant provocation for two years, since the "Lusitania" incident, President Wilson had held to his neutral policy, and if his excess of patience angered many of his own people it at least was the means of consolidating American opinion and reconciling it as a whole to intervention in the War. Meantime he strove by speech and by the agency of Colonel House, his unofficial ambassador—to find a basis of peace on which the belligerents could agree. This effort was doomed to failure by its misunderstanding of the psychology of the warring peoples and of the fundamental objects for which they were fighting. He was still thinking in terms of traditional warfare, between governmental policies, while the conflict had long since passed into the wider sphere of the struggle of peoples dominated by the primitive instinct of self-preservation.

The declaration of the unlimited submarine campaign brought convincing proof of the futility of these peace hopes and of the reality of the German intentions, and when followed by the deliberate sinking of American ships and an attempt to instigate Mexico to action against the United States, President Wilson hesitated no longer, and on April 6 1917 America entered the War against Germany.

Her potential force in man-power and material was illimitable, but, even more unready than Britain in 1914, it must be long in exerting more than a moral influence, and Germany confidently anticipated that the submarine campaign would take decisive effect within a few months. How near her calculation came to fulfilment the record of 1917 and 1918 bears witness.

The Western Front Campaign of 1917.—The year 1916 closed in gloom for the Entente. The simultaneous offensive on all fronts, planned a year before, had misfired, the French Army was at a low ebb, the Russian still lower, the Somme had failed to produce visible results in any way proportional to its cost, and another fresh Ally had been overrun. At sea the negativeness of Jutland was a disappointment, and although Germany's first submarine campaign had been abandoned a stronger one was threatened. To offset these debits, the Entente could only show the capture of distant Baghdad and a limited Italian success on the Isonzo in Aug., which had gained the important position of Gorizia. Its value, however, was mainly as a moral tonic to Italy herself.

The Entente plan for 1917 was complicated by changes in the command. French opinion had tired of the meagre results of Joffre's attrition strategy, and the method of the limited objective had fallen into disfavour because of the unlimited losses, on the wrong side, which accompanied it without apparent gain. They contrasted the dull course of his strategy with the brilliant results gained by Mangin at Verdun, in the autumn, under Nivelle's direction, and as a result Joffre gave place to Nivelle, who promised a real breakthrough. His confidence so inspired Mr. Lloyd George, the new British Prime Minister, that Haig was subordinated to him for the forthcoming operations—an arrangement which violated the axiom that a general cannot direct one force while exercising executive command of another. For carrying out a plan essentially audacious, Nivelle had two further handicaps; he failed to convert several of his subordinates to the idea, and he was given less rein by the Government than his predecessor. Again, while Joffre had intimated that the British must take the chief part, Nivelle changed this policy, and in his desire to conserve the glory for France overlooked how severely the French fighting power had been strained. Joffre's plan had been for a convergent attack on the great German salient Lens-Noyon-Reims, first against its west flank and then against its south—the British to attack north of the Somme, including but extending beyond the old battle ground, and the French south of it to the Oise. The attacks were to begin early in Feb. and to be followed by a French main attack in Champagne. Nivelle's change was to ask the British to take over more of the front in order to release French troops for the Champagne blow, and as a result the start was postponed a month.

Before it could begin the Germans had dislocated it. Ludendorff's first step had been to set on foot a complete programme for the reorganisation and expansion of German man-power, munitions and supplies. While this was developing, he intended to stand on the defensive, hoping that the new submarine campaign would either decide the issue or pave the way for a decisive blow on land when his new reserves of men and material were ready. Anticipating the renewal of the Entente advance on the Somme, he had a new line of defence, of great artificial strength, built across the chord of the arc Lens-Noyon-Reims. Then after devastating the whole area inside the arc, he began a methodical retirement, by stages, to the new line called by the Germans the "Siegfried" and by the Allies the "Hindenburg" line. A consummate manoeuvre, if brutal in application, it showed that Ludendorff had the moral courage to give up territory if circumstances advised it. The British, confronted with a desert, were inevitably slow in pursuit, and their preparations for an attack on this front were thrown out of gear, limiting them to the sector around Arras, where the front was unchanged.

On April 9 Allenby's III. Army opened the spring offensive at this point, but failed to develop its initial success, and continued the attack too long after the resistance had hardened. This costly action was partly to take the pressure off the French. The French blow south of the Somme was stultified by the German retirement, and the main attack was a worse fiasco. With a prolonged bombardment giving away any chance of surprise, and without first drawing away the German reserves, the idea of a rapid breakthrough was doomed to fail. Nivelle was replaced by Pétain, whose first concern was to restore the shaken morale of the French troops, and for the rest of the year the British bore the brunt of the campaign. The strain was increased by the failure of Russia to make any effective contribution to the pressure on Germany owing to the revolution which broke out in March. Haig decided to keep the Germans occupied by carrying out the original plan for an offensive in Belgium, and if the principle was right the method and choice of site were open to criticism.

The initial move was an attack on the Messines ridge in order to straighten out the Ypres salient and attract the enemy's reserves. Carried out by the II. Army under Plumer, with Harington as chief of staff, it proved a model example of the "limited" attack, with success economically gained by able staff-work and co-operation between the arms.

It was followed on July 31 by the main attack at Ypres which, hampered by the heavy rain, was foredoomed by its own destruction of the intricate drainage system of the area. The British com-

mand had persevered for 2½ years with the method of a prolonged preparatory bombardment, believing that quantity of shells was the key to success, and that unlike all the great captains of history they could disregard the element of surprise. The offensive at Ypres, which was finally submerged in the swamps of Passchendaele in Oct., threw into stronger relief than ever before the fact that such a bombardment blocked the advance for which it was intended to pave the way—because it made the ground impassable. The discomfiture was increased by the new German method of defence, which Ludendorff introduced, of thinning the front defences and using the men so saved for prompt local counter-attacks. The defence was built up of a framework of machine-guns distributed in concrete "pill-boxes" and disposed in great depth. On the British side the profitless toll of this struggle in the mud was to some extent mitigated by better staff work, when the direction of the attack was handed over to Plumer's II. Army.

Three months of dreadful struggle came to an end with the British not appreciably nearer their object of driving the Germans from their submarine bases in the Belgian ports, and if they had worn down the German strength they had worn down their own still more.

The Renaissance of Surprise at Cambrai.—The 1917 campaign in the west closed, however, on a note brighter in promise if not in accomplishment. Appreciating from the first days the futility of using tanks in these Flanders swamps, the Tank Corps headquarters looked around for an area where they could try out a new and different method. The chief general staff officer, Colonel Fuller, drew up a project for a large scale raid to scour a canal-enclosed "pocket" near Cambrai, where the rolling downland lent itself to tank movement. The basic idea was the release of a swarm of tanks without any preparatory bombardment to give warning of the attack. When their hopes at Ypres waned, the British command adopted the scheme, retaining the basic idea, but transforming the operation into a definite offensive with far-reaching aims, for which they had not the resources because of the drain of Ypres. The operation was to be carried out by Byng's III. Army with six divisions, and the date was fixed for Nov. 20. Led by nearly 400 tanks, the attack came as a complete surprise, and despite minor checks achieved a penetration far deeper and at less cost than any past British offensive. But all the available troops and tanks were thrown into the first blow, and the higher command failed to give Byng the few reserves they possessed in time to exploit the success. The cavalry, as always on the western front, proved unable to carry out this rôle.

Thus the advance died away, and on Nov. 30 the German Army commander, Von der Marwitz, launched a convergent counter-stroke against two flanks of the salient created by the British progress. In the north it was parried but in the south broke through and a disaster was only averted by the superb counter-attack, first of the Guards division and later of a tank brigade. But if Cambrai was a disappointment it revealed that surprise and the tank were the combination by which the trench-barrier could be unlocked. Meanwhile Pétain, after overhauling his instrument, the French Army, sought to test its readiness for 1918. In Aug. a stroke by Guillaumat's army recovered all the remainder of the ground lost in 1916, and in Oct. Maistre's army flattened the southwest corner of the German front, seizing the Chemin des Dames ridge.

The Collapse of Russia.—The temporary breakdown of the French fighting power was not the worst of the troubles which together crippled the Entente offensive in 1917. The collapse, first partial and then complete, of Russia was a loss which even the entry of America into the War could not possibly compensate for many months, and before the balance was restored the western Allies were to be perilously near the brink of defeat. Russia's enormous losses, due to her own defective machine but incurred in sacrifice for her Allies, had undermined the moral even more than the material endurance of her forces. Revolution broke out in March, superficially against the corrupt *entourage* of the Tsar, but with more deep-seated moral causes beneath. The Tsar was forced to abdicate and a moderate Provisional Govt. climbed into the saddle, but without reins. This was only a makeshift, and in May another succeeded it, more Socialist in tendency and outwardly led by Kerensky. While clamouring for a general peace and undermining discipline by a system of committee control suitable to a trade union but not to the field of battle, Kerensky imagined he could send troops against the enemy by platform appeals. Brusilov succeeded Alexeiev in the supreme command, and on July 1 the army gained some initial success against the Austrians, only to stop as soon as real resistance was met, and to crumble directly the Germans counter-attacked. In Sept. the Germans took the opportunity to practise their new method of attack intended for use in France and captured Riga, but next month the Bolsheviks under Lenin overthrew the wordy Kerensky, imposed their self-constituted rule on the Russian people and sought an armistice with Germany, which was concluded in December.

Italy's Caporetto Disaster.—The defection of Russia did not end the Entente tale of woe. Each autumn with demoralising regularity Germany had seized an opportunity to eat up one of the weaker Allies. In 1915 it had been Serbia's fate, in 1916 Rumania's and now it was Italy's turn, or so the Germans intended. Ludendorff's decision, taken in Sept., was determined by the appeals of the Austrian authorities, who felt that their troops could not endure the strain of another defensive battle on the Italian frontier—they had lost ground in Aug. in face of the Italians' eleventh offensive on the Isonzo. Ludendorff had a difficult problem to solve. Russia had not yet capitulated, the front there was already weakly held for its extent, and the British offensive in Flanders made impossible a large withdrawal of troops from France. As he could only scrape together seven German divisions, and the Austrians' quality was lower than ever, he came to the conclusion that the only chance of decisive results was to pick out a particularly weak point which at the same time offered scope for a strategic exploitation of the breakthrough. He found this in the Caporetto sector of the Italian front.

The Italian frontier province of Venezia (Venice) formed a salient pointing to Austria and flanked on the north by the Austrian Trentino, on the south by the Adriatic. Bordering on the Adriatic is a stretch of relatively low ground on the Isonzo front, but the frontier then follows the Julian and Carnic Alps in a wide sweep round to the northwest. The seven German divisions with nine Austrian formed the XIV. German Army under Otto von Below, and were to climb the southern end of the mountain barrier, while Boroevic's two Austrian armies were to join in the advance along the Adriatic shore. The organisation and deployment of the attack in such mountainous country was difficult, but on Oct. 24, after a short bombardment, the blow was launched and pushed deep down the western slopes of the mountains, imperilling the Italian forces to both south and north. On Oct. 28 Von Below's van reached Udine, the former Italian General Headquarters, and on Oct. 31 the Tagliamento.

While the Austrian command issued the orders, Ludendorff pulled the strings which set them in motion. And not the least significant feature of this offensive was the way it was prepared not by an artillery but by a moral bombardment. Propaganda had been exploited for months as a means of sapping the Italian discipline and will to resist. Cadorna, the Italian commander, had failed alike to counteract this demoralisation of the army and to guard against the military attack of which he had ample warning.

But its effect seems also to have surprised Ludendorff, who with his slender forces had not calculated on such distant objectives as were now possible of attainment. Boroevic was slow in following up the Italian right, and Ludendorff tried to switch part of his force to Conrad's army which flanked the north of the Venezia salient, but was foiled by the inadequacy of the rail communications. Even so, Cadorna, with his centre broken through, only saved his wings by a precipitate retreat to the line of the Piave, covering Venice, and on Nov. 9 the whole Italian

Army was behind this river except for 250,000 prisoners in the enemy's hands, and twice as many other casualties—killed, missing or sick. The same day Cadorna was superseded in supreme command by Diaz. Italy's allies had begun to rush reinforcements to her aid, a British and French army corps, and on Nov. 5 their political and military chiefs arrived at Rapallo for a conference, out of which sprang the Allied council at Versailles, and ultimately a unified command.

The invaders had outrun their transport and the resistance of the Italians, morally braced by the emergency, succeeded in holding the Piave in face of direct assaults and strenuous efforts by Conrad to turn their left flank from the Trentino. At the beginning of Dec. the British and French, who had been waiting in reserve in case of a fresh breakthrough, moved forward to take off vulnerable sectors, but the attack was only renewed in the north and on Dec. 19 it came to an end with the snows. If Caporetto seriously damaged Italy, it also purged her, and after an interval of recuperation she was to vindicate herself at Vittorio Veneto.

The Capture of Jerusalem.—Once more a distant theatre of war provided the sole triumph of the Entente cause during the year—this time in Palestine. The second reverse at Gaza in April 1917 led to a change in command, Murray being succeeded by Allenby, who was strong enough and fortunate enough to obtain the adequate force for which Murray had asked in vain. The British Govt. was anxious for a spectacular success to offset the moral depression of the Nivelle failure and the decline of Russia, and the British General Staff desired to dislocate the Turkish attempt to recapture Baghdad by drawing away their reserves.

Allenby took over in July and devoted the first three months to intensive preparations for an autumn offensive, when the season would be suitable. The command was reorganised, the communications developed, and his own headquarters moved forward from Cairo to the front. By complete secrecy and ruses he deceived the Turks as to the main point of attack. The defences of Gaza were bombarded from Oct. 20 onwards, and an attack followed on Nov. 1 to pin the enemy and draw in his reserves. Meanwhile, as a necessary preliminary to the real blow, the inland bastion of Beersheba was seized by a convergent manoeuvre on Oct. 31, a prelude to the decisive attack on Nov. 6, which broke through the enemy's weakened centre and into the plain of Philistia. Falkenhayn, now in command at Aleppo, had also been planning an offensive, but the better communications of the British had decided the race, and although Falkenhayn tried to stem the tide by a counter-stroke against Beersheba, the breaking of his centre compelled a general retreat. The pursuit was hampered owing to lack of water, but even so by Nov. 14 the Turkish forces were driven apart in two divergent groups, the port of Jaffa was taken, and Allenby wheeled his main force to the right for an advance inland on Jerusalem. He gained the narrow hill passes before the Turks could block them, and after a necessary pause to improve his communications brought up reserves for a fresh advance, which secured Jerusalem on Dec. 9. By the time the winter rains set in the British had expanded and consolidated their hold on the region. As a moral success the feat was valuable, and one immediate result was a revolt in Arabia against the Turks.

Yet, viewed strategically, it seemed a long way round to the goal. If Turkey be pictured as a bent old man, the British, after missing their blow at his head—Constantinople—and omitting to strike at his heart—Alexandretta—had now resigned themselves to swallowing him from the feet upwards, like a python dragging its endless length across the desert.

The Conquest of East Africa.—The year 1917 witnessed another overseas success, the clearing of German East Africa, although not the close of the campaign. More than a year elapsed after the rebuff at Tanga before a serious attempt was made to subdue their last German stronghold on the African continent. To spare troops from the main theatres was difficult, and the solution was only made possible by the loyal co-operation of the South African Government. In Feb. 1916 Gen. Smuts was appointed to command the expedition and formed the plan of a drive from north to south through the difficult interior, in order to avoid the fever-rampant plain on the coast. In conjunction with this central wedge a Belgian force under Tombeur was to advance eastwards from Lake Tanganyika, and a small British force under Northey was to strike in from Nyasaland in the southwest. The Germans under Lettow-Vorbeck were weak in numbers but handled with masterly skill, and with all the advantages of an equatorial climate, a vast and trackless region—mountainous in parts and covered with dense bush and forest—to assist them in impeding the invader. From Dar-es Salaam on the coast to Ujiji on Lake Tanganyika ran the one real line of rail communication, across the centre of the colony. After driving the Germans back across the frontier and seizing the Kilimanjaro gap, Smuts moved direct on this railway at Morogoro, over 300 m. distant, while he dispatched a force under van Deventer in a wide sweep to the west to cut the railway further inland and then converge on Morogoro. Lettow-Vorbeck delayed this manoeuvre by a concentration against van Deventer, but Smuts' direct advance compelled him to hurry his force back, and thus enabled van Deventer to get astride the railway.

However, Lettow-Vorbeck evaded the attempt to cut him off and fell back in Sept. on the Uluguru mountains to the south. The Belgians and Northey had cleared the west and the net had been drawn steadily closer, confining Lettow-Vorbeck to the southeast quarter of the colony. Early in 1917 Smuts returned to England and van Deventer conducted the final operations which ended with Lettow-Vorbeck, avoiding envelopment to the end, slipping across the frontier into Portuguese Africa. Here he maintained a guerilla campaign throughout 1918 until the general Armistice. With an original force of only 5,000, 5% being Europeans, he had caused the employment of 130,000 enemy troops and the expenditure of £72,000,000.

The Mastering of the Submarine.—The military side of 1917 is thrown into shadow by the naval, or more strictly the economic, side. The vital issue turned on the balance between Germany's submarine pressure and Britain's resistance. April was perhaps the most critical month. The Allies lost nearly a million tons of shipping, 60% British, and although the German Navy's promise of victory by the end of the month was proved a miscalculation, it was clear that ultimately the continuance of such a ratio of loss must starve the civilian population and automatically prevent the maintenance of the armies. Britain, indeed, had only food enough to sustain her people for another six weeks. The British Govt. sought to counter the menace by the indirect means of rationing, increasing home production and the expansion of shipbuilding; by the direct means of the system of convoys with naval escorts, and a counter-offensive against the submarine. Aided by new devices to detect the presence of submarines and the use of thousands of patrol craft this highly organised campaign exacted an ever-rising toll, and by the end of 1917 the menace, if not broken, was at least subdued. In this task America's aid became a potent factor long before her military assistance. It embraced her provision of light craft to reinforce the British anti-submarine fleet, her rapidly developed construction of new mercantile ships and still more her financial aid. By July 1917 Britain had spent over £5,000,000,000, her daily expenditure had risen to £7,000,000, and the burden of financing her Allies as well as her own efforts was straining even her resources, when America's aid came to ease the pressure.

These were the defensive benefits; the offensive were at least as great. No longer was the grip of the naval blockade hampered by neutral quibbles, but instead America's co-operation converted it into a strangle-hold under which the enemy must soon grow limp, since military power is based on economic endurance. As a party to the War, the United States, indeed, wielded the economic weapon with a determination, regardless of the remaining neutrals, far exceeding Britain's boldest claims in the past years of controversy over neutral rights. The submarine menace, crippled in 1917, was ended to all intents during the early months of 1918, largely through two positive achievements. The first

was the laying of a mine-barrage by the American Navy across the 250-mile wide passage between Norway and Scotland; the second, the daring attacks of Sir Roger Keyes' force on Zeebrugge and Ostend, which closed the Belgian coast as a base for the German submarines. Yet the removal of the menace should not lead to an underestimate of its powers for the future. The 1917 campaign was launched with only 148 submarines and from the most unfavourable strategic position. Great Britain lay like a huge breakwater across the sea approaches to northern Europe and the submarines had to get outside through narrow and closely watched outlets before they could operate against the arteries of supply. And despite these handicaps they almost stopped the beat of England's heart.

The Air Offensive.—Another new form of action reached its crest at the same time as the submarine campaign. As the submarine was primarily an economic weapon, so was the aeroplane primarily a psychological weapon. The explosive bullet had virtually ended the Zeppelin raids in 1916, but from early in 1917 aeroplane raids on London grew in intensity until by May 1918 the air defences were so thoroughly organised that the raiders thereafter abandoned London, as a target, for Paris. If the stoicism of the civil population took much of the sting from a weapon then in its infancy, the indirect effect was serious, interrupting business and checking output in industrial centres, as well as drawing off, for defence, many aircraft from the front. In reply the British formed an Independent Air Force, which carried out extensive raids into Germany during the closing months of the War, with marked effect on the declining morale of the "home front." To relate the action of aircraft in the military sphere is not possible, for it formed a thread running through and vitally influencing the whole course of operations, rather than a separate strategic feature.

The beginning of 1918 witnessed the development and thorough organisation of another psychological weapon, when Lord Northcliffe was appointed Director of Propaganda in Enemy Countries, and for the first time the full scope of such a weapon was understood and exploited.

VI. THE ALLIED VICTORY

On the Threshold of 1918.—The middle years of the World War had been, in a military sense, a tussle between a lean Hercules and a bulky Cerberus. The Germanic alliance was weaker in numbers but directed by a single head, the Entente stronger in numbers but with too many heads. Owing to their own excessive losses, diffusion of effort and the collapse of Russia, the Entente at the end of 1917 were faced with the grim fact that the numerical balance had been reversed, and months must elapse before the prospective stream of America's new divisions came to tilt the scales once more in their favour. The emergency paved the way for the creation of a unified command but it still needed disaster to bring it into being.

At the conference at Rapallo in Nov. the formation of a Supreme War Council was decided upon, to be composed of the principal ministers of the Allies, with military representatives, and to sit permanently at Versailles. If the fundamental defect was that it merely substituted a formal for an informal committee, a further flaw was that the military representatives had no executive status. In the economic sphere, where deliberation rather than instant action was necessary, it led to a real improvement in the combination of shipping, food and munition resources. Militarily, it was futile, for it set up a dual advisorship —the Versailles representatives on the one hand and the chiefs of the national general staffs on the other. As the menace of the German attack grew closer and with it the need for common action, this advisory body was converted into a military executive committee to handle an inter-Allied general reserve, a fresh compromise which set up a dual control—the commanders-in-chief and the Versailles committee.

If concentration of control was lacking, so also was concentration of force. The political chiefs were slow to realise how grave was the danger. Since early in Nov. the stream of German troop-trains from east to west had been steadily swelling. When the 1917 campaign opened there had been a proportion of nearly three allies to two Germans, but now the Germans had a slight balance and the likelihood of bringing still more. Yet with this knowledge the allied statesmen could not agree to draw reinforcements from the other fronts. Mr. Lloyd George went further and urged an offensive in Palestine, a scheme which was sanctioned on the understanding that no reinforcements went there from France, but which also meant that none came from there to France. Robertson, the Chief of the Imperial General Staff, disagreed both with this Palestine plan and the creation of the Versailles executive committee, and resigned, being succeeded by Sir Henry Wilson. The position was still further weakened by the insistence of M. Clemenceau, the new French premier, that the British should extend their front south to the Oise. This meant that Gough's V. Army was dangerously stretched out and took over ill-prepared defences on the very front that Ludendorff was about to strike.

Haig, rightly, and Pétain, wrongly, each expected the main German attack to fall on their respective fronts, and in view of this uncertainty the Supreme War Council decided to form a common reserve, which the new military executive committee under Foch should use wherever necessary. Foch called on Haig to contribute seven of the thirty divisions, and when the British commander replied that he could spare no troops the scheme broke down a week before the German blow fell.

On the German side the submarine panacea for victory had been replaced by a military panacea, and hopes were perhaps exaggerated by the unexpected collapse of Russia. But although Ludendorff promised victory in the field, he did not disguise that a western offensive would be a far harder task than the conquests in the east. He realised also that it would be a race between the effect of Germany's blow and the arrival of American reinforcements, although he hoped to win the race. To secure the rear of his offensive, a definite peace was won from the Bolshevik Govt. of Russia by a military demonstration, and also forced on Rumania. And to secure if possible the economic base of his offensive the Ukraine was occupied, for its wheat supplies, with little resistance except from Czechoslovak troops, who had formerly been taken prisoners from the Austrian Army.

The German Offensive.—Ludendorff's next problem was to decide his first point of attack. The sector between Arras and St. Quentin was chosen, on the western face of the great salient formed by the German front in France. The choice was governed by tactical reasons—this sector was the enemy's weakest point and the ground offered fewer difficulties than elsewhere—although Ludendorff had in mind the possibility of separating the Allied Armies and driving the British back against the Channel coast, too closely penned in to evade the blows. The tactical bias was, however, to have vital results, leading the Germans to change direction and dissipate their strength owing to their principle of taking the line of least resistance. If the Franco-British command had erred hitherto by aiming at the strategically correct target without enough attention to the tactical difficulties, the German command was now to concentrate on tactical success at the expense of the strategical goal. Ludendorff's strategy in the East had been so masterly and so far-sighted that the change is difficult to explain. From the experience of the vain allied attacks he had drawn the deduction that "Tactics had to be considered before purely strategical objects which it is futile to pursue unless tactical success is possible." Presumably he hoped by firm control to guide these tactical movements to a strategic destination. If so, he failed. Perhaps he himself was feeling the strain of directing so many vast operations; in any case the campaign leaves the impression that Ludendorff had neither his former clearness as to the goal, nor quite the same grip on the changing situations. But in the organisation of his attacks his powers were at their highest level. The troops were trained in the new infiltration tactics already tested at Riga, and the most thorough arrangements were made for concealing and for exploiting the attacks (*see* TACTICS). The assaulting divisions were to be brought up over night, the masses of artillery brought close to the front line in concealment, and their ranges obtained

by methods which did away with preliminary "registration." The bombardment was to be brief but intense and its surprise effect to be increased by lavish use of gas and smoke shell. Further, while Ludendorff had settled to strike first on the Somme sector, to which blow the code-name "Michael" was given, he also made preparations for successive attacks at other points, which besides being in readiness for the future helped to mystify the enemy. Two were on the British front and one on the French —"St. George I.", against the Lys sector, "St. George II." against the Ypres sector and "Blücher" in Champagne.

The "Michael" attack was to be made by the German XVII., II. and XVIII. armies on the 47-mile front Arras–St. Quentin –La Fère, but its main force was intended to be exerted north of the Somme, and after breaking through, the XVII. and II. armies were to wheel northwest and press the British Army against the coast, while the river and the XVIII. Army guarded their flank. The attack was launched on March 21, and while it broke through completely south of the Somme, where the defence was thinnest, it was held up near Arras, a check which reacted on all the attack north of the river. As a result, on March 23 Ludendorff abandoned his original idea, and directed his main effort towards Amiens. By March 27 the advance had penetrated nearly 40 m. and reached Montdidier, cutting one railway to Paris; by March 30 the German flood was almost lapping the outworks of Amiens. But their route had led them across the desert of the old Somme battlefields, a brake on communications and supply, and to an area where the French could most easily support their hard-pressed allies.

This support was certainly slow to arrive, for Pétain still expected the main blow on his own front, but disaster drove the Allies to an overdue step, and largely through Lord Milner's intervention Foch was appointed on March 26 to "co-ordinate" the operations of the Allied armies. Once before, in the crisis at Ypres in 1914, he had filled such a rôle, on a smaller scale, and his will-power and energy had helped to buttress the resistance. And if since then he had fallen into disfavour owing to the heavy cost of his attacks in Artois during 1915 and the barren fruit of the Somme in 1916, he was later to show that he had turned the experience to profit, and to justify in practice his unique reputation as a theorist. On April 14 he was definitely made commander-in-chief of the Allied armies. Foch was stimulating the flow of reserves to cement the already hardening resistance, when he was interrupted by a fresh menace.

On March 28 Ludendorff had launched the XVII. Army to a fresh effort, this time to secure the heights near Arras, in order to pave the way for his "St. George I." attack on the Lys. The blow was repulsed by Byng's III. Army and inevitably affected Ludendorff's designs. Nevertheless, on April 9 he launched his "St. George I." attack, and its astonishing early success against a weakened front led him to convert it into a major effort. The British were desperately close to the sea, but their resistance stopped the German tide just short of the important railway junction of Hazebrouck, and an attempt to widen the front towards Ypres was nullified by Haig's swinging his line back just before and by the gradual arrival of French reinforcements.

Thus Ludendorff had fallen short of strategic results; on the other hand he could claim huge tactical successes—the British casualties were over 250,000. The British lion had been badly mauled, and although fresh drafts were hurried out from England and divisions brought back from Italy, Salonika and Palestine, months must elapse before it could recover its offensive power. Ten British divisions had to be broken up, reducing the Allied strength to 158 divisions against 208 German with 80 still in reserve. A restoration of the balance, however, was now in sight. A dozen American divisions had arrived in France and, responding to the call, great efforts were being made to swell the stream. Further, Pershing, the American commander, had placed his troops at Foch's disposal for use wherever required. For Germany the sands were running out, and, realising this, Ludendorff launched his "Blücher" attack between Soissons and Reims, on May 27. Falling by surprise with 40 divisions against seven, on a 30-mile front, it swept over the Aisne and reached the Marne on May 30, where its impetus died away. Blocked frontally by the river, an attempt was made to push west, but it failed in face of Allied resistance—notable for the appearance of American divisions at Château-Thierry, where they gallantly counter-attacked.

Ludendorff had now created two huge bulges, and another smaller one, in the Allied front. His next attempt was to pinch out the Compiègne "tongue" which lay between the Amiens and Marne bulges. But this time there was no surprise, and the blow on the west of the "tongue," June 9, was too late to coincide with the pressure on the east. A month's pause followed. Ludendorff was anxious to strike his long-cherished decisive blow against the British in Belgium, but he considered that their reserves here were still too strong, and so again decided to take the line of least tactical resistance, hoping that a heavy blow in the south would draw off the British reserves. He had failed to punch out the Compiègne "tongue" on the west of his Marne salient; he was now about to attempt the same method on the east, by attacking on either side of Reims. But he needed an interval for rest and preparation, and the delay was fatal, giving the British and French time to recuperate, and the Americans to gather strength. The tactical success of his own blows had been his undoing; yielding to their influence, he had pressed each too far and too long, so using up his own reserves and causing an undue interval between each blow. He had driven in three great wedges, but none had penetrated far enough to sever a vital artery, and this strategic failure left the Germans with an indented front which invited flanking counter-strokes.

The Turning of the Tide.—On July 15 Ludendorff launched his new attack, but its coming was no secret. East of Reims it was foiled by an elastic defence, and west of Reims the German penetration across the Marne merely enmeshed them more deeply to their downfall—for on July 18 Foch launched a long-prepared counter-stroke on the other flank of the Marne salient. Here Foch turned the key which Ludendorff lacked, using masses of light tanks to lead a surprise attack on the Cambrai principle. The Germans managed to hold the gates of the salient open long enough to draw their forces back into safety and straighten their line. But their reserves were depleted, Ludendorff was forced to postpone the offensive in Belgium and the initiative definitely and finally passed to the Allies. Foch's first concern was to keep it, by giving the enemy no rest while his own reserves were accumulating. To this end he arranged with Haig, Pétain and Pershing for a series of local offensives, aimed to free the lateral railway communications and to improve the position of the front ready for further operations. But already before the Marne counter-stroke, Rawlinson, commanding the British IV. Army in front of Amiens, had submitted to Haig a plan for a large surprise attack there, and Foch agreed to this in place of his own idea for an attack on the Lys front. He also placed under Haig the French I. Army (Debeney) to extend the attack to the south. Rawlinson's army was doubled, and by skilful precautions the enemy were kept in the dark until, on Aug. 8, the attack was delivered—led by 450 tanks. Great as a material success, it was still greater as a moral.

Ludendorff says: "Aug. 8 was the black day of the German Army in the history of the War. . . . It put the decline of our fighting power beyond all doubt. . . . The War must be ended." He informed the Emperor and the political chiefs that peace negotiations ought to be opened before the situation became worse, as it must. On Aug. 10 Foch issued a fresh *directive* for the preparation of an "advance" by the British III. Army "in the general direction of Bapaume and Péronne." And as the momentum of the IV. Army was waning, the III. Army moved. From then on Foch beat a tattoo on the German front, a series of rapid blows at different points, each broken off as soon as its initial impetus waned, each so aimed as to pave the way for the next, and all close enough in time and space to react on each other. Thus Ludendorff's power of switching reserves to threatened spots was stopped, as his balance of reserves was drained.

On Aug. 10 the French III. Army had struck to the south; then on Aug. 17 the French X. Army still further south; next on

Aug. 21 the British III. Army, followed by the British I. Army on Aug. 26. Ludendorff's order to the troops holding the Lys salient to retire was hastened in execution by the attacks of the reformed British V. Army, and by the first week in Sept. the Germans were back on their original starting line—the strong defences of the Hindenburg Line. And on Sept. 21 Pershing completed the series of preliminary operations by erasing the St. Mihiel salient—the first feat of the Americans as an independent army.

The clear evidence of the Germans' decline and Haig's assurance that he would break the Hindenburg Line where the German reserves were thickest, decided Foch to seek victory that autumn instead of postponing the attempt until 1919. All the Allied armies in the west were to combine in a simultaneous offensive.

The Collapse of Bulgaria.—But before it could develop an event occurred in the Balkans which, in the words of Ludendorff, " sealed the fate of the Quadruple Alliance." He had still hoped to hold fast in his strong lines in the west, and with his strategic flanks in Macedonia and Italy covered, while the German Govt. was negotiating for a favourable peace. At the same time there was alarm as to the moral effect of the western front defeats on the German people, their will-power already undermined by shortage of food, and perhaps also by propaganda.

But on Sept. 15 the Allied armies in Salonika attacked the Bulgarian front, which crumpled in a few days. Guillaumat, who had succeeded Sarrail in Dec. 1917, had prepared the plan for an offensive, and when recalled to France in the crisis of July as Governor of Paris he won over the Allied governments to consent to the attempt. His successor in Salonika, Franchet d'Esperey, concentrated a Franco-Serb striking force, under Michich, on the Sokol-Dobropolye sector, west of the Vardar, where the Bulgarians trusted to the strength of the mountain ridges and were weak in numbers. On Sept. 15 Michich attacked and, while the British attack at Doiran pinned a large part of the Bulgarian reserves, he broke right through towards Uskub. With their army split into two parts the Bulgarians, already tired of the War, sought an armistice, which was signed on Sept. 29. Franchet d'Esperey's achievement not only knocked away the first prop of the Central Alliance but opened the way to an advance on Austria's rear.

The Collapse of Turkey.—The offensive planned for the spring in Palestine had been interrupted by the crisis in France and the consequent withdrawal of most of Allenby's British troops. The depletion was made up by reinforcements from India and Mesopotamia, and by Sept. Allenby was again ready to take the offensive. He secretly concentrated, on the Mediterranean flank, the mass of his infantry, and behind them the cavalry. In this way he changed a two to one superiority on the general front into four to one at the decisive point. At dawn on Sept. 19 the western mass attacked, rolling the Turks back northeast towards the hilly interior—like a door on its hinges. Through the open doorway the cavalry passed, riding straight up the coastal corridor for 30 m., before swinging east to cut the Turkish communications and close all exits of retreat. Completely trapped, the main Turkish armies were rounded up, while the British cavalry exploited the victory of Megiddo by a swift and sustained pursuit which gained first Damascus and finally Aleppo. Defenceless and threatened with a direct advance of Milne from Macedonia on Constantinople, Turkey capitulated on Oct. 30.

The First Peace Note.—The capitulation of Bulgaria and, if to a less degree, the destruction of the Turkish armies, convinced Ludendorff that it was necessary to take a decisive step towards securing peace. While he was scraping together a paltry half dozen divisions to form a new front in Serbia, and arranging a meeting with the political chiefs, Foch's grand assaults fell on the Western defences, Sept. 26–28, and the line began to crack. On Sept. 29 Ludendorff told the Foreign Minister that an armistice must be asked for at once, and on Oct. 4 the German Govt. dispatched the first peace note to President Wilson. While they were debating the conditions for an armistice and questioning Ludendorff as to the situation of the army for further resistance if the terms were unacceptable, Foch continued his military pressure.

The Final Advance.—The plan agreed upon between Foch and the Allied commanders was for a series of convergent and practically simultaneous attacks:—

1 and 2. By the Americans west of the Meuse, and by the French west of the Argonne, both in the direction of Mezières—beginning on Sept. 26;

3. By the British on the St. Quentin-Cambrai front in the general direction of Maubeuge—beginning on Sept. 27;

4. By the Belgian and Allied forces in the direction of Ghent—beginning on Sept. 28.

The general aspect was that of a pincer-like manoeuvre against the vast salient jutting out between Ypres and Verdun. The attack towards Mezières would shepherd that part of the German armies towards the difficult country of the Ardennes and away from their natural line of retreat through Lorraine; it was also dangerously close to the hinge of the Antwerp-Meuse line which the Germans were preparing in rear. The attack towards Maubeuge would threaten the other main line of communication and retreat through the Liége gap, but it had further to go. In these attacks, the Americans had the hardest natural obstacle, the Argonne Forest; the British had the strongest defences and the heaviest weight of enemy troops.

Pershing's attack, adding surprise to its four to one superiority in numbers, opened well, but lost impetus owing to the difficulties of supply and exploitation in such country. A new force, it was suffering the growing pains which the British had passed through in 1915–6.

Haig, by pushing forward his left wing first, facilitated the attack of his right on the strongest section of the Hindenburg Line—the Canal du Nord, and by Oct. 5 the British were through the German defence system, with open country beyond. But on this front the attackers were in actually inferior numbers to the defenders, their tanks were used up, and they could not press forward fast enough to endanger the German retreat.

Nevertheless the combined pressure of the Allied armies, and their steady advance, were loosening the will-power of the German Govt. and people. The conviction of ultimate defeat, slower to appeal to them than to the army chiefs, was the more forcible when it was realised. And the indirect moral effect of military and economic pressure was accentuated by the direct effect of peace propaganda, skilfully directed and intensively waged by Northcliffe. The " home front " began to crumble later but it crumbled quicker than the battle front.

The Collapse of Austria.—The last Austrian attempt at an offensive on the Italian front, in conjunction with the German assaults in France, had been repulsed on the Piave in June. Diaz waited until conditions were ripe for an offensive in return, until Austria's internal decay was spreading and she was without hope from Germany. On Oct. 24 Cavan's army moved to seize the crossings of the Piave and on Oct. 27 the main attack opened, driving towards Vittorio Veneto to divide the Austrians in the Adriatic plain from those in the mountains. By Oct. 30 the Austrian Army was split in two and the retreat became a rout, and the same day Austria asked for an armistice, which was signed on Nov. 4.

The Curtain Falls on the Western Front.—Already on Oct. 23 President Wilson had replied to the German requests by a note which virtually required an unconditional surrender. Ludendorff, who had wished to anticipate such terms by seeking peace before the situation had degenerated, now wished to carry on the struggle in hopes that a successful defence of the German frontier might damp the determination of the Allies. But the situation had passed beyond his control, the nation's will-power was broken, and his advice was in discredit. On Oct. 26 he resigned, and a few days later Germany became a republic in outward response to President Wilson's demand and in inward response to the uprising of the German people against the leaders who had led them into disaster. The German fleet had already mutinied when their commanders sought to send them out on a forlorn hope against the British.

On Nov. 6 the German delegates left Berlin to treat for an armistice. Their acceptance of the severe terms was hastened less by existing military events than by the imminence of a fresh blow. The Allied advance was still continuing, in some parts seeming to gather pace in the last days, but the main German forces had escaped from the perilous salient, and their complete destruction of roads and railways made it impossible for supplies to keep pace with the advancing troops. A pause must come while these communications were being repaired, and thus the Germans would have breathing space to rally their resistance. The advance reached the line Pont à Mousson-Sedan-Mezières-Mons-Ghent by Nov. 11—the line of the opening battles in 1914—but strategically it had come to a standstill.

To meet this situation Foch had concentrated a large Franco-American force, of 28 divisions and 600 tanks, to strike below Metz directly east into Lorraine. The general Allied advance had fixed the enemy's reserves, and now this decisive manoeuvre was to fall on his bared flank, turning the whole of his new line of defence along the Meuse to Antwerp. In addition Trenchard's Independent Air Force was about to bomb Berlin, on a scale hitherto unattempted in air warfare.

With revolution at home and this menace on their front, the German delegates had no option but to accept the drastic terms of the Armistice, which was signed in Foch's railway-carriage in the Forest of Compiègne on Nov. 11, and at 11 o'clock that morning the World War came to an end.

Controversy has long raged as to what was the deciding act of the conflict, what were the causes of victory, and, even less profitably, which country won the War. If it be accepted that the mind of the enemy's ruling power is the ultimate target, aimed at indirectly through the bodies of their troops and their civil foundations, then, so far as any military act was decisive, the memoirs of Ludendorff reveal that it was the attack of Aug. 8 reinforced by the overthrow of Bulgaria. But if these would have ensured peace it is most improbable that Germany would have accepted the conditions ultimately secured.

The truth is that no one act, still less one cause, was, or could be, decisive. The western front, the Balkan front, the tank, the blockade and propaganda have all been claimed as the cause of victory. All claims are justified, none is wholly right. In the new warfare between nations victory is a cumulative effect, to which all weapons—military, economic, and psychological—contribute. Victory comes, and can only come, through the utilisation and combination of all the resources existing in a modern nation, and the dividend of success depends on the way in which these manifold activities are co-ordinated. It is even more futile to ask which country won the War. France did not win the War, but unless she had held the fort while the forces of Britain were preparing and those of America still a dream the release of civilisation from this nightmare of militarism would have been impossible. Britain did not win the War, but without her command of the sea, her financial support and her army to take over the main burden of the struggle from 1916 onwards, defeat would have been inevitable. The United States did not win the War, but without their economic aid to ease the strain, without the arrival of their troops to relieve considerable parts of the Allied forces—freeing them for offensive use, and, above all, without the moral tonic which their coming gave, victory would have been impossible. And let us not forget how many times Russia had sacrificed herself to save her Allies; preparing the way for their ultimate victory as surely as for her downfall. Finally, however we may judge her motives, let us pay tribute to the incomparable endurance and skill with which Germany more than held her own for four years against superior numbers, an epic of military achievement.

The principles of war as disclosed and evolved in this period are described in the articles: WAR; STRATEGY; TACTICS; CAVALRY; ARTILLERY; INFANTRY.

The campaigns and battles have received separate and detailed treatment in articles such as the following: AIR WARFARE; ANTWERP, SIEGE OF 1914; ASIAGO, BATTLE OF 1916; BELGIUM, INVASION OF 1914; BREST-LITOVSK, BATTLES OF, 1915; CAMBRAI, BATTLE OF, 1917; CAMEROONS, OPERATIONS 1914–6; CAPORETTO, BATTLE OF; CARPATHIANS, BATTLES OF THE; CAUCASUS, CAMPAIGNS IN THE; DARDANELLES CAMPAIGN; DUNAJECSAN, BATTLES OF THE; EAST AFRICA, MILITARY OPERATIONS 1914–8; EASTERN EUROPEAN FRONT CAMPAIGNS 1914–8; FRONTIERS, BATTLES OF THE: 1. Early Operations in Upper Alsace, 2. First Battles in Lorraine, 3. Battle of the Ardennes, 4. Battles of Charleroi, Mons, le Cateau and Guise. ITALIAN CAMPAIGNS, 1915–8; JUTLAND, BATTLE OF; LEMBERG, BATTLES OF; LODZ-CRACOW, BATTLES OF 1914; LUCK (LUTSK) BATTLES OF, 1916; MARNE, BATTLE OF THE; MASURIAN LAKES, BATTLES OF THE; MESOPOTAMIA, OPERATIONS IN; NAREW, BATTLES OF THE, 1915; NAROCZ, BATTLE OF LAKE; WORLD WAR, NAVAL; PRZEMSYL, SIEGES OF 1914–5; SALONIKA CAMPAIGNS; SERBIAN CAMPAIGNS, 1914–5; SOMME, BATTLE OF THE; VERDUN, BATTLES OF; VICTORY, ADVANCE TO; VISTULA-SAN, BATTLES OF THE; VITTORIO VENITO; WESTERN FRONT, 1914–8; YPRES, BATTLES OF: First Battle of, (1914) 2nd Battle of—Gas Attack; Third Battle of, (1917); YSER, BATTLE OF THE; ZEEBRUGGE, ATTACK ON.

The mechanism of war, the organisation of naval, military and air forces, and the scientific aspects of military machinery are dealt with in such articles as those on ADMIRALTY, BOARD OF; AIR FORCES; ARTILLERY (inc. Trench Ordnance); BALLISTICS; BOMBS; BRIDGING, MILITARY; CAMOUFLAGE, MILITARY; CAMOUFLAGE, NAVAL; CHEMICAL WARFARE; EXPLOSIVES, MILITARY; FLAME-THROWERS; INTELLIGENCE, NAVAL and MILITARY; MINELAYING AND MINESWEEPING; MOTOR TRANSPORT, MILITARY; ORDNANCE; PARAVANE; RANGE-FINDERS AND POSITION FINDERS; RIFLES AND LIGHT MACHINE GUNS; SUPPLY AND TRANSPORT, MILITARY; TANKS.

(B. H. L. H.)

WORLD WAR, NAVAL.—It was on July 28 1914 that Austria issued her declaration of war on Serbia and the First Fleet received orders to proceed to Scapa Flow in the Orkneys. It left Portland at 7 A.M. on July 29. The bulk of the navy at this time was to be found in the Home Fleet, which was divided into three forces, representing three successive stages of efficiency. The First Fleet, which became the Grand Fleet, mustered all the latest ships, fully manned and in permanent commission. The Second Fleet consisted of older but still efficient battleships and cruisers, manned in peace time with nucleus crews amounting to two-fifths of their complements. Last of all came the Third Fleet, a motley collection of obsolescent ships in the basins of the naval ports.

The war organisation of these fleets is summarised in Tables I. and II., which show the strength of the forces ranged against one another in the North Sea. In terms both of ships and gun power the British Fleet was superior; 13 of its 19 dreadnoughts were armed with 13·5-in. guns, and the rest with 12-in., while the Germans had 12-in. guns in only nine of their ships and 11-in. in the remainder.

I. THE OPENING OF HOSTILITIES

On July 29 "warning telegrams" went out to all squadrons abroad. On Aug. 1 the tension had increased and Germany issued the ominous order for *Kriegsgefahr* (precautionary period). Late that night the news came in that Germany had declared war on Russia, and at 1:25 A.M. on Aug. 2, Mr. Churchill issued the order to mobilise. By 4 A.M. on Aug. 3 the whole navy stood mobilised and ready for action. The German Fleet had returned hurriedly from a visit to Norway. On Aug. 1 the 2nd and 3rd squadrons came round from Kiel to the North Sea and at 8 P.M. that evening the order to mobilise went out in Germany. On the morning of Aug. 4 the Grand Fleet received orders to put to sea from Scapa. The term of Adml. Sir George Callaghan's command was nearly expired. It was thought that a younger commander was required to face the heavy strain of war, and the Grand Fleet (for it so was to be designated) put to sea at 8:30 A.M. under its new commander, Adml. Sir John Jellicoe. That night at 11 P.M. the eventful order went out from Cleethorpes to all ships and squadrons, "Commence hostilities at once against Germany."

The British war plans were primarily based on the concentration of the main fleet in the north to guard the northern exit of the North Sea and bar Germany's path to the ocean. The protection of the coast was entrusted to patrol flotillas under the Admiral of Patrols (the 8th Flotilla in Forth, 9th in Tyne, 7th in Humber, 6th at Dover). Behind these plans stood the coastline of Great Britain stretching like a colossal breakwater across Germany's path to the sea. The northern passage between the

TABLE I.

Disposition of British Fleet, Aug. 1914

	Dr.	Pre-Dr.	B.Cs.	Cr.	L.Cs.	T.B.D.	Old T.B.Ds.	S-ms.	Fleet Sweepers
First Fleet									
Adml. Sir John Jellicoe, 1st, 2nd, 3rd, 4th B. S.	19	8	..	..	4	..	..	..	9
1st B.C.S. (Vice-Adml. Sir David Beatty) 2nd C.S., 3rd C.S., 1st L.C.S.	..	..	4	8	6	..	..	..	..
10th C.S. (from Third Fleet)	..	..	..	8	..	..	..	..	..
Flotillas 2nd and 4th	..	..	..	..	2	40	16	..	..
Harwich Force									
Commodore (T) Reginald Tyrwhitt Flotillas 1st and 3rd	..	..	..	..	2	40	..	..	..
Second Fleet (Channel)									
Vice-Adml. Sir C. Burney, 5th B.S., 6th B.S.	..	15	..	3	2	..	..	..	..
(5th C.S. to Trade Routes)	..	..	..	..	..	..	..	..	..
Third Fleet									
Vice-Adml. Sir A. Bethell	..	..	..	..	..	..	..	..	..
7th and 8th B.S.	..	..	..	..	..	..	..	..	..
(6th, 7th, 9th, 11th, 12th C.S. to Trade Routes)	..	14	..	..	..	..	..	..	..
(10th C.S. to First Fleet)	..	..	..	..	..	..	..	..	..
(8th C.S. not constituted)	..	..	..	..	..	..	..	..	..
Patrol Flotillas (Coastal Areas)									
Rear-Adml. G. Ballard, *Admiral Patrols*, Flotillas 6th, 7th, 8th, 9th	..	..	..	..	8	73	23	..	..
S-m Flotillas, Commodore (S) Roger Keyes, 3rd, 4th, 5th, 7th, 9th	..	..	..	..	..	..	..	old 31	..
S-m Flotillas 6th and 8th	..	..	..	..	..	..	..	new 23	..
Home Ports	..	..	..	..	..	..	78	..	..
Cruiser Squadrons (Trade)									
5th (Cruiser Force D) (South Atlantic) Rear-Adml. A. P. Stoddart	..	..	..	4	..	..	..	..	..
6th (Escorts various)	..	..	..	4	..	..	..	..	..
7th (Cruiser Force C) (Narrows) Rear-Adml. A. H. Christian	..	..	..	5	..	..	..	..	..
9th (Cruiser Force I) (Finisterre) Rear-Adml. J. M. de Robeck	..	..	..	6	..	..	..	..	..
11th (Cruiser Force E) (West of Ireland) Rear-Adml. R. S. P. Hornby	..	..	..	5	..	..	..	..	..
12th (Cruiser Force G) (Soundings) Rear-Adml. Rosslyn Wemyss	..	..	..	4	..	..	..	..	..
Squadrons Abroad									
Mediterranean (Vice-Adml. Sir Berkeley Milne) 2nd B.C.S., 1st C.S., 5th Flotilla	..	..	3	4	4	16	..	..	..
North America and West Indies (Rear-Adml. Sir Chris. Cradock) 4th C.S. (Cruiser Force H)	..	..	..	4	1	..	..	.	..
China (Vice-Adml. Sir Thos. Jerram)	..	1	..	2	2	8	..	..	..
East Indies (Rear-Adml. R.H. Peirse)	..	1	..	2	1	..	..	..	..
Cape (Rear-Adml. H. G. King-Hall)	..	..	..	3	..	..	..	..	..
Australia (Rear-Adml. Sir G. Patey)	..	..	1	1	2	3	..	..	..
S.E. Coast America	..	..	..	..	1	..	..	..	..

TABLE II.

Disposition of German Fleet

	Dr.	Pre-Dr.	B. Cs.	Cr.	L. Cs.	D.	S-ms.
High Sea Fleet							
Adml. von Ingenohl, 1st, 2nd, 3rd Squadrons	13	8	..	..	..	..	..
1st Scouting Group	..	..	3	..	..	..	..
Cruisers	..	..	..	..	7	..	..
Flotillas 1 to 7	..	..	..	..	..	77	..
Submarines	..	..	..	..	..	..	old 18 new 10
Reserve	..	14	1	5	20	86	..
Mediterranean (Rear-Adml. Souchon)	..	..	1	..	1	..	..
East Asiatic (Vice-Adml. von Spee)	..	..	..	2	3	..	..
West Indies	..	..	..	..	2	..	..

Shetlands and Norway, 190 m. wide, could be kept constantly patrolled. The Straits of Dover, only 21 m. wide, lay exposed to attack, but any attacking force was threatened with a heavy counter-attack from the north on its return, and Germany never actually took the risk with her big ships. So long as the enemy refrained from an attack in force the dispatch of British troops across the Channel was no more hazardous than sending them to Ireland. The average time of transport across the Channel was no more than 13 hours, which meant that no transport could ever be more than seven hours from port, leaving an ample margin of time to reach harbour if a German force was reported in the Narrows. The Straits of Dover remained the weak point of the war plans, and there can be little doubt that a determined attack on the Channel at the beginning of the War would have severely shaken the whole structure of British strategy. Germany did not attempt it, and troops poured across the Channel in a continuous stream. To the westward there was only the "Goeben," and on Aug. 10 came the news that she had entered the Dardanelles.

The Submarine Menace.—Germany's strategy was defensive. It was based on the idea that the British Fleet would enter the Bight, where it was hoped to wear it down by ruthless mine-laying and submarine warfare. Then when an equality of strength (the greatly desired and much-talked-of *Kräfteausgleich*)

had been attained, a decisive battle would be dared. First a policy of waiting and attrition, then the decisive action. This was the essence of Germany strategy in the North Sea.

In pursuance of these aims, at 2:30 P.M. on Aug. 4 the "Königin Luise," a Hamburg-America liner, was dispatched to lay mines off the Thames. She did not return. Commodore Tyrwhitt was already at sea with the "Amethyst," "Amphion" and the Harwich destroyer flotillas. The "Königin Luise" was sighted on the 5th about 10 A.M., chased by the "Lance" and "Landrail," and sunk some 50 m. east (true) from Lowestoft. But she had laid her mines off Aldeburgh, and the "Amphion," on her way home, ran on one of them and went down in a few minutes with a loss of 150 men. This threat to the North Sea routes emphasised the necessity of minesweeping and started the enormous expansion of that important service, which became one of the principal spheres of naval activity (*see* MINE-LAYING AND MINESWEEPING).

For the Germans the problem was to find the British Fleet and, on Aug. 6, 10 German submarines went off into the North Sea to search for it. They found it at sea the same day. A torpedo, fired at the "Monarch," missed; U15 was rammed by the light cruiser "Birmingham" and sunk (58°26′ N., 1°58′ E.), and U13 never returned. This encounter, however, roused a sense of insecurity on the British side, and that night (10 P.M. on 6th) the commander-in-chief received orders to take his whole force to the northwest of the Orkneys. The menace of the submarine was already beginning to work.

Protection of the Expeditionary Force.—On Aug. 5 the Cabinet decided to send the Expeditionary Force to France, Mr. Churchill guaranteed its safety at sea, and Aug. 9 was fixed as the first day of passage. The transports were already assembling at Southampton. The war plans had provided that for this operation the Grand Fleet was to come down as far as the Forth (lat. 56° N.). But it was now west of the Orkneys, and as it remained north of Cromarty (58° N.) till Aug. 15, the burden of protection fell for a time on the Channel Fleet. By Aug. 9 the latter's 18 ships had assembled off Portland. In the Narrows, between Holland and Harwich, Tyrwhitt had 12 to 18 destroyers watching on a 30 m. front. The armoured cruisers "Bacchante," "Cressy," "Hogue" and "Aboukir" were in the Downs, and in the Straits were destroyers of the Dover patrol and Commodore Keyes' 10 submarines. To the westward, cruising from Land's End to Ushant, was Rear-Adml. Rouyer's French force of 14 old cruisers with Rear-Adml. Rosslyn Wemyss' cruiser squadron of four "Talbots." Covered by these forces a steady stream of transports passed across the Channel, rising to the number of 44 on Aug. 14 and remaining well over 30 a day. When the flow of troops was at its height, the Grand Fleet returned to the North Sea and on the 16th swept down to the latitude of the Forth (56° N.) and joined hands for a few hours with the southern forces. Nothing was seen of the enemy. On Aug. 23 the troops were across. Out of 240 transports employed not one had been lost.

To secure the position to the southward, a squadron (cruiser force K) of two battle cruisers, the "New Zealand" and "Invincible," was stationed for a time in the Humber. Hardly had the passage been accomplished than there came news of the terrible retreat in France, and so dangerous did things appear that on Aug. 24 Boulogne was closed and the army base shifted, with an immensity of labour, to St. Nazaire. Mr. Churchill was intent on saving Ostend and for nearly two days (Aug. 26–8) the Channel Fleet was hurrying marines across and lying off Ostend to support their landing. The effort availed little and they were no sooner landed than they were re-embarked. Meanwhile the attention of the German Fleet had been riveted to the Bight. There on Aug. 28 Beatty's battle cruisers had swooped down, driving in the German patrols and sinking the light cruisers "Mainz," "Ariadne" and "Cöln" (*see* HELIGOLAND BIGHT). This action, fought in Germany's very gate, had weighty consequences, for it confirmed the Kaiser in his decision to follow a strictly defensive policy and hardened him against Von Tirpitz's ardent pleadings for a strenuous offensive. German naval strategy settled down to a minor warfare of submarines and minelayers, varied by occasional raids against the English coast. The activity of the submarine soon began to be felt. On Sept. 5 U21 at the mouth of the Forth sank the small cruiser "Pathfinder," the first vessel to succumb to the submarine.

Scapa's defenceless state was a source of acute anxiety to Adml. Jellicoe at this time. On Sept. 1 a submarine was reported in the harbour, and the alarm culminated in the battle fleet weighing and putting to sea at night. It withdrew to Loch Ewe on the northwest coast of Scotland, 115 m. to the westward, and was there till Sept. 7, when it was recalled to the North Sea to cover the passage of the 7th Div. to France. Ten days later (Sept. 17) an important conference assembled in the "Iron Duke's" cabin at Loch Ewe. The First Lord was there with the Chief of the War Staff (Rear-Adml. Doveton Sturdee) and there was weighty discussion on the defences of Scapa, the possibility of entering the Baltic and the control of neutral traffic on the east coast. When the First Lord got back to London the German thrust was threatening the Channel ports, and on Sept. 19 orders went out for the Marine Brigade to be landed at Dunkirk. It was the task of the southern force to screen its passage and it came as a severe shock to find cruiser force C swept suddenly off the board.

Weddingen's Exploit.—On Sept. 22, patrolling at 10 knots, without a destroyer screen, off the coast of Holland (lat. 52°18′ N., long. 3°41′ E.), the armoured cruisers "Aboukir," "Hogue" and "Cressy" were torpedoed in quick succession between 6:25 and 7:30 A.M. by U9 (Otto Weddingen); they sank with a loss of 60 officers and 1,400 men. Mr. Churchill on Sept. 18 had suggested that they should not continue on this beat, a view in which the First Sea Lord concurred, but no orders had been issued to withdraw them. The exploit created a profound impression. Weddingen became the hero of Germany. The Belgian coast had to be covered, and it was decided to lay a defensive minefield in the North Sea. On Oct. 2 1914 a large area was notified and the first line was laid between the Downs and Holland. The same day there came the startling news of the Belgian intention to retire from Antwerp.

The First Lord was caught up in the whirl of events and found himself in Antwerp involved "in a hideously critical local situation." The idea of holding Antwerp superseded everything else. The Marine Brigade at Dunkirk was ordered up; the Royal Naval Div., raw and unequipped, was hurried across, and on Oct. 7 the 7th Div. was landed at Zeebrugge; the next day the British force fell back from Antwerp, which surrendered on Oct. 10. These movements brought a heavy strain on the Dover Patrol, which was created a separate command under Rear-Adml. the Hon. Horace Hood on Oct. 13. In the north the commander-in-chief had been ordered, on Oct. 2, to take special measures for the safety of the Canadian convoy, then on its way across, and for eight days the whole fleet was at sea, covering the waters between Scotland and Norway. The battle cruiser "Princess Royal" went out into the Atlantic to screen it, and the convoy of 31 ships arrived safely at Plymouth on Oct. 14. The 10th Cruiser Squadron was still patrolling at 10 A.M. on Oct. 15 off Peterhead, when U9 appeared and sent a torpedo into the old cruiser "Hawke," which sank in a few minutes with a loss of 500 lives. The losses, however, were not all on one side. The British submarine E9 (Lieut.-Comm. Max Horton) lying off Heligoland had sunk the small cruiser "Hela" on Sept. 12.

Operations off Nieuport.—A great German attack was gathering at Nieuport, and when General Joffre asked on Oct. 16 for the support of naval guns, Adml. Hood and his light craft hurried across, followed by monitors, and for nearly a week maintained a heavy fire on the German flank. In reply to an urgent call from German army headquarters for action against the monitors, four German destroyers left the Ems on Oct. 17 to lay mines off the North Foreland. They were met by the "Undaunted" (Capt. Cecil Fox) and four Harwich destroyers ("Lennox," "Lance," "Legion" and "Loyal") in the Nar-

rows and after a sharp fight and chase the last German boat was sunk off the Texel at 4:30 P.M.

In Scapa Flow there had been another submarine alarm. In the afternoon of Oct. 16 a supposed submarine was reported off the main entrance, and again the fleet raised steam and put to sea by night. This time the commander-in-chief decided to take the fleet around to Lough Swilly (Ireland). Its arrival there, on Oct. 22, meant a serious dislocation of the war plans, which were beginning to give way both in the north and south, through the pressure of the submarine. The remedies were simple. In the north an efficient boom, in the south an ample supply of effective mines, but these requirements were not forthcoming at the time. The sinking of the German destroyers had, however, given an assurance of safety to Hood's flotilla on the Belgian coast, but on Oct. 26 the German army swept down like an avalanche threatening to seize the sluices and engulf the whole Belgian line. The old battleship "Venerable" was dispatched to Hood and, while the culverts were being bricked up in breathless haste, the crash of her 12-in. guns enabled the Belgians to hold on for a few days till the waters rising round the sluices forced the Germans to retire. Again the German army called for help to the navy, but U19, hurrying down, was rammed by the "Badger" (Comm. Chas. Fremantle); U28 was hunted, by another destroyer and got into a trawler's net; and only U27 reached the Straits of Dover, where it sank the old cruiser "Hermes" (transformed into an air carrier) on Oct. 31.

In the north the move to Lough Swilly had been unfortunate. Two days before the battle fleet left Scapa, the "Berlin," a large Norddeutscher-Lloyd, had left the Jade and on Oct. 23 laid mines some 26 m. northwest of Lough Swilly. On the 26th the dreadnought battleship "Audacious" (Capt. Cecil Dampier) struck one of them. The White Star liner "Olympic," outward bound, came up and tried to tow her in, but she was still some 15 m. from Lough Swilly when she sank and blew up at 9 P.M. Her loss was kept a profound secret in Great Britain, and a whole fortnight elapsed before it was known with certainty in Germany. With the Grand Fleet 300 m. from the North Sea, the original war plans were giving way, and the commander-in-chief went up to confer with the Admiralty. It was a new board that he met. Prince Louis of Battenberg (Marquis of Milford Haven), who had given the order for the First Fleet to stand fast on July 26, had resigned and Lord Fisher had taken his place. It was decided that the 3rd Battle Squadron of "King Edwards" should come down to reinforce the Channel Fleet, and, to secure the approach to Dover, mines were to be laid in the North Sea, which was declared a military area on Nov. 2. It was announced that all ships passing northabout did so only at their peril, and all ships were advised to go and come by the English Channel.

First German Raid.—The notification was barely issued when on Nov. 3 a German raid was made on the east coast by the battle cruisers "Seydlitz," "Moltke," "Von der Tann" and "Blucher," with three light cruisers escorting the "Stralsund," with the object of laying a minefield on the British coast some 15 m. from Yarmouth. The morning was misty; the Germans, after laying their mines, engaged the patrols, dropped a number of rounds harmlessly on the beach near Yarmouth, and made off. Adml. Beatty with the battle cruisers put to sea from Cromarty, but by 4 P.M. the Germans were well on their way to the Bight and he was ordered to return. Hipper got safely back at 11 P.M. but the next day the armoured cruiser "Yorck" struck a German mine in the Jade and sank. This was the first sortie of the High Sea Fleet. The commotion had hardly died down when on Nov. 4 a telegram arrived from the British Consul-General at Valparaiso with the news of Coronel (*see* CORONEL) and the whole system of trade defence began to tremble under the menace of Von Spee. This is a milestone in the naval war and to understand it we must leave home waters for a time.

II. CRUISER WARFARE

Outside home waters the principal task of the British Navy was the protection of trade, for which purpose cruiser squadrons were stationed at the focal points of maritime traffic. The number of German cruisers abroad was comparatively small. The largest squadron, whose influence was felt in every sea, was in the Pacific commanded by Vice-Adml. Graf von Spee, consisting of the armoured cruisers "Scharnhorst" and "Gneisenau" (each 8 8·2-in., 8 5·9-in.) and the light cruisers "Emden," "Nürnberg" and "Leipzig." In the East Indies was the "Königsberg" (10 4·1-in., 23·5 knots) and in the Atlantic the "Dresden" and "Karlsruhe," armed with 12 4·1-in. and with a speed of 24 and 27·6 knots respectively.[1]

At the outbreak of war, the Admiralty was faced with insistent demands for convoy which would not be denied. In the East the whole of the East Indies squadron was engaged in the convoy of troops from India, and the convoy of the expeditions to New Guinea and Samoa occupied the whole Australian squadron for a time. The Cape, the Cameroons and British East Africa all made similar demands, and the system of patrolling focal areas was constantly threatening to break down in the attempt to meet these urgent calls.

Cradock's Pursuit of the "Dresden."—When war broke out, the "Karlsruhe" had just relieved the "Dresden" and both were still in the West Indies. In New York were several fast German liners, but the "Kronprinz Wilhelm" was the only one that actually put to sea. On Aug. 6 she was being armed and equipped by the "Karlsruhe" at a rendezvous some 120 m. northeast of Watling Island (off Cuba), when the "Suffolk," Cradock's flagship at the time, came upon them at 11 A.M., but after a long chase and night action with the "Bristol" the "Karlsruhe" got away. Then there came news of her and of the "Dresden" to the southward, and on Aug. 22 Cradock, who had transferred his flag to the "Good Hope," went off in pursuit and began his fateful journey to the south. The "Karlsruhe" remained in the West Indies and South Atlantic. The liner "Kaiser Wilhelm der Grosse," the only merchant cruiser which had succeeded in slipping out of the North Sea (on Aug. 5), was trying to get in touch with her but on Aug. 26 was caught coaling at Rio Ouro, a desolate anchorage on the Sahara coast, by the British cruiser "Highflyer" (Capt. Henry T. Buller) and after a short action was sunk. The "Karlsruhe" (Commander Kohler) continued her depredations on trade for some months, and up to Nov. 4 had captured or sunk 17 ships (76,609 tons registered) when she suddenly blew up in the West Indies (lat. 11°7′ N. long. 55°25′ W.)

On Sept. 3 Rear-Adml. Sir Christopher Cradock was appointed to command on the southeast coast of America. He was given the two armoured cruisers "Good Hope" and "Monmouth," the light cruisers "Glasgow" and "Bristol" and the armed merchantmen "Otranto," "Carmania" and "Macedonia." There ensued a hunt for the "Dresden" down the coast of South America. The "Carmania" (Capt. Noel Grant, 8 4·7-in.) went off to Trinidada, a tiny islet (lat. 20°30′ S., long. 29°22′ W.) 600 m. out in the South Atlantic, and there on Sept. 14 came upon a German armed merchantman, the "Cap Trafalgar" (2 4·1-in.), coaling. An action ensued, the "Cap Trafalgar" was sunk and the "Carmania" limped back to Gibraltar for repairs. Meanwhile the "Dresden" (Capt. Lüdecke), with two colliers, the "Baden" and "Santa Isabel," had sped south to a little harbour, Orange Bay, hidden away in Hoste Island in the vicinity of Cape Horn, where she lay from Sept. 5 to 16. In the Atlantic she had sunk only two ships.

Von Spee had been located at Ponape in the Caroline Islands on Aug. 9, and on Sept. 15 Cradock, then at Santa Caterina (Brazil), received an important message sent on Sept. 14 from the Admiralty. He was told that there was strong probability of Von Spee's arriving in Magellan Straits and that the armoured cruiser "Defence" (4 9·2-in., 10 7·5-in.) and the old battleship "Canopus" (4 12-in., 12 6-in.) were being sent out to reinforce him. He was to keep the "Canopus" and "Monmouth" with him, until the "Defence" joined, then concentrate a squadron

[1] Three battleships to Grand Fleet as minebumpers on 7/8/17. 6th B.S. ceased to exist 8/8/17, and 7th was merged with 8th, leaving Channel Fleet composed of 5th and 8th B.S.

strong enough to meet Von Spee, "search Magellan Straits, break up German trade and destroy the German cruisers." But the very next day, Sept. 16, the Admiralty heard that von Spee had appeared off Samoa on the 14th; and Cradock was informed that the situation had changed; "cruisers need not be concentrated and German trade on the west coast was to be attacked at once." This second telegram was the beginning of a chapter of misfortunes. The situation on the southeast coast had not changed; it had merely been postponed; concentration and reinforcement were as necessary as ever, but the order to the "Defence" to proceed to the southeast coast was cancelled without Cradock's being informed of it. He was at Montevideo when he received this telegram on Sept. 17 and proceeded south with his squadron on the 22nd. For another reason, Sept. 15 stands out as a red-letter day in cruiser warfare, for on it came the news that the "Emden" had burst into the Bay of Bengal. She had parted from Von Spee and the "Scharnhorst" on Aug. 14.

Von Spee's Force.—Von Spee was at Ponape in the Carolines when war broke out. Thence he went to Pagan in the Marianas Islands, where the "Emden" brought him a dozen supply ships from Tsingtao. The squadron proceeded eastward to Eniwetok (Aug. 19) in the Marshall Islands; then on to Majuro in the same group, arriving on Aug. 26, where Von Spee, having heard on Aug. 25 of Japan's declaration of war, finally abandoned all idea of return. His next port of call was Christmas Island, in the very middle of the Pacific, where he arrived on Sept. 7. On his way he heard of the fall of Samoa and, after coaling from his colliers at Christmas Island, proceeded there on Sept. 9, hoping to surprise any British ships in the vicinity. But when he arrived at 3 A.M. on Sept. 14, the harbour was empty. The report of his visit was passed by wireless to Suva in Fiji and thence by cable to New Zealand and London, where it arrived early on Sept. 16. In China it left Adml. Jerram's forces free to hunt the "Emden" down, and in Australia removed all anxiety as to the expedition to New Guinea and the homeward-bound convoy of Australian troops.

China Squadron.—In China the effective force of the commander-in-chief, Vice-Adml. Sir Thomas Jerram, consisted of the old battleship "Triumph," the armoured cruisers "Minotaur" (Capt. Edward Kiddle, 4 9·2-in., 10 7·5-in.) and "Hampshire" (Capt. H. W. Grant, 4 7·5-in., 6 6-in.) and the light cruiser "Yarmouth" (Capt. H. L. Cochrane, 8 6-in.). Japan's entry into the War on Aug. 23 secured the China seas and Jerram, leaving only the "Triumph" (Capt. Fitzmaurice) and destroyer "Usk" to assist in the investment of Tsingtao, took his ships south to secure the road to the East Indies. On Aug. 23 came instructions from home to proceed in search of the "Scharnhorst" and "Gneisenau" and keep in touch with Rear-Adml. Patey in Australia, but as nothing was known of the German ships, Jerram, on his arrival at Singapore on Aug. 30, sent his cruisers to search the Dutch East Indies, where 22 German merchant ships had taken refuge.

This search lasted till Sept. 13, but already demands for convoy had begun to dislocate his plans. On Sept. 8 the Admiralty ordered him to send his two best ships, the "Minotaur" and "Hampshire," to meet the Australian convoy, which was due to leave Fremantle for Europe on Oct. 3. The Vice-Adml. decided to send the "Minotaur," in the meantime, with two Japanese ships, the battle cruiser "Ibuki" (4 12-in., 8 8-in.) and cruiser, "Chikama" (8 6-in.), to Rabaul in New Britain to cover Australia, when suddenly the situation in China was changed on Sept. 15 by the news of von Spee's appearance off Samoa, and more imperatively by the simultaneous appearance of the "Emden" in the Bay of Bengal. Till the "Emden" was finally run down by the "Sydney" at Cocos Island on Nov. 9 Jerram's ships were almost wholly engaged in hunting for her in the East Indies.

In Australia the same influences had been at work. On the outbreak of War Rear-Adml. Sir George Patey had decided to take up a position at Port Moresby in the Gulf of Papua, British New Guinea (lat. 9° 28′ S., long. 147° 9′ E.), covering Australian waters and within reach of the two principal German harbours, Rabaul (or Simpsonhafen) in New Britain and Friedrich-Wilhelmshafen (Madang) in New Guinea. Demands for convoy began even earlier than at Singapore to dislocate his plans. New Zealand's expedition to capture Samoa was ready to go on Aug. 18 and the Admiralty approved of its starting, directing Patey on Aug. 13 to give it naval support. But no sooner had he arranged to meet it with the battle cruiser "Australia" and the "Melbourne" 450 m. south of Fiji on Aug. 24 than the Australian Navy Board asked that their expedition to New Guinea should be taken first. Finally it was decided that the cruiser "Sydney" should take the New Guinea force as far as the Barrier Reef, on the east coast of Australia, and then wait for the "Australia" and "Melbourne" to return from Samoa. This was done. The "Australia" arrived at Samoa on Aug. 29, the force was landed, the British flag hoisted, and she left the next day to join the New Guinea force.

But now the demands of the European convoy came flooding in. Patey was then engaged in the New Guinea operations. Rabaul was occupied on Sept. 13, and on Sept. 15 the news of Von Spee's visit to Samoa cleared up the situation. Friedrich-Wilhelmshafen was occupied on Sept. 24 and Angaur wireless station was destroyed by the "Sydney" on Sept. 26. When news arrived of Von Spee's appearance off Tahiti on Sept. 22, Patey received orders to take his squadron to Suva (Fiji) to bar the road to his return, and sailed from Rabaul on Oct. 3.

It had been intended that the Australian convoy should leave Fremantle on Oct. 5, escorted by the "Minotaur," "Sydney" and "Ibuki," but New Zealand refused to let her transports proceed to Australia without a strong escort and the "Minotaur" and "Ibuki" had to trail the whole way to Wellington to bring them on. This meant a delay of three weeks and it was not till Nov. 1 that the great convoy of 37 transports left King George's Sound, Albany, escorted by the "Melbourne," "Minotaur" and "Ibuki." The "Sydney," too, was with them on the road that was to lead her to the "Emden" and to victory and fame.

Cradock's Force.—Meanwhile, in the Atlantic Cradock had gone from Montevideo to the southward and by Sept. 28 his ships stood before the Magellan Straits, and started searching the creeks and crannies of Tierra del Fuego. On Oct. 3 the "Glasgow" and "Monmouth" went off to the west coast to attack German trade in accordance with the Admiralty telegram of Sept. 16, but the "Good Hope" remained in the Falklands area, waiting for the "Canopus." Von Spee had been reported a second time off Tahiti in the Society Islands on Sept. 22, and on Oct. 5 was again located by an intercepted wireless to the "Dresden," which stated that he was on his way to Easter Island. No shadow of doubt could remain that he was on his way across the Pacific, and the Admiralty on Oct. 5 sent word to Cradock to be prepared to meet him, adding that the "Canopus" should accompany the "Glasgow," "Monmouth" and "Otranto" in their search. The idea can be regarded as sound on only the assumption that Cradock was expected only to find and locate Von Spee, for, tied to a battleship which could not be trusted to go more than 15 knots, his armoured cruisers could not be expected to attack or pursue a fast and powerful enemy.

Cradock received the message on Oct. 7, and on the 8th sent a message to say that he was concentrating at the Falklands, and suggesting the formation of a strong second squadron on the east coast to intercept the German squadron if it should evade him. The telegram reached the Admiralty on the 11th, and the armoured cruisers "Defence" and "Kent" (14 6-in.) were immediately ordered to reinforce Rear-Adml. Stoddart on the east coast. The First Lord (Mr. Winston Churchill) also recommended the postponement of Cradock's cruise to the west coast, but the reply actually sent to him merely took the form of "concurring" in the "concentration" of his vessels "for combined operations." The "concentration" at the Falklands never materialised. The "Good Hope" left for the west coast (via Cape Horn) on Oct. 22, leaving the "Canopus" to follow with her colliers (via Magellan). Cradock's conception of the situation

will never be known. He probably felt it incumbent on him to support the "Glasgow" and "Monmouth." There was a vagueness at both ends of the wire. Cradock spoke of concentrating at the Falklands, when half his squadron had already gone to the east coast. The Admiralty, knowing that the "Glasgow" and "Monmouth" had gone to the west coast, concurred in a concentration for "combined operations," whatever that might mean. But the Admiralty's readiness to reinforce Stoddart, at Cradock's suggestion, indicates that it would have been equally ready to reinforce Cradock if he had asked for it. But neither in his telegrams nor in his last dispatch of Oct. 12 did he suggest, much less definitely state, that his squadron was too weak to face the foe. There was one vessel which might have saved the situation, namely the battle cruiser "Australia," if Cradock had been told to wait for her, but in response to urgent representations from New Zealand, she had been retained off Fiji, and remained there straining on her leash.

Coronel and the Falkland Islands.—Von Spee was then at Masa-fuera (Oct. 18–26), a small island 450 m. from the coast of Chile, and the two squadrons were approaching one another, for Cradock had joined the "Glasgow," "Monmouth" and "Otranto" at Vallenar in Chonos Archipelago (lat. 45° 24′ S., long. 74° 18′ W.) on Oct. 27. The squadrons met off Coronel on Nov. 1, the "Good Hope" and "Monmouth" sank in the Pacific, the "Glasgow" and "Otranto" got away. The "Canopus" was 300 m. off at the time toiling northward with her colliers at 12 knots (*see* CORONEL).

The news arrived in England on the morning of Nov. 4 and fell on the country like a thunderclap. Lord Fisher was then First Sea Lord and every effort was made to redeem the situation. The battle cruisers "Invincible" and "Inflexible" were taken from the Grand Fleet and sailed from Devonport on Nov. 11 with Vice-Adml. Sir Doveton Sturdee, late chief of the War Staff, in command. Rear-Adml. Stoddart was waiting for him at Abrolhos Rocks off the coast of Brazil, with the "Carnarvon," "Cornwall," "Defence" and "Kent," while Von Spee, unaware of the thunderbolt launched at him, had visited Valparaiso and was on his way southward. Sturdee coaled at Abrolhos Rocks and rushed on with his ships ("Inflexible," "Invincible," "Carnarvon," "Cornwall," "Kent," "Glasgow," "Bristol" and "Orama") to the south, arriving at Port William, Falkland Islands in the forenoon of Dec. 7. The "Australia" meanwhile was speeding across the Pacific, while a strong Japanese squadron had taken her place off Fiji. Von Spee passed the Horn in a gale at midnight on Dec. 1. The next day he met a Scottish barque, the "Drummuir" with 2,800 tons of coal, and put back to Picton Island near Beagle Channel to transfer her coal. The "Drummuir" was sunk on Dec. 6 and with her sank Von Spee's hope of getting home. He had decided at Picton Island to make a raid on the Falklands. On Dec. 8, at dawn, the islands were in sight and the "Gneisenau" and "Nürnberg" were sent in towards Port William. In the battle which followed (*see* FALKLAND ISLANDS BATTLE) the "Scharnhorst," "Gneisenau," "Leipzig" and "Nürnberg" were sunk and Von Spee and his two sons perished. The battle stands as one of the great beacons of the naval war, marking the collapse of German sea power in the outer seas.

The Emden.—The "Emden's" career in the East Indies had already come to an end with a tale of 15 ships. She had ranged the Bay of Bengal from Sept. 7–25, bombarded Madras on Sept. 22, cruised in the approach to Colombo till Oct. 21, coaling in the Maldive Islands and at Diego Garcia, and raided Penang on Oct. 28. The armoured cruisers "Hampshire" and "Chikuma," the armed merchant cruiser "Empress of Asia" and light cruiser "Yarmouth" were all chasing her in vain pursuit, though the "Hampshire" just missed her on Oct. 21 and the "Yarmouth," on Oct. 9 sank two of her supply ships at Pulo Tapak on the west coast of Sumatra. At dawn on Nov. 9 she appeared off the cable station at Cocos, Keeling Island, where the operator promptly sent out an S.O.S. to all ships, and flashed the news by cable to Singapore just as the boats of the German landing party grounded on the beach before his door. The big convoy of 37 transports bound for Europe from Australia and New Zealand had left Albany on Nov. 1 and, escorted by the "Melbourne" (Capt. M.L'E. Silver), the "Sydney" and Japanese battle cruiser "Ibuki," was at the moment approaching Cocos. It was only 55 m. off when the "Melbourne" received the S.O.S. and the "Sydney" was sent off to Cocos Island at full speed. The "Emden" (Comm. Karl von Müller, 10 4·1-in. had not even time to get her landing party on board. The "Sydney" (Capt. J. C. Glossop, 8 6-in.) came down on her suddenly and at 11:30 A.M., after a sharp fight, drove her ashore, a blazing wreck.

There remained then only the "Dresden," hiding in the ice creeks of Tierra del Fuego, and the "Königsberg," shut up in the swamps of the Rufiji river (German East Africa) both powerless for harm. By the end of 1914 the ocean passages were secure. Samoa and New Guinea had fallen; a Japanese guard stood in the gates of Tsingtao. In the Cameroons, Duala, Buea and Victoria had been occupied with the help of a naval squadron under Capt. Cyril M. Fuller, and his ship the "Cumberland" joined the stream of British cruisers homeward bound.

Hipper's Raid.—At home the old battleship "Bulwark" had been blown up by an internal explosion at Sheerness on Nov. 26. The Germans had continued their policy of raids and minelaying. On Dec. 15 Rear-Adml. Hipper left the Jade with a force of four battle cruisers, three light cruisers, 18 destroyers and the "Kolberg" with mines on board. Behind him in support came the German battle fleet of 14 dreadnoughts and eight Deutschlands.

The Admiralty, warned by German signals of Hipper's sortie, but not knowing that their battle fleet was out, dispatched a force including the 2nd Battle Squadron (Vice-Adml. Sir George Warrender) and the 1st Battle Cruiser Squadron under Vice-Adml. Beatty, mustering in all six dreadnoughts, four battle cruisers, four armoured cruisers, four light cruisers and seven destroyers, to a position near the Dogger Bank (lat. 54° 10′ N., long. 3° 0′ E.) to intercept Hipper. At 5:20 A.M. on Dec. 16 the destroyer "Shark" (Comm. Loftus Jones), 10 m. on Beatty's port beam, struck the destroyers ahead of the German battle fleet. The destroyer action which ensued caused Adml. von Ingenohl, who was then only some 30 m. from Warrender's force, to turn back and make for home.

Hipper meanwhile had reached the coast at 6:40 A.M. After bombarding Hartlepool at 4,000 yd. (killing 103 civilians and wounding 344) and also Scarborough (17 killed, 99 wounded), he had laid his mines five miles off Scarborough and at 9:40 A.M. was making for home. Warrender and Beatty were then some 140 m. to the east, making straight for him. But by noon a heavy sea was running with mist and rain. Hipper's light craft, 50 m. ahead of him, emerged suddenly at full speed from the mist, and after a running fight for 20 min. with the "Southampton" and "Birmingham" (lat. 54° 36′ N., long. 1° 55′ E.), disappeared. Hipper, hearing from them of the British force in front of him, made a long détour to the north and got safely home. This was apparently the first occasion on which the German movements were successfully anticipated by their own signals.

III. THE DARDANELLES

The year 1915 began badly. At 2:20 A.M. on Jan. 1 the old battleship "Formidable" (Capt. Arthur Loxley) cruising with the Channel Fleet, was sunk by U24 off Start Point. But later in the month, on Jan. 24, Hipper and his battle cruisers suffered a heavy blow at the battle of the Dogger Bank (*see* DOGGER BANK) where the Germans lost the "Blücher." Adml. von Ingenohl was superseded and Adml. von Pohl, chief of the staff, took his place in command of the High Sea Fleet, charged to observe a still more cautious policy. The successes of Von Weddingen had led the German naval staff to favour submarine warfare, which opened with the declaration of a war-zone round the British Isles on Feb. 4 (*see* SUBMARINE WARFARE). These views were no doubt strengthened by the final collapse of their cruiser warfare abroad. The "Dresden," lurking since the Battle of the Falklands in the fiords of the Magellan Straits, had crept

back into the Pacific to meet a German collier off Juan Fernandez (Chile). The "Kent," searching for her with the "Glasgow" in Magellan Straits, heard of it and hastened north. On March 7 she was at the rendezvous, but the "Dresden's" speed enabled her to get away. The "Glasgow," however, had made out the words "Juan Fernandez" in a signal and there in Cumberland Bay on March 14 at 8:50 A.M. the "Glasgow," "Kent" and "Orama" found her and brought her career to an end (her casualties numbered 7 killed and 15 wounded).

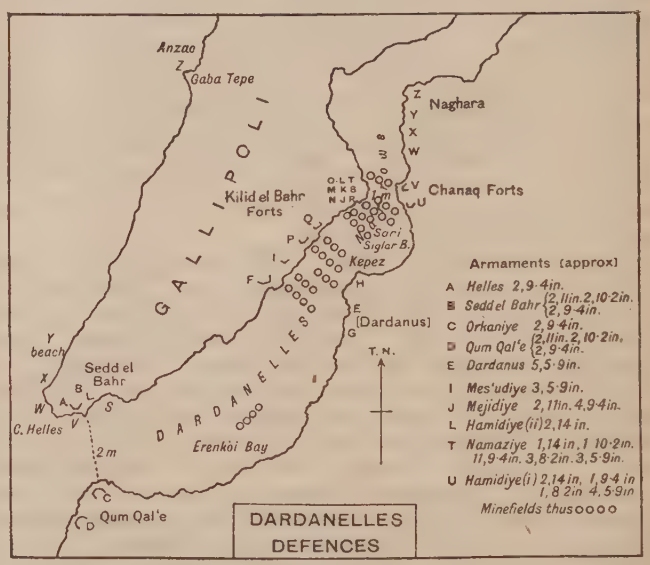
Dardanelles Plan Broached.—In Europe the centre of interest was shifting to the Dardanelles. The German Fleet rarely left the Bight. A deadlock seemed to have arisen and the idea of an attack on the Dardanelles was mooted, challenging even the Grand Fleet in its insistency and swallowing the Channel Fleet at a gulp. The scheme offered advantages of the first magnitude, strategic, diplomatic and economic, but its beginning was marred by the idea of a "purely naval enterprise," arising in its turn out of Lord Kitchener's refusal to supply troops for a combined operation, and by the failure to appreciate that a naval bombardment must imperil the success of any subsequent combined operation, where surprise was the essence of success. It began with a request from Petrograd on Jan. 2 for a diversion to relieve the Russians in the Caucasus. The idea of the Dardanelles was broached. Vice-Adml. Sackville Carden, senior officer in the Mediterranean, gave his opinion on Jan. 5 and 11 that the Dardanelles might be forced by "extended operations," a phrase which soared easily over a multitude of difficulties. The First Lord (Mr. Winston Churchill) waxed enthusiastic over it. Lord Fisher consented to the new battleship "Queen Elizabeth" doing her gunnery trials there, and Mr. Churchill saw her creeping relentlessly forward with the forts disappearing one by one in clouds of dust before her 15-in. shell. Aerial reconnaissance and the great range of naval guns were supposed to have revolutionised bombardment and it was thought that the proposition was worth a trial. On Jan. 13 the War Council agreed that the Admiralty should prepare for a naval expedition in Feb. to bombard and take the Gallipoli Peninsula with Constantinople as its objective. Lord Fisher and Sir James Murray, chief of the General Staff, were ominously silent.

The result was an endeavour to perform a task of first-class magnitude with second-class material and insufficient preparation. Aerial reconnaissance in conjunction with naval guns was not then born. To force the Straits a nucleus of the best artillerists, the best minesweeping vessels in the fleet and at least two score of first-class airmen would have been required. These were not forthcoming, and apart from this need the whole conception was strategically weak, for the fleet, even if it broke through, would have been left in the air in the Sea of Marmora, relying on the precarious chance of a revolution in Turkey.

But by Feb. 1915 the idea of a "purely naval enterprise" was being abandoned. A military force was to be available "to reap the fruits." The opinion found favour that if the navy failed, the army should help—a conception utterly contrary to the generally accepted strategy of combined operations. Lord Fisher's attitude of lukewarm acquiescence had changed by then to one of downright disapproval, but his arguments were blunted by his passionate adherence to the idea of a great landing in the Baltic, a plan even more difficult and dangerous. The War Council approved of the project on Jan. 28, bringing Lord Fisher to the verge of resignation.

Bombardment of the Forts.—The main naval force assembling for this purpose consisted of two modern and 12 older battleships, drawn from the Channel Fleet and every quarter of the globe, and four old French battleships, viz.: "Queen Elizabeth" (Capt. Geo. Hope, 8 15-in.), "Inflexible" (Capt. R. F. Phillimore, 8 12-in.), "Agamemnon" (Capt. H. Fyler, 4 12-in., 10 9·2-in.), "Lord Nelson" (Capt. J. W. McClintock, 4 12-in., 10 9·2-in.), "Vengeance" (Capt. Bertram Smith, 4 12-in., 12 6-in.), "Albion" (Capt. Alg. Heneage, 4 12-in., 12 6-in.), "Irresistible" (Capt. Douglas Dent, 4 12-in., 12 6-in.), "Triumph" (Capt. Maurice Fitzmaurice, 4 10-in., 14 7·5-in.), "Cornwallis" (Capt. Alex Davidson, 4 12-in., 12 6-in.), "Ocean" (Capt. A. Hayes Sadler, 4 12-in., 12 6-in.), "Swiftsure" (Capt. Cecil Lefroy, 4 12-in., 12 6-in.), "Canopus" (Capt. Heathcote Grant, 4 12-in., 12 6-in.), "Prince George" (Capt. A. V. Campbell, 4 12-in., 12 6-in.), "Majestic" (Capt. H. F. Talbot, 4 12-in., 12 6-in.), "Suffren" (Rear-Adml. Guepratté, 4 12-in., 10 6·4-in.), "Bouvet" (Capt. de la Touche, 2 12-in., 2 10·8-in.), "Charlemagne" (Capt. Lagresille, 4 12-in., 10 5·5-in.), "Gaulois" (Capt. Biard, 4 12-in., 10 5·5-in.). It was under the command of Vice-Adml. Sir Sackville Carden with Commodore Roger Keyes as his chief of staff. Rear-Adml. John de Robeck was in the "Vengeance," and at Port Mudros in Lemnos, Rear-Adml. Rosslyn Wemyss was busy making a base for the armada out of nothing.

At 8 A.M. (times are East European) on Feb. 19 the attack on the four outer forts was commenced by eight ships—the "Inflexible," "Agamemnon," "Cornwallis," "Vengeance," "Triumph," "Bouvet," "Suffren" and "Gaulois." The ships first



engaged at long ranges; the forts were apparently silenced and the ships closed to medium ranges (7,000 yd.) at 2 P.M.; when failing light put a stop to the operation, Orkaniye alone was maintaining a fitful fire. On Feb. 25 the operations were resumed. The "Queen Elizabeth," assisted by the "Agamemnon," put both the guns at Helles out of action; the Qum Qal'e forts on the Asiatic side were dealt with by the "Irresistible," "Gaulois," "Suffren" and "Charlemagne" and by 5:15 P.M. all the outer forts were effectually silenced. The fleet anchored that night full of hope and confidence, while the minesweepers entered and swept a channel four miles up. But the outer forts were merely the outworks of the position. The real dangers loomed at the Narrows, where a channel only a mile wide was defended by nine lines of mines and commanded by heavy batteries, mounting 6 14-in. guns, 6 11-in. and at least two score 10·2-in. and 9·4-inch.

Attempt to Sweep the Narrows.—The next fortnight (March 3–17) was occupied with an attempt to sweep the channel by night and reduce the forts by day. On March 5 the "Queen Elizabeth" opened indirect fire on the Kilid el Bahr forts, shelling them over the hills from the west side of Gallipoli and apparently putting Hamidiye II. out of action. Indirect fire was continued the next day on Hamidiye I. and II. at 21,000 yd., while the "Vengeance," "Albion," "Majestic," "Prince George" and "Suffren," inside the Straits, engaged Forts Dardanus and Mes'udiye half-way up. The air reconnaissance available was of little use, and hidden howitzers forced ships to keep on the move and prevented their observing the fire.

On March 7 the French battleships engaged Fort Dardanus, and the "Lord Nelson" went up and engaged Mejidiye and Hamidiye II. in the Kilid el Bahr group at a range of 12,000 yards, apparently silencing them. Meanwhile the progress of the mine-

sweepers was poor. It was here that the principal difficulties arose. The minesweeping force was too feeble for its colossal task, and its trawlers, which could make no more than four knots against the current, were an easy target for the Turkish guns. On March 10 they went up at night, supported by the light cruiser "Amethyst" (Comm. G. J. Todd) and the "Canopus." Two trawlers were hit by 6-in. shell, one was sunk by a mine and the whole force had to be reorganised and manned with naval ratings. At home the First Lord was growing insistent, and on March 11 sent a telegram to the Vice-Adml., urging a decision, and suggesting that the point had been reached when it was necessary to "overwhelm" the forts at the Narrows at decisive range. Everything now hinged on clearing the minefields. On the night of March 13–4, seven trawlers and five picket boats manned by volunteers made a determined effort to sweep the channel, supported by the "Amethyst" and "Cornwallis." They were driven back at 3:50 A.M. under a tornado of fire. The "Amethyst" received nine hits and had 22 killed and 38 wounded. The result effectually demonstrated the insuperable difficulty of sweeping under fire by night, and it was decided to attempt it by day under cover of a heavy bombardment.

The Final Attack.—Vice-Adml. Carden's health broke down and the final attack took place on March 18 1915 under Vice-Adml. John de Robeck. It was a clear sunny day when the "Agamemnon" at 10:30 A.M. led the fleet into the Straits. At 10:45 the "Queen Elizabeth," "Inflexible," "Agammemnon" and "Lord Nelson" engaged the batteries at the Narrows at 16,000 yd., while the "Triumph" and "Prince George" kept down the fire of the forts and howitzers on the adjacent shores. After a bombardment of about an hour and a half the four French battleships advanced as far as Kephez and engaged the Narrows forts at about 9,000 yards. The fire of the forts was slackening, when at 1:45 the "Vengeance," "Irresistible," "Albion," "Ocean," "Swiftsure" and "Majestic" were ordered to relieve the French line. As the "Bouvet" retired, she was struck by a mine or shell at 1:50 P.M. and sank in two minutes with the loss of all but a score of her crew. The minesweepers had got their sweeps out and by 3:10 P.M. were proceeding up stream. Up to this point the day had gone fairly well though the "Inflexible" had been badly hit by howitzers posted near Eren Köi. Her forebridge was set on fire, the control station on the foremast put out of action and Comm. Verner, her gunnery officer, mortally wounded. No other ship, however, had received serious damage.

By this time the position in the Turkish forts was growing critical. The supply of modern ammunition was scanty, several guns were out of action and nearly all were choked with sand and dirt from the terrific earth spouts cast up by the English shell. Hamidieh I. alone, manned by German gunners, was firing steadily. Then came the climax within one short hour. Shortly after 4 P.M. the "Inflexible" struck a mine and only with difficulty reached Tenedos, where she had to be beached. At 4:15 the "Irresistible" struck another; the general recall was flying, when the "Ocean," going to help her, met the same fate at 6:05 P.M. and both had to be abandoned. All this happened in Eren Köi Bay on the Asiatic side, only four or five miles from the entrance, where mines had been laid by the Turks on March 8. The "Suffren" and "Gaulois" were also so severely injured by gunfire that they had to be docked. Out of 18 battleships, three had been sunk and three disabled. On the Turkish side eight guns had been put out of action, and four officers and 40 men killed, but the minefields remained practically intact. The fleet had attempted too much. To force a channel defended by a minefield and heavy batteries was a task of the first magnitude, beyond the compass of de Robeck's force. On March 23, after a conference with Gen. Sir Ian Hamilton, de Robeck decided that he must keep the fleet intact to assist in the landing operation. Mr. Winston Churchill urged the admiral to renew the attempt to break through, but Lord Fisher would not agree.

This was the end of the "purely naval enterprise." Sir Ian Hamilton had arrived without plans; the transports had not been loaded for an immediate landing; a month elapsed before the army could make their attack, and in that month the peninsula was converted into a fortress.

The Gallipoli Landing.—It was now the task of the navy to prepare to support the landing. This did not take place till April 25. The naval force acting in support numbered 18 battleships, 12 cruisers, 29 destroyers and eight submarines, while a great armada of transports and auxiliary craft assembled gradually behind them at Port Mudros in Lemnos (Greece). The whole shore of Gallipoli had been reconnoitred and six beaches chosen for the landing on the 12-mile strip of coast, stretching northward from the northern entrance of the Straits. These were designated by the letters S (just inside the Straits), V (just west of Sedd el Bahr), W (by Cape Teke), X (1 m. north of W), Y (1 m. north of X) and Z (10 m. north of Y), near Gaba Tepe, to be christened in a baptism of fire with the new and splendid name of Anzac.

The force to be landed numbered 75,000 with 140 guns. The ships were divided into "covering" ships (to support the landing with their fire) and "attendant" ships (to carry the troops and assist in their landing). The landings at the nose of the peninsula that is at S, V, W, X and Y beaches, were under Rear-Adml. Rosslyn Wemyss with seven battleships, viz.: the "Lord Nelson," "Swiftsure," "Implacable," "Cornwallis," "Vengeance," "Albion" and "Prince George" and four cruisers, the "Euryalus" (Capt. R. Burmester, 2 9·2-in., 12 6-in.), "Talbot" (Capt. F. Wray, 11 6-in.), "Minerva" (Capt. P. Warleigh, 11 6-in.), and "Dublin" (Capt. John Kelly, 8 6-in.). The landing at Anzac was under Rear-Adml. Cecil Thursby with five battleships, the "Queen" (flag, Capt. H. A. Adam), "Prince of Wales" (Capt. R. Bax), "London" (Capt. J. Armstrong), "Triumph" and "Majestic," and one armoured cruiser, the "Bacchante" (Capt. Hon. Algernon Boyle, 2 9·2-in., 12 6-in.).

These last six ships left Port Mudros in the afternoon of the 24th. The night was calm without a breath in the air or ripple on the sea. The moon set at 3 A.M. and it was dark when they approached the coast. Of the advanced force for Anzac, 1,500 men were in the "Queen," "Prince of Wales" and "London," each of which was provided with four tows of six boats; the remaining 2,500 were in seven destroyers, each towing six lifeboats. The rest of the force was following in 40 transports. The ships stopped two miles from the shore, and the steam picket boats started off with their tows in dead silence. At Anzac by good fortune the boats struck the beach a mile and a half north of the intended spot, which had been strongly entrenched. The Australians leapt into the water, rushed the Turks up the hills and out of them. By 5:30 A.M. the whole of the advanced force was ashore at Anzac.

At Y Beach the advanced force was landed in four trawlers, each towing six boats supported by the cruisers "Sapphire" (Comm. P. W. Hill), "Amethyst" and the "Goliath" (Capt. T. L. Shelford), and was ashore at 7:15 A.M. At X Beach the advanced force was in the "Implacable" (Capt. H. C. Lockyer). The captain dropped anchor close in, veered till the ship was almost aground, then let fly with all her guns just over the beach, raising such a dust and smoke and din that the troops landed there with hardly any casualties. W Beach was bristling with wire and flanked with high cliffs. The advanced force was in the "Euryalus" with boat tows to take it ashore; the "Swiftsure" was the covering ship. The beach was strongly defended and the Lancashire Fusiliers had a terrible time. V Beach, just under the castle, became a place of despair. The old collier "River Clyde" full of troops was run ashore with a bridge of lighters to carry the men ashore. The lighters broke adrift, though Comm. Edward Unwin and three gallant companions (all four awarded the V.C.) made desperate attempts to get them into place, and the landing broke down entirely. At S Beach the troops were landed in trawlers, which were run aground under a heavy fire from the "Cornwallis" and "Lord Nelson," and the 2nd South Wales Borderers got ashore with very few casualties. Such was the landing at Helles, which, as a feat of arms, ranks high in the annals of the British army (*see* DARDANELLES CAMPAIGN).

Resignation of Lord Fisher and Mr. Churchill.—But another danger was looming on the horizon. Otto Hersing, one of the most skilful German commanders, was on his way out in U21. On May 13, too, the " Goliath," anchored in Morto Bay just inside the entrance, was attacked at 1:15 A.M. by a destroyer, the " Muavenet-i-Millet," with a German commander, and hit by three torpedoes, sinking in a few minutes with a loss of over 500 men. Lord Fisher insisted on the recall of the " Queen Elizabeth " but in the attitude of the War Council and the First Lord on May 14 he saw his great alternative scheme in the Baltic doomed. On May 15 he walked out of the Admiralty, precipitating a political crisis which swept the First Lord from Whitehall; Mr. Balfour took his place and Adml. Sir Henry Jackson became First Sea Lord. On May 25 Otto Hersing arrived at the Dardanelles. At 12:25 P.M. he torpedoed the " Triumph," which capsized in 10 minutes, with the loss of three officers and 70 men. On the 27th at 6:45 A.M. the " Majestic " suffered the same fate, with the loss of only 40 men.

The battleships had to be replaced by monitors and by old cruisers of the " Theseus " class which had been fitted with bulges, but the fleet still maintained the army's supplies by sea and remained its " father and mother " right up to the amazing night of Jan. 8 1916, when swiftly and silently it gathered into its arms the men of those tremendous legions and bore them home. But the passage of the Dardanelles, impenetrable to big ships, had been made by submarines. Nine British and three French submarines passed the Straits, of which three French and four British never returned. It was on this hazardous service that Lt.-Comm. Norman Holbrook in B11, Lt.-Comm. E. C. Boyle in E14 and Lt.-Comm. M. E. Nasmith in E11 won the V.C. Here too E15 (Lt.-Comm. T. S. Brodie), AE2 (Lt.-Comm. H. H. Stoker), E7 (Lt.-Comm. A. D. Cochrane) and E20 (Lt.-Comm. C. H. Warren) were lost and E12 (Lt.-Comm. Kenneth Bruce) on Oct. 25 got entangled in a net, but with her conning-tower flooded and under a hot fire won through in safety. From July 1915 to the end of the year there were usually two British submarines working in the Sea of Marmora, seriously interfering with the Turkish transports and supplies.

The end of the year saw the great crusade setting in a cloud of glory and stormy disappointment. It had in it the elements of a striking success, but there was no real staff at the Admiralty or War Office; France and the Grand Fleet were insistently calling, and Lord Fisher was wedded to his plan of attack in the Baltic, a still more dangerous enterprise, where German granite would have to be bitten instead of Gallipoli sand. In that sea, as at the Dardanelles, British assistance was limited to submarines, which did excellent work after their kind, but could do no more. The Sound was not passable to big ships, and Germany, at the beginning of the War, had agreed with Denmark to close the Great Belt with mines.

The Baltic.—The defence of the Baltic had been left to the older German ships but the Russians proved themselves no mean antagonists. An attempt on June 28 1915 to land troops at Windau (Courland) to support the German army closing round Warsaw was frustrated by a swarm of Russian destroyers attacking the transports and driving them off, bringing the operation to an abrupt close. On July 2 Russian cruisers drove the German minelayer " Albatross " ashore at Ostergarn (Sweden) and the German armoured cruiser " Prinz Adalbert " (4 8·2-in., 10 6-in.) making for the spot was torpedoed and seriously damaged by the British submarine E9 (Comm. Max Horton). In Aug. 1915 a serious attempt was made to force the Gulf of Riga in order to support the German army's advance; a large part of the High Sea Fleet including eight dreadnoughts and four battle cruisers came round from the North Sea, but on Aug. 19, E1 (Comm. N. F. Laurence) torpedoed and seriously injured the battle cruiser " Moltke." Next day the operations were abandoned, all the High Sea Fleet ships were sent back, and there ensued in the Baltic a long period of only minor activity.

Home Waters, 1915.—In the North Sea during 1915 U29 (Weddingen) had been rammed by the " Dreadnought " about 70 m. from Scapa. German strategy took the shape of minelaying sorties, in which light cruisers to lay the mines were escorted by battle cruisers and the battle fleet. Such were the sorties of March 29, April 17, April 22 and May 17, " one day out and one day back "—this was the strategical formula. The Grand Fleet, fully informed of German movements, came out and the High Sea Fleet returned to harbour. British minelayers were not idle and Von Pohl nearly ran his evasive fleet full tilt into minefields laid by the " Princess Margaret " and " Orvieto " on the German coast on May 8 and 10. British cruiser squadrons continued their sweeps down the North sea, and on June 20 1915 the 3rd Cruiser Squadron crossed the path of four German submarines lying in wait off the Forth. The " Roxburgh " was hit by U38 and had to go into dock.

Some three weeks later came the last echo of cruiser warfare. The " Königsberg " had been lurking in the Rufiji river since Sept. 1914, watched by the " Chatham " (Capt. S. R. Drury-Lowe). There, on July 11, she was bombarded by the monitors " Severn," " Mersey " and " Humber," under Capt. E. J. Fullerton. Fire was opened by the " Mersey " at 9,500 yards, hitting was established with the help of an aeroplane after the eighth salvo, and the last German cruiser afloat abroad was left a blazing wreck in an African jungle. A supply ship, the S.S. " Rubens," which had left Germany on Feb. 18 1915 with coal and munitions, had slipped safely through the blockade and reached the African coast, but Rear-Adml. George King-Hall, in the " Hyacinth," receiving exact intelligence of her, drove her into Tanga harbour (German East Africa) on April 14, where she was scuttled. The auxiliary cruiser " Meteor," fitted as a minelayer, had also slipped through the blockade on May 31 and laid mines off Archangel on the Russian route. On the night of Aug. 7–8 the same ship (Lt.-Comm. von Knorr) laid a large minefield of 380 mines off the Moray Firth, sinking the patrol vessel " Ramsey." Betraying her position by wireless, she was intercepted within 30 m. of Horn Reef on Aug. 9 by Commodores Tyrwhitt and Goodenough and was scuttled about 1 P.M. by her commander, who escaped in a Swedish vessel.

In Germany, the controversy on submarine warfare again had become acute. After the sinking of the S.S. " Arabic " on Aug. 19 1915, by U24, orders were issued that no passenger steamers were to be sunk without warning. Tirpitz again asked to resign. Adml. Bachmann, the chief of the naval staff, entered a protest against the decision and was relieved of his post. The commander-in-chief recalled his submarines and submarine activity in the Channel and to the westward ceased for a time.

The pressure of the blockade was by this time beginning to be severely felt in Germany (*see* BLOCKADE). In the north this work was performed by the 10th Cruiser Squadron, but the New Year of 1916 saw another German ship, the " Moewe," one of the most notable German raiders, slip through its weather-beaten lines and get safely to sea after laying a large minefield on the west side of the Orkneys, where the battleship, " King Edward VII." was lost on Jan. 5 1916.

IV. THE NORTH SEA

On Jan. 18 1916, Adml. von Pohl, the German commander-in-chief, who had been seriously injured in an accident, was relieved by Adml. Scheer, a strong believer in a more offensive strategy. One of his first measures was the dispatch of 33 destroyers to the Dogger Bank on Feb. 10 1916, where they attacked the 10th Sloop Flotilla of the Humber patrol and sank the " Arabis " sloop while minesweeping. The safe passage of the " Moewe " induced another raider, the " Greif " (4 5·9-in.) to try and get to sea. She was sighted on Feb. 29 some 90 m. north-east of the Shetlands and the " Alcantara " (Capt. Thomas Wardle) of the 10th Cruiser Squadron got within 6,000 yards of her at 9:15 A.M. and ordered her to stop. An action ensued in which the " Greif " was sunk, but the " Alcantara," hit by a torpedo, went down as well. Two days later, in the night of March 2, the " Moewe " slipped through the patrol line and reached home on the 4th. Her cruise in mid-Atlantic in the region of flying fish had been very successful. She had captured 15 ships of 57,835 tons, of which the most important was the

"Appano" (Jan. 15), an Elder Dempster liner of 7,781 tons, with the governor of Sierra Leone and a cargo worth £2,000,000 on board. Sent, however, to Newport News as a German prize, the "Appano" was released by the U.S. Supreme Court in March 1917, on the plea that she had been sent in with the intention of being laid up indefinitely.

In March Von Tirpitz and the German naval staff had pressed for the commencement of unrestricted submarine warfare, but the Chancellor's view again prevailed and Von Tirpitz's resignation, offered for the third time, was finally accepted.

On March 24 1916 Tyrwhitt in the "Cleopatra," with five light cruisers and 18 destroyers, escorted the "Vindex" with five aeroplanes to attack the Zeppelin sheds at Tondern. Beatty's battle cruisers were supporting the advance. The aeroplanes did little and only two returned, but a situation developed not unlike that of Aug. 28 1914 at Heligoland Bight (*q.v.*), for the destroyer "Laverock" rammed the "Medusa," which had to be abandoned on the 25th. The German destroyers pushed out that evening, and during the night the "Cleopatra" (Tyrwhitt's flagship, Capt. F. P. Loder-Symonds) rammed and sank G194, but was herself rammed by the "Undaunted," whose speed was reduced to six knots. Scheer, with his fleet on March 26, was coming westward in pursuit, and Beatty, coming down from the north to cover the light cruisers, was 80 m. from the German battle cruisers when Scheer turned back at 7 A.M. The aircraft dropped one bomb in Denmark.

Bombardment of Lowestoft.—The end of April 1916 was full of events. Sir Roger Casement was landed by U19 at Tralee on the 20th to take part in the Irish rising, and the "Libau," a small ship disguised as the Norwegian S.S. "Aud," with a cargo of 25,000 rifles, 10 machine guns and ammunition for the Irish, was captured on the Irish coast by the sloop "Bluebell," only to be scuttled off Queenstown. On April 24 a large barrage of mines and nets was laid by Adml. Sir Reginald Bacon and the Dover patrol off the Belgian coast, and the same night Scheer struck a blow at the east coast.

The whole High Sea Fleet with 17 dreadnoughts and five battle cruisers left harbour by 2 P.M., April 24. At the very start it received a nasty blow when the battle cruiser "Seydlitz" at 2:45 P.M. struck one of the mines laid by the "Princess Margaret" in Nov. 1915. The Admiralty had the usual intelligence that the High Sea Fleet was out, and by midnight Jellicoe with the battle fleet had left Scapa and Beatty with the battle cruisers had left the Forth. All night long bombs were falling from the German Zeppelins on the east coast, and at 4:11 A.M. Boedicker, with his four battle cruisers (Hipper was ill), bombarded Lowestoft, destroying some 200 houses, and opened fire on Yarmouth at 4:24 A.M. Tyrwhitt had left Harwich at midnight with the light cruisers "Conquest," "Cleopatra," "Penelope" and nine destroyers. He pushed up the coast, and engaged the light cruisers "Rostock" and "Elbing" off Lowestoft at 4:30 A.M. The German battle cruisers came down on him and engaging him at 4:49 A.M. sent five 12-in. shells into the "Conquest," killing and wounding 40 officers and men, then made off hurriedly at 4:56 A.M. Tyrwhitt followed till 9:25 A.M. (April 25), when he was ordered to return, and on the way back the "Penelope" was torpedoed by UB29 and her rudder blown off. Beatty was now striking down towards Terschelling, but was still 50 m. off when Boedicker reached the Bight and got behind the German minefields, and the Admiralty sent out his recall at 12:30 P.M. Six submarines (E55, E29, E26, E22, D4, D6) had been sent out from Harwich with the destroyer "Melampus," by Capt. A. W. Waistell, Capt. (S), and just missed by four miles the German battle cruisers flying homewards. In these operations the German submarine UB13 was lost, and the British submarine E22 (Lt. Reg. Thos. Dimsdale) torpedoed and sunk by UB18 at 11:40 A.M.

To strengthen the position in the south, it was decided to station the 3rd Battle Squadron (seven "King Edwards") in the Thames, and it sailed for Sheerness on April 29. On May 5 1916 Jellicoe launched another air attack against the Zeppelin sheds at Tondern. Two minefields were laid at the same time in the Bight, one off Horn Reefs by the minelaying destroyer "Abdiel" (Comm. Berwick Curtis), the other off Borkum by the "Princess Margaret" (Comm. Lockhart Leith). The Grand Fleet put to sea in support. The 1st Light Cruiser Squadron escorting the "Vindex" and "Engadine" with nine sea-planes was off Sylt at 3 A.M., May 4. The sea-planes would not rise, and only one got away, but the "Galatea" and "Phaeton" damaged Zeppelin L7. She came down near E31, which completed her destruction.

The Battle of Jutland.—On April 24 Scheer, as he returned from Lowestoft, had received an order that submarines were not to sink merchant ships without warning and examination. He immediately recalled all the High Sea Fleet submarines from the war against commerce, and set to work to devise a scheme for enticing the British Fleet out. Twenty-two submarines were to be stationed off the British ports, the High Sea Fleet was then to appear off the coast of England or Norway, in the hope that the Grand Fleet would rush out in pursuit and meet the German submarines. Such was the plan of the Jutland operations. It did not develop "according to plan." The submarines, 14 in number, were off the British coast by May 23, but weather delayed the sailing of the High Sea Fleet till May 30. The German battle cruisers left the Jade at 2 A.M. followed by the battle fleet. It met the British battle fleet on May 31. There followed the battle of Jutland (*see* JUTLAND, BATTLE OF). The British lost three battle cruisers, three armoured cruisers and eight destroyers, 6,094 killed, including two rear admirals, 674 wounded and 177 prisoners. The Germans lost one older battleship, one battle cruiser, four light cruisers and five destroyers, 2,551 killed and 507 wounded. Scheer, threatened with envelopment, made good his escape and the High Sea Fleet remained intact, to guard the Bight, to ensure the safe entry and exit of submarines and to compel the British to keep a mass of craft locked up in the Grand Fleet when they were wanted for convoys and the tremendous struggle against the submarine.

The German submarines achieved a single belated success. U75 had laid mines on the west side of the Orkneys on May 29 and on June 5 the "Hampshire" on her way to Archangel struck one of them and went down, bringing Lord Kitchener's mission and great career to a sudden end. A gale had been blowing from the northeast that afternoon, but Lord Kitchener at Scapa insisted on sailing. To give the "Hampshire" a lee she was sent up the west side of the Orkneys and sailed at 5:30 P.M., but the wind backed to N.N.W., and the destroyers escorting her, unable to face the gale, had to put back. About 7:50 P.M. she struck a mine, 1½ m. from shore between the Brough of Birsay and Marwick Head and sank in 15 minutes with the loss of all but 12 men.

Scheer's Renewed Attempt.—In Aug. Scheer renewed his efforts. This time the submarines, instead of being off the ports, were disposed in lines in the North Sea on the expected track of the British Fleet. The High Sea Fleet put to sea in the evening of Aug. 18 with the intention of bombarding Sunderland at sunset the next day. The new battleship "Bayern" and the "Grosser Kurfürst" and "Markgraf" were attached to the battle cruisers of the 1st scouting group in place of the "Derfflinger" and "Seydlitz," which were still under repair. The battle fleet with eight Zeppelins followed only 20 m. behind. E23 was waiting for them on the way across and put two torpedoes into the dreadnought "Westfalen," forcing her to return. Directionals and intercepts supplied ample intelligence of the German movements and Jellicoe had put to sea with the Grand Fleet at 5 P.M. on Aug. 18. He was on his way down the east coast with the battle cruisers 30 m. ahead when the 2nd Light Cruiser Squadron ran into the first line of German submarines in the latitude of Farne Islands at 5:55 A.M. on Aug. 19, and the "Nottingham," going 20 knots, was struck by two torpedoes from U52. Jellicoe turned and made to the northward for a time. The "Nottingham," badly damaged, was hit by a third torpedo at 7 A.M. and sank.

Meanwhile the Harwich force made towards the enemy, while Scheer held steadily on, receiving a stream of reports from his

Zeppelins, submarines and the German intercept station at Neumünster which enabled him to locate the British forces. Jellicoe at noon was some 100 m. east of the Farne Islands, steering down the coast, with Beatty's battle cruisers ahead of him while the German Fleet about 100 m. east of Whitby was steering to the west on a converging course. At 12:30 Beatty's battle cruisers with battle flags hoisted were abreast of Newcastle, only 42 m. from the German Fleet, when Scheer turned to the southward and made a push against the Harwich forces. He turned for home at 2:35 P.M., and Jellicoe, thinking it unwise to follow on account of the submarines, directed Beatty to turn back at 4 P.M., but at 3:20 P.M., on receiving another report of a submarine, ordered him to turn at once. At 4:52 P.M., while returning, the "Falmouth" of the 3rd Light Cruiser Squadron, going 23 knots, was hit by two torpedoes from U66. On Aug. 20 at noon U63 sent two more torpedoes into her and she sank off Flamborough Head. The Harwich flotillas kept in touch with Scheer till 7:30 P.M., but without the support of the Grand Fleet could not press home an attack. Scheer regarded this as a very successful operation, and intended to repeat it, but in Oct. his submarines were ordered to resume their war on merchant ships and were no longer available for fleet operations.

The resumption of the submarine campaign called for a clear passage down the Channel, where a barrage of mines and nets had been laid by Adml. Bacon in April 1916, extending from the South Goodwins towards Dunkirk. This was patrolled by a force of 23 drifters and the German 3rd and 9th Flotillas were sent round to Zeebrugge for the special purpose of raiding it. Intelligence of their arrival had been received and the vice-admiral at Dover distributed his destroyers to meet an attack—four in the Downs, eight at Dunkirk and six at Dover. The night of Oct. 26 was dark and the German destroyers attacked in two divisions of five and six boats. The destroyer "Flirt" on patrol was sunk with all hands at 11 P.M. The destroyers at Dover, Dunkirk and in the Downs put to sea. The "Nubian" sighted the Germans, challenged them and was torpedoed in reply (12:40 A.M.); the enemy disappeared in the night and got back to Zeebrugge, after sinking seven drifters and two destroyers. This was the first of a series of attacks on Dover intended to assist the passage of submarines. In the north the "Moewe" (Comm. Graf Nikolaus zu Dohna-Schlodien) had got safely to sea again in the winter nights (Nov. 23–5) and was followed by another raider the "Wolf" (Capt. Karl Nerger) on Nov. 30.

Submarines were again engaged in their war on trade (*see* SUBMARINE CAMPAIGN) and on Nov. 5, when U30 and U20 ran ashore on the Danish coast in a fog, Scheer sent out a half flotilla of destroyers supported by the "Moltke" and the 3rd Squadron of battleships to get them off. J1 (Comm. N. F. Laurence) was there as well and torpedoed the battleships "Grosser Kurfürst" and "Kronprinz," driving them both back to harbour. The Kaiser remonstrated with Scheer for risking battleships in this work, but Scheer maintained that the fleet's principal task at this stage of the War was to secure the safety of the submarines passing in and out.

V. THE SUBMARINE WAR, 1917–8

The peril of the submarine was now growing more and more acute, and on Nov. 29 1916 Adml. Sir John Jellicoe left the fleet to take the post of First Sea Lord of the Admirality and Adml. Sir David Beatty succeeded him as commander-in-chief of the Grand Fleet. Unrestricted submarine warfare (that is sinking at sight without warning) was being urged by both the army and navy in Germany. The Chancellor's opposition was overcome, and on Jan. 9 1917 an Imperial order went out to commence it on Feb. 1. The war at sea now became a war against the submarine and to assist the submarine.

The Dover Raids.—In the south the Harwich flotillas were kept constantly busy. Early in the morning of Jan. 23, the German 6th Flotilla of eight destroyers, trying to return from Zeebrugge to the Bight, was met by a Harwich force of three light cruisers and some 14 destroyers. It was a cold dark night and a general mêlée ensued. V69, the flotilla leader's boat, was driven into Ijmuiden and S30 had to put back. The British destroyer "Simoon" was torpedoed and sunk. Feb. 1 saw the beginning of the momentous submarine campaign followed by the rupture between Germany and the United States. The principal concern of the German commanders was to maintain a safe passage for the submarines, and with this in view a series of raids was made on the Straits of Dover. On March 17 1917 the night was dark; the barrage patrol consisted of four destroyers patrolling on separate beats. Six more were lying in Deal, and the "Broke" and five others were in Dover. The "Paragon" on patrol sighted three or four destroyers at 10:50 P.M., challenged and was torpedoed in reply. The "Llewellyn," thinking she had struck a mine, went to help her and was torpedoed at 11:15 but got back to Dover. The Germans then disappeared into the night. While these events were happening, the "Moewe" had slipped through the blockade and got back to Kiel on March 20 1917, after capturing 27 ships in the Atlantic. Another raider on the way out was not so fortunate. On March 17, at 4 P.M., the armoured cruiser "Achilles" (Capt. F. M. Leake) and the merchant cruiser "Dundee" (Comm. S. M. Day) intercepted the "Leopard" disguised as a Norwegian, northeast of the Faroes and sent her to the bottom.

The night of April 20 saw another raid at Dover. The patrols had been reinforced. Two flotilla leaders, the "Broke" (Comm. E. R. Evans) and "Swift" (Comm. Ambrose Peck), were patrolling off the Goodwins, and a whole division of destroyers was on patrol in the Straits, with reserves at Dover and Deal. The German 2nd Flotilla attacked in two sections, one of which went off to the French, and the other hugged the English coast. The latter was on its way back and at 12:45 A.M. was off the Goodwins on an easterly course when it was sighted on the port bow by the "Swift" and "Broke," patrolling on an opposite course. There was no challenging. The "Swift" turned at once to port, fired a torpedo which probably hit G85, and dashed through the enemy's line. The "Broke" did the same and crashed into G42, the third boat in the line. A hand-to-hand fight ensued as the Germans attempted to board and were driven back, and the "Broke" then completed the destruction of G85. This was the famous little action of the "Swift" and "Broke" and except for two ineffective sorties on April 26 and May 2 put a stop to destroyer raids on Dover for nearly a year.

United States at War with Germany.—On April 6 the United States entered the War, and Vice-Adml. W. S. Sims was despatched to Europe to devise means of co-operating with the Allies. This was a black month for merchant shipping. The war at sea was developing into a protracted struggle with the submarine, while the battle fleets acted as shields, behind which the submarine and its antagonists fought out a bitter fight for supremacy. The baleful effect of Scheer's escape at Jutland was now severely felt. The High Sea Fleet stood guarding the roads for its submarines, and its menace compelled the Grand Fleet to retain for fleet use numbers of destroyers urgently required for the fight with the submarine. In this sphere the United States was able to afford invaluable assistance and United States destroyers, the first six of which, under Comm. J. K. Taussig, arrived at Queenstown on May 4 1917, helped to save the situation.

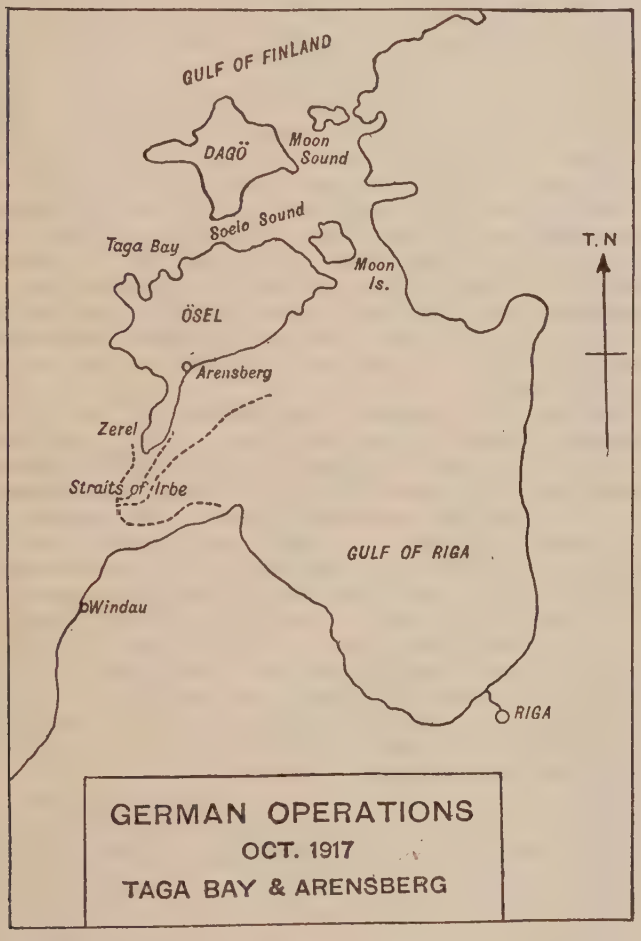
In the Mediterranean, the War was becoming more and more a war of flotillas. There the Straits of Otranto took the place of the Straits of Dover and a force of some 50 vessels, chiefly drifters, patrolled it to prevent the passage of submarines from their base at Cattaro. These little ships were attacked by a force of Austrian cruisers and destroyers on May 15 1917 and 14 drifters, which stoutly refused to surrender, were sunk. On the approach of the light cruisers "Dartmouth" (Capt. A. P. Addison) and "Bristol" the Austrians retired to Cattaro; the "Dartmouth" was torpedoed but got safely back.

At Dover since 1915, Adml. Bacon had been attacking the submarine by bombardments of their bases at Zeebrugge and Ostend, and these were continued in 1917 with the monitors "Lord Clive," "General Wolfe," "Prince Rupert" and "Prince Eugene" (2 12-in.) and the "Marshal Soult," "Erebus" and

"Terror" (2 15-in.). Zeebrugge was bombarded on May 12, and Ostend on June 5, and a number of heavy shells fell close to the basins, though the lock gates were not actually hit.

On July 9 the dreadnought "Vanguard" (Capt. I. M. Dick) was lost at Scapa by an internal explosion in the same terribly sudden way as the six other Allied ships which suffered this fate in the War—"Bulwark," Nov. 26 1914; "Benebetto Brin," Sept. 27 1915; "Natal," Dec. 30 1915; "Leonardo da Vinci" (fire), Aug. 2 1916; "Tsukuba," Jan. 14 1917 and "Kawachi," July 12 1918.

The Plans Division recently constituted at the Admiralty was busy at this time with a project for mining Heligoland Bight, though its execution was delayed till Oct. 1917, by lack of mines. On Sept. 1 the 4th Light Cruiser Squadron and 15th Flotilla made a raid on the channel by Horn Reefs, driving four German



minesweepers ashore. These minesweepers working sometimes 150 m. from Heligoland sweeping the ways for the submarines were a natural target for attack, but as they were always supported by heavy ships, light cruiser attacks on them were not easy.

German Capture of Osel.—In the Baltic the Germans had been engaged in a big operation to assist their army. In Nov. 1916, they had tried to force the Gulf of Finland, but after the loss of seven destroyers on mines had abandoned it. In Sept. 1917, the capture of Riga by the army (Nov. 3) led to an attempt by the German navy to open up the Gulf of Riga.

To capture the defences it was decided to land a force of 23,000 men at Taga Bay in the north of the island of Osel which lies across the Gulf of Riga with the Straits of Irben on the south side between it and the mainland. Vice-Adml. Schmidt with the battle cruiser "Moltke," 10 of the latest dreadnoughts, eight light cruisers and 47 destroyers came round from the North Sea to perform the task. The fleet and transports sailed from Libau on Oct. 11 and the force was landed in Taga Bay by 5:30 A.M. on Oct. 12, though the "Bayern" and "Grosser Kurfürst" both struck mines on entering the Bay. The Straits of Irben were swept, the Russian battleship "Slava" sunk and by Oct. 17 the Germans were in complete occupation of the island. Three of their battleships however had been attacked by British submarines, and on Oct. 29, when the dreadnought "Markgraf" struck a mine, orders came for the naval forces to be withdrawn. The operation is specially interesting as being somewhat similar to that of the Dardanelles, involving an attack on a minefield defended by heavy guns.

Symptoms of the spirit which was to end in Germany's collapse were already beginning to appear. Sporadic outbreaks of mutiny had occurred in the 3rd Squadron as early as May, 1917, and the "Kaiserin," "Kaiser" and "König Albert" had to be sent to Brunsbuttel for recreation and leave. The crew of the "Westfalen" too was disaffected, and the spirit and courage of the German Fleet were evidently beginning to flag.

The convoy system, which was one of the most effective replies to the submarine, was a natural target of attack, and on Oct. 17 1917, the Scandinavian convoy received a heavy blow. This convoy, sailing regularly from Lerwick to the Norwegian coast, was on its way to Lerwick, consisting of 12 ships (two British, one Dane, one Belgian, five Norwegian, three Swedish) with an escort of two destroyers, the "Strongbow" (Lt.-Comm. Edward Brooke) and "Mary Rose" (Lt.-Comm. Chas. L. Fox). It was about half way across (60° 26′ N., 1° 16′ E.) steaming eight knots about 6 A.M. on Oct. 17 when the "Brummer" and "Bremse" two fast new German cruisers, armed with four 5·9-in., were seen on the port side coming up at 25 knots. They opened fire and sank both the destroyers, with all hands (132 men), before they had even time to send out a wireless to the light cruiser squadron supporting them, and went off at 8:20 A.M. after sinking nine of the merchant ships without examination or warning of any kind. The armed trawler "Elise" got away but as she had no wireless, it was not till 7 P.M. that the Admiralty received the report. This attack led to a general revision of the arrangements for convoys and to the provision of stronger forces to cover them. The question of using the Grand Fleet, or portions of it, to cover convoys was a difficult one. The use of directionals had induced what may be called a policy of immediacy, in which the battle fleet with all its light craft had to be ready for immediate excursion, and could not always be available for the routine work of convoys.

Nov. 1917 was marked by Grand Fleet light cruiser raids in the Cattegat and Bight. The Cattegat had become more and more a sphere of German activity against British commerce. Minefields and guardships had long guarded the southern entrance to the Sound, ships proceeding to Sweden were constantly exposed to attack and decoy ships cruised in the Cattegat to attack British submarines. One of these was the "Kronprinz Wilhelm," which was cruising off Kullen Light on Nov. 2 at 7 A.M., when several British cruisers swept down on and sank her, with a very damping effect on German activity in this area.

Engagement in the Bight.—In the Bight the increase in British minelaying, which started in earnest about Oct. 1917, involved an enormous expansion in the German minesweeping service. As the minefields grew, the swept channels or "ways" grew longer and longer, and the minesweepers, working out at sea, had to be supported by light cruisers and battleships. An engagement on Nov. 17 1917 affords an interesting illustration of the part played by the German battleships in this respect. The German minesweepers that morning were making their test trip escorted by destroyers, covered by the light cruisers of the 2nd and 4th Scouting Groups and supported by the battleships "Kaiser" and "Kaiserin," when at 7 A.M. they were attacked by a British force consisting of the "Courageous" (Rear-Adml. T. D. Napier) and "Glorious" (Capt. Chas. B. Miller, 4 15-in. 30 knots), the "Renown" (Capt. Michael Hodges) and "Repulse" (Rear-Adml. R. F. Phillimore, 6 15-in., 30 knots), the 1st and 6th Light Cruiser Squadrons and a number of destroyers. The horizon was misty and an action developed at 12,000 yards with the German light cruisers running to the southeast raising a smoke screen to cover their minesweepers. At 8:50 A.M. the

British destroyers attacked the 2nd Scouting Group without success. The light-cruiser "Königsberg" had been hit by a heavy shell, when at 9:30 the "Kaiser" and "Kaiserin" came on the scene. The "Kaiserin" scored a hit, but on their arrival the British force withdrew, before the "Moltke" and "Hindenburg," which were hurrying to the spot, arrived. The Germans lost one outpost vessel, 21 killed and 21 wounded. On the British side the "Calypso" was hit and her captain (Capt. H. L. Edwards) killed. The engagement furnishes another illustration of the difficulty of opposing heavy guns on the edge of a minefield.

The attack on the German minesweepers was answered by another German thrust at the Scandinavian convoys made by the 4th Half Flotilla on Dec. 12 1917. At 11:30 A.M. about 35 m. from the coast of Norway an attack was made on a British convoy of six steamers escorted by the destroyers "Pellew" (Lt.-Comm. Jas. Cavendish) and "Partridge" (Lt.-Comm. Reg. Ransome), which advanced boldy and engaged the five German destroyers at 5,000 yards. The "Partridge" was badly hit, but before sinking fired a torpedo, which hit V100 but did not explode. The four armed trawlers were sunk. The "Pellew" managed to escape in a squall of rain. The armoured cruisers "Minotaur" and "Shannon" heard the "Partridge's" call for assistance and steamed at full speed for the spot (59° 30′ N., 4° E.), but by the time they arrived, all was over, and the German destroyers got safely back to Kiel with four officers and 71 men as prisoners. The raid led to the provision of stronger covering forces and to considerable changes in the Scandinavian convoy system which had almost broken down under these successive blows.

The Dutch convoy in the south suffered a little later an equally nasty blow of a different kind. Its escort was provided by the Harwich destroyers, and on Dec. 23 at 8 A.M. a few miles N. of the Maas light, they stumbled into a German minefield, where the "Torrent," "Surprise" and "Valkyrie" were all mined in quick succession and sank before they could reach the shore.

The year was drawing to a close but before it closed Adml. Sir John Jellicoe had left the Admiralty, and his place as First Sea Lord was taken by Adml. Sir Rosslyn Wemyss. The war at sea was expressing itself more and more in terms of the submarine. It was imperative to close the Straits of Dover to submarines and Rear-Adml. Sir Roger Keyes was sent to do it, and did it very effectually. In the next four months nine submarines were destroyed in the Dover area and the High Sea Fleet submarines ceased to use the Straits of Dover.

All this time the Black Sea had been the scene of sporadic warfare between Russian and Turco-German forces. Russia at the beginning of the War had possessed two pre-dreadnoughts, the "Ivestafi" and "Ivan Zlatoust" (1906, 4 12-in., 4 8-in., 12 6-in.), to pit against the "Goeben," and by the end of 1915 three dreadnoughts had been completed in these waters—the "Ekaterina II.," "Imperatritza Maria" and "Alexander III." (all 12 12-in.)—which gave her the control of the Black Sea and ensured her communications with the Caucasus. The collapse of Russia and the mutiny of the Black Sea Fleet may have led the "Goeben" (Sultan Selim) to look to the westward for, on Jan. 20 1918, she made a sortie from the Dardanelles. The British force in that area under Rear-Adml. Hayes Sadler consisted of the "Lord Nelson" (flag) and "Agammemnon," six old light cruisers, 12 monitors, seven sloops and 27 old destroyers. The "Lord Nelson" was at Salonika and the "Agammemnon" at Mudros. The destroyers "Tigress" (Lt. J. B. Newill) and "Lizard" (Lt. N. A. Ohlenschlager) were patrolling off the Straits and the monitors "Raglan" (Comm. Visct. Broome) and M28 (Lt.-Comm. Donald Macgregor) were anchored at Imbros, some 15 m. from the Straits. The "Goeben" and "Breslau" sallied out about 5 A.M. and made for Imbros shadowed by the "Tigress" and "Lizard." The "Raglan" sighted them at 5:35 and gave the alarm by wireless. She was engaged by the "Breslau," set on fire and sunk. M28 was set on fire and blew up with her captain at 6:27. The "Goeben" and "Breslau" went off to the southward, but off the southeast point of Imbros the latter struck a mine at 7:07 A.M. and sank, leaving 40 survivors to be picked up by the "Tigress." The "Goeben" struck two mines about the same time and heading for the Straits beached herself off Nagara in the Narrows. In the course of the ensuing week more than 15 tons of bombs were dropped round her by aeroplanes with several hits, but the small 112 lb. bombs inflicted no vital damage. An heroic attempt to torpedo her was made by E14 (Lt.-Comm. M. Geoffrey White), which was sunk and her captain killed.

The Last of the Dover Raids.—In the North Sea the Dover barrage had been greatly strengthened. It consisted of 18 lines of deep mines, patrolled by a strong force of drifters and trawlers, with searchlights and enormous flares burning all night to discover submarines and force them to dive. The High Sea Fleet submarines no longer dared to pass there, and the German 2nd Flotilla, numbering 11 of their best and fastest boats, was sent straight from the Bight to attack it on Feb. 15 1918. There were 58 drifters in the Straits that night, with a monitor M26 and four destroyers, while two destroyers were off the Goodwins, and the "Attentive" and three more were in the Downs. The Germans arrived in the Straits about 11:30 P.M. and one half flotilla made for Folkestone, the other for Gris Nez. The former set fire to a searchlight vessel, sank two drifters and disappeared without anyone firing the alarm—a green rocket. Flashes were seen and guns were heard, but they were thought to be ships on patrol firing on submarines. The other half flotilla set fire to a searchlight vessel and sank three drifters, but it was not till about 1 A.M. when the enemy were retiring that the alarm signal went up. The Germans got away after sinking seven drifters and one trawler.

They were not so fortunate a month later. On March 21 the destroyer "Botha" (Comm. Roger Rede, 2 4·7-in., 2 4-in.) and "Morris" (Lt.-Comm. P. R. Percival 3 4-in.) were lying with the French destroyers "Bouclier," "Capitaine Mehl" and "Magon" in Dunkirk when a burst of firing was heard at 3:30 in the morning. The destroyers slipped and passing through the Zuydcoote Pass, a narrow channel between Dunkirk and Ostend roads, sighted the German destroyers and came on two of their boats. The exploit of the "Broke" was repeated. The "Botha" rammed a German at full speed and cut it in half. Another was disabled by gunfire from the two boats. The "Botha" was torpedoed in the darkness by a friend, but the "Morris" chased the enemy into Ostend and on her return sank the disabled boat and took the "Botha" home in tow. This was the last of the long series of Dover raids.

The War had become a war of straits and passages, but it was not till 1918 that mines were laid in the Cattegat. In the early part of the War this had been a "no man's sea," but by 1917 German ships were regularly cruising there. The British sweep of Nov. 2 1917 had diminished their activity, but submarines had begun to use this route regularly whenever the Bight ways were blocked. In Feb. 1918 a deep minefield was laid off the Skaw to catch them and another on April 15 1918 off Laesö. This was laid by the "Princess Margaret" and "Angora," supported by ships of the 6th Light Cruiser Squadron and 13th Flotilla and escorted by the destroyers "Valentine" and "Vimiera," which sank 10 German trawlers off Anholt. The discovery of the mines apparently raised serious apprehension in German naval circles but the operation was not repeated

The Blocking of Zeebrugge.—At Dover Rear-Adml. Roger Keyes was maturing a plan to supplement the closure of Dover Straits with the blocking of Zeebrugge and Ostend. This would seal up not only the Flanders submarines but the destroyers as well, which were a constant menace to the barrage and its patrols. The enterprise was a daring one, but it was carefully prepared and skilfully carried out on the night of April 22–3. The "Vindictive" (Capt. Alfred B. Carpenter) proceeded alongside Zeebrugge Mole to draw the fire from the three blocking ships, two of which achieved their object and the whole attack remains a great and inspiring example of careful planning and heroic execution. At Ostend the attempt miscarried and a second

attempt, made by the "Vindictive" on May 9, also failed (*see* ZEEBRUGGE).

As the "Vindictive" was returning from Zeebrugge the German Fleet was putting to sea on its last excursion for a big attack against the British Scandinavian convoys. The fleet left at 6 A.M. on April 23 with Hipper's battle cruisers ahead and 17 battleships and four flotillas behind. By the morning of the 24th Hipper's battle cruisers had reached the Norwegian coast, when the battle cruiser "Moltke" broke down and had to put back. By 7 A.M. when she was off Stavanger she could only go four knots and began to call for assistance; the battle fleet sighted her at 9:40 A.M. and she was taken in tow. Hipper meanwhile had run up as high as lat. 60° N., but saw nothing of the convoy. The fleet turned back with the "Moltke" in tow which was torpedoed by E42 (Lt. C. H. Allen) off Sylt at 6:50 P.M. but got safely home. It was a bad day for the excursion. The homeward bound convoy of 34 ships was approaching the Forth at 8 A.M. on the 24th, and the outward bound convoy had not left the river. The sortie was futile, but it led to an important conference held in the Forth on April 29 on the subject of convoys, where it was decided to shift the Scandinavian route to the northward of 61° North. Up to the moment too when the "Moltke" began to call for help, there had been none of the usual indications of the German Fleet being at sea. Submarine J4 had sighted it at 7 P.M. on April 23, but her report had not reached Beatty, and the disadvantage of relying too exclusively on directionals and wireless was clearly demonstrated. This was the last excursion made by the German Fleet, and ranks in importance with that of Jutland and Aug. 19 1916.

In the north a great effort was being made in conjunction with the United States to close the northern exit to submarines (*see* MINELAYING) and the Grand Fleet was largely occupied in escorting and covering the minelayers, just as the High Sea Fleet was busy in covering its minesweepers. One of the last important operations in the North Sea was another air attack on the Zeppelin sheds at Tondern near Sylt on July 19 1918. This was made by the aircraft carrier "Furious," an immense cruiser, similar to the "Courageous," which had been converted into an air carrier. She was supported by five battleships of the 1st Battle Squadron ("Repulse" class) and escorted by the 6th Light Cruiser Squadron and a number of destroyers. The attack, representative of the stage reached by air carriers at the end of the War was made by seven aeroplanes, each carrying two 65-lb. bombs. Six machines started and reached their destination, setting fire to a double Zeppelin shed which was burnt out. Two got safely back, one fell into the sea and three landed in Denmark and were interned. On Aug. 11 1918, a combined raid of aircraft and coastal motor boats—light boats going 35 knots and carrying two torpedoes—was carried out in the Bight. A Zeppelin L53 was brought down by the aircraft, but German aircraft swept down on the motor boats; three of which were sunk and three lost.

The Mediterranean.—In the Mediterranean, the Straits of Otranto, 40 m. wide, corresponded to the exits of the North Sea, and on Aug. 16 1914, were closed by the arrival of the French Fleet, based on Malta 300 m. away. The Austrians then had three dreadnoughts ("Viribus Unitis," "Tegethoff," "Prinz Eugen") to oppose to the French four ("Courbet," "Jean Bart," "Paris" and "France"). The torpedoing of the "Jean Bart" by the Austrian U12 on Dec. 21 1914 and the sinking of the armoured cruiser "Leon Gambetta" on April 26 1915, by the Austrian U5 compelled the French admiral to withdraw his battleships from the narrow waters of the Adriatic.

Italy's declaration of war against Austria on May 24 1915, gave the Allies eight Italian and French dreadnoughts to the Austrian three. The supreme command in the Mediterranean was nominally vested in the French commander-in-chief Adml. Boué de Lapeyrère, but Italy became responsible for the blockade of the Adriatic and her fleet there was reinforced by four old British battleships ("Queen," "London," "Implacable," "Prince of Wales") and four light cruisers ("Dublin," "Dartmouth," "Sapphire," "Amethyst"), 12 French destroyers and seven French submarines. Her battleships were based on Taranto, and her cruisers and destroyers on Brindisi, and operations in the Adriatic consisted chiefly of cruiser raids. The "Dublin" was torpedoed and damaged on June 9 1915, and on July 18 1915, the Italian cruiser "Giuseppe Garibaldi" was torpedoed and sank.

On the coast of Syria in 1914 the cruisers "Minerva" and "Doris" (Capt. Frank Larken) had shelled Alexandretta on Dec. 17 1914, but on Feb. 2 1915, Adml. Dartige du Fournet was appointed to command on that coast and with the "St. Louis," "Doris" and two French armoured cruisers shelled Gaza and El'Arish in April 1915. Egypt was a separate command and there Vice-Adml. R. H. Peirse, in Feb. 1915, put up a stout defence of the Suez Canal assisted by two battleships the "Swiftsure" and "Ocean."

The year 1915 saw the Dardanelles campaign, the advent of German submarines and the beginnings of the Salonika expedition. When Serbia collapsed in Nov. 1915, the Serbian Army fell back on Albania. This led, on Dec. 29 1915, to a raid on their base at Durazzo by the Austrian cruiser "Helgoland" (9 3·9-in., 27 knots) and five destroyers, supported by an armoured cruiser "Kaiser Karl VI." One Austrian destroyer was mined and the "Helgoland" was chased and engaged by the "Dartmouth" (Capt. A. P. Addison), the "Weymouth" and an Italian cruiser the "Nino Bixio" and was severely damaged but got away. The end of the year saw the reinforcement of the East Mediterranean squadron by the battleships "Hibernia" (Rear-Adml. Sydney Fremantle), "Zealandia," "Albemarle" and "Russell." The Salonika campaign led to the occupation of Corfu on Jan. 11 1916, as a base for the Serbian Army and in the numerous complications with Greece which followed, the pressure exercised by the navies played a large part.

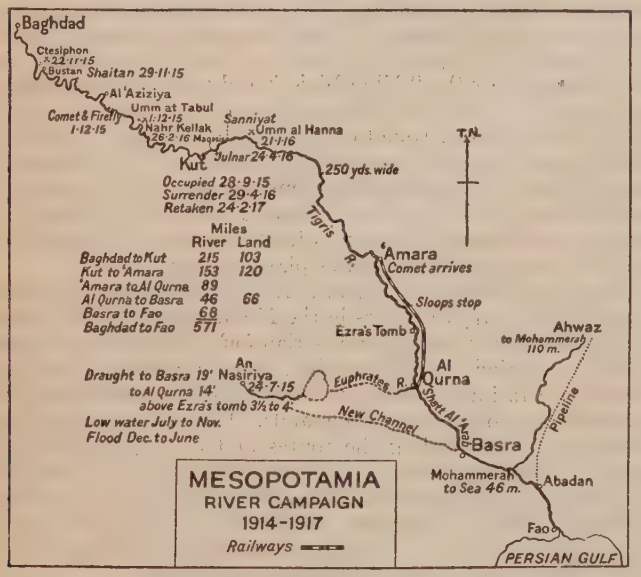
It was not till Aug. 28 1916, that Italy declared war on Germany, and in 1917 the Allies in the Mediterranean could muster 12 dreadnoughts against the Austrian four. But it was no longer solely a question of dreadnoughts, and the advent of the submarine, operating all over the Mediterranean, emphasised the disadvantages of separate commands. The necessity of a single authority for controlling the routes and for the protection of merchant shipping had to be recognised and Vice-Adml. Sir Somerset Gough-Calthorpe was appointed British commander-in-chief at Malta to perform this work. A system of convoys was introduced, and 14 Japanese destroyers which arrived in this year gave invaluable assistance in this work.

The great problem in the Mediterranean was to co-ordinate the work of the Allies and on Nov. 29 1917, it was decided to create an Allied Naval Council, of which Sir Eric Geddes was chairman, which helped matters very considerably. The centre of Mediterranean strategy was the Straits of Otranto. The Austrian dreadnoughts never ventured out, but it was very difficult to keep the submarines in, on account of the depth of water, about 500 fathoms, which precluded the use of mines. The net and drifter barrage placed there in Sept. 1915 was not very effective, and the efforts to make it so in 1917 and 1918 led to raids on it, like those at Dover. On May 15 1917 the Austrian cruiser "Helgoland" and two others attacked it and sank 14 drifters. The "Dartmouth" and "Bristol" chased them back to Cattaro, but the former was torpedoed and nearly sank. Another raid by Austrian destroyers took place on April 22 1918. On June 10 1918, the Austrians, spurred on by Germany, sent their dreadnoughts down to Cattaro to attack the barrage, but two of them were met by Comm. Luigi Rizzo with two tiny torpedo craft near Premuda Islands and the dreadnought "Szent Istvan" was torpedoed and sunk and the attack collapsed. The barrage at this time employed 35 destroyers, eight submarines, and 36 United States "chasers," with three or four score drifters. On the night of Oct. 31 1918, a little Italian motor boat entered Pola and sank another dreadnought, the "Viribus Unitis." On the Syrian coast, a naval force of French and British ships co-operated in the bombardment of Gaza and maintained Gen. Allenby's communications by sea from Egypt to Haifa, Beirut and Tripoli.

To meet the danger of the Russian dreadnought "Volnya" falling into German hands, the Aegean squadron had been strengthened by four French battleships and the dreadnoughts "Superb" and "Temeraire" from England. It was the "Superb," which flying the flag of Vice-Adml. Gough-Calthorpe led the Allied Squadrons up the Dardanelles on Nov. 12 1918.

Mesopotamia.—In three great river expeditions the navy played an important part; one up the Dvina in the icy waters of the White Sea; another up the Tigris in the deserts of Mesopotamia; and a third up the Duala in the swampy creeks of the Cameroons. In the first Mesopotamian campaign which ended with the investment of Kut on Dec. 2 1915, the naval force consisted of the sloops "Espiegle" (Comm. Wilfred Nunn, 6 4-in., 2 3-pdr.) and "Odin" (4 4-in., 4 6-pdr.), the Indian Marine paddleship "Laurence" (4 4-in., 4 6-pdr.) and three small armed vessels.

The principal base was at Basra 70 m. up the Shatt al 'Arab and accessible to ocean steamers drawing 19 feet. Above Basra the river was uncharted, but vessels of 11 ft. draught could get to Al Qurna, 40 m. farther up, a port of great importance, as the point of junction of the Tigris and Euphrates.

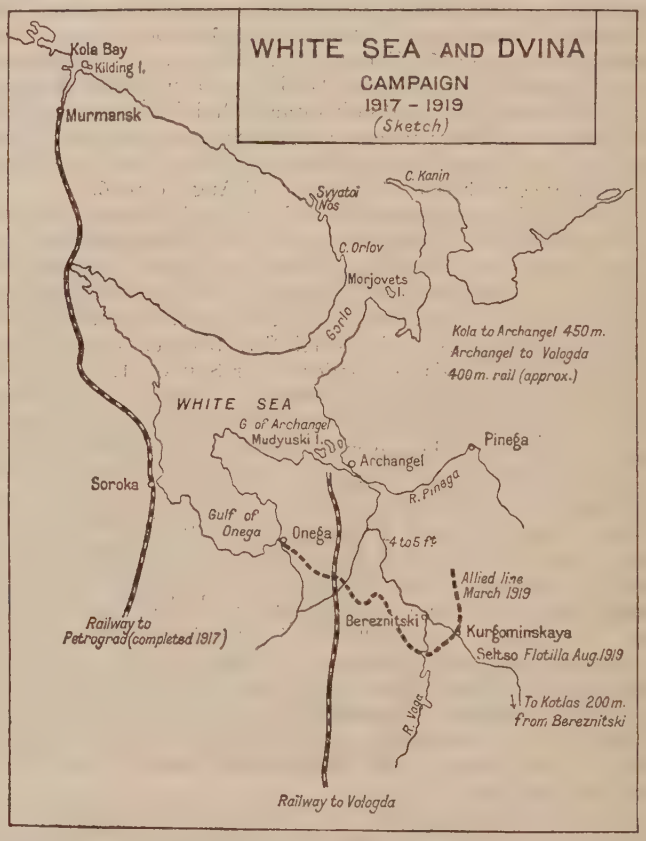


The flotilla hastened the retirement of the Turks from Basra and pushed on to Al Qurna, where it took part in the attack and capture of the town on Dec. 9 1914. From Al Qurna the sloops pushed up the Tigris, under Commodore Wilfred Nunn, as senior naval officer. The Turks were entrenched at Bahran about six m. above Al Qurna. Gen. Townshend arrived in April and on May 31 1915 there followed the amphibious battle of Al Qurna, where Gen. Townshend was on board the "Espiegle," supported by the sloops "Clio" and "Odin." As the Turks retired, the flotilla followed hot on their heels, shelling the Turkish gunboat "Marmaris," and when the sloops were held up by their draft above Ezra's Tomb, Gen. Townshend and Commodore Nunn shifted to the "Comet," a small yacht (one 6-pdr., 3 3-pdr.), and pushed boldly on to 'Amāra where their arrival on June 2 1915 greatly disconcerted the Turks. The original object of the campaign had been to secure the head of the Persian Gulf, but there followed the advance to Kut 143 m. farther up, supported by the "Comet," the "Shaitan" and "Sumana" with 4 4·7-in. guns in horseboat. There followed the victory of Sept. 27–8 1915, eight miles from Kut, where Lt.-Comm. E. C. Cookson of the "Comet," senior naval officer at the time, was killed (and awarded a V.C.) gallantly trying to cut the wire hawser of a boom under fire.

The army was now in Kut 240 m. up the Tigris, and went on through the baking marshes towards Baghdad and the battle of Ctesiphon on Nov. 22 1915. The flotilla, consisting of the "Firefly" (1 4-in., 1 6-pdr.), "Comet" and two armed launches, was held up by heavy artillery, and could do little in the actual battle, but did yeoman service in the retreat shepherding the army river craft. Kut was invested, and, in the first attempt to relieve it, a heroic attempt was made on April 24 1916, by Lt.-Comm. Chas. Cowley and Lt. H. O. Firman in the "Julnar" to get 270 tons of stores into the town, but the ship was held up by a wire, and they were both killed, being awarded the V.C.

Gen. Sir Stanley Maude's campaign brought with it a whole fleet of river craft, scores of barges and dozens of Lynch's river paddle steamers. Commodore Nunn's naval flotilla had been strongly reinforced and by this time consisted of three "Insect" class (2 6-in., 2 12-pdr.), five "Fly" class (1 4-in., 1 12-pdr., 1 3-pdr.) drawing 3½ to 4 feet. It advanced with the army reaching Kut on Feb. 24 1917, coming under a heavy fire at the Nahr Killak bend, where the "Mantis" and "Moth" suffered severely and the captains of both (Comm. Bernard Buxton and Lt.-Comm. Chas. Cartwright) were wounded. But the flotilla forced its way through and with its 6-in. guns converted the Turkish retreat into a rout. On March 11 1917 the British flag was hoisted at Baghdad.

The White Sea, 1917–9.—The expedition to Archangel and up the Dvina began only in 1918 and survived the War. The



closure of the Baltic and Black Sea to the Allies had enormously enhanced the importance of the Arctic route. There were two ports there, Murmansk in Kola Bay and Archangel, the former ice free, the latter accessible to ships of 24 ft. from July to October. From Lerwick in the Shetlands to Kola Bay was 1,152 m. and from Murmansk a railway was being built to Petrograd, though it was not completed till 1917. Archangel therefore remained the only port of entry on the Russian railway system, and direct telegraphic communication was established by a cable 1,427 m. long laid from Peterhead to Murmansk in Jan. 1915. In 1917, 600,000 tons of war stores had entered Archangel in addition to 600,000 tons of coal, which were left derelict when Russia collapsed in that year. The armoured cruiser "Cochrane" and the French cruiser "Admiral Aube" were then sent to reinforce the old battleship "Glory" at Murmansk, and in May 1918, when the Germans were in Finland, a force of 600 British and 2,000 other troops was dispatched to Archangel, and 1,500 British and 5,000 others to Murmansk. It was decided to occupy

Archangel and push on down to Vologda to join hands with General Koltchak's force, and the town was occupied with little resistance on Aug. 2 1918. General Poole then advanced up the railway, in conjunction with a flotilla moving up the Dvina. This consisted of two monitors M23 and M25, four Russian river gunboats, and two Russian motor launches under Capt. Ed. Altham. **Bereznitski, 200 m.** from Archangel, was reached on Sept. 3 1918, but by Oct. 19 the flotilla had to retire as the river froze. In March 1919, it was decided to withdraw all forces from North Russia. The flotilla then consisted of six monitors (M23, 25, 26, 27, 31, 33), four gunboats (2 6-in., 2 3-in., 6 maxims), four minesweepers and six motor boats. Then the decision was reversed and it was decided that Gen. Ironsides should push on up the river to Kotlas, 200 m. above Berenski. But the river in June was commencing to fall and hopes of going further fell with it. The flotilla dropped gradually down to Archangel blowing up M25 and M27 which had gone aground. By Sept. 27 1919 the evacuation was complete.

The Cameroons.—The primary object of the expedition to the Cameroons was to blockade the river and destroy the German wireless station at Duala. The work of the navy began on Aug. 23 1914, when Capt. Cyril Fuller in the cruiser "Cumberland" (14 6-in.) proceeded there and organised the small vessels of the Nigerian marine for river work. The gunboat "Dwarf" (Comm. F. E. Strong, 2 4-in., 4 12-pdr.) and the "Ivy," a small Nigerian steamer armed with 3-pdr. guns, did good service in clearing the creeks, and on Sept. 16 the "Nachtigall," a small armed German steamer, attacked the "Dwarf" and was sunk. By Sept. 22 the mouth of the river had been swept, and on Sept. 23 the cruiser "Challenger" (Capt. C. P. Beatty-Pownall, 11 6-in.) arrived with six transports, and drawing 19½ ft., succeeded in passing into the river. The British force then consisted of 54 officers, 1,859 natives, six guns and 1,000 carriers and a French contingent of another 2,000 men was expected from Dakar. On Sept. 27, when an attack on Duala was pending, the Germans blew up the wireless and surrendered the town. Eight vessels of the Woermann line and one of the Hamburg-American were captured in the river. To the flotilla fell the task of clearing the enemy from the tortuous creeks of the river and transporting the troops and on Oct. 14 Jabassi, 50 m. further up the river, was captured.

The "Cumberland" was recalled after the battle of Coronel, but Capt. Fuller remained to complete his work, and though the final surrender of the colony did not take place till Feb. 28 1916 it was virtually in our power by the end of 1914.

East Africa and Tanga.—Things did not go so happily in East Africa. Early in Aug. 1914, the German governor at Dar-es-Salaam had agreed to regard the ships there as British prizes, but when the boats of the "Goliath" and "Fox" entered the harbour on Nov. 28 1914 to disable their engines a heavy fire was opened on them. Comm. Peel Ritchie was severely wounded in bringing the boats out of harbour and won a Victoria Cross. Far inland on Lake Tanganyika two motor launches the "Mimi" and "Toutou" arrived in Dec. 1915, and after an action with the German craft secured British communication there. They were under Comm. Spicer Simson, who had brought them all the way from the Cape by land a long journey of 2,000 miles. Early in 1916, another German ship managed to evade the blockade in the North Sea and in March slipped into Sudi in the south of the colony with an invaluable cargo of stores and munitions for Von Lettow-Vorbeck, the German military commander, which enabled him to continue the campaign. The coastline remained in German hands till June 1916, when Tanga was occupied by the cruisers "Talbot" and "Severn"; Bagomoyo was occupied by the "Vengeance" and the cruiser "Challenger" on Aug. 15 1916, and by the end of Sept., Rear-Adml. Edward Charlton with his flag in the "Vengeance" could report the whole coast in British hands. But in the interior fighting dragged on till the Armistice.

Another raider got home in 1918. The "Wolf" (Capt. Karl Nerger) an armed steamer (7 5·9-in., 4 torpedo tubes and mines) carrying a small plane for reconnaissance had sailed on Nov. 30 1916, passed down the Atlantic, laid mines off Cape Town, and Colombo, cruised in the Indian Ocean, passed on to New Zealand, returned by Fiji to Singapore, and finally arrived home in Feb. 1918, after a cruise of 451 days. She captured 13 ships and her mines laid off Capetown, New Zealand and Singapore, were responsible for 15 more. The first news of her came from a bottle thrown overboard in the Celebes by a prisoner. In Sept. 1918 there came news of the last German raider, the "Seeadler" (Capt. von Luckner) which left Bremen in Dec. 1916, and slipped through the blockade disguised as a Norwegian timber ship. Armed with two 4-in. guns and manned by 60 men, she had cruised off South America and sunk six British ships, and then rounding Cape Horn had disappeared into the Pacific. In the Society Islands off Mopihaa, a small atoll, she dragged on to a reef and broke her back. Out of six attempts by German raiders to pass the blockade, four were successful. Their cruises were unstained by any of the incidents which marred the German submarine campaign and may rank, with the cruise of the "Emden" and "Karlsruhe," among the brightest exploits of the German navy in the War.

VI. THE END

The War was now drawing to a close. In July 1918 Adml. Scheer was summoned to Imperial Headquarters and on Aug. 11 was appointed Chief-of-the Staff, von Hipper succeeding him as commander-in-chief. Under the hammers of Foch and Haig the German front was breaking up. On Sept. 18, Scheer was told to be ready to leave the Flanders coast. On Sept. 29, the Bulgarian front collapsed, and on Oct. 5 Germany was forced to her knees. Immense explosions heralded the evacuation of the Belgian coast. On Oct. 17 the German troops left Ostend and two days later were in full retreat from Zeebrugge. Eleven destroyers and nine torpedo boats succeeded in reaching the Bight. The four submarines left there were blown up. Scheer wished to continue the warfare on commerce to the bitter end but on Oct. 21, the submarines at sea received orders to cease the campaign and return home. He then set to work to plan a great sortie of the High Sea Fleet. The submarines were ordered to assemble on Oct. 22 off the Scottish coast. A last great raid was to be made on the Channel while the submarines attacked the Grand Fleet on its way down. They were to be assisted by a large minefield laid off the Forth, which unknown to Scheer had been swept up as soon as it was laid. The plan was not to be fulfilled. Scheer saw the weapon he trusted break in his hands. On Oct. 29 the signal was made to prepare for sea; a great clamour arose and a mutiny broke out which compelled Von Hipper to abandon his project. The flotillas and submarines remained true and the commodore of submarines with 16 boats took refuge in Sylt on Nov. 8. But the end was near. Revolution was flaming everywhere. The troops were disloyal, the navy passed out of the admiral's hands. The War was over.

Surrender of the German Fleet.—Under the terms of the Armistice, 10 German battleships, six battle cruisers, eight light cruisers, 50 destroyers and all submarines were to be surrendered. On Friday Nov. 15, Rear-Adml. Hugo von Meurer arrived in the "Konigsberg" in the Forth to make the final arrangements with Adml. Beatty. On Wednesday Nov. 20 a long line of submarines began their dolorous journey to Harwich where they were met by Rear-Adml. Sir Reginald Tyrwhitt with his flotillas 35 m. from the Essex coast. They passed into Harwich in dead silence. Not a sound arose from the vast crowds watching them on shore and sea. A total of 129 passed into Tyrwhitt's hands (57U, 49UB, 23UC).

On Nov. 21 the battleships of Germany's proud navy were surrendered to Adml. Beatty. It was a misty day and the Grand Fleet, cleared for action, steamed slowly down the Forth for the last time in two long lines six miles apart. The light cruiser "Cardiff" led the ships of Germany (nine battleships, five battle cruisers, seven light cruisers) up the lines. Beatty stood on the bridge of the "Queen Elizabeth," and as the "Seydlitz," heading the German ships, came abreast of her, the whole British line turned, enclosing the German ships in a serried avenue of steel.

The naval conditions of the Peace terms signed in June 1919, comprised 17 articles and laid down that the German navy was not to exceed six battleships of a pre-dreadnought type, six light cruisers, 12 destroyers and 12 torpedo boats, and was not to include submarines. Within two months of signature the eight dreadnoughts still in German hands (" Oldenburg," " Thuringen," " Ostfriesland," " Helgoland," " Posen," " Westfalen," " Rheinland," " Nassau "), eight light cruisers, 42 of the latest destroyers and 50 of the latest torpedo boats were to be surrendered, disarmed but with all guns on board. At the expiration of one month all German submarines building were to be handed over; such as could move or be towed were to be taken to Allied ports, the remainder were to be broken up. Units were only to be replaced in the case of battleships at the end of 20 years, in the case of destroyers at the end of 15. The personnel, including reserves of the fleet and coast defences, was not to exceed 15,000 officers and men.

The disposal of the German ships gave rise to lively argument. Great Britain wanted to destroy them all, France to add her share to her fleet. The question was complicated by the Germans scuttling most of their ships at Scapa on June 21. There were interned there 11 battleships (" Baden," " Bayern," " Friedrich der Grosse," " Grosser Kurfürst," " Kaiser," " Kaiserin," " Kronprinz Wilhelm," " Markgraf," " Prinzregent Luitpold," " König," " König Albert "), five battle cruisers (" Seydlitz," " Moltke," " Von der Tann," " Hindenburg," " Derfflinger "), eight light cruisers (" Emden," " Frankfurt," " Nürnberg," " Cöln," " Dresden," " Karlsruhe," " Brummer," " Bremse ") when on a signal made at 10 A.M. by Rear-Adml. von Reuter from the " Emden," the ships were scuttled and began to sink. Only four were salved—the " Baden," " Emden," " Frankfurt " and " Nürnberg." Germany gained little by this act. She had to hand over, in default of the battleships, 300,000 tons of floating docks; her remaining light cruisers (" Graudenz," " Königsberg," " Pillau," " Regensburg," " Strassburg ") in place of the cruisers; and 42,000 tons of floating cranes, tugs and dredgers instead of the destroyers.

The terms of peace were no mere formality. The destruction of the submarines and vessels building was entrusted to a naval section of the Inter-Allied Commission under Vice-Adml. Sir Montague Browning (subsequently under Vice-Adml. Sir Edward Charlton) and was strictly executed. The fortifications of Heligoland were razed and its guns broken up. The destruction of Germany's sea power was complete. It had been achieved by economic pressure and the imminence of military defeat based on command of the sea. The year 1920, which was to have seen the consummation of Germany's Navy Law of 1900 embodied in a great fleet of 61 capital ships, 40 cruisers and 144 destroyers, saw the whole fabric of her naval aspirations shattered, her proud fleet lying at the bottom of a desolate harbour, her Emperor, who had inspired its creation, a fugitive in a foreign land.

Superiority of the Allies.—The fleets of the Allied and Associated Powers covered every sea and their immense superiority is shown in the following figures:—

	Dreadnoughts	Battle Cruisers	Light Cruisers	T.B.D.	Subm.
Allied Powers	64	16	138	477	356
Germany and Austria	21	6	41	134	239

The Grand Fleet had grown to double its size in 1914. It mustered with Rear-Adml. Rodman's 6th Battle Squadron (" New York," " Texas," " Wyoming," " Florida," " Arkansas ") 38 battleships, making with Rear-Adml. T. S. Rodgers' squadron at Berehaven (" Nevada," " Oklohama " and " Utah "), which came over specially to anticipate any sudden sortie of the German Fleet at the end, a total of 41 battleships in British waters. The battle cruisers numbered nine. Its single light cruiser squadron had become seven; its two destroyer flotillas had increased to eight (3rd, 11th, 12th, 13th, 14th, 15th, 20th, 21st), mustering 167 destroyers, and its five submarine flotillas (10th, 11th, 12th, 13th, 14th) numbered 48 submarines.

And this represented only a portion of its activities. Round the coast an enormous organisation had grown up under the name of the Auxiliary Patrol for keeping the sea approaches clear of mines and secure against submarines. It comprised craft of all sorts and sizes, chiefly trawlers and drifters with a considerable sprinkling of yachts and motor launches. This motley collection of vessels running into thousands, manned by fishermen, yachtsmen, officers of the Merchant Navy and men of the Royal Naval Volunteer Reserve, became a great disciplined force which bore no small share of the burden and heat of the day and played an important part in the struggle with the submarine (*see* SUBMARINE CAMPAIGN). It formed in reality a great Auxiliary Navy on duty round the coast and at the Dardanelles, at Otranto, and at Dover worked strenuously and fought valiantly to the last. The whole coastline of these islands was divided into 21 sections and in each section a number of these auxiliary vessels was constantly at work, each in its particular way. Thus Immingham (Humber), Yarmouth, and Lowestoft were pre-eminently minesweeping bases, which ensured the safety of the swept channel, called the War Channel, up the east coast. Queenstown (Adml. Sir Lewis Bayly) became one of the principal bases for escorts for the Atlantic convoys. There was stationed in 1918 a United States force of 37 destroyers and seven submarines and more than 40 other smaller craft. Buncrana with 30 destroyers and 33 smaller craft performed the same work on the north of Ireland route. At Larne again the work was chiefly directed to securing the North Channel and the Liverpool approach against the submarine, performed by four destroyers, 38 trawlers, 55 drifters and 15 other craft. At Granton (Adml. James Startin) in the Firth of Forth, over 100 trawlers were engaged in patrolling, and the convoy of Scandinavian ships to the Tyne and Humber absorbed six destroyers and 30 trawlers. As the War went on and on, the Merchant Navy and the Navy Royal became more and more a single force, ensuring the safe passage of the soldiers and the nation's daily bread.

British Losses.—The British losses had not been small. They amounted to 254 war vessels of which the greatest number fell to enemy submarines.

British Warship Losses

A, Action; B, Submarine; C, Mine; D, Destruction to avoid capture; E, Block-ship; F, Internal explosion; G, Collision; H, Wreck; J, Accident; K, Unknown.

	A	B	C	D	E	F	G	H	J	K	Total	Tonnage (deadweight)
Dreadnoughts	..	..	1	..	..	1	..	..	..	..	2	200,735
Pre-Dreadnoughts	1	5	4	..	..	1	..	..	..	..	11	
Battle Cruisers	3	..	..	..	..	..	..	..	..	..	3	63,000
Cruisers	5	5	1	..	..	1	..	1	..	..	13	158,300
Light Cruisers	1	3	2	..	6	..	..	..	..	..	12	46,255
Aircraft Carriers	1	1	..	..	..	..	1	..	..	..	3	27,488
Minelayers	..	1	..	..	..	1	..	..	..	..	2	11,000
Gunboats	..	1	1	..	..	..	2	2	..	..	6	4,235
Monitors	3	1	1	..	..	..	..	..	..	..	5	8,125
CoastDefence Ships	..	..	..	..	..	1	..	..	..	..	1	5,700
Sloops	1	11	5	..	..	..	..	..	..	1	18	22,630
Flotilla Leaders	1	1	..	..	..	1	..	..	..	..	3	5,204
Destroyers	16	7	20	..	..	..	12	8	..	1	64	52,045
Torpedo Boats	..	2	1	..	..		4	4	..	..	11	2,230
Submarines	3	4	4	9	1	..	4	4	4	21	54	43,649
Patrol Boats	..	..	1	..	..	..	1	..	..	..	2	1,226
Armed Merchant Cruisers	1	11	1	..	..	..	..	2	..	2	17	179,169
Armed Boarding Steamers	1	9	1	..	..	..	1	1	..	..	13	23,799
Coastal Motor Boats	5	..	..	2	..	..	2	..	3	1	13	85

Of auxiliary craft 815 were sunk, including 246 trawlers, 244 colliers, 130 drifters, 44 oilers, 24 motor launches and 18 mine-

sweepers. Of this total 289 (35·4%) were sunk by submarines, 225 (27·7%) by mines and 77 (9·4%) by wreck and stranding. The losses of the other Allies were not so heavy in comparison.

Comparative Naval Losses
(to Nov. 11 1918.)

Naval Losses	Dread-noughts	Pre-drs.	B. Cs.	Cr.	L. Cs.	Destroy-ers.	Sub-marines
Great Britain and Dominions	2	11	3	13	12	64	54
France	..	4	..	5	..	12	14
Italy	1	3	..	1	2	8	8
Japan	1	..	1	..	2	1	..
United States	..	..	..	1	..	2	11
Russia	2	2	..	2	..	20	20
Germany	..	1	1	6	17	66	199
Austria	2	1	..	..	3	6	14
Turkey	..	1	..	..	1	3	..

Though these figures give a merely statistical picture of the colossal ramifications of the War, they leave ample room for comment. The submarine inflicted and suffered most of the damage done in the War. It was the most active and the most dangerous service, and it was the German submarine that in 1917 became our worst menace. In the North Sea, Great Britain and the United States maintained a force of 46 capital ships (battleships and battle cruisers) against the German 23, in numbers a twofold, in gun power a threefold superiority. In the Mediterranean, France and Italy could muster 12 dreadnoughts against Austria's scanty three. These battleships were the shields behind which the other forces worked.

The Effect of Sea Power.—The work wrought by sea power, envisaged as a whole, he who runs may read. German trade was swept from the sea, the oceans were kept open for the troops and trade of the Allies and the shores of Great Britain and France and all the Dominions were never once threatened with invasion. In the Far East the fleet of our ally Japan drove Von Spee from Germany's only base and then, closing up behind him, barred the sea to his return. It may be said that the seas were not barred to the German submarine, but the answer is that the submarine merely attempted to do laboriously and slowly what a couple of battle cruisers appearing unopposed in the Channel could have done at once. And though the submarine was powerful against merchant shipping it accomplished much less against the fleet. Not a single dreadnought was sunk by it during the War and it was only in narrow waters like the Adriatic that it became a pressing danger to the fleet. It was countered by anti-submarine measures and convoys, working under the aegis of the battle fleet, which except in the case of sudden raids, like those on Dover, preserved them immune from attack. The fact that there was no great decisive battle has made some doubt the utility of the battleship. It is true that the opportunity which escaped the British fleet at Jutland was never wholly redeemed. If a battle is merely an incident in a blockade then its end may be achieved when the enemy retires to harbour. But if a battle represents the economy of the decisive blow, if the enemy's fleet can remain intact to play an important part in the campaign, then nothing can take the place of decisive battle. The fact that the battle fleet was never able to get to grips with the enemy does not diminish the importance of the battleship nor the importance of battle. It meant that vast resources of personnel and material had to be kept locked up in the Grand Fleet which a decisive victory would have released for the war against the submarine.

No surface ship was sunk by aircraft, but the end of the War left large possibilities still on the horizon, such as the use of aircraft on a large scale with a fleet. The power of the mine remains one of the lessons of the War and the combination of a minefield, supported by heavy guns either afloat (as in the Bight) or ashore (as at the Dardanelles) remains a very difficult proposition, for the mines offer an insuperable obstacle to heavy ships approaching, and the guns are able to prevent minesweepers approaching the mines. The paravane offered only an uncertain solution to the problem which can only be solved in its entirety by destroying the heavy guns or by capturing the forts, as the Germans did at Ösel (Saaremaa) in 1917, but even there three dreadnoughts were severely damaged by mines. The mine must not be regarded as a merely defensive weapon. It is an immobile weapon but it can be very offensive, and in the Bight, and the Dardanelles, proved more than a match for the stronger fleet.

Certain other outstanding lessons remain as the fruit of our experience in the War. Invasion or landing on a large scale becomes more hazardous than ever, if it is opposed by submarines and large and powerful aircraft, while aircraft carriers laden with opposing aircraft are necessarily vessels of the largest size and offer an enormous target to attack. The interception of wireless signals and the location of ships by means of wireless directionals played a large part in the intelligence systems on both sides.

The Decisive Factor.—But the tendency to interpret war wholly in terms of the mechanical apparatus of war is one to be avoided. The dominating factor in the War was not guns but maritime geography and was to be found in the Sound, in the Bight, at Dover and at Otranto. When the War broke out, grave doubts arose in the minds of some as to the advisability of sending a British army to France in the face of an undefeated German Fleet. It was not merely the inactivity of the German Fleet, but maritime geography and the dangers of approach to the Straits of Dover at night that enabled this to be done in safety. England was 300 m. ahead of Germany. The War was dominated by the fact that Germany's path to the ocean was barred by the solid bulk of the British Isles. It was peculiar in another way. Both navies were working in close proximity to their principal bases of repair and supply, and both navies were therefore able to exert the full strength of all their combined weapons of air, sea and submarine to an extent only possible within a reasonable distance (say 1,000 m.) of the great bases of a fleet. The navy that fights within easy reach of its great bases and principal industrial centres, fights at a great advantage. The lessons of the World War must not therefore be applied indiscriminately to the conditions of a war 5,000 m. away.

It is barely possible for a single mind to envisage in all their aspects the colossal ramifications of the War or to gauge precisely the relative part played in the final victory by economic, naval or military pressure. But this may be said. If the British navy in that tremendous quartet of years had to face an even greater task than anyone dreamt of when King George called it the "Sure Shield" of the nation, it could feel that this confidence had not been misplaced on that memorable day when Beatty received the surrender of the great German Fleet.

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WORTHINGTON-EVANS, SIR LAMING (b. 1868), British politician, was born Aug. 23 1868 and became a solicitor in 1890. In 1910, after one unsuccessful attempt, he was elected conservative M.P. for Colchester, and in 1918 for the Colchester division of Essex. In 1916 he entered the Coalition Govt. as parliamentary secretary to the Ministry of Munitions, having previously been controller of the foreign trade department of the Foreign Office. He left the Ministry of Munitions in 1918 to become Minister of Blockade, and afterwards filled the following offices under Mr. Lloyd George and Mr. Baldwin: Minister of Pensions, 1918–20; Minister without portfolio, 1920–1; Secretary for War, 1921–2; Postmaster-General, 1923–4; and again Secretary for War, 1924. He has written books on company law.

WRANGEL, PETER NICHOLAIEVICH, BARON (1878–), Russian soldier, was born at St. Petersburg (Leningrad) Aug. 15 1878. After experience in the ranks of the horse guards and as a mining engineer in Siberia, he served as an officer in a Cossack regiment, transferring after the Russo-Japanese War to the horse guards as a captain. During the World War he commanded successively a squadron, a regiment and a division of Cossacks. He was one of the first officers to join Kaledin against the Bolsheviks. After Kaledin's suicide Wrangel allied himself to Alexeyev and Deniken, distinguishing himself particularly by his defence of Tsaritsyn. On April 4 1920, after Deniken's retreat, Wrangel was appointed commander-in-chief of the volunteer army. From May to Oct. 1920 his forces met with considerable success, but after the signing of a peace treaty between Poland and the Bolsheviks the tide turned. On Nov. 15, Sebastopol was lost and the evacuation of the army carried out.

WRESTLING (*see* 28.844). —The popularity of this sport among amateurs has increased considerably since the institution of the modern Olympic Games, as is proved by the extension of the number of nations entering competitors for these Games. At the Games held in Paris, 1924, no fewer than 25 countries were represented. At the same time, the catch-as-catch-can (free) style, the inclusion of which in the Games was secured by Great Britain in 1914, has made great strides. At Antwerp, in 1920, of the four weights contested, two championships were secured by Finns and one by a Swiss. In 1914, the weights were increased to seven. Switzerland captured two, Finland one, the four others went to the United States. Great Britain's solitary success was third place in the heavy weight.

The pre-eminence in the Graeco-Roman style that France once held has been transferred to the Scandinavian countries. The Finnish wrestlers have proved the most successful. Finland and Sweden shared the championships in the Games at Stockholm, 1912, repeated the success at Antwerp, 1920 and won four of the six weights at Paris, 1924, France and Estonia respectively taking the heavy and bantam weights.

In 1924, Turkey, Egypt and Japan were represented for the first time, with results indicating that the Western styles of wrestling are being well studied throughout the East. The inauguration, in 1921, of an International Federation of Amateur Wrestling will certainly lead to a yet wider development of the sport. In Great Britain, apart from professional tournaments encouraged by local associations in the northern and western counties, it seems probable the sport would have disappeared altogether but for the exertions of the National Amateur Wrestling Association. This organisation has kept the sport alive by the holding, except during the War, of annual championships at various weights in the Cumberland and Westmoreland and catch-as-catch-can styles.

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WRIGHT, SIR ALMROTH EDWARD (1861–), British bacteriologist, was born at Middleton Tyas, Yorks., Aug. 10 1861. He was educated at Dublin University, and afterwards studied law, subsequently obtaining his scientific and medical training at the Universities of Leipzig, Strasbourg and Marburg. In 1887 he became a demonstrator of pathology at Cambridge, in 1889 went to Sydney as lecturer in physiology and from 1892 to 1902 was professor at the army medical school at Netley, being then appointed professor of experimental pathology in the university of London. He was in addition principal of the institute of pathology and research at St. Mary's Hospital, and was attached to the medical research service under the National Insurance Act. He was knighted in 1906 and was elected F. R. S. in the same year.

Sir Almroth Wright came into prominence primarily by his remarkable researches into the problems of parasitic diseases (*see* 20.775; 783). He introduced the system of anti-typhoid inoculation and also did much valuable work on the preparation of other vaccines and toxins, while he carried out many important experiments in bacterial infection and in measuring the protective matter of human blood. He acted as consulting physician to the army in France from 1914–9 and was in 1919 created K. B. E. He was a member of many learned societies and received numerous British and foreign awards and honours including the gold medal of the Royal Society of Medicine in 1920. He published a short Treatise on *Anti-Typhoid Inoculation* (1904); *Principles of Microscopy* (1906) and *Studies in Immunisation* (1909) besides many papers in medical and scientific journals. In 1913 appeared *The Unexpurgated Case against Woman Suffrage* which provoked much discussion. (*See* HUMANITY.)

WRIGHT, WILBUR (1867–1912), American inventor, was born near Millville, Ind., April 16 1867, the son of Milton Wright, a bishop of the United Brethren in Christ. After a high school education in Richmond, Ind., and Dayton, O., together with his brother Orville, he opened a shop for repairing bicycles at Dayton. The Wright brothers early became interested in the problem of flying, and from about 1900 made many experiments with gliding machines at Kittyhawk, North Carolina. On Dec. 17 1903, such a machine with a petrol motor attached flew 260 yd., the first successful flight of an aeroplane; and on Oct. 5 1905, near Dayton, they accomplished their first successful long flight, more than 24 m., at the speed of 38 m. an hour. In spite of this proof of the practicability of flight in heavier-than-air machines, they were unsuccessful in enlisting financial support in America. In 1908 Wilbur Wright went to France, and on Sept. 21 won the Michelin Prize by a flight of 56 miles. This brought him international fame. In Dec. of the same year he made from Le Mans, France, a flight of 77 m. in 2 hr. and 20 minutes. In 1909, during the Hudson-Fulton

Exposition in New York City, he flew from Governor's Is. up the Hudson river to Grant's tomb and back, travelling 21 m. in 33 minutes and 33 seconds. On March 3 1909, Congress awarded the Wright brothers a special medal. Later the U.S Govt. purchased a machine for $30,000, and afterwards the invention was officially adopted by the U.S. Army. The French patents were sold for $100,000. After 1910 Wilbur Wright gave up public flying and devoted his time to mechanical improvement of the Wright machine. He received many medals and honours from European countries. He died at Dayton May 30 1912.

His brother, ORVILLE WRIGHT (1871–), was born at Dayton, O., Aug. 18 1871. He was educated in the Dayton schools, worked with his brother Wilbur in the bicycle-repairing business, and was closely associated with him in all his experiments in developing a practicable aeroplane. He shared in the many honours awarded by foreign countries, and after the death of his brother became director of the Wright Aeronautical Laboratory at Dayton. In 1913 he received the Collier trophy for developing the automatic stabiliser. In 1915 he was appointed a member of the U.S. Naval Consulting Board. The same year the Wright Aeroplane Co. sold its patents to a New York syndicate, Orville Wright remaining chief engineer.

WRIGHT, WILLIAM ALDIS (1836–1914), British man of letters (*see* 28.847), died at Cambridge May 19 1914. His last publication was *The Hexaplar Psalter* (1911).

WUNDT, WILHELM MAX (1832–1920), German philosopher (*see* 28.855) died near Leipzig Aug. 31 1920. His latest work was *Die Nationen und ihre Philosophen* (1915).

WU PEI FU (1873–), Chinese general, was born at Shantung. He graduated from the Kai Ping military academy, near Tientsin, in 1898, after a brilliant scholastic career, and, after a short spell of service, entered a military school of which Marshal Tuan Chi-jui was director. He joined the Third Army Division, commanded by Tsao Kun, distinguished himself in several minor campaigns, and was rewarded by Tsao Kun in 1916 with the command of a division. The civil wars that followed the death of Yuan Shih-K'ai in that year gave ample opportunities to a soldier of Wu Pei-fu's ability and by 1917 he was the Peking Government's chief bulwark against the Monarchists, Sun Yat-sen's independent republic at Canton and the ambitions of Marshal Chang Tso-lin, the governor general of Manchuria. Sun Yat-sen was not in a position to take the offensive, but Chang Tso-lin invaded Chihli in the spring of 1922 and, being defeated by the forces of Wu Pei-fu launched another attack in 1924. Wu Pei-fu was defeated in a great battle near Tientsin in Oct. and fled after which he remained in retirement at Yochow.

WÜRTTEMBERG (*see* 28.856), a free State and territory of the German Reich (*Volkstaat Württemberg*). Its area is 7,534 sq. m. and its population (1921) 2,591,340. (*See* GERMANY.)

Political History.—Up to 1918 Württemberg was a monarchy. Its ancient constitution was somewhat out of date, but King William II. was universally popular. Differences were rather acute between the Conservatives and Catholic Centre ("Black and Blue *bloc*") and the Left. The general tendency was, however, liberal. The Weizsäcker Ministry, which held office during the War, resigned in Oct. 1918 in consequence of the alterations in the constitution of the Reich introduced by its Chancellor, Prince Max of Baden. A new coalition Parliamentary Govt. was about to meet when revolution broke out on Nov. 9. The first revolutionary Government was formed solely of Socialists, but its extreme members left it on Nov. 11, and members of the Catholic Centre, the Democrats and the National Liberals entered the Cabinet. The King abdicated Nov. 30. In Jan. 1919, there were industrial disturbances, soon suppressed, after which the Independent Socialists left the Ministry. After this date the Social Democrats and the Liberal parties co-operated without friction.

Constitution.—The new constitution was adopted on Sept. 25 1919. The powers of the State proceed from the people, which transfers them to the Diet, retaining, however, the right of dissolving the Diet or giving a popular vote on a law. The Diet transfers the executive power to the Government. At the head of the Government there is the minister-president, who has the title of President of the State but is not independent of the Diet. The Diet elects the President of the State, who selects the Ministry in accord with the Diet. A peculiarity of the Württemberg constitution is that councils (*Beiräte*), formed from the different classes according to occupations (*Berufsstände*), are attached to the Ministries. Elections for the Diet take place every four years. No provision is made for a dissolution of the Diet except that, as already mentioned, the Diet can be dismissed by a vote of the people. After the elections of 1920 the Government was formed by the Centre and Democrats, supported by the Social Democrats; it passed several important laws, especially that regulating the relations of Church and State. The elections of 1924, on a new franchise, brought a more conservative ministry, formed by the "Bürgerpartei" and Catholic Centre, under Herr Bazitte, leader of the Bürgerpartei. (W. v. B.)

WYNDHAM, SIR CHARLES (1837–1919), British actor (*see* 28.872), died in London Jan. 12 1919. In 1916 he married, as his second wife, Miss Mary Moore, who had been for many years his leading actress and his partner in management.

WYNDHAM, GEORGE (1863–1913), British politician and man of letters, was born Aug. 29 1863, the eldest son of Percy Scawen Wyndham, and grandson of the 1st Lord Leconfield. His mother was Madeline Caroline Frances Eden, daughter of Sir Guy Campbell, Bart., and through her he was great-grandson of Lord Edward Fitzgerald, the Irish rebel. He was educated at Eton and Sandhurst, obtained a commission in the Coldstream Guards in 1883, and served through the Suakin campaign of 1885. But, interested as he was in soldiering, his eager temperament impelled him still more to adventure into politics and letters. He left the army in 1887, married Sibell Mary, daughter of the 9th Earl of Scarborough, widow of Earl Grosvenor, mother of the 2nd Duke of Westminster, and became private secretary to Mr. Balfour, at the time Irish Secretary. In 1889 he entered Parliament as Conservative member for Dover and retained the seat till his death.

After serving, from 1898–1900, as financial secretary to the War Office, he was appointed in 1900 Chief Secretary for Ireland. Having been private secretary for four or five years to the most successful Chief Secretary of modern times, he started with a large store of experience; and his appointment was regarded with benignity even by the Nationalists on account of his descent from Lord Edward Fitzgerald. His early work in Ireland met with general approval. He developed enormously the Conservative policy of land purchase; and the Act which he carried in 1903 for that end was the most comprehensive measure of the kind ever submitted to Parliament. He entertained hopes of arranging some form of local government which should sufficiently meet Nationalist demands, and with this in view appointed in 1902 an eminent Anglo-Indian, Sir Antony (afterwards Lord) MacDonnell, who was known to be a decided Home Ruler, to the under-secretaryship, giving him at the same time greater authority and wider scope than is usually conferred on a civil servant. The Unionist party, both in Ireland and in England, became suspicious of the tendencies of his administration, and he was driven in 1905 to resignation. He never held office again, but he was very active in support of the causes which he had at heart, such as tariff reform and woman suffrage; he was a keen critic of Lord Haldane's army reforms, and threw himself vigorously into the "Diehard" campaign against the Parliament Bill in 1911.

This varied political activity was, however, but a portion of his life. He was also a man of letters, possessed of fine taste and a graceful style. Here his genius was stimulated by his friendship for W. E. Henley, who dedicated a book to "George Wyndham, soldier, courtier, scholar." His principal published work was an edition of *Shakespeare's Poems* (1898); but he wrote also on North's *Plutarch* and *Ronsard*. The Admirable Crichton of his day, handsome and debonair, he was keen alike on field sports and the arts, the friend and admirer equally of Cecil Rhodes and of Rodin, a working railway director and an efficient

colonel of yeomanry, the pet of society and the recipient of honorary distinctions from several universities. On June 8 1913, at the comparatively early age of 50, he died in Paris of congestion of the lungs, after only a few hours' illness. (G. E. B.)

WYOMING (*see* 28.873).—The population according to the state census of 1925 was 206,381. In 1920 it was 194,402, an increase of 33·2% in the decade 1910–20, as against an increase of 57·7% in the preceding decade. The density of population was two per sq. m. in 1920. The rural population in 1920 was 137,054; the urban population (in places having 2,500 or more) was 57,348 or 29·5%. The principal cities are:—

	1925 (state census)	1920	1910
Caspar	23,288	11,447	2,639
Cheyenne	13,202	13,829	11,320
Laramie	9,629	6,301	8,237

In 1920 there were 25,255 foreign-born whites, 1,375 negroes, 1,343 Indians and 1,538 Asiatics. In 1922 Wyoming ranked lowest among the states of the Union in its death rate (9·3 per 1,000 population).

Agriculture.—In 1924 there were 15,687,833 ac. of unappropriated public lands. The area of national forests was 8,426,927 acres. The period following the World War was one of depression for the ranching and agricultural interests. The open range and the old-time cattle ranch were giving place to a more varied agriculture, and experiments, such as dairying and honey production, became increasingly prominent. The number of farms in 1920 was 15,748. The acreage for all crops for 1923 was 1,784,000. Wyoming ranks second among the States in number of sheep. The estimate for Jan. 1 1924 was 2,700,000, valued at $24,300,000. The wool product for 1923 was 19,520,000 lb., an average weight of 8 lb. per fleece. On Jan. 1 1924, there were 825,000 cattle, valued at $25,891,000; 190,000 horses, valued at $5,700,000; 3,000 mules, valued at $165,000 and 129,000 swine, valued at $1,290,000. Important agricultural products in 1923 were:—

Crop	Acres Sown	Production	Value
Hay, tame	730,000	1,409,000 short tons	$13,526,000
Hay, wild	315,000	331,000 short tons	2,979,000
Oats	165,000	5,610,000 bu.	2,637,000
Wheat	175,000	2,785,000 bu.	2,228,000
Corn	150,000	4,050,000 bu.	2,835,000
Barley	28,000	840,000 bu.	546,000
Potatoes	18,000	1,800,000 bu.	1,674,000

Sugar beets have been important in the last few years; in 1924 the acreage sown was 25,000 which produced 260,000 tons, valued at $1,950,000. The irrigated area in 1924 was 1,007,083 acres. The area capable of irrigation under completed systems was 2,035,000 acres. There were 874,615 ac. of dry farm land and 16,872,152 ac. of grazing land privately owned. In 1910 89% of the farms were operated by owners; in 1920, 85·1%.

Mining.—The total value of Wyoming's mineral products for 1923 was $77,664,547. Wyoming ranked tenth in the output of bituminous coal with 7,575,031 short tons valued at $20,916,000. Other items were: gypsum, 33,644 short tons valued at $176,791; sand and gravel, 1,377,271 short tons valued at $403,911; stone, 186,150 short tons valued at $281,595; and clay products valued at $136,493. Copper and iron mining declined. Most important in mining development after 1912 was the petroleum industry. The total production to the end of 1921 was 89,356,000 barrels. In 1923 Wyoming ranked fourth among the States in oil production, with an output of 44,785,000 bbl. valued at $48,900,000, at the wells, the greater part from the Salt Creek field in Natrona county. There were some 50 pipe lines varying from 3 to 104 m. in length. There were 19 oil refineries with a capacity per day of 94,000 bbl. and 11 gasoline plants. Natural gas became important after 1916. In 1923 Wyoming ranked eighth with an output of 35,523,000 million cu. ft., valued at $4,222,000. It ranked sixth in production of natural gas gasoline with an output of 21,292,000 gal., valued at $1,992,000.

Manufactures and Railways.—Manufactures are of little importance aside from railway shops and the petroleum-refining industry. The increase shown in the table is due chiefly to the latter.

	1921	1919	1909
Number of establishments	254	576	268
Persons engaged	8,337	8,095	3,393
Value of products	$80,246,919	$81,445,394	$6,249,078
Value added by manufacture	31,927,000	39,194,866	3,640,889

Railway mileage in 1909 was 1,623 m., in 1922 1,959 miles.

Education.—There has been considerable progress in education. In 1914 the school enrolment was 29,301, in 1924, 50,581. The total expenditure for schools in 1914 was $1,265,750; in 1924, $5,761,655. The permanent common school fund in 1914 was $632,855; in 1924, $10,955,373. The percentage of illiteracy among persons ten years of age and over was 2·1% in 1920. The state university exhibited a remarkable growth. In 1913–4 there were 411 students in residence; in 1923–4, 1,726.

History.—Wyoming was the first state to provide for woman suffrage, and the first to elect a woman as governor. The nine amendments to the constitution and the legislation of recent years indicate a gradual development from frontier conditions and an increasing measure of public control of business and of social welfare. A workmen's compensation law, a mothers' pensions law, an eight-hour day for underground work in mines, a 56-hour week for women and a child labour law, illustrate the latter. In 1915 a public service commission was established, in 1919 a " blue sky " law was passed, in 1921 a system of rural credits was begun and a dept. of oil and gas conservation provided for, in 1923 a state dept. of agriculture was created and laws passed to facilitate co-operative marketing and to prevent price discriminations in the sale of coal, oil and other products of the soil. The problem of fair distribution of the waters of interstate rivers has been a vexing one to Wyoming as to other states dependent on irrigation.

The direct primary was adopted in 1911, the executive budget system in 1919. The state debt was $99,000 in 1918, $4,133,000 in 1922, $2,937,000 in 1924, the increase being due chiefly to road building. Wyoming has been normally a Republican state in politics, but since 1910 opposing parties have won frequent victories. A combination of Progressives and Democrats won in 1910. Francis E. Warren (Rep.) was re-elected to the U.S. Senate in 1912, 1918, 1924, but John B. Kendrick (Dem.) was elected as his colleague in 1916 and 1922. The presidential vote in 1912 was 15,310 for Wilson, 14,560 for Taft, 9,232 for Roosevelt; in 1916, 28,316 for Wilson, 21,698 for Hughes; in 1920 35,091 for Harding, 17,429 for Cox; in 1924, 41,858 for Coolidge 25,174 for La Follette, 12,868 for Davis. Governors since 1911 have been: Joseph M. Carey (Prog.), 1911–5; John B. Kendrick (Dem.), 1915–7; F. L. Houx (acting, Dem.), 1917–9; Robert D. Carey (Rep.), 1919–23; William B. Ross (Dem.), 1923–5; Nellie Taylor Ross (Dem.), 1925– (L. A. W.)

YACHTING (*see* 28.890 and 12.916).—Much of the finest racing in the whole history of yachting took place from 1910 until 1913. The International Yacht Racing Union was well established, and its rule of measurement and rating had produced and was still producing very sound and seaworthy boats in many classes. British yacht building was flourishing, German yachting was at its zenith under the Kaiser. International regattas on a big scale were held at Spithead in 1911, at Kiel in 1912 and at Le Havre in 1913. The number of racing yachts, steam yachts and cruisers sailing about the coast exceeded all records. The history of yachting for nearly 100 years shows that when racing is successful the whole pastime benefits. America was attracted to European yachting during this halcyon period and in 1910 a wonderful American racing schooner came to Europe, the "Westward," 323 tons, designed and built by Herreshoff. She started in 11 races and won them all. Sir Thomas Lipton's 23-metre cutter "Shamrock" remained the best British cutter during these seasons.

In 1910 there was a remarkable class of 15-metre yachts about 50 tons. Sir William Burton's "Osturu" led it, followed by "Vanity," the King of Spain's "Hispania," "Mariska," "Tritonia" and "Ma'oona." In 1911 the 19-metre class made their appearance. There were four cutters of exactly 100 tons, "Octavia," "Mariquita," "Corona" and "Norada." They were almost exactly equal in speed, and it was only the cleverness of Sir William Burton as a helmsman that enabled the "Octavia" to lead the fleet by the narrowest margin, just as his "Ostava" had been at the top of the "15's" in the previous year. Both were designed by Alfred Mylne.

Nicholson's "Istria" Design.—The season of 1912 was chiefly notable for the appearance of a new 15-metre yacht, the "Istria," designed on novel lines by C. Nicholson for Sir Charles Allom, and the first of a series of yachts by the same clever designer which quickly began to defeat the purpose of the "International Racing Rule" (*see* 28.894). In 1912 and 1913 his great schooners "Margherita," "Istria," "Pamela," "Paula III." and others were of most undesirable type, but so efficient as racers that they outsailed the yachts of all other designers. The features of these yachts were huge sails, shallow heavy bodies, high freeboard, short water line and great overall length. It was in connection with the "Istria" that the term "Marconi topmast" was first used, her topmast having a large number of small wire stays to support its enormous height. Nicholson defeated all comers in the last stages of the International Rule of 1907–17 and may be said to have killed it. An interesting experiment was effectively carried out by the marquess of Ailsa from 1909–14. He repurchased his old 40-tonner "Bloodhound," built in 1874, and gave her new rigging, spars, sail plan and keel. He started her in 217 races and, sailing with modern yachts, she crossed the winning line first on 32 occasions. She won 64 first prizes—a remarkable achievement.

The New Rating Rule.—On the eve of Cowes Week, 1914, the War put an end to all yacht racing. The pastime was only revived in 1919–20, after much difficulty, by the Yacht Racing Association. At the end of the War the Scandinavian nations, having amassed great wealth, purchased nearly all the best British racing yachts. The cost of building new yachts was prohibitive and the high wages of sailors raised the running expenses to nearly treble the pre-War rate. At the instance of the Y.R.A. the International Yacht Racing Union was reformed and a new rating rule was adopted. The new rule reduced the sails of racing yachts to about two-thirds of the pre-War size and prescribed a more compact form of hull, measures which enabled crews to be reduced and thus effected a substantial saving in running costs. As more normal conditions returned many of the old British yachts were repurchased from Scandinavia. The greatest encouragement of all, however, was that the King took the lead in the sport and fitted out the old "Britannia" for racing. This Royal yacht, built in 1893, by a peculiar coincidence of events, had a hull-form very similar to the shape favoured by the new rating rules of 1920, and after some alterations raced successfully against "Westward," "Shamrock," "Nyria," "White Heather" and many modern vessels.

In new classes naturally smaller craft have been built since the War. The 92-ton cutter "Moon-Beam" (Fife), built in 1920, is a model of the new compact form. The new 12-metre class about 35 tons (20 tons displacement, 42 ft. LWL and 2,000 sq. ft. of sail) is the latest pattern of compact racing yacht, with good cabins for living and a paid crew limited to four men. The greatest sport internationally was from 1921–4 between Britain and America in a series of races called the British American Cup. W. Fife and F. J. Stephen were the chief British designers for this race which was for 6-metre class yachts. The British defeated the Americans in the 6-metre team racing. W. Fife has been the most successful designer. From 1921 to 1926 the most marked development in the design of sailing yachts has been the change from the gaff-mainsail rig to the triangular or Bermudian rig. No cutter-rigged yacht below 35 tons has been successful against a new vessel with a Bermudian sail.

(B H–S)

United States.—In America, since the War, the sport of yacht racing has increased materially. During these years the racing fleet has grown steadily in size, both on the Atlantic and on the Pacific coasts. It has developed especially in two divisions—that which includes the smaller yachts which may be raced by men of moderate means, and that which takes in the schooners which are a combination racing and cruising type. There is a constantly enlarging group of racing yachtsmen who are devotees of long-distance contests which bring into play not only a knowledge of sail handling but of navigation. These men own scores of staunch, seagoing vessels which are not in any sense of the word racing machines. This is a certain indication that the sport is developing along most durable lines. At what might be called the other extreme, the small boat classes are flourishing. As an example, the International Star Class is now the largest racing division in the world, numbering almost 400 boats. The Stars, on which it is said "the sun never sets," are only 22 ft. long overall, and 15½ ft. long on the waterline, but they have provided some of the keenest sport that has ever been seen in yacht racing and have done a great deal to popularise small boat competition. Each year, when the Star Class championships are held, the competitors come from the far ends of the earth to try for the International Trophy. In the old days, when races for the America's Cup were the great events of the yachting world, the conception became firmly fixed that yacht racing was a sport only for the wealthy. This has largely been lived down during the growth in recent years of the numerous small boat classes.

(S. La.)

YAKUB KHAN (1849–1923), ex-Amir of Afghanistan (*see* 28.898), died at Dehra, United Provinces, Nov. 15 1923.

YALE UNIVERSITY (*see* 28.899).—In 1919 President Arthur T. Hadley announced his decision to resign the presidency of Yale at the close of the university year; and on June 22 1921 his successor, James Rowland Angell, was inaugurated. In 1920 the university underwent a thorough reorganisation in its administrative and educational system to meet modern conditions.

A school of nursing was established in 1923 through a gift from the Rockefeller Foundation. The course of 28 months leading to a degree or diploma includes public health and community work as well as hospital service. The Laura Spelman Rockefeller Memorial in 1924 granted a contribution for a period of five years for an Institute of Psychology. A group of specialists was in 1925 engaged in the study of fundamental problems of human and animal behaviour and in the training of personnel for the further pursuit of new studies in the field of teaching research and of practical applications.

Developments.—Many changes were effected in the curriculum; a new course of study in Yale College, designed to provide for substantial mastery of some one field of study, while giving reasonable assurance that no student will be graduated without an intelligent acquaintance with the major subdivisions of the modern world of arts, letters and science; in the Sheffield Scientific School changes were made with a view to increasing the flexibility of the course of study and to emphasising basic scientific and humanistic material as contrasted with purely technical specialisation; the schedules of work in administrative and chemical engineering were definitely crystallised, and through the gift of Mr. and Mrs. Louis J. Horowitz a new group of courses in building construction was offered in the department of civil engineering; changes in the requirements for degrees in the school of law were introduced as well as a summer session, designed for those who desire to pursue graduate law study and for those who wish to save an academic year in the completion of their course by attending three such sessions; a department of the drama was established in the School of the Fine Arts in 1924, funds for the department and for the erection of a University Theatre being provided by Edward S. Harkness (B.A., Yale, 1897); in the school of music the changes were designed to adapt the curriculum in a greater degree to the special talents and interest of the individual student; the curriculum of the school of forestry was broadened and liberalised and facilities for experimental and research work on a scale heretofore impossible were provided in Sage Hall, completed in 1923 (gift of William H. Sage, B.A., Yale, 1865); a chair in transportation was founded in the graduate school and named in honour of T. De Witt Cuyler (B.A., Yale, 1874); also the Dudley chair, Service of the railroads, established in 1923 by receipt of a bequest from Lucy B. Dudley, added to by bequest of Plimmon H. Dudley.

Benefactions.—Through the bequest of John W. Sterling (B.A., Yale, 1864) 14 professorships were established; two buildings were erected; the Sterling chemistry laboratory, which provides for instruction and research in every branch of chemistry, and the Sterling Hall of Medicine, which contains the administrative offices of the school, and teaching and laboratory facilities for the departments of anatomy, physiology, chemistry, psychology and pharmacology and toxicology; the Sterling scholarships established by a fund of $1,000,000; and $250,000 was received towards a total of $1,000,000 for the Sterling Fellowship fund. At the same time the university's property holdings were augmented and several important buildings constructed, including the Osborn memorial laboratories, the Sloane physics laboratory, the Dunham laboratory of electrical engineering, the Mason laboratory of mechanical engineering, Sprague memorial hall (music), the Brady memorial laboratory (pathology), Artillery Hall and the Artillery armory, and the magnificent Memorial quadrangle, the gift of Mrs. Stephen V. Harkness, of New York City. The University Library, containing over 1,600,000 vol. and pamphlets, received many important accessions, notably the Edward M. House collection of historical papers and the Penniman Memorial Library of Education, besides numerous additions to collections previously announced. The new Peabody Museum, which is French Gothic in design. was formally dedicated on Dec. 29 1925.

A complete plan was announced in Jan. 1924, for the architectural development of the university during the next 100 years. This includes a new cross campus, designed to unify the Yale College campus and adjacent grounds, and the indication of sites for future buildings, which will tend to control the direction of growth of the university. Edwin McClellan Hall, a new dormitory, following closely in size and style Connecticut Hall (1752), was opened for Yale College students in Sept. 1925, and another dormitory under construction will be completed in the spring of 1926. The total university enrolment in the autumn of 1925 was 5,294, including 572 who were not candidates for degrees or certificates. The faculty numbered 575 and there were 428 assistants in instruction and administration. (J. R. A.)

YAMAGATA, ARITOMO Prince (1838–1922), Japanese soldier and statesman (*see* 28.902), died at Odawara Feb. 1 1922.

YAP (*see* 20.436).—This island of the Caroline group, formerly owned by Germany, is situated in the Pacific Ocean, south of Japan and east of the Philippines, and north of the equator, in latitude 9.35 north, longitude, 138.15 east. It has an estimated population of 7,155, almost entirely of Malay origin.

The importance of Yap arises from its cable connections, since it is a station on the direct line from the United States to the Dutch East Indies *via* Guam, while another cable runs from Yap to Shanghai. On May 7 1919, Japan was given a mandate over the islands north of the equator previously owned by Germany, including Yap. The U.S. Govt. protested, and asked for a reopening of the subject on the ground that at the Peace Conference it had reserved the right to object to exclusive control of the cable landings by Japan and taken the position that the island should be internationalised for cable purposes. Further, it was contended, the United States, not having ratified the Treaty of Versailles, was not bound. The supreme council of the Allies expressed its inability to reopen the matter. The controversy was finally disposed of at the Washington conference, Dec. 12 1921, by an agreement between the two Powers, wherein the United States recognised the Japanese mandate and Japan agreed that the United States should have free access to the island on a footing of entire equality with Japan or any other nation in respect to the Yap-Guam cable and any other cables which might be laid by the United States or its nationals, and also similar rights and privileges in regard to radio-telegraphic service. The United States was also granted free entry and exit for persons and property. The U.S. Senate ratified the convention embodying this agreement March 1 1922. (*See* Washington Conference.)

YARMOUTH, England (*see* 28.905), the largest herring fishery port, with numerous curing and brewing establishments, had a population of 60,700 in 1921 (39,724 in Yarmouth, 20,391 in Gorleston and 585 in Runham Vauxhall), and an area of 3,598 acres. A comprehensive town plan has been prepared. The parish of Southtown was formed from that of Gorleston in 1911. The esplanade has been extended one-fourth of a mile northwards, and the North Denes estate of 46 ac. was in process of development in 1925. The pavilion on the Britannia pier was burnt down in 1910, but has been rebuilt to seat 1,400, and a large bathing-pool was opened in 1922. An art school was opened in 1913. The East Anglian school for blind and deaf children was opened at Gorleston in 1911, and Melton Lodge, on the Marine Parade, as a home for ex-service men's children in 1921; a children's ward was added to the general hospital as a memorial to King Edward VII., and in 1921 a war memorial monolith was erected in St. George's Park.

In 1912 the powers of the Port and Haven Commissioners over the water area of the harbour, and of the corporation over the wharves were transferred to an enlarged harbour commission. Since then the quays have been extended. There is a new trawl market to the north of the fish wharf, with offices. An export quay, 750 ft. long, has been built to the south of the Trinity magazine, making a total of 23,400 ft. of quayage in the port.

YEATS, WILLIAM BUTLER (1865–), Irish author (*see* 28.909). In 1907 was published vol. 5 of plays for an Irish theatre, containing *Deirdre.* In 1907 *Discoveries,* a volume of essays, appeared. In 1908 appeared a verse play, *The Golden Helmet, Poetry and Ireland,* (essays by Yeats and Lionel Johnson) and *The Unicorn from the Stars and other plays* by Yeats and Lady Gregory. *The Green Helmet,* and other poems were published in 1910, and in 1911, *Synge and the Ireland of His Time;* in 1912 *The Cutting of an Agate* (essays); in 1913 *Poems written in Discouragement;* in 1914 a volume of poems, *Responsibilities;* and in 1915 a prose book, *Reveries over Childhood and Youth.* In 1916 a poem, *Easter 1916* appeared and also *Eight Poems;* 1917, *The Wild Swans at Coole,* other verses and a play in verse; 1918, *Nine Poems* and *Per Amica Silentia Lunae,* (essays); 1919, Two *Plays for Dancers;* 1920 *Michael Robartes and the Dancer;* 1921 *Four Plays for Dancers* and a prose book *Four Years;* 1922, *Later Poems,* and in the same year *The Player Queen, Plays in Prose and Verse, Seven Poems and a Fragment,*

and *The Trembling of the Veil* (prose). *The Cat and the Moon* (a play and poems) was published in 1924.

The early poetry of Yeats showed traces of the influence of Shelley, William Morris and Sir Samuel Ferguson, but even through this influence a very original imagination was already apparent. He became more fully himself in *The Wanderings of Oisin* (1889), and in *The Wind Among the Reeds* (1899), all early influences had finally vanished. In this he appears the self-conscious and fastidious artist, and so remains. The later verse is more intellectual and in contrast to the richly coloured poetry of his youth there is in it a finer sense of the beauty to be revealed by bare words. Mr. Yeats is the pivot around which Anglo-Irish literature has turned from crudity and a rather facile energy to subtlety and self-conscious art. He was awarded the Nobel Prize for literature in 1924. (S. L. M.)

YELLOW FEVER (*see* 28.910c).—The dreaded "vomito negro" which for four centuries claimed more than 50% mortality among its victims, has been relegated to a place of secondary importance since the institution, in 1901, of the anti-mosquito campaign. Between 1910 and 1925 no epidemic invasion of yellow fever into temperate regions occurred, and some of the most noted endemic centres in Ecuador, Mexico and Brazil have been freed of the disease, probably forever; no case has been reported in the entire Western Hemisphere for many months. The use of oil for destroying mosquito larvae has now been practically abandoned in favour of placing in the tanks which serve as water supply for houses in the tropics one or two small fish, which eagerly devour the "wrigglers."

Connor, in Guayaquil, first used this method successfully in 1919, and it has since been used in other countries with excellent results. The fish must be of small size and able to withstand handling and transportation. Those chiefly used are the minnows, *Gambusia affinis*, *Dormitator latifrons* and *Fundulus heteroclitus* and the common "lefa" of South America (*Pygidium piurae C.*) some being top-feeding and others bottom-feeding fish.

Isolation of the Causative Micro-organism of Yellow Fever and Preparation of a Prophylactic Vaccine and a Curative Serum.—While the transmitter of the yellow-fever germ had been experimentally proven, by the American Army Board under Reed, to be the mosquito, *Aedes aegypti* (formerly known as *Stegomyia fasciata* or *S. calopus*), the microbe which produced the disease, had remained unknown until 1918 when a minute spiral organism, subsequently named *Leptospira icteroides*, was isolated from the blood and organs of yellow fever patients, in Guayaquil, Ecuador. Inoculation of cultures of this organism reproduced all the characteristic symptoms and lesions of yellow fever in guinea pigs, marmosets and young puppies. Yellow fever was also transmitted directly to guinea pigs with blood taken from yellow-fever patients and the same micro-organism from experimentally infected animals. Investigations previously conducted by the American Army Board in Havana had demonstrated that the germ of yellow-fever could pass through the pores of certain bacteria-proof filters (*see* FILTER-PASSING MICROBES), and this fact alone had been sufficient to disprove the relation to yellow fever of a dozen or more different bacteria. *Leptospira icteroides*, on the other hand, proved to be a filter-passer and to conform with other well-known characteristics of the yellow-fever virus: thermal death-point; transmissibility by *Aedes aegypti;* ability to produce typical fever, extensive haemorrhages into the gastro-intestinal tract, resulting in the "black vomitus" and melena, severe nephritis, general jaundice and the characteristic changes of liver and kidney (fatty degeneration and necrosis). Another important proof that connects *Leptospira icteroides* with yellow fever is that this micro-organism is killed by the blood serum of persons who have just recovered from yellow fever but not by that of healthy persons or persons recovering from other diseases.

Leptospira icteroides was subsequently isolated from cases of yellow fever in Mexico, Peru and Brazil. It is actively motile, measures 4–9μ long and 0·2μ wide and there are two spirals for each micron. The ordinary microscope does not reveal its presence in the living condition, but it is easily seen by means of dark-ground illumination. It grows only on special culture media. The isolation of *Leptospira icteroides* has made it possible to prepare a preventive vaccine, similar in type to that in use for protection against typhoid fever, and a curative serum. While a given locality may be freed from yellow fever by destruction of mosquito larvae, this type of preventive work requires some months. Newcomers meantime are in danger, and protection, even of a temporary nature, is welcome. Injection of a small quantity of killed cultures of *Leptospira icteroides*, as first shown in experimental animals, confers temporary protection from the yellow-fever infection, the inoculation taking effect within about two weeks. The results of prophylactic inoculation of 20,000 or more individuals since 1919 indicate that if persons are satisfactorily vaccinated they are protected against yellow fever for about six months. The curative serum has been tried in 237 cases. When it has been used early in the disease, *i.e.*, before the fourth day of illness, the death-rate has been comparatively small (16% as compared with the usual 50% or more in yellow fever). It is without appreciable benefit when given later in the illness, when the micro-organisms have done irreparable injury to the liver and kidneys.

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YELLOW RIVER: *see* HWANG HO.

YOKOHAMA (*see* 28.921), the chief port of Japan, with a population of 422,942 in 1920, was practically destroyed by an earthquake in Sept. 1923. Many thousands of its inhabitants were killed, some 60% of the houses were burnt and about 19% collapsed. Temporary barracks and tents were used at first to house the surviving population. The electric light and water systems and the tramways were restored very promptly, but in the reconstruction Yokohama was far behind Tokio in 1925, owing largely to the fact that it had a much bigger foreign element and was much more western in construction. The débris of these solid erections was more difficult to remove, and their replacement slower and costlier than that of the Japanese type of buildings.

The starting-point of reconstruction was the new railway station on the coast, and it is proposed to widen 25 m. of existing streets and to build 29 m. of new streets; but in 1924–5 there remained many acres of ruins, the Bluff was still bare, and there were only temporary buildings, mostly dwelling-houses, on the Bund. Railways had been restored, and a plan for their further reconstruction was in hand. A memorial hall was opened in 1925. In 1924 shipping and industry were gradually approaching normal conditions and trade, especially in raw silk, exceeded expectations. Shipbuilding, however, had not recovered. Considerable improvements in the dock accommodation, wharves and equipment of the harbour had been effected before 1923, but during the earthquake about a mile of the breakwater sank 8 ft. and most of the wharves were destroyed. The repair of the docks and harbour was undertaken by the central government, and was practically complete in 1924. Two-thirds of the original warehouse accommodation was then available, and the space for open storage had been doubled.

YORK, ALBERT FREDERICK ARTHUR GEORGE, DUKE OF (1895–), second son of King George V. and Queen Mary, was born at York Cottage, Sandringham, Dec. 14 1895. After passing through Osborne and the Royal Naval College, Dartmouth, he was gazetted midshipman in Sept. 1913. Though debarred by ill health from active service during the early years of the World War, he served in the battle of Jutland as a sub-lieutenant, being mentioned in despatches. At the end of 1917 he was attached to the naval branch of the Royal Air Force and, in Oct. 1918, was on the Western Front, qualified as a pilot and eventually became wing-commander in 1920. After the War (Oct. 1919) he entered Trinity College, Cambridge, taking an abridged course in history, economics and civics. He has since shown a special interest

in industrial questions, becoming President of the Society for Industrial Welfare. He was created Duke of York in June 1920 and K.T. on the occasion of his marriage to Lady Elizabeth Bowes-Lyon, April 26 1923, having been previously (Dec. 1916) created K.G. In 1922 and 1923 the Duke represented the King at court ceremonies in Rumania, Serbia and Czechoslovakia. In 1925 he was made president of the British Empire Exhibition, Wembley, and in June was appointed to the Privy Council. On April 21 1926 a daughter was born to the Duke and Duchess of York. The Princess Elizabeth, as she is called, is, after the Prince of Wales and her father, the heir to the British throne.

YOSHIHITO (1879–), 122nd Emperor of Japan, third son of the Emperor Meiji (Mutsuhito), was born at Tokyo on Aug. 31 1879. On the eighth anniversary of his birthday the Prince was proclaimed heir-apparent, the first and second sons of the Emperor Meiji having died in infancy. In Sept. 1887 the Prince commenced attending the Peers' School, and on Nov. 3 1889 he was declared imperial crown prince. Two years later he left the school to continue his studies under private tutors. In 1897 he took his seat, in accordance with prescriptive right, in the house of peers. On May 10 1900 the crown prince married Sadako, fourth daughter of the late Prince Michitaka Kujo, and on April 29 1901 a son, Hirohito, was born, followed by a second son Prince Yasuhito Chichibunomiya, on June 25 1902, and a third, Prince Nobuhito Takamatsunomiya, on Jan. 3 1905. On July 30 1912 on the demise of his father, the crown prince ascended the throne; but owing to the national mourning the formal ceremony of enthronement did not take place until Nov. 1914. In the following year a fourth son, Prince Takahito Suminomiya, was born on Dec. 2. Owing to the indifferent health of the Emperor, Crown Prince Hirohito became prince regent on Nov. 25 1921.

YOSHIZAWA, KENKICHI (1874–), Japanese diplomat, born in Niigata-Ken. He had literary tastes as a student and studied English literature for his degree in the Imperial University of Tokyo. He later turned his attention to diplomacy, and he had his first experience, as Éléve-Consul at Amoz, South China. After spending two years in Shanghai and in London he returned to the Foreign Office in Tokyo, and was sent as Secretary to the Legation in Peking. This office he held until, in 1919 he became director of the Asiatic Bureau, where his experience of Far-Eastern people enabled him to adjust differences between his own country and other Oriental Powers. He retained this post until 1923, and was again in Peking in an official capacity when the new Russo-Japanese Alliance was broached in 1924. Many Japanese fought against the proposed alliance, thinking it unwise to link their country with Soviet Russia, but Mr. Yoshizawa believed that this bond between the two countries could bring nothing but good and worked to that end. It is said that the strain of innumerable conferences and discussions undermined Yoshizawa's health. When, in January of 1925, the treaty was made mutually agreeable, it was signed by the representatives of the two Powers grouped round the Japanese Minister's bed. He was made ambassador in the same year.

YOUNG, MAHONRI MACKINTOSH (1877–), American sculptor, painter and etcher, was born at Salt Lake City, Utah, Aug. 9 1877. He studied with J. T. Harwood, Salt Lake City, at the Art Students' League, New York City, and at the Julien and other Academies in Paris. After his return to the United States he became instructor in drawing at the Art Students' League and later instructor in sculpture at the American School of Sculpture. His works are characterised by simplicity, dignity and breadth of conception, united with exquisite workmanship. He is known chiefly through his statuettes, figures of labourers and cowboys, which exhibit close observation of nature and virile form. Among his best known works are "Man with Pick" in the Metropolitian Museum of Art; the Hopi and Apache groups in the Museum of Natural History, New York City; "A Labourer" and "The Rigger" in the Free Public Library, Newark, N. J.; the "Sea-Gull" monument in Salt Lake City; "Rolling His Own"; and "Monument to the Dead" (with Bertram Goodhue), in Paris.

YOUNG, OWEN D. (1874–), American lawyer and business man, was born at Van Hornesville, N. Y., Oct. 27 1874. He was educated at St. Lawrence University, N. Y., (A.B., 1894), and Boston University (LL.B., 1896). He commenced the practice of law in Boston, 1896, being associated with and later a partner of Charles H. Tyler until 1912, when he retired in order to become general counsel for the General Electric Company. In 1913 he was elected vice-president in charge of policy and in 1922 was elected chairman of the Board of Directors. He organised and became chairman of the Board of the Radio Corporation of America. He was also a director of the Federal Reserve Bank of New York, General Motors Corp., the International General Electric Co., and chairman of the American Section of the International Chamber of Commerce. He was a member of President Wilson's second industrial conference, chairman of the Committee on Business Cycles and Unemployment appointed by President Harding, and chairman of the American Group, International Court of Arbitration of Trade Disputes of the International Chamber of Commerce. In December 1923, he accepted the invitation of the Reparations Commission to act as a member of the first committee of experts charged with the enquiry into the balancing of the German Budget and the stabilising of the German currency. Their ensuing report was accepted by the commission, Sept. 1. (*See* REPARATIONS.) He was appointed agent-general for Reparation payments *ad interim* on that date, holding the position till Oct. 31, when he resigned and was succeeded by S. Parker Gilbert.

YOUNGSTOWN, Ohio, U. S. A. (*see* 28.941), the centre of a district which produces one-twentieth of the world's output of steel, extended its boundaries from 6,606.8 ac. in 1910 to 16,224 by 1923. The population increased 67·4% in the 10 years after 1910 to 132,358 in 1920, of whom 6,662 were negroes (an increase of 244%) and 33,945 were foreign born; and was estimated at 159,970 in 1925 (census bureau). The output of factories within the city was valued at $81,271,000 in 1909; $241,458,000 in 1919; $272,183,553 in 1923. The character of the dominating industries is reflected in the preponderance of men in the population (114·9 males to 100 females, 1920) and in the small number of women employed (18·5% of all 10 years of age and over, the smallest proportion in any of the large cities in 1920). Natural gas from Ohio and West Virginia is used for domestic fuel. Improvements (to 1925) included a belt-line railway, a service-at-cost franchise for the transit system, zoning ordinances, new school buildings, parks and playgrounds, a golf course, the Butler Art Institute and the Stambaugh Memorial Auditorium. A new charter, effective Jan. 1 1925, provided for non-partisan ballots, the recall of elected officers, the initiative and referendum and a budget system.

YPRES, JOHN DENTON PINKSTONE FRENCH, 1ST EARL OF, (1852–1925), British soldier, was born at Ripple, Kent, Sept. 28 1852. The son of a naval officer, he entered the royal navy, in which he served as cadet and midshipman from 1866 to 1870. Joining the militia he passed from this into the army in 1874 and was gazetted to the 19th Hussars. He married Eleanora, daughter of R. W. Selby Lowndes in 1880. He served in the Nile expedition in 1884-5, and commanded his regiment from 1889 to 1893. After two years on the War Office staff he commanded a cavalry brigade from 1897 to 1899, and on the mobilisation of the expeditionary force for S. Africa in the latter year he was chosen to command the Cavalry Division and was promoted major-general. Pending the assembly of this he served in Natal where he commanded the troops on the field at Elandslaagte and took part in the early combats near Ladysmith, but he proceeded to Cape Colony just before the place was invested. After a few weeks in charge of the force at Colesburg, he led the cavalry during Lord Robert's advance from Cape Colony, relieved Kimberley, cut off the retreat of Cronje's army, and occupied Bloemfontein. During the subsequent advance into the Transvaal he was in command of the left wing, and at a later stage of the victorious campaign he played a prominent

part in the move from Pretoria to Komati Poort. For these services he was given the K.C.B. During most of the second phase of the struggle he was in command of the forces operating against the enemy in Cape Colony, and he was on the conclusion of hostilities promoted lieutenant-general and was given the K.C.M.G.

He commanded at Aldershot from 1902 to 1907, in which year he was promoted general, and he then became inspector-general of the Forces for five years. He was appointed chief of the Imperial General Staff in 1912 and was promoted field-marshal in 1913. In April 1914 he vacated the post of C.I.G.S., owing to military troubles in Ireland in connection with Ulster, but four months later he was chosen to take charge of the Expeditionary Force on the outbreak of the World War, and he commanded the British Army on the Western Front from the outset of the struggle until the end of 1915. He resigned in December of that year, Sir D. Haig taking his place, and he returned to England, to be raised to the peerage as Viscount French of Ypres and High Lake in recognition of his great services. He then became commander-in-chief in the United Kingdom, and he held that appointment until May 1918, when he was selected to be lord lieutenant of Ireland. This position he occupied under most trying conditions until early in 1921. On resigning he was rewarded with an earldom. He died May 22 1925 at Deal Castle, Kent. At the end of the war, Lord French published his personal narrative under the title, "*1914.*"

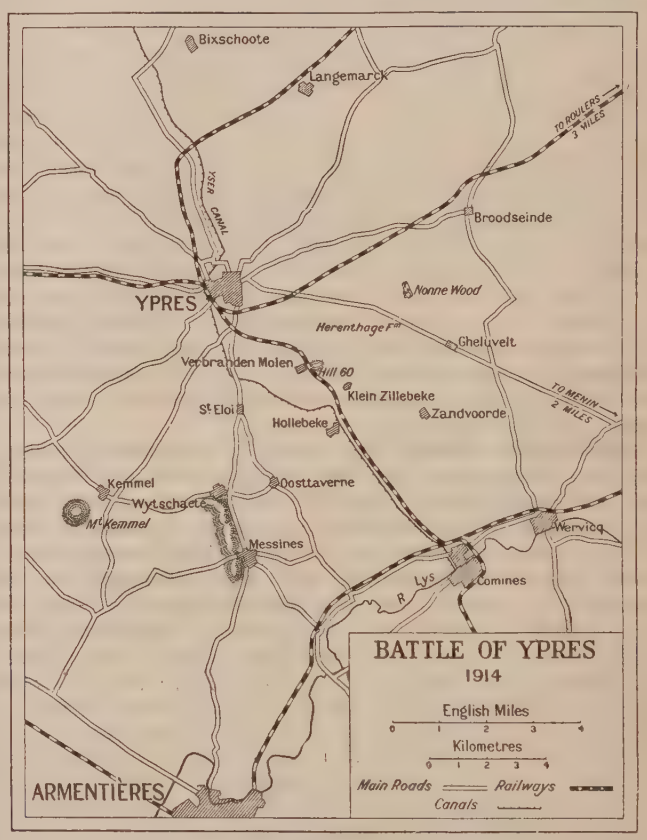
YPRES, BELGIUM (*see* 28.941), for four years the centre of the Ypres salient, never more than seven and sometimes less than three miles from the front line, suffered greatly during the World War. The town was deliberately wrecked, and was a blazing furnace for three days in 1915. Nothing remained after the Armistice but cellars and foundations, excepting fragmentary ruins of the Cloth Hall and St. Martin's church. The town was awarded the British Military Cross and the French Croix de Guerre in 1920.

Ypres is now again a beautiful town, with a population estimated at 14,000 in 1924. First temporary hostels, garages, etc., were built outside the Menin Gate, the ruins were cleared, and the materials found were classified. Then the rebuilding of the streets on the old lines, with houses of the original picturesque designs, was pushed rapidly forward. Work was begun at once on the cathedral, the churches of St. Martin, St. Peter and St. James, the Templars' House, the Châtellerie (now used as the town hall), the Belle Hospital and the Boucherie. The reconstruction of the Cloth Hall and the building of a palais de justice were started in 1924. A hospital has been built outside the town in place of the old one in the Grande Place, and the working class district has been replaced by the garden city of Kalfvaart, between the roads to Bruges and Zonnebeke. The station square has been laid out with lawns and flower beds, and only the battered ramparts remain to show what Ypres suffered. The Menin Gate has been rebuilt as a memorial to missing British soldiers, with a fine triple arch and a Hall of Memory in the centre. There are 40 cemeteries within two miles of the town.

YPRES, FIRST BATTLE OF.—While the operations which preceded the battle of the Yser were in progress (*see* YSER, BATTLE OF THE), the British I. Corps arrived in Flanders. On Oct. 19 it was ordered to Ypres, Sir John French still hoping to push back and outflank the German right. The full strength of the Germans had not yet been disclosed and the opinion at British headquarters was that there were not more than $3\frac{1}{2}$ German corps north of the Lys; actually there were $5\frac{1}{2}$.

First Phase of the Battle.—The I. Corps advanced with the expectation of attacking the enemy and it was not until the 21st, when it had taken up position on the left of Rawlinson's command between the Ypres-Roulers railway and Bixschoote and had repulsed a great attack by the German XXIII. and XXVI. Res. Corps upon Langemarck, that the true facts became known and Sir John French issued orders that positions were to be entrenched and held defensively. It had become a question of saving the Channel ports, not of outflanking the enemy. Joffre, informed of the situation, had informed Sir John French that he was sending his IX. Corps at once to Ypres. The arrival of this corps enabled Gen. d'Urbal to take over the front from the Roulers railway to Bixschoote and enable Haig to place his 1st Div. in reserve. D'Urbal hoped to take advantage of the repulse of the Germans at Langemarck and ordered an attack for the 24th, but at this period the opposing forces were approximately equal and neither side had sufficient strength to force the other back. The effort of the French IX. Corps, therefore, yielded but small results, and so the first phase of the first battle of Ypres ended with the French holding the northern and the British the southern half of a semi-circle around Ypres, the apex of the semi-circle and the dividing line between the French and British being near Broodseinde.

Preparations for Renewed Action.—During the next few days there was a comparative lull, of which Haig took advantage to



re-organise his front. The 7th Div., weakened by prolonged fighting, was placed under his orders, Rawlinson leaving the battle front to await other employment; the front of that division was shortened and part of the 1st Div. went again into the line between it and the 2nd Division. The attempt of Duke Albrecht's army to break through had been foiled but the Germans were not yet at the end of their resources. Falkenhayn had formed a new army group composed of the II. Bavarian Corps, the XV. Corps, the 6th Bavarian Res. Div. and the 26th Div. behind Von Marwitz's cavalry, which had been engaged with the British cavalry corps and the left of the British III. Corps on the Messines ridge.

This group under Von Fabeck was with the help of Von der Marwitz's six cavalry divisions to drive in the British front between the Lys and the Menin road. This was to be continued with a new attempt on the Yser front before the rise of the floods had made attack impossible. The attack on the Yser front began on Oct. 30 and the Germans breaking through the front of the 2nd Belgian Div. captured Ramscapelle. The situation was critical but was restored by a counter-attack, ordered by Gen. Grossetti, the commander of the 42nd Div. which took the French and Belgians again into Ramscapelle and repaired the gap. The rising water prevented the Germans from re-

newing the attack as they had intended and this ended the battle of the Yser except for a few somewhat desultory efforts on either side. The battle had cost the Belgians some 18,000 and the French some 5,000 casualties.

The German Attack.—Meantime Von Fabeck, after some preliminary attacks on the 29th, made his principal effort. On Oct. 30 the XV. Corps fell upon the weary 7th Div. and drove it back from Zandvoorde, while the II. Bavarian Corps pushed the British cavalry back through Hollebeke and Oosttaverne. There appeared to be real danger that the roads through Ypres behind the British and French troops east of the town would be cut. Foch at once promised reinforcements for the Hollebeke front. The French 32nd Div. went to the help of the British cavalry at Oosttaverne and five French battalions under Moussy came up to support the left of the 7th Div. at Klein Zillebeke and St. Eloi. Ere the effect of these reinforcements could be felt a crisis had developed on the Menin road. On Oct. 31, the German XV. Corps and 54th Res. Div. attacking on either side of the road, had captured Gheluvelt and broken the line between the 1st and 7th Divisions. For a time it appeared that retreat was inevitable but a gallant counter-attack organised by Brig-Gen. FitzClarence and delivered by the 2nd Bn. Worcestershire Reg. against Gheluvelt from the north drove the Germans out of the village. Later in the day this success was confirmed by another counter-attack on a larger scale organised and directed by Maj-Gen. Bulfin. Thus the situation was with difficulty restored. But if Von Fabeck's right was checked his left and centre were not done with. On Nov. 1 and 2 he renewed his efforts against the British cavalry and captured Messines and Wytschaete and the whole of the Messines ridge, but his further progress was stopped by the timely arrival of French reinforcements, and on this portion of the battle front the Allied line was established east of the village of Kemmel and of the important Mount Kemmel.

German Guard Attack: Nov. 11.—Another lull ensued and the battle of Ypres appeared to have come to an end. The Indian Corps had relieved the infantry of the II. Corps on the La Bassée-Neuve Chapelle front and the greater part of that infantry had gone up to Ypres and taken over the trenches of the 7th Div. which had left only 4,149 of the 12,522 infantry landed at Zeebrugge a month before. These changes were made without further interference from the enemy than constant shelling, but the Germans had yet another great effort in preparation. Six more divisions, including a division of the German Guard, were collected for a final effort to break through to Ypres. In preparation for this attack Duke Albrecht was directed to keep up the utmost pressure and this resulted in a series of local attacks chiefly against the French, in one of which, on Nov. 10, the gallant defenders of Dixmude were at length driven out of the ruins of that place.

On the next day the attack, commonly called the German Guard attack, was made after an intense bombardment on the front from the Messines ridge to the north of the Ypres-Menin road. The German Guard attacking astride the Menin road gained the only success of importance won by the Germans on Nov. 11. The Guard broke through the left of the 1st Div. and penetrated into the Nonne wood, but again the situation was restored by two counter-attacks, the first delivered by the Royal Scots Fusiliers near the Menin road, the second by the 2nd Oxford and Bucks Light Infantry driving the Germans out of the Nonne wood. In preparing the latter attack Gen. FitzClarence was killed. Further south the German XV. Corps secured Hill 60 near Verbranden-Molen, a small rise destined to be a bone of contention during the early months of 1915, but elsewhere the attack made no progress.

Closing Stages.—The failure of this last attack by the Germans to break through practically closed the battle, though Duke Albrecht made on Nov. 17 an attack on the Herentage Wood which met with no success. Thereafter the Germans decided to adopt a defensive attitude in the West and to send all available troops against Russia. On Nov. 21 the British troops were relieved by the French, the infantry of the II. Corps being returned to its commander, who took over the front opposite the Messines ridge, while the I. Corps went into reserve for a short rest. From Oct. 14 to Nov 17 the battle had been almost continuous from the La Bassée canal to the Yser and on that front during that period the British losses had amounted to 54,106 killed, wounded, and missing.

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(F. B. M.)

YPRES, SECOND BATTLE OF.—Early in April 1915 the British front was extended some five m. to include the Ypres salient, so that by the 17th the left of the V. Corps (Plumer) rested on the Ypres-Poelcappelle road.

Situation Before the Action.—The V. Corps right joined the II. Corps (Fergusson) just north of Hill 60 on the Ypres-Comines railway, and the two corps formed the II. Army commanded by Sir Horace Smith-Dorrien. Between the British left and the Yperlee river at Steenstraat, a distance of five miles were the French 45th and 87th Divs., which with a cavalry detachment formed the " Groupement d'Elverdinghe " commanded by Putz. The Belgian 6th Div. (de Ceuninck) then held the canal to Drie Grachten, with the remainder of the Belgian Army extending through the flooded area to join another group of Foch's command between it and the sea at Nieuport. On the German side lay the IV. Army with the XXIII. Res. Corps opposite the Belgians and adjoining the XXVI. Res. Corps, whose left was marked by the Ypres-Poelcappelle road; facing the point of the salient were the 2nd Ersatz and 38th Landwehr Bdes. with the XXVII. Res. Corps and the XV. Corps on the south.

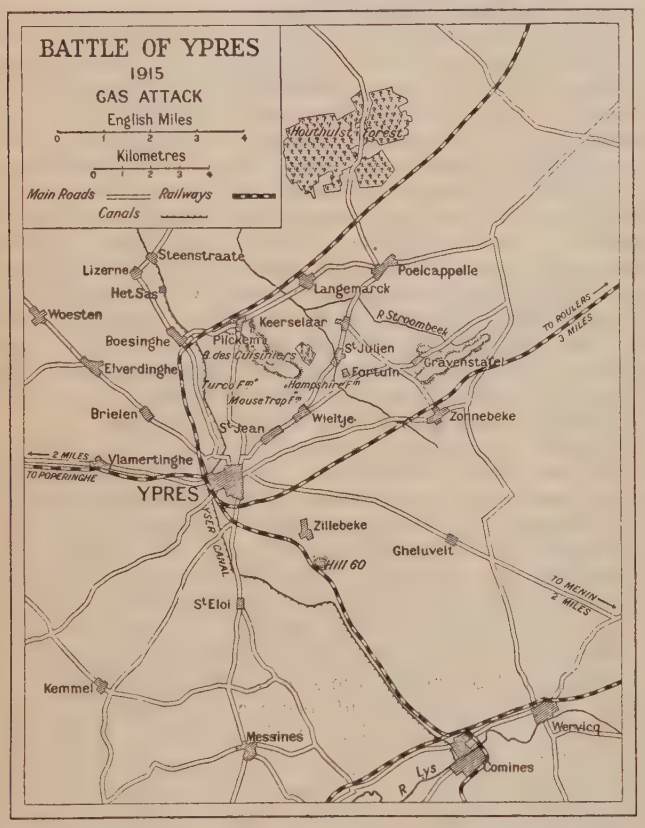
On April 14 reliable and detailed information was received at British and French Headquarters that the Germans intended to use a new weapon: to discharge asphyxiating gas from cylinders installed in the trenches opposite Langemarck and southwards beyond the Ypres-Poelcappelle road. Two German corps would follow through the gap made by the gas cloud. The offensive would begin on the night April 15–6 or with the next favourable wind thereafter. The intention, as is now known, was to cloak the transportation of divisions to Russia for a new drive in Galicia, and to shorten the line by reducing the salient at Ypres. The first move would secure a bridgehead across the canal on the north; successive attacks in echelon to the south would roll the British line back to the west of Ypres; thus the threat of combined operations by sea and land along the Flemish coast would be dispelled, and the stage set for a thrust towards the Channel ports. The warning was timely; formations in the salient were cautioned to expect an attack, but the intended use of gas was not communicated to the troops. The days passed without any noticeable augmentation of the German forces, already concentrated unseen in Houthulst Forest. The unusual noise of traffic behind the enemy's lines caused so little alarm that three of the eight Canadian field batteries in action were caught in the act of carrying out reliefs.

Beginning on the 19th, the preparatory bombardment of Ypres and Elverdinghe by heavy guns, including a 17-in. howitzer, and an increase of gas shelling in the forward area, were ominous signs of the coming battle. The extension of the British front was effected without incident, but to the south the Germans on April 14 fired a mine at St. Eloi; three days later the British blew up most of Hill 60 and the 5th Div. on the II. Corps front attacked and captured what remained. These and consequent activities diverted attention from the northern face of the salient where the first German blow would strike the junctions of the British, French and Belgian forces.

The British Positions.—The new line taken over by the British was marked by short unconnected lengths of breastwork with little wire and no parados. There were no trenches for supports, and ditches served for communication; a few localities had been fortified with breastworks similar to those of the front line and

affording as little protection; but 5,000 yd. behind the British line and running from Zillebeke to east of Wieltje, then turning northwest, was a second position consisting of a continuous belt of wire covering a series of strong points, each capable of holding 50 men and sometimes linked by trenches. This was known as the G.H.Q. 2nd line.

On completion of the readjustment on April 17 the V. Corps held an arc of 8½ m. with a five-mile radius. Of this the 27th Div. occupied the right, the 28th Div. the centre and the Canadian Div. the left. On April 21 the dispositions of the Canadian Div. were: from right to left the 2nd Canadian Infantry Bde. the 5th Bn. from south of the Gravenstafel road to the Stroombeek; the 8th Bn. north of the stream and along the valley for 1,000 yd., two companies from each being in support and reserve on and behind the Gravenstafel ridge; the 7th Bn. was in brigade reserve between Wieltje and Fortuin, the 10th in divisional



reserve between St. Jean and Ypres. On the left the 3rd Canadian Infantry Bde. also held the line with two battalions: the 15th and 13th each with three companies in the trenches, and two platoons in support; the remaining two companies, with one of the 14th, were posted in St. Julien as a garrison. The 14th (less one company) was in brigade reserve at St. Jean; the 16th, along the canal north of Ypres, was in divisional reserve. The 1st Canadian Infantry Bde. lay at Vlamertinghe in II. Army reserve and had been under orders to be ready in case assistance should be required at Hill 60.

German Gas Attack.—At 5 P.M. on April 22 a heavy greenish yellow smoke rose from the German trenches opposite Langemarck and rolled southwestwards in a sullen penetrating cloud on the gentle breeze of that sunny afternoon. Soon native French troops were seen staggering back through the storm of high explosive and gas shells, past the Canadian batteries and reserve infantry battalions already standing to arms. It was clear that the line on the left had broken, but the extent of the disaster was not realised at first. Actually the German XXIII. and XXVI. Res. Corps., after a short artillery preparation, had attacked under cover of a discharge of 180,000 kgr. of chlorine gas, the former with the 46th Res. Div. to secure the line Pilckem-Boesinghe, the latter with the 52nd and 51st Res. Divs. to capture the ridge marked by the road from Pilckem to Poelcappelle. The effect of the gas was greater than the German infantry had anticipated; by nightfall the XXIII. Res. Corps, inclining to the right, had reached the canal and crossed at Het Sas and Steenstraate, the XXVI. had penetrated 2,000 yd. south of Pilckem, and swinging to the left was close to St. Julien. By 8 P.M. there were no formed bodies of French troops east of the canal, all their batteries in that sector had been captured, and the Canadian flank for more than 8,000 yd. lay bare and exposed to attack. A gate to Ypres had been pushed open; the Belgian and Canadian hinges held firm, but no German troops were ready to pass through, although the 43rd Res. Div. had been concentrated near Roulers to support the attack.

At the first alarm the St. Julien garrison manned the half-made trenches north of the village, and the two brigades in line ordered their reserve battalions up to the left flank, the 7th to Locality C (a few trenches near the houses along the Keerselaar-Zonnebeke road crowning the Gravenstafel ridge), the 14th to the G.H.Q. line at Mouse Trap farm, 1,000 yd. north of Wieltje. The left company of the latter pushed on until at Hampshire farm, 700 yd. farther west, they found about 200 French, with a machine-gun, occupying elements of a trench and in touch with the enemy.

Conditions at the left of the Canadian front were precarious from the first, but some 200 of the Algerians, although gassed, took up a position near and parallel to the Ypres-Poelcappelle road and, reinforced by two platoons and a machine-gun from the 13th Bn., formed a short but effective flank. Between there and St. Julien the two supporting platoons of that battalion were exterminated in countering the move to penetrate behind the trench line and roll it up; the 10th Canadian Field Bty., by switching fire to the left rear, stopped the enemy at 200 yd. before moving to a less exposed position.

British Counter-Attack.—Meanwhile, the 10th and 16th Bns. had been placed at the disposal of the 3rd Canadian Infantry Bde. for a counter-attack to capture the Bois des Cuisiniers, an oak wood of 160 ac. lying 1,000 yd. west of St. Julien. The 10th moved up from the G.H.Q. trenches occupied when the attack began, and was joined near Mouse Trap farm by the 16th. Shortly before midnight the battalions formed up in eight ranks on a two-company front, the 10th leading, and the advance began. At first hedges and ditches made it difficult to keep order in the darkness. Three hundred yards from the German trench covering the wood on the south the movement was detected, flares soared upwards, rapid fire flickered from the parapet, and the two battalions charged. Sweeping over the trench they pressed on through the wood, recovering the four guns of the 2nd London Heavy Bty., but, losing direction, they inclined to the right and emerged to dig in along a hedge northeast of the wood. Thus far the counter-attack had been a remarkable success, but machine-guns placed near the southwest corner of the wood still commanded the southern approaches; the nearest troops on the right were about St. Julien, and the 14th were equally distant on the left; so before daylight the line was withdrawn to the captured trench south and east of the wood. The 16th extended towards St. Julien and dug in; the 10th held the left and patrolled the wood.

The case of the defenders at the point of the new salient was becoming hourly more serious. Between the short refused flank and St. Julien, a distance of over a mile, was a gap through which the Germans had crossed the road, and a machine-gun swept the unprotected rear of the old front line. A withdrawal of 250 yd. by the left company of the 13th was cancelled after midnight on the arrival of reinforcements laden with ammunition. The old front line and the flank along the road were held in the hope that a counter-attack would restore the left. Soon after 3 A.M. conditions were further improved by the 7th Bn. (less one company) moving westwards along the ridge to dig a north and south line some 700 yd. long, the left in touch with the St. Julien garrison, the right bent back and in the air east of Keerselaar.

Other troops in the vicinity when the battle opened were the 2nd East Kent, 3rd Middlesex and 5th King's Own all in bivouac about St. Jean as 28th Div. Reserve. Of these, B Company of

the East Kent was detached, two companies of the Middlesex moved after dark to guard the canal bridge east of Brielen; the remainder with the 1st York and Lancaster from south of Brielen were placed as a detachment under the Canadian Div., and commanded by Col. Geddes of the East Kent. His instructions were to advance and occupy the gap between the Canadian left near Mouse Trap farm and the French, behind whose right the 2nd East York from 28th Div. Res. had arrived before midnight at Brielen. Daybreak found the 9th Royal Scots, 2nd Duke of Cornwall's Light Infantry and 4th Rifle Brigade, from 27th Div. Res. west of Ypres, already east of St. Jean and the first two added to Geddes' detachment.

Consolidation of the British Line.—As soon as news came back of the breaking of the line on the left, the 1st Canadian Infantry Bde. at Vlamertinghe had been released from Army reserve and returned to the Canadian Division. The 2nd and 3rd Bns. were sent to the 3rd Canadian Infantry Bde. to strengthen the line between St. Julien and Bois des Cuisiniers. They arrived at Trap farm at 1:30 A.M. The 1st Bde. was first sent to the canal bank at the bridge east of Brielen, and then ordered to cross and attack along the Ypres-Pilckem road at 5:30 A.M. in conjunction with the advance of Geddes' detachment on the right and a projected French attack on the left. This latter attack had been ordered by Foch at midnight to regain the ground lost, and the French 153rd. Div. was being brought up, but it took some time to gather fresh troops and three Belgian battalions were lent for the attack. The greatest handicap was lack of guns; the Canadian frontage was 300 yd. per gun.

At daybreak began the process of establishing a continuous line along the Canadian flank to join the French on the canal. Two companies of the 3rd Bn. went into the gap between St. Julien and the right of the 16th near Bois des Cuisiniers, the 2nd Bn. moved into close support of the 10th and 16th. The 2nd East Kent by 6 A.M. had worked forward to the G.H.Q. line northwest of Mouse Trap farm, and on their left found the French detachment and the company of 14th Canadians in Hampshire farm. Then there was a gap of 1,000 yd.: orders to the 5th King's Own and 1st York and Lancaster had miscarried and they did not go forward. But farther left the two companies of the 3rd Middlesex established touch with the 4th Canadian Battalion. Advancing by short rushes across the open under devastating fire, they carried that part of the line to the lower slopes of the Pilckem ridge within a short distance of the enemy's new trench. On the right the Middlesex captured Turco farm (3,200 yd. from Ypres) but the survivors were too few to hold it and the line came to a standstill immediately south of the farm, with the Canadian left, now strengthened by the 1st Bn., bent slightly back to form a flank, as the French attack had not materialised.

To take the place of the V. Corps Res., the 13th Bde. of the 5th Div. moved late on April 22 from the II. Corps Res. to west of Ypres. The British Cav. Corps also, from G.H.Q. Res., was brought to Poperinghe on April 23 and the 1st Cav. Div. was sent at 11:40 A.M. towards Elverdinghe-Woesten to clear up the situation on the canal. At 5:15 P.M. the whole Cav. Corps became the mobile reserve of II. Army. The 50th Div. in G.H.Q. Res. just out from England was warned to be ready to move. But there were not sufficient French reserves available to recover the lost ground and a further thrust across the canal was to be expected, so the 13th Bde. at 10:30 A.M. was given to the Canadian Div. and ordered to counter-attack northwards along the east of the canal towards Pilckem. This attack began at 5 P.M. and the right advanced to the thin line of the 1st Canadian Bde.; the left, assisted by the French, came up abreast and extended to the canal. Simultaneously a second advance moved down the open slopes towards the German trenches on the opposite ridge. Two field batteries only were available in support, and casualties were so heavy that little ground was gained in the face of the 240th Res. Regt. which, aided by the 37th Landwehr Bde. entrenching along the Pilckem ridge, filled the gap caused by the divergent attacks of the XXIII. and XXVI. Res. Corps.

Positions after the Action.—The position of the line at nightfall on April 23 was little different from that of the morning; the German move to widen the breach had failed; an attempt to cross the canal in front of the Belgians met with no success and the refused flank of the 6th Div. still held; opposite the French the ground captured west of the canal had been slightly increased in spite of the efforts of the 87th Div. reserves and fresh troops brought down from Nieuport, but the objective for the day had not been reached and Lizerne was not taken until midnight. On the British front the counter-attacks of the morning had made it possible to build up the long exposed flank, and, but for a gap of 1,000 yd. along the Ypres-Poelcappelle road north of St. Julien a line of defence now existed from the original Canadian left to the canal. But the situation of the troops in the salient was desperate; if the French could not recover the ground on the left an extensive retirement would be necessary, and converging attacks might break down the apex before a withdrawal could be completed.

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YPRES, THIRD BATTLE OF.—Almost continuous fighting took place in the Ypres-Yser region during many weeks in summer and autumn of 1917, but the operations as a whole may be said to have consisted of two distinct phases. First came the brilliantly successful combat, lasting a few hours, which has come to be known as the battle of Messines. Then, after a lull, there came to be launched immediately north of the scene of the Messines victory a series of attacks at short intervals which gained ground by successive waves and which lasted four months.

British Objectives.—The object in view throughout was the occupation of the whole of the belt of high ground which extends from a point about three m. north of Armentières to near Dixmude. It rises some 100 to 150 ft. above the great Flanders plain, and reaches a height of over 200 ft. at some points. In the spring of 1917 its southern portion enclosed to a great extent the Ypres salient, although the Allies' trenches gave them possession of the lower slopes of their side of the high ground. Farther to the north the enemy held the whole of the high ground, as well as some stretches actually to the west of this. The Allies' general plan of operations was to begin at the southern end and to work thence northwards. But the capture of the high ground, it should be noted, only represented the first part of a strategical plan which contemplated a subsequent effort that was to be carried out in the coast district by fresh forces.

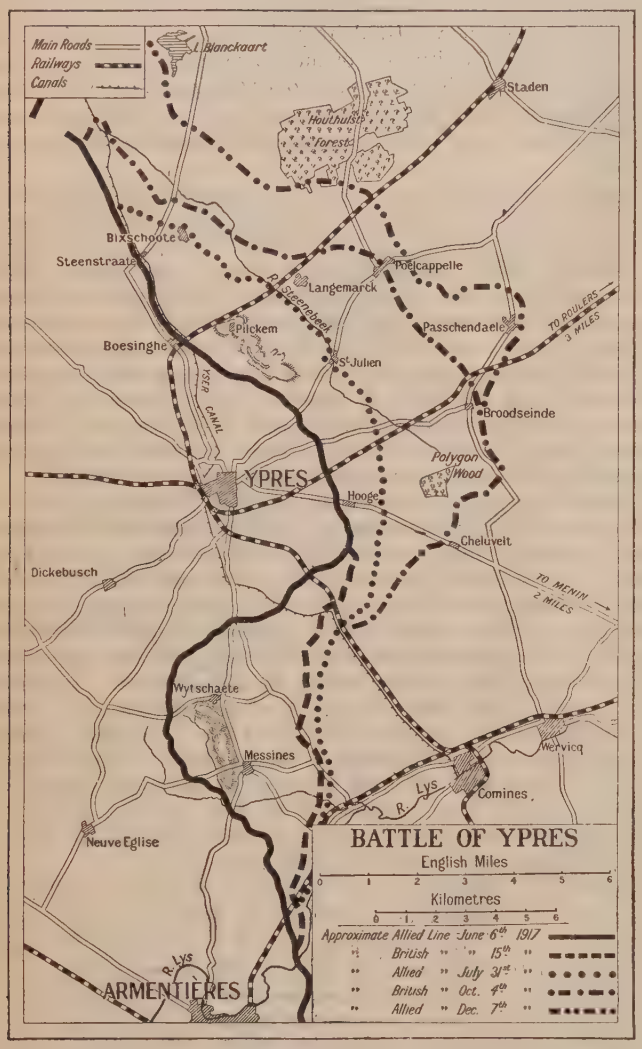
Positions of the Adversaries.—The line held by the Allies to the north of Armentières, at the outset, formed in plan an inverted "S," with the lower loop turned to the west, the upper loop turned to the east, and creating the Ypres salient. The lower loop, on the other hand, represented a pronounced enemy salient jutting into territory in Allied hands and consisting almost entirely of high ground known as the Messines-Wytschaete ridge. From this position the Germans enfiladed and even took in reverse Allies' trenches along the east and the north of the salient, and they commanded the communications leading up to these trenches from the rear, while they also overlooked the town of Ypres within field-gun range; so Haig framed his plans for the Flanders offensive so as to capture the high ground about Messines and Wytschaete in the first place.

THE FIRST STAGE

General Plumer and his II. Army, who had been acting as wardens of the Ypres front for two years, had been selected to carry out this operation, while the V. Army under General Gough had been transferred from Artois to hold the line north of the II. Army. Preparations for the undertaking had been going on during the winter and spring; they included an elaborate railway scheme, much road construction, and arrangements for deep mining on a colossal scale. Twenty huge mines had been established at the end of galleries running right under the enemy's front line of trenches, and 600 tons of explosives had been distributed among them.

For the defence of this salient which they occupied the Germans depended on two separate sets of lines, coinciding in trace

with its arc, the more advanced one pushed down the forward slope of the high ground while the rear one followed its crest; the enemy had also constructed two chord positions, stretching along the base of the salient on the reverse slope. The troops of the II. Army detailed for the enterprise were, enumerating from right to left, the II. Anzac Corps, with the Australian 4th Div. in support, the IX. Corps with the 11th Div. in support, and the X. Corps with the 24th Div. in support. There were thus nine divisions in front line and three in support. As the final objective



of the assailants was the chord of the arc forming the salient, the time-table took account of the greater distance which some divisions had to traverse than others.

The First Attack.—The moment of assault was fixed for 3:10 A.M. on June 7, and at that hour the line of mines exploded beneath the enemy's front line with devastating effect. At many points the hostile trenches were completely obliterated and their garrisons wiped out, so that at first very little resistance was offered to the assailants and the first objective was secured almost at once. The infantry then proceeded to the execution of their next task, that of carrying the German second line, and here again they were completely successful. Messines was taken by the New Zealanders, Wytschaete fell to the 36th (Ulster) and 16th (Irish) Divs., fighting side by side, while on the left the 47th (London) Div. overcame most formidable obstacles and took many prisoners.

So rapid indeed were the movements of the attacking infantry in these opening phases of the combat, that the tanks in many cases were unable to get up in time to share in the struggle for the enemy's second line of defence; by early afternoon all the upper part of the Messines-Wytschaete ridge was in the hands of the British and Australian troops. Guns were promptly pushed up on to the heights to assist in the capture of the German chord lines of trenches, and this closing effort, which was made later in the afternoon, proved completely successful. So it came about that by the evening the last objectives had been attained. The total casualties incurred by the assailants amounted to only about 16,000, while 7,200 prisoners, 67 guns, 94 trench mortars and 294 machine-guns had been taken from the enemy.

A Period of Quiet.—A pause of some weeks in active operations in Flanders now took place while preparations for carrying out the rest of Haig's programme were being completed. Although Plumer's victory of June 7 had put an end to the enemy overlooking Ypres from the south, the Germans still, in a measure, dominated the place from the east, from the northeast and from the north, a fact which exercised an important influence over the arrangements in progress for the offensive about to be undertaken. The preparations could not be concealed and the Germans knew that they were being made. The plan at the outset was that, while the II. Army stood fast, the V. Army under General Gough on its left with the French I. Army still further to the left, should attack the enemy line along their front extending from near Hooge to some distance north of Steenstraat on the Yser canal.

It should be noted that the valley of the little river Steenbeke proved of considerable tactical importance during the operations that followed, for it created a marked depression in the high ground of which Gough was to gain possession. Between the depression and the V. Army lay the low Pilckem Ridge—its first objective—and after that ridge was taken any further advance towards the main ridge involved crossing the depression. Another point to note is that, whereas the line occupied at the outset by the V. Army and the French I. Army ran from southeast to northwest, the main line of heights which formed the ultimate objective ran from south to north, so that the assailants would in due course be called upon to make a half-wheel to the right, pivoting on that section of the high ground which was situated about east of Ypres. The troops forming the outer (left) flank in the wheel would moreover be called upon to traverse some miles of low, marshy ground before they began to ascend.

Aware since early spring that the Allies contemplated offensive operations in this region, the Germans had taken steps to meet the eventuality with characteristic thoroughness and ingenuity. Having learnt by experience that a continuous system of trenches did not proffer a wholly satisfactory form of defence unless there was abundant underground cover, and realising that the waterlogged character of the soil of Flanders militated against the creation of subterranean galleries, they had established a system of numerous disconnected trenches and strong points, arranged in depth rather than in breadth, together with numbers of concrete blockhouses armed with machine-guns. As their front line near Ypres had been in existence since 1915, they trusted to the old system to meet the first shock of attack, and it was rather in the later offensive operations that the Allies found themselves confronted with these new defensive devices.

The Second Stage

The offensive was to have started on July 25 but it was for various reasons deferred until the 31st. During that period the enemy retired out of his foremost trenches along the canal between Boesinghe and Steenstraat, which enabled the British and French troops on the left to throw bridges, and facilitated their task when they delivered their attack. This first day proved very favourable to the Allies, who reached the line of the Steenbeke, after capturing the Pilckem Ridge. Bixschoote and St. Julien were taken, and only on the extreme right about the Menin road did the assailants fail to gain their objectives. Over 6,000 prisoners were taken, together with 25 guns, and as a result of the fighting Ypres was no longer overlooked from the northeast and north.

But the weather broke that day, and in consequence of the continuous rain in the early days of August the offensive could not be resumed until the 16th of that month. On this day the Allies were successful along the left half of the battle front, pass-

ing the Steenbeke and capturing Langemarck; but little progress was made along the right half of the battle front, which represented the more important section. Although 2,000 prisoners and 30 guns were captured, little improvement had been effected as a result of a fortnight's operations about the crest of the ridge immediately north of the ground that had been won on June 7. Up there, the line had only been advanced a very few hundred yards as a result of two regularly prepared attacks. Haig therefore decided to extend the left of the II. Army northwards and to entrust the attacks against this higher ground to Plumer, who was to work in conjunction with the V. Army operating farther to the left. The weather, however, continued most unfavourable, and it was not until Sept. 20 that the next attack was delivered.

Very important results were, however, achieved on this occasion, for the efforts of the II. Army were crowned with brilliant success in a sector where previous attempts had to a great extent failed. The crest of the main ridge on either side of the Ypres-Menin road was wrested from the enemy and a footing was gained close to Gheluvelt and in Polygone Wood. The V. Army likewise gained ground farther to the left, and over 3,000 prisoners and many guns were captured. This victory was followed up by a fresh attack on the 26th, when the British position was improved almost all along the line and particularly about Polygone Wood, while another 1,600 prisoners were secured.

The combats of Sept. 20 and 26 having given almost the entire crest of the main ridge east of Ypres to the British, to a depth of 1½ m. from the positions that had been occupied on July 31, Haig arranged for a very important operation to take place on Oct. 4, the front this time extending from Polygone Wood to the Ypres-Staden railway, although a minor advance was also to take place to the south of Polygone Wood. A severe gale blew on the night of the 3rd, and torrents of rain fell, so that next morning the ground in most parts of the battlefield was little better than a morass. The attacking side nevertheless gained a signal victory, securing nearly all its objectives in a few hours' fighting. Especially important were the gains made in the centre, where a position was won along the forward crest of the main ridge about the village of Broodsinde and to the south of it, while on the left a footing was gained in Poelcappelle and the V. Army secured a line clear of the lowest and most marshy part of the Steenbeke depression. Prisoners taken totalled 5,200 with a number of guns, machine-guns and trench mortars, and this highly satisfactory achievement had moreover been accomplished without very heavy sacrifice.

The Final Operations

As a result of the operations begun on June 7 the crest of the long belt of high ground overlooking the Flanders plain had now, after four months of intermittent fighting, been secured from Messines northwards to within a few hundred yards of the Ypres-Roulers railway. And yet, regarding this Flanders offensive as a whole, the work was in reality only begun. The Houthulst forest, with the long line of high ground forming the quadrant of a circle beyond it, was still in the enemy's hands. Until the ridge had been secured to the vicinity of Staden it would be premature to embark upon the second part of the general scheme of operations—an attack on the German positions along the coast between Nieuport and Ostend, for which the IV. Army under General Rawlinson had been assembled on the extreme left, by the sea. Winter was approaching and Haig had now to decide whether or not to continue his gradual advance northeast of Ypres.

The whole undertaking had been much delayed at the outset owing to General Nivelle's unsuccessful offensive in the Aisne country. The weather since the end of July had been deplorable, with the result that the pushing forward of heavy artillery as new positions were secured proved most difficult, and that the British tanks were terribly hampered in their movements. Had the line secured on Oct. 4 been made good two months earlier, there would still have been a quite reasonable prospect of the ridge being secured to beyond Staden several weeks before winter set in, thus allowing for the IV. Army to play its part in the coastal region. As it was, but little likelihood remained of these Flanders operations achieving the success that had been hoped for when the plan was matured. In view of the discouragement existing at the time in the French forces it was, however, almost imperative to occupy the attention of the enemy as far as possible, and there were, moreover, grounds for hoping that the Allied position to the northeast of Ypres could still be considerably improved from the defensive point of view within the next few weeks. Haig therefore decided to continue the offensive to the north of the Ypres-Roulers railway, and with a view to this a certain readjustment of the orders of battle of the II. and V. Armies was effected.

The wet weather unfortunately continued during early Oct. but an improvement then set in which lasted till the 25th, the very day for which the fresh attack had been fixed. In spite of a downpour of rain the troops detailed for the work on the crest of the ridge gained ground on that day right up to the outskirts of Passchendaele. During the following week the French and Belgian troops on the extreme left pushed forward successfully up to the Blankaart lake and to the outskirts of the Houthulst forest, while progress was also made at a number of other points along the line. Then, on Nov. 4 Passchendaele was captured by a sudden advance of the 1st Div. and the Canadian 2nd Div., and the victory brought the 1917 Flanders offensive at last to a close.

Results of the Undertaking

The situation in this position of the Western Front had been transformed by the events of the past five months. The chain of heights from north of Armentières to Passchendaele had changed hands. The Ypres salient, vastly extended, had, from constituting a weak and barely defensible sector of the Allies' front, become a serious menace to the enemy. Haig had secured a satisfactory defensive position between the Yser and the Lys, and great hostile forces had been kept fettered to the northwestern extremity of the general theatre of war, striving to maintain possession of a tract that had been captured by the invader three years before. But the main object for which the offensive had been undertaken had been only very partially attained. The German hold upon the coast district remained unshaken. The third battle of Ypres, chiefly perhaps because of unfortunate delays in starting operations and of untoward weather conditions after they had been started, had not, as had been intended, prepared the way for subsequent advance upon Ostend and the great plain north of the Lys.

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(C. E. C.)

YSER, BATTLE OF THE.—On Oct. 10 1914 the whole of the Belgian field army encamped on the west bank of the Ghent-Terneuzen canal. The British Naval Div., which had embarked at St. Gilles-Waes, regained Dunkirk with the exception of two battalions, which were cut off, and passed into Holland; the French Fusilier Marine Bde., half of the English 7th Div. and the 4th Belgian Bde. were holding Ghent and had repulsed an attack on that city by the 1st Res. Ersatz Brigade. Information had been received that a division of Bavarian cavalry had advanced towards Deynze, passing between the Schelde and the Lys; that a column of 20,000 men had passed by Courtrai and Menin and that the German IV. Cav. Corps was holding the region Tourcoing-Ypres-Poperinghe. The only way of baffling the threat to the Belgian Army of envelopment on a large scale was an immediate march to the coast, and it was decided to transport all the forces without delay to the coastal region of Ostend-Thourout-Dixmude-Furnes, the infantry by rail, the artillery and transport by road under the protection of all the cavalry and Rawlinson's Corps.

Plans of Opposing Commanders.—The "race to the sea" had in the meantime caused the Western Front to extend to La Bassée. The British Army had been withdrawn from the region of the Aisne and was beginning to detrain west of Lille. Certain French divisions, taken from other sectors, were given the same

destination. It seemed to Gen. Joffre that the moment had come for bringing about the much-desired envelopment of the German right wing by a concentric offensive against Lille. The British Army, the Belgian Army and some French reinforcements would constitute, it was believed, under the high command of Gen. Foch, an *ensemble* capable of securing a decisive victory. Unfortunately, the assembling of the Allied troops by means of the Paris-Calais and Paris-Hazebrouck railways would take time. On the other hand, it was necessary to take in account that the Von Beseler Army Group would not fail to follow on the heels of the Belgians.

The mission of the Belgian Army was once again that of gaining time. The King, anxious to keep his left wing resting on the sea, and to preserve at all costs a fragment of national territory from invasion, thought best to entrench the army on the river Yser and the Ypres canal. The following orders were accordingly issued on Oct. 14 and 15: " The line of the Yser constitutes our last line of defence in Belgium and its preservation is necessary for the development of the plan of operations. This line is therefore to be held at all costs."

Events soon proved the wisdom of this decision. The British II. and III. and Cav. Corps were stopped at the Lys by the German IV., VII. and XIII. Corps; Rawlinson's Corps found Menin in the hands of the XIX. Corps. Von Beseler's troops now entered Bruges and Ostend. It was known that numerous detrainments were taking place west of Brussels and that a new German IV. Army had installed its headquarters at Ghent. In fact Falkenhayn, the new chief of the German General Staff, had anticipated the Allies' projects and, like them, considered the moment for a decisive victory to have arrived.

With four new army corps, composed entirely of volunteers, the XXII., XXIII., XXVI. and XXVII. Res. Corps, Von Beseler's group and the artillery park from the siege of Antwerp, Prince Albert of Würtemberg was charged to proceed to the Yser with his right towards the sea, in order to attack in flank and in rear the Allied left, whose front the VI. Army was engaging between Arras and Armentières. Falkenhayn considered that: " The conquest of the coast was the sole means of frustrating the war of blockade which England contemplated and of retaliating through our destroyers, submarines, aeroplanes and Zeppelins. . . . If we succeeded in driving the enemy out of the Yser valley and pursuing him at the point of the sword, there was no doubt that, having replenished our ranks and our stores, we should be in a condition to overthrow the western front."[1]

Thus the Belgian Army, which had only just moved into position in the general Allied line, found itself in focus for a new battle. It occupied a front of 40 km., from the sea to Boesinghe, with $4\frac{1}{2}$ divisions and $1\frac{1}{2}$ divisions in reserve behind the centre. The cavalry division was operating with Mitry's French Cav. Corps, east of the forest of Houthulst. On the army's right a French territorial division extended as far as Ypres and Rawlinson's Corps had entrenched itself along the line Passchendaele-Gheluvelt.

Opening of the Battle.—The battle commenced on the 18th with an attack by Von Beseler's corps (4th Ersatz and 5th and 6th Res. Divs.) between the sea and Keyem. The Belgian outposts were only driven back after desperate fighting and the enemy did not even reach the Yser. On the morning of the 19th Ronarch's Marine Bde. and the 5th Div. debouched from Dixmude on the flank of the III. Res. Corps. Beerst and Vladsloo were retaken; but the intervention of the XXII. Corps, coming from Thourout, and the XXIII. coming from Cortemarck, checked the counter-attack. By the 20th the fighting had become general all the way from the sea to Gheluvelt between the Duke of Würtemberg's $5\frac{1}{2}$ divisions on the one hand and the Belgian Army, Mitry's Cav. Corps and Rawlinson's Corps on the other. After 48 hours of obstinate fighting the Belgian positions remained practically unchanged.

The attack of the 4th Ersatz Div. on Nieuport had failed, partly on account of the flanking fire from Admiral Hood's flotilla; while that of the XXII. Corps against the bridgehead at Dixmude had been checked by Meiser's Brigade. But in the night of the 21st–22nd the 6th Res. Div. made a surprise crossing of the Yser in the Tervaete salient and threw over $2\frac{1}{2}$ battalions to the west bank. Concentrated artillery fire prevented the division from making any progress on the 22nd, but a notable counter-attack, in which four battalions of grenadiers and carabineers faced death with superb indifference, broke down completely under their machine-gun fire, owing to the exposed nature of the ground. The following night the Germans passed a second regiment into the bend without, however, extending their ground.

On the 24th, the whole of the III. Res. Corps and half of the 44th Res. Div., preceded by a bombardment from 10 heavy howitzer batteries and 150 field guns, broke through the front at St. Georges–Tervaete, only to find the Belgians deployed behind the Nieuport—Dixmude railway embankment, together with the French 42nd Div. which had arrived in the meantime.

German Failure at Dixmude.—Finding themselves checked in this direction, the Germans renewed their attack on Dixmude, preluding it with an intense bombardment of four hours (in which 21 and 42 cm. howitzers were employed amongst others) which left the town in ruins and in flames. At midnight the 43rd Res. Div. delivered its assault, driving its guns through the middle of—and even in advance of—its infantry, but in spite of a three-fold attempt it was completely repulsed by the 12th Belgian Regt., assisted by some French companies of marines. A new attack on the night of the 25th–26th met with the same fate.

Opening of the Nieuport Sluices.—The battle had been in progress for eight days. Over a total of 48,000 rifles the losses amounted to 15,000 in all ranks. Many guns had been put out of action, by excessive use of rapid fire; the munitions were nearly exhausted, the men at the end of their tether. Neither the British nor the French, both hard pressed at Bixscoote, Langemarck and Zonnebeke, were able to send reinforcements. Having no reserves, the Belgian commander decided to call in the sea to his assistance. The Nieuport sluices could, by opening a network of small canals to the ocean, put part of the battlefield under water; but the King did not wish to have recourse to this expedient until the last extremity.

On the 26th and 27th all the pioneers were set to stop up the 22 aqueducts of the Nieuport-Dixmude railway embankment so as to prevent the liberating tide from invading the Belgian positions; fortunately, the Germans—being also weary—remained relatively quiet during that time. On the 29th however, their artillery blazed forth again, and it seemed that a new attack was imminent. The sluices were therefore opened during the night. At dawn on the 30th, the three divisions of Von Beseler's corps attacked along the line of the railway, taking possession finally of Ramscapelle and Pervyse; but the drains were now overflowing; the flooded meadows soon made it impossible for the Germans to move, and forced them to a hasty retreat. The battle of the Yser was won and the left flank of the Allies definitely saved. Checked along the coast line, the Germans moved off to make their desperate assault on Ypres. The Belgian Army, in scrupulous observance of the spirit of the obligations of neutrality, had, from Aug. 4 to Oct. 31 1914, gloriously defended its honour and fulfilled all international obligations, paying the price with its blood and abandoning practically the whole of its territory. (*See* also YPRES, FIRST BATTLE OF; also map, p. 961.)

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(R. VAN O.)

YUAN SHIH-K'AI (1859–1916), Chinese statesman, was born at Hsiang Cheng, a member of a family belonging to the smaller landed gentry of the province of Honan. Through the influence of relatives he entered upon the career of a military official, having failed to achieve distinction at the literary examinations. His first important post was in Korea, where, as Imperial Resident and the trusted lieutenant of the Viceroy Li Hung-chang, he strove by adroit diplomacy to preserve China's shadowy suzerainty over the Hermit Kingdom and to check the steadily in-

[1] Falkenhayn, *Die Wichtigsten Entschliessungen der O. H. L.*

creasing ascendancy of Japan. After the disastrous war with that country (1894–5) he held office as Judicial Commissioner, with military functions, under the Viceroy Li, in Chihli. The remarkable success which he achieved in this post, by bringing a division of troops to a standard of discipline and efficiency hitherto unknown in the Chinese army, gained for him the favourable notice of the Manchu Court.

Thenceforward, as the prestige of his foreign-drilled forces increased, he and they became important factors in the plots and intrigues around and about the Dragon Throne. In Aug. 1898, the Emperor Kuang Hsü, hoping to secure Yuan's loyal services in support of his scheme to seize and imprison the Empress Dowager, summoned him to a special audience at the Summer Palace. Reassured by his promises and by his professed sympathy for the objects of the reform edicts, His Majesty issued a decree conferring upon Yuan the rank of an expectant Vice-President of a Board, with special duties in connection with army reorganisation. The subsequent *coup d'état* by the Empress Dowager, which removed the Emperor from the throne and replaced him under severe tutelage, owed its success to Yuan's betrayal of the Emperor's confidence and to his active support of the conservative Manchu party. From the orthodox Chinese official point of view, his action was to some extent defensible, the Emperor's plot against the Empress, his aunt, being tantamount to lack of filial piety. In any case, it was justified by success and never seriously condemned by Chinese public opinion. But to the end of his unhappy career, the Emperor never forgave Yuan's treachery, and on his death-bed (Nov. 1908) bade his brother, Prince Chun, see to it that he should not go unpunished.

After the return of the Empress Dowager to the control of affairs, Yuan received the Governorship of Shantung as reward for his services. Accompanied by the pick of his troops, he entered upon that office at the end of 1899. In the summer of the following year, upon the outbreak of the Boxer rising, he distinguished himself by prompt and unhesitating firmness, in maintaining order and protecting foreigners throughout his jurisdiction. He was never under any delusions as to the futility and folly of the Empress Dowager's policy in encouraging the anti-foreign movement. After the signature of the peace protocol (Peking 1901), as the aged Li Hung-chang desired to be relieved of further duty, Yuan was appointed to act in his place as Viceroy of Chihli. At Li's death (Dec. 1901) the appointment was made substantive. Thus at the early age of 42, Yuan attained to the highest office in the gift of the Throne; at the same time he was made a Junior Guardian of the heir apparent. A month later the Yellow Jacket was conferred upon him, together with the appointments of Consulting Minister to the Government Council and Director General of the Northern railway. In the following year he became a Minister of the Army Reorganisation Council. During the five years of his viceroyalty, he raised and equipped six divisions of troops, greatly superior in every way to those of the Peking field force or the best provincial levies. But his rapid rise to place and power aroused fears and jealousies of a number of high Manchu dignitaries, and many were the schemes for injuring him in the eyes of the Empress Dowager. Finally, the cabal against him, led by his old rival, the ex-Boxer Tartar General Tieh Liang, succeeded in persuading her Majesty, in the autumn of 1907, to transfer him from the Tientsin viceroyalty to the capital. She saved his face and her own, however, by making him a grand councillor and President of the Board of Foreign Affairs, which post he held until the death of the Empress Dowager and the Emperor in Nov. 1908.

The subsequent accession to the Regency of Prince Chun, brother of the late Emperor, was fraught with peril for Yuan. For a month after the death of the "Old Buddha," rumours were rife in the north concerning the Regent's vindictive intentions with regard to him. It was the general belief that his days were numbered; but the Regent was eventually persuaded that extreme measures would be impolitic. His decision, finally announced by an edict of Jan. 2, merely deprived Yuan of office and ordered him into retirement at his native place in Honan. There, until the outbreak of the revolution in the autumn of 1911, he remained, professedly contented with a life free from the cares of office and devoted to the management of his estates. But the lack of his guiding hand was unmistakably felt, even by his enemies, at Peking during those two years. After the death of Chang Chih-tung (1909), Yuan was the only survivor of the great Chinese viceroys to whom the Manchu Court had looked for help and counsel in time of trouble. When, therefore, the first signs of the revolutionary movement at Wuchang were followed by ominous symptoms of hostile activity amongst the Catonese faction, the Regent lost no time in summoning Yuan to his assistance. By an Edict of Nov. 14 1911, he was appointed Viceroy of Hunan and Hupeh, with a mandate to proceed south with his foreign-drilled troops and put an end to the insurrection.

Whatever the defects of his character in other respects, there was never any doubt as to Yuan's unswerving belief in the monarchical principle as essential to the good government of China; there was therefore no question of his refusing to obey the summons of the Throne in peril. It was impossible for him to sympathise with the Republican programme, gradually evolved by the Cantonese extremists as the helplessness of the Manchus and the disorganisation of the Government became revealed. If, at the outset, he seemed disposed to temporise and to make terms, it was not because of any hesitation to face the situation, but simply because he realised that his failure or success would depend upon control of adequate funds. Before consenting to emerge from his retirement (he arrived at Peking on Oct. 27) he insisted on assurances from the National Assembly and from his foreign supporters at the capital, that the sinews of war would be forthcoming. If he eventually failed in his brave endeavour to maintain the monarchy, it was because, at the most critical juncture of the struggle, the predominant influence of Great Britain with the Diplomatic Body was finally exercised in favour of a policy of impartial neutrality.

Yuan clearly foresaw and declared that if the Monarchy were overthrown, the result would be chaos, "amidst which all interests would suffer and for several decades there would be no peace." Thus his avowed policy was to preserve a limited Monarchy, pledged to systematic and practical reforms. Had he been loyally served by his representative, Tang Shao-yi, in the negotiations with the revolutionary leaders at Shanghai, above all, had he received the support which he was entitled to expect in the shape of a foreign loan, he would most probably have won. As it was, he continued to fight on, practically single-handed, against the forces of disruption, until Feb. 1912 when the Manchu Court, terrified by bomb explosions at the capital, decided to abdicate. Within two days of the issue of the abdication Edict. (Feb. 12), the Southern revolutionaries, on the initiative of Sun Yat-Sen, exemplified the "unbroken continuity of immemorial tradition" in China by inviting him to stand for the Presidency of the Republic.

Despite his previous declaration that "to be a party to the establishment of a Republican form of government would brand him as a liar before all the world," Yuan made a virtue of necessity and on March 12 took the oath of office as President. But he did so with mental reservations which were soon demonstrated and ostensibly in deference to the sanction of the new form of Government given by the Throne in its abdication Edicts. His policy as president reflected his unmistakable and fixed determination to maintain the authority of the central Govt. and with it the prerogatives and practice of benevolent despotism. He continued to uphold the principles which he had publicly proclaimed in justification of his defence of the monarchy, and to insist upon maintenance of the continuity of the classical tradition of Government and the preservation of the Confucian system. He was willing for a time to pay lip-service to the Republican formulas, but his actions proved clearly that he had no sympathy with the "rampant democracy" of the Cantonese Radicals. His methods of ridding himself of prominent members of the Kuo-Min tang (Radical party) who opposed his authority were typically Oriental and ruthless, but being in accordance

with Chinese traditions of statecraft, they aroused no popular indignation beyond the ranks of the Republican group of politicians.

In the summer of 1913, a "war to punish Yuan" was started in the south by Sun Yat-Sen, Huang Hsing and other malcontents, but Yuan, having by this time secured a foreign loan and the moral support of the Powers, had no difficulty in retaining the venal "loyalty" of the chief military commanders in the provinces; the Cantonese insurrection came, therefore, to a swift and inglorious end. He proceeded, thereupon, to dissolve and proscribe the Kuo-Min tang and with it made an end of its farce of parliamentary Government and representative institutions. Upon his formal "election" to the Presidency in October, he announced his intention of governing the country thenceforward without interference. He took occasion to observe that "he had always preferred conservative to radical courses," and denounced the "minority of turbulent demagogues" who, under the name of Republicanism, had "dragged principles and laws in the dust"; finally he declared his intention of proceeding with a policy of gradual and suitable reforms. The dissolution of the Kuo-Min tang was naturally followed by the abolition of the national assembly, and Parliament was replaced by a political council, consisting chiefly of Yuan's own nominees. The provincial governorships having been similarly filled, he was able to proceed with his schemes for the centralisation of power and the restoration of autocracy; unanimous recommendations by the provincial tuthorities enabled him to assert in his presidential mandates that they were in accordance with the will of the people. Similarly fortified by their approval, after the suspension of the provisional constitution and other significant measures, he announced his intention of performing the winter solstice sacrifice at the temple of heaven, a declaration tantamount, in Chinese eyes, to the assumption of autocratic rulership and the impending restoration of the throne. That he should aspire to revive the monarchy in his own person was the logical conclusion of his openly avowed principles; as a matter of internal politics, his ambition was not only defensible but likely to be justified by results.

The movement for the restoration of the throne organised by a society composed chiefly of Yuan's adherents, began to assume a definite direction in the autumn of 1915; its plans and propaganda were skilfully handled, but, like Yuan himself, they erred in failing to appreciate the necessity for conciliating foreign, as well as native, opinion. The leaders of the movement failed especially to perceive the danger of the situation created by Japan's twenty-one demands (May 1915) and to realise that the active opposition of the Japanese Govt. would in all probability be fatal to Yuan's ambitions. Warned in this sense from more than one quarter, Yuan nevertheless persisted. In Oct. the State council made an elaborate show of constitutional procedure by referring the question of the monarchy to the provinces. The result (a foregone conclusion) was a practically unanimous vote in favour of Yuan's accession. Meanwhile, however, the Japanese Minister at Peking, supported by his British and Russian colleagues, had made friendly representations to the Chinese Foreign Office, deprecating the restoration of the monarchical system at this juncture. Yuan apparently believed that the War in Europe would prevent the Allies from actively intervening and overlooked the possibility of serious opposition being organised against him in China. On Dec. 12 the monarchy was proclaimed and the enthronement ceremony fixed for Feb. 9 1916. But it was not to be. A week after the issue of the mandate in which this announcement was made, an insurrection, led by one of Yuan's own nominees, broke out in Yünnan; several of his provincial military commanders proved disloyal and the movement began to spread with great rapidity, one province after another declaring its independence. On Jan. 22 Yuan was persuaded to announce that the establishment of the monarchy would be indefinitely postponed. But the tide of ill fortune was now running too strongly against him and his position soon became untenable. At the end of March, his few remaining supporters urged him to retire into private life. Towards the end of April he consented, while retaining the Presidency, to surrender all civil authority to the Cabinet, under the premiership of Tuan Chi-jui. Had he lived, some compromise of this kind would most probably have been arranged, but his health gave way and on June 6 1916 he died. With him passed the last of the great Viceroys of the old régime and the last hope of an early restoration of stable government in China. (J. O. P. B.)

YUDENICH, NIKOLAI NIKOLAEVICH (1862–), Russian soldier, was born July 18 1862. He entered the army in 1879, and from 1887 to 1902 served on the general staff. In 1902 he became a regimental commander, in 1905 a general, an assistant chief of staff in 1907 and a chief of staff in 1913. At the beginning of the World war he commanded the II. Turkistan Corps with marked success and was soon placed in command of all the military forces in the Caucasus, a post which he held till the arrival of the Grand Duke Nicholas in 1915. In March 1917 he resumed command, but here as elsewhere further advance was rendered impossible by the increasing disorganisation of the Russian army. In 1919 Yudenich led anti-Bolshevik forces in an attempt against Petrograd (Leningrad). This venture was a failure and shortly afterwards Yudenich went into retirement.

YUGOSLAVIA, officially known as "the Kingdom of the Serbs, Croats and Slovenes" (Kraljevina Srba Hrvata i Slovenaca), came into being in the closing months of 1918, as a result of the collapse of Austria-Hungary and the voluntary union of its Yugoslav territories with the former Kingdoms of Serbia and Montenegro. In point of international law, its existence may be said to date from Dec. 1 1918, when the Prince Regent Alexander of Serbia formally complied with the invitation of the Yugoslav National Council, to assume the Regency over the sister provinces also. That the Great Powers were so long in according official recognition to the new State, was due to purely political reasons, connected with the Adriatic dispute. The previous history of the units which now comprise the Yugoslav kingdom, will be found under SERBIA, MONTENEGRO, CROATIA-SLAVONIA, BOSNIA-HERCEGOVINA, DALMATIA.

Area and Population.—The new State covers a total area of 96,136 sq. m. whereas Serbia before the Balkan War only comprised 19,286 and after her conquests in 1912–13, 36,938 square miles. The area of the other provinces is:—Bosnia-Hercegovina, 20,429; Croatia-Slavonia, 16,920; Slovenia, 6,241; Voivodina, 7,213; Dalmatia, 4,662; Montenegro, 3,733. The total population at the census of 1921 was 12,017,323 or a net decrease of 608,444 during the previous 11 years in the area corresponding to the new state. This decrease, due to the ravages of the two Balkan Wars and the Great War, was naturally heaviest in Serbia proper (316,271 or 10·9%), in Macedonia (222,599 or 13·4%) and Montenegro (38,566 or 16%). This is the more striking because in the two decades 1890–1910 Serbia's population was increasing at the rate of 34·6% (or 749,740 in a total of 2,911,701 inhabitants). The only province which showed an increase of population was the Voivodina (+27,569 or 2%). That the decrease was much less marked in the provinces north of the Save and Danube line was due not only to the fact that the War hardly reached them, but also to the steady immigration into them from Hungary since 1918.

The population was divided as follows:—Serbia (1913 area) 2,655,078; Southern Serbia (*i.e.* Macedonia, etc.) 1,474,560; Montenegro 199,857; Bosnia-Hercegovina 1,889,929; Dalmatia 621,429; Croatia-Slavonia (with Medjumurje) 2,739,593; Slovenia (with Prekomurje) 1,056,464; Voivodina (Banat, Bačka, Baranja) 1,380,413. On a basis of nationality the population is divided as follows:—Serbo-Croats 8,946,884 (74·4%), Slovenes 1,024,761 (8·5%), Germans 513,472 (4·3%), Magyars 472,409 (3·9%), Albanians 441,740 (3·7%), Rumanians 229,398 (1·9%), other Slavs (Slovaks and Ruthenes) 174,466 (1·5%), Italians 12,825 (0·1%), "others" (*i.e.*, mainly Turks, Spanish Jews, Gypsies) 201,368 (1·7%). Thus the Yugoslav population amounts to 82·9% of the total.

Religious distribution shows the following results: Orthodox 5,602,227; Catholic 4,735,154; Mahommedan 1,337,687; Protestant 216,847; Jewish 64,159.

The principal towns are: Belgrade 111,740; Zagreb (Agram) 108,338; Subotica (Szabadka) 101,857; Sarajevo 66,317; Ljubljana (Laibach) 53,306; Skoplje (Uskub) 41,066; Novi-Sad (Neusatz) 39,147; Osijek (Essek) 34,412; Sombor 31,332; Senta 30,697; Maribor (Marburg) 30,641; Bitolj (Monastir) 28,418; Beckerek 27,511; Vršac 26,975; Kikinda 25,809; Niš 25,096; Split (Spalato) 25,042.

I. POLITICAL HISTORY

The Adriatic Dispute at Paris.—At the Paris Conference there was from the first a deadlock in the Adriatic dispute (*see*

SERBIA). M. Clemenceau and Mr. Lloyd George found themselves between two irreconcilable standpoints—between Sonnino, who claimed the literal fulfilment of their treaty pledges, with the addition of the port of Fiume, and Wilson, who refused all cognisance of the secret treaties and regarded them as abrogated by the Allies when they accepted his successive Notes as the basis of the Armistice. The three Western Powers were in the impossible position of judges in a dispute to which one was a party, while two were accessories. On Feb. 11 1919 the Yugoslavs offered to submit the whole dispute to the arbitration of President Wilson, and on April 16 to leave the settlement of frontiers to a plebiscite.

But these proposals were rejected by the Italians, who even withdrew for a time from Paris; and Wilson's public manifesto on the Adriatic question (April 23) so far from improving matters, actually stiffened Italian resistance. The problem was left unsolved during the final stages of the negotiations on the German treaty, and was still being postponed when on Sept. 12 D'Annunzio and his Arditi, with official Italian connivance, seized Fiume and proceeded to create a *fait accompli*. On Dec. 9 1919 the Supreme Council made a definite proposal to Italy on the basis of a slight modification of the so-called "Wilson Line," Fiume as a buffer State, a special régime in Zara, Valona in full sovereignty and an Italian mandate in Albania. Neither this nor a later improvised proposal of Clemenceau and Lloyd George (abandoning the buffer state) found acceptance, while Wilson's three Notes to the Allied Cabinets (Feb. 10 and 25 and March 6 1920), though they will always remain classic documents of the controversy, failed to overcome the opposition of Italy, who reckoned with the eclipse of his influence at home in America.

Late in April the Yugoslavs consented to direct negotiations with Italy, but the Nitti Cabinet fell before any decision could be reached, and it was not till Nov. 12 1920 that the Treaty of Rapallo was signed.[1] By it Italy acquired a frontier considerably farther east than the Wilson line, the watershed of the Julian Alps as far as Snježnik (Monte Nevoso), almost all Istria with Abbazia and Volosca, and a narrow strip of shore connecting it with Fiume, which was to become an independent unit under the League of Nations, while the Croat suburb of Sušak was to remain in Yugoslavia and the Baroš Port was added as an outlet for Yugoslav trade. Zara became a free city under Italian sovereignty, but as a tiny island isthmus without hinterland or islands. Italy renounced all claim to Dalmatia, and of all the islands retained only Lussin and Cherso. Special linguistic and other privileges were assured to the tiny Italian minority in the Dalmatian towns, but no corresponding charter was granted to the 400,000 to 500,000 Slovenes and Croats annexed to Italy.

The settlement, though far from ideal, involved concessions on both sides: and Italy though still forgetful of the principles enunciated at the Roman Congress, could at least claim to be the only victorious Power which had relinquished its hold upon conquered territory. One practical result of the Treaty was that Italy tacitly abandoned the cause of King Nicholas and accepted as inevitable Montenegro's incorporation in Yugoslavia. Unhappily Italy allowed the treaty to remain a dead letter as

[1] Fuller accounts of these long negotiations will be found in *A History of the Peace Conference of Paris* (ed. H. W. V. Temperley), vol. IV.

regards Fiume, which was firmly held by D'Annunzio's irregulars, to the utter ruin of its trade and prosperity. The final liquidation of the Adriatic dispute was postponed till Jan 27 1924 when Mussolini and Pašić (Pashitch) concluded the so-called " Pact of Rome " guaranteeing the Peace Treaties of St. Germain, Trianon and Neuilly and promising neutrality if either should be attacked by a third party. A supplementary agreement recognised Italy's annexation of Fiume, but left to Yugoslavia the Baroš Harbour and also a free commercial zone in Fiume itself, with proper railway access.

The New Frontiers.—In four other directions also the regulation of the new frontiers was a slow and difficult process.

1. The frontier between Yugoslavia and Rumania rests on a decision of the Peace Conference, published on June 13 1919. Rejecting equally the frontier fixed by the secret Treaty of 1916, under the terms of which Rumania entered the War, and the line up to which the Serbs had been allowed to occupy after the Armistice, the Allies divided the Banat on a mainly ethnographic basis. At the last moment they drove two awkward salients into Rumanian territory, in order to include Vršac and Bela Crkva in Yugoslavia, thereby blocking the railway outlet of Timişoara and Arad towards the Danube at Bazias.

2. The regulation of the Austro-Yugoslav frontier was decided according to a plebiscite supervised by an inter-Allied Commission at Klagenfurt. After a keen contest between rival Slovene and Pan-German propagandists, voting took place in Oct. 1920 and resulted in a majority of 12,747 for Austria in Zone A (the more southerly section in dispute), whereupon Zone B also was automatically assigned to Austria

3. By the Treaty of Neuilly (Nov. 27 1919) Bulgaria was forced to cede to Yugoslavia (*a*) the Strumnica salient, which threatened the Vardar railway from the east, (*b*) the district of Kočana and the Bregalnica and (*c*) the town and district of Tsaribrod, which places Sofia strategically at the mercy of her neighbour.

4. The Albanian frontier remained in suspense till 1921, when the Supreme Council sanctioned the line laid down by the Council of Ambassadors in the winter of 1913, thus putting an end to the disreputable design favoured in some quarters of an Italo-Yugoslav " deal " on the lines of " Skutari for Fiume."

5. The frontier with Hungary was the last to be regulated. By the Treaty of Trianon the Banat (save a small Magyar triangle opposite the city of Szeged) was divided between Rumania and Yugoslavia, while the latter received the whole Bačka (except Baja and district), part of the Baranya (forming the angle between Drave and Danube) and the Medjumurje (between Drave and Mur). Thus, in order to secure the town of Subotica (Szabadka) with its large Bunjevac (or Catholic Serb) population, she was allowed to annex not less than 250,000 Magyars. Her claim to Pécs (Fünfkirchen) was disallowed, but owing to the long delay in ratifying the treaty Yugoslav troops remained in occupation of this district and its valuable coal-mines till Aug. 1921.

The Provisional Parliament, 1918–20.—So long as vital frontier disputes were unregulated, the central Government in Belgrade held that elections could not be held, and governed for the first two years through a provisional Parliament for which no one could claim a really representative character. The deputies for Serbia held mandates which had actually expired as long ago as June 1914, but whose renewal war and invasion had prevented; those for Croatia had been elected in Jan. 1914, those for Montenegro were delegated by the revolutionary Assembly of Podgoriča in Nov. 1918. But in Bosnia and most of the other provinces the deputies had no popular mandate whatever, beyond being members of the revolutionary local committees formed when Austria-Hungary collapsed. The union of so many distant political organisms had reduced the party system to a state of chaos, and the first two years were taken up by a process of regrouping, the issue being centralism versus federalism.

There was a very keen struggle between the Radicals, who still possessed the best party machine and stood for a narrowly Serbian as opposed to a Yugoslav programme, and the newly constituted Democratic party, which absorbed most of the Serbian Opposition parties, the old Serbo-Croat Coalition of Zagreb and the Slovene Liberals. The Radicals of Serbia, being conservative in all but name, made a working alliance with the Clericals of Zagreb and Ljubljana, and under the leadership of Protić favoured decentralisation, combined with concessions to the expropriated land-owners. But in the land question the Radical party was paralysed by its Bosnian wing, which sided with the peasantry; and thus in Aug. 1919 Protić was replaced by Davidović, the Democrat leader, and though the government remained a Coalition, its weight was transferred farther to the Left. An internal trial of strength continued throughout the winter between the rival governmental groups, until in May 1921 a breach was averted only by a reconstruction of the Cabinet under Vesnić, who as Serbian Minister in Paris since 1905 enjoyed wide prestige, and, though a Radical, stood aloof from party dissensions. Under his weaker but more neutral guidance, and aided by the unifying force of the Adriatic crisis, the parties reached agreement upon a new parliamentary franchise, based on universal suffrage.

The Constituent Assembly and the Constitution.—The elections to the Constituent Assembly (Nov. 1920) did not clear up the situation as had been expected. No party secured an absolute majority, and the two strongest, the Radicals and Democrats, being almost exactly balanced, were forced to prolong still further their unnatural alliance. In open opposition stood (*a*) Stephen Radić, the Croat peasant-leader whom the Democrats had unwisely imprisoned in 1919–20 and who now swept the boards in Croatia with a republican and federalist programme and induced his party of 50 to absent itself from the Constituent Assembly; (*b*) the Croat and Slovene Clericals, who strongly advocated decentralisation; and (*c*) the 58 Communists, led by a small group of extreme theorists, but owing their strength to the subversive elements in the Bačka, Macedonia and Montenegro and the secret aid of the Carlists in Vienna and Budapest. As the Coalition lacked the necessary majority, it was reduced to gathering support piecemeal among the more neutral groups and for this task Pašić, who became Premier in Jan. 1921, was specially qualified.

By the promise of 100,000,000 dinars to the expropriated Begs, he won over the Moslems of Bosnia, and by similar methods he detached the Slovene section of the newly founded Agrarian party (Zemljoradnici). But though he was thus able to carry the first reading of the new constitution by 227 to 93 votes (May 12), he was faced by the passive resistance of the great majority of Croats and Slovenes, who regarded with suspicion his " Great Serbian " and centralising aims. It is significant that Protić, hitherto Pašić's most intimate associate, withdrew from the Radical party and from Parliament rather than sanction a constitution so inimical to provincial interests; while Trumbić, the foremost advocate of full national unity, recorded his vote against it.

The Struggle between Centralists and Federalists.—On June 28 (Kosovo Day) the Prince Regent took the oath to the new constitution, but the ceremony was marred by an attempt to assassinate him and the Premier by a bomb thrown as they drove home to the palace. This outrage, which was traced to the Communists, provided fresh proof that the Democratic leader Drašković, as Minister of the Interior, was justified in his charges of widespread terrorist conspiracy and even in the much-debated Decrees (Obznane) by which he sought to combat them. When on July 21 Drašković was murdered by a young Bosnian Communist, Parliament resolved on reprisals, and 10 days later passed, by 190 to 54, laws of extraordinary severity for " the Defence of the State," terrorist agitation being made punishable by death, prolonged penal servitude or heavy fines. The mandates of the 58 Communist deputies were annulled, and the party rendered ineffective.

As the Croat Peasant party under Radić maintained its unwise policy of abstention, the parliamentary opposition became almost negligible, but the dissensions between the two governing parties rendered constructive work impossible. At last in the winter of 1922 it came to an open breach and the Democratic Ministers resigned. After the failure of prolonged attempts to produce a compromise between Davidović and Radić, the King invited Pašić to form a purely Radical Cabinet, which appealed to the country. The elections of March 1923 still brought no definite decision. The Radicals increased from 91 to 108, and the Croat Peasants from 50 to 70, while the Democrats fell to 52. The Government lacked a majority, but so long as Radić and his followers refused to take their seats in the

Skupština, there was no possibility of overthrowing or replacing it. Negotiations between Radić and emissaries of Pašić failed, and in Aug. after a series of indiscreet and inflammatory speeches Radić fled abroad, and settled first in London, then in Vienna, in the hope of interesting Western opinion in his cause. Early in 1925, from this retreat, he reached a working agreement for a joint Opposition bloc with the Democrats, Agrarians, Slovenes and Moslems, and instructed his deputies to enter the Skupština. Pašić saved himself for the time from a precarious situation by allying himself with the dissident Democrats under Pribičević who were strongly Centralist. From April till July there was a prolonged political crisis, during which Government and Opposition used threatening language toward each other.

At last on July 27 Davidović and his bloc were invited to form a Cabinet, which the Radić party supported but did not enter. Radić, who had meanwhile visited Moscow and coquetted with the "Peasant International," now returned home and undermined the Government's position by a series of more than usually indiscreet speeches, with the result that on Oct. 15 Davidović, under pressure from the Crown, the army and other quarters, resigned office. After another long crisis he was replaced by a "Concentration Cabinet" under Pašić and Pribičević which only commanded 123 votes out of a total of 315; it therefore ordered new elections, quashed the last Cabinet's enquiries into corruption and governed on rigidly centralist lines. In Jan. 1925 it went so far as to dissolve the Croat Peasant party, prohibit its newspaper *Slobodni Dom* and throw Radić himself into prison on a charge of revolutionary and anti-militarist propaganda. At the Feb. elections the Government, by employing pressure and corruption wherever possible, succeeded in securing a small working majority—163 to 152—though it polled 300,000 fewer votes than its rivals. Radić remained in prison, but with his approval his party changed its name from "Croat Republican Peasant Party" to "Croat Peasant Club," issued a new programme and formed a united bloc with Davidović, Trumbić, Korošec and the Moslems.

The Government retorted by annulling 58 out of the 67 Croat mandates. At the last moment, however, Radić's nephew Paul issued a declaration in the party's name, recognising the constitution, dynasty and army, and thus abandoning the whole basis of its agitation for the six years previous.

After a further interval Radić made his terms with Pašić, the one abandoning his alliance with the Democratic bloc while the other dropped the now useless ballast of the Pribičević group. Radić himself became Minister of Education, and though his flow of indiscreet public speeches increased rather than diminished, his statements ceased to be taken too seriously, while his stronghold upon the minds of the peasantry could now be exploited in the interests of national unity and concord. This alliance between the strongest Serb and the strongest Croat party, though setting at defiance all the political principles hitherto current, none the less represented a fresh stage in the consolidation of Yugoslavia. The federalist idea in its extreme form has probably been finally defeated, and it now remains to work out the lines of local autonomy and reasonable devolution of powers in provinces whose culture, institutions and traditions will long remain too divergent to be treated satisfactorily on uniform lines.

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II. ECONOMIC AND FINANCIAL HISTORY

Agriculture.—Agriculture occupies about 80% of the total population of Yugoslavia. The different provinces vary greatly in climate, soil, configuration and methods of cultivation. The coastal districts and the high Karst land immediately behind them are mountainous and often barren and present great difficulties of communication. The most fertile districts are the Voivodina (Banat and Bačka), Slavonia and Northern Serbia (especially the Mačva, Morava and Timok districts) and portions of Croatia, Slovenia and Bosnia. The principal crops are maize and wheat (40% of both being produced in the Voivodina), sugar-beet, hemp and hops (also in the north), opium (in Macedonia) and tobacco (chiefly in Macedonia and Hercegovina).

Area Sown and Production in 1924

	Hectares	Quintals
Wheat	1,717,343	15,722,496
Barley	363,641	2,934,577
Rye	195,303	1,407,508
Oats	352,674	3,018,477
Maize	1,965,355	37,949,376
Haricot beans	40,080	378,020
Potatoes	217,953	10,274,825
Sugar-beet	48,257	10,631,066
Beet for fodder	17,526	2,262,592
Flax	13,086	84,746
Hemp	25,070	253,076
Clover	112,601	3,607,746
Lucerne	60,345	1,989,442
Hay	1,595,698	33,427,712

Admirable wines are produced in Dalmatia and Hercegovina (both rather strong), Syrmia (of the Hungarian type) and along the Danube in Serbia (Smederevo). The fruit industry is growing steadily in importance, notably in the Sumadija district of Serbia and in the East of Bosnia. In an average year some 750,000 tons of fresh plums are produced, and 40,000 to 50,000 tons of dried plums and prune pulp are exported. Great efforts are being made to improve the methods of drying and packing. The famous Maraschino liqueur is made in the district round Zara (Zadar), and excellent plum brandy (sljivovica) in almost all districts. The pyrethrum is grown in considerable quantity in Dalmatia, for the purpose of preparing insect powder. There are eight sugar factories, two state-owned, the rest in the hands of foreign banks and companies; but though the area of beet cultivation has actually grown since the partition of the great estates among the peasantry, the decline in the price of sugar in the world-market has produced a certain crisis in the industry, despite the specially low freights granted on the state railways.

Forestry.—The forests of Yugoslavia cover 7,500,000 hectares of land, of which all save 2,000,000 is old forest. Timber is a main article of export, Italy, Egypt and the Levant being the best customers. The most important state forests are in Bosnia, beech, fir and oak being the commonest trees. The Slavonian oak (known abroad as "Austrian oak") is valuable and of high quality. In Serbia 60% of the forests are beech. At Teslić there is a wood-distilling factory which is the largest in Europe and produces methylated spirit, alcohol, formaldehyde, acetone and other chemical products. Here and at Bijelišeć charcoal is produced by the dry distillation process. In Slovenia large quantities of tannin are produced. There are cellulose factories in Bosnia and Belgrade, and bentwood furniture is manufactured to a considerable extent in Slovenia and Croatia.

Livestock.—The livestock of the country, though greatly depleniished by the War, afterwards rapidly revived. In 1924 there were 1,062,893 horses (46,800 being exported), 3,869,985 horned cattle and 7,639,257 sheep (half of the latter being in Serbia). Pigs are estimated at between 2,500,000 and 3,000,000. Goats are naturally most numerous in the poorer districts of the South (Hercegovina, Dalmatia, Montenegro).

Mining and Mineral Resources.—The mineral resources of Yugoslavia have for the most part lain idle since Roman and mediaeval times, but offer very great possibilities. Iron ore of good quality occurs in enormous quantity and near the surface at Ljubija, in Bosnia, where it is mined by the state mining authorities and sold

for exportation. Another iron mine worked by the State exists at Vareš, in Bosnia, and is worked in conjunction with a coal mine and iron-smelting establishment and the ironworks at Zenica. The metallurgical works here are on a primitive scale, their production being pig-iron and small castings. The ironworks at Jesenice (Slovenia), which have a capacity of 70,000 per annum, produce bar iron, iron and steel sheets, steel rails up to 22 kilogrammes per metre (as used on the Bosnian narrow-gauge railways), cold rolled iron, drawn iron and wire nails. Bar iron is manufactured at Store, near Celje, in Slovenia; steel and steel springs at Guštanj, on the Maribor-Klagenfurt railway, and highly-silicated foundry iron is produced at Sopusko in Slovenia. Large deposits of brown coal and lignite occur in many parts of Yugoslavia, but there is no coking coal. Copper is produced at Bor and Majdanpek in Serbia, the first mentioned being an important concern, largely in the hands of French interests.

Whereas the total production in terms of metal in 1923 was 6,700 tons for the whole country, in 1911–2 it was 7,600 tons from the Bor mines alone, and in 1917 it is estimated that from the latter mines the Central Powers obtained as much as 30,000 tons. Alluvial gold is found in the river Timok (East Serbia), manganese ores are worked near Sarajevo, lead in the Mežica valley (Slovenia), bauxite or aluminium ore in Dalmatia.

Foreign Trade.—The total exports in 1924 amounted to 3,734,974 metric tons, valued at 9,533,774,432 dinars—the principal items being as follows:—

	Metric Tons	Dinars
Cereals	454,046	1,389,852,056
Beans and potatoes	41,994	172,383,715
Fruit	32,440	246,547,434
Wine and Spirits	1,508	9,521,227
Alcohol	1,233	19,213,610
Animal Products	23,783	748,428,831
Skins	3,452	276,740,543
Wood	10,043	119,473,432
Soda	21,887	65,917,813
Calcium	37,133	123,591,652
Cement	341,628	189,421,784
Iron	4,070	33,054,229
Lead	10,641	135,596,956
Copper	7,605	346,490,091
Other Minerals	813,976	308,085,497
Live Stock (less Poultry)	698,429 (head)	1,353,045,347

Their chief countries of destination were as follows:—

	Metric Tons	Dinars	%
Italy	1,530,878	2,757,305,162	28·9
Austria	452,338	2,332,971,109	24·4
Czechoslovakia	244,333	943,747,132	9·8
Hungary	699,284	756,133,382	7·9
Greece	255,374	676,169,377	7·0
Switzerland	70,226	389,554,057	4·0
Germany	45,461	388,962,378	4·0
France	84,205	362,874,301	3·8
Rumania	91,656	252,623,807	2·6
Great Britain	75,602	131,529,444	1·3

Imports amounted to 1,127,686 metric tons, valued at 8,221,743,552 dinars, the most important articles being cotton and woollen fabrics (25%) and machinery. Among the countries of origin Italy again takes first place (29·52%) followed by Czechoslovakia, Austria, Great Britain.

Revenue and Expenditure.—The budget for April 1 1924–March 31 1925 estimated a revenue of 10,405,000,000 dinars and an expenditure of the same amount. The actual expenditure amounted to 10,579,388,339 dinars but the revenue exceeded the estimate.

The principal sources of revenue as estimated for 1925–6 were as follows:—

	Dinars
A. General:	
Customs duty and Customs dues	1,690,000,000
Excise	1,810,000,000
Monopolies	2,468,050,000
Profit on Exchange	163,000,000
Turnover Tax	225,100,000
Receipts from Communications	2,462,850,000
Post-Office Saving Bank	15,000,000
War Invalids Tax	140,000,000
Ordnance Tax	70,000,000
Direct Taxation with Surtaxes	500,000,000
State Properties	235,000,000
Various revenues	21,000,000
B. Special:	
Indirect Taxes	910,000,000
State Enterprises	1,120,000,000
Miscellaneous	80,000,000
Total	11,916,000,000

Public Debt.—According to figures published by the Inspectorate-General of the Ministry for Finance, the consolidated public debt stood as follows in 1926:—

	Amount in 1926 Dinars	Annual Payment: Dinars
1. Pre-War Debts	2,217,630,960	125,159,576
2. War Debts	15,312,967,707	(Not commenced)
3. Post-War Debts	6,054,989,870	293,204,827
4. Debts arising from the Innsbruck Agreement	1,353,291,749	48,293,213
Total (Dinars)	24,938,880,287	467,288,316

The statistical data given above are based mainly upon an "Economic Survey of Yugoslavia" (compiled for the Department of Overseas Trades, and published in No. 11 of the *Slavonic Review*) and on "Economic Resources and Problems of Yugoslavia," by Miss M. R. Shackleton (*Scottish Geograph. Mag.*, Nov. 1925).

(R. W. S.–W.)

YUKON TERRITORY (*see* 28.945), a territory of the Dominion of Canada. With the decline of the gold-mining industry, the population decreased from 27,219 in 1901 to 8,512 in 1911 and 4,157 in 1921. In 1918 an amendment to the Yukon Act abolished the council of the Yukon and the territory is now administered by the Northwest Territories Branch of the Canadian Department of the Interior. Law and order are enforced by members of the Royal Canadian Mounted Police. The Yukon is represented in the Dominion Parliament by one member in the House of Commons.

The mineral production in 1923 was valued at $2,972,823. Placer gold is still the principal mineral product, the value of the gold output in 1923 being $1,243,287. The Yukon has also been a steady producer of silver and in 1923 yielded 1,914,438 oz. valued at $1,241,953. Lead production amounted to 6,771,113 lb. worth $486,098. The wide distribution of the ores of gold, copper, silver and lead indicate enormous mining possibilities. Coal, of which there are large reserves, is mined in small quantities, 313 tons valued at $1,485 being produced in 1923. Large game and fur-bearing animals abound. The value of pelts purchased by traders from trappers in the Yukon during the season of 1922–3 amounted to $199,522.

ZAGHLUL, SAAD (1860–), Egyptian pasha, was the son of a notable in the district of Ibian, Gharbia Province. He was educated at the village school and afterwards at the University of El Azhar, in Cairo. When he had completed his prescribed course of studies, he was, in 1880, appointed editor of the *Official Journal*. Later he was nominated a Moawin under the Ministry of the Interior and eventually became Chief of the Contentieux for the province of Giza. Involved in the Arabi revolt, he was one of the many notables detained on the occupation of Egypt by British troops in 1882. On his release he ceased to hold office and in 1884, when the native tribunals were instituted, he began to practice at the bar. In 1892 he was appointed counsellor of the native court of appeal. Having become proficient in the French language and in the science of law, he obtained his diploma in law. He became Minister of Education in 1906, and under his " enlightened administration " it was said by Lord Cromer (*Modern Egypt*, vol. II., p. 535) that " education in Egypt made rapid strides in advance. " A change of the Ministry during Lord Kitchener's tenure of the Cairo Agency resulted in Zaghlul's ceasing to hold the Portfolio for Education, but he was appointed vice-president of the Legislative Assembly and he took a special interest in its deliberations until the outbreak of the World War.

On the signing of the Armistice Zaghlul, who had for long been considered the principal spokesman of the Nationalist party, appealed to the Residency in Cairo for the recognition of Egyptian independence, basing his demand on President Wilson's self-determination policy to which effect had been given by the British Government's issue of a proclamation defining the status of the other countries liberated from Turkish rule by the War. When his proposal that he and some representative Nationalists should visit London to press their views was refused by the Government, he became discontented, and his attitude was so hostile that he and three others were arrested on March 8 1919 and deported to Malta. This was the signal for a murderous outbreak in Egypt in which British officers and others were killed and the country became much disturbed. Zaghlul and his friends were later released by Lord Allenby, and freedom of travel, which War measures had hitherto restricted, was permitted to all. A special mission under the chairmanship of Viscount Milner was sent to Egypt in Nov. 1919 to inquire into matters and make representations. Zaghlul eventually came to London and discussions between him, Adly Pasha and Lord Milner took place, the results of which were published in the " Milner Report. "

Zaghlul returned to Egypt early in 1921, where he represented the extreme Nationalist party in opposition to the more moderate ministry under the presidency of Adly Pasha. At the end of the year, when the trouble again broke out in Egypt, Zaghlul was arrested once more and deported, first to Aden and then to the Seychelles. In Sept. 1922 he was transferred to Gibraltar, whence he was released on April 4 1923, on the grounds of ill-health. After the promulgation of the new constitution, martial law was abolished and Zaghlul was free to return to Egypt. An enthusiastic reception was accorded to him on his landing at Alexandria and in the elections of Jan. 1924 his supporters gained an overwhelming majority. Yehia Ibrahim Pasha resigned and Zaghlul formed a ministry. The question of the evacuation of the Sudan now became prominent and conversations took place in London (Sept. 25—Oct. 3) between the Egyptian and British prime ministers; Zaghlul refused to modify his intransigent attitude and returned to Egypt. On Nov. 19 1924 Sir Lee Stack, the Sirdar, was assassinated and Zaghlul was forced to resign. (*See* EGYPT.)

ZAGREB, Yugoslavia (*see* 1.382).—Zagreb or Agram has increased largely in population (79,083 in 1910; 108,338 in 1921), as the influx of officials and business men since the formation of the state of Yugoslavia has outweighed the exodus of Magyars and Germans. Zagreb is the second city of the kingdom and its financial and commercial centre. It is also the home of an aristocracy and a seat of culture on a level with more famous European centres. Previously the centre of the Yugoslav movement, it is now particularist and Croat in sympathy. The modern part of the town, with tall buildings, wide streets and large open spaces, stands in a long narrow tract between the levels along the river Sava and the ridge on which the old town, with its narrow winding streets, is situated. An exchange was opened in 1919, and additions have been made to the buildings of the medical faculty at the university, but little building is in progress. A hydroelectric station has been planned, but sufficient capital was not forthcoming in 1925. The chief industries are the manufacture of linen, leather and tobacco. A trade fair is held twice yearly, and a motor exhibition was instituted in 1924 and is intended to be annual. Work is in progress on a railway to unite Zagreb with Spalato (Spljet) and Sebenico (Šibenik).

There were nationalist disturbances in the town in 1912, and the two military courts of justice which sat here during the World War were considered too strongly Croat in sympathy by the authorities at Vienna and Budapest, so that in 1918 prisoners on trial for treason or military offences were sent to Bratislava (Pressburg). In that year, when the Austrian empire was breaking up, an independent nationalist body assembled at Zagreb. In 1924 there was serious rioting between the Croat Nationalists and the Yugoslav Sokols at a meeting of these patriotic athletic societies in the town.

ZAÏMIS, ALEXANDER (1855–), Greek statesman, was born in Athens Oct. 28 1855, and came of a family of politicians. Entering public life rather from duty than ambition, Zaïmis became the " utility man " of Greek politics; thus he was first appointed Prime Minister in Oct. 1897, to clear up the aftermath of the disastrous Greco-Turkish War. Resigning in 1899, after having accomplished that task, he again became Premier after the " Gospel Riots " had caused the fall of Theotokes in Nov. 1901, but succumbed to the majority which supported his uncle, Deliyannes, in 1902. In Sept. 1906 he was appointed high commissioner of the Powers in Crete, a post which he held until 1911. In 1913 he was appointed governor of the National Bank. He became Premier for the third time in Oct. 1915, but returned to the Bank after a month's office, emerging, however, to resume the premiership in June 1916. He became for the fifth time premier in 1917, and announced to King Constantine the decision of the three Protecting Powers that he must abdicate. He then retired again to the National Bank, but was removed on the restoration of King Constantine. After the King's second abdication, Sept. 1922, Zaïmis refused a sixth premiership, and was talked of as a possible president.

ZANGWILL, ISRAEL, (1864–1926) English man of letters, (*see* 28.956) died Aug. 1 1926.

ZANZIBAR (*see* 28.958) had a population (1921) of 221,925, including 295 Europeans and 18,965 Asiatics, mostly British Indians. In 1924 the population had fallen to 203,265 (Zanzibar island 115,616; Pemba island 87,649). With the development of trade direct between Mombasa and Dar-es-Salaam and oversea ports, Zanzibar has lost its pre-eminence as the entrepôt for the commerce of East Africa, but Zanzibar and Pemba islands continued to provide the greater part of the world's supply of cloves. The port, too, still commands the coastwise trade with the mainland, and the very considerable dhow traffic with Arabia and Persia.

History.—The Sultan (Sayýid) Ali bin Hamud, a young man educated at Harrow and fond of travel, abdicated in 1911. (He died in Paris in 1918). His successor, Sayýid Khalifa bin Harud (born 1879) was a great nephew of Sultan Bargash. Sayýid Khalifa showed the greatest loyalty to the British connection, and, as the leading Moslem prince in East Africa his moderating influence did much to steady Moslem opinion in

that part of Africa during the World War. The most dramatic incident of the War, for Zanzibar, was the sinking of the ancient British cruiser " Pegasus " by the German cruiser " Königsberg " on Sept. 20 1914, the " Pegasus " being at the time at anchor in Zanzibar roadstead, undergoing repairs.

In July 1913 the control of the protectorate was transferred from the Foreign to the Colonial Office. The governor of British East Africa (Kenya Colony) was appointed High Commissioner of Zanzibar, the local administration being in the hands of a British Resident. The High Commissioner had, however, little time to spare from Kenya to supervise the affairs of Zanzibar, where local feeling was also against centralisation. In Sept. 1925 the High Commissionership was abolished and the British Resident became directly responsible to the Colonial Office. In 1926 the purely advisory council which had existed for some years was superseded by a nominated legislative council, with six unofficial members, holding their seats for three years. Of this council the British Resident is president, and has a casting vote.

Economic Conditions.—Trade is largely dependent on the clove harvest, the only other important industry, apart from trans-shipment of goods, being the production of copra from the coco-nut palm. In poor seasons profits are precarious, for the islands are dependent upon the free immigration of labour from the mainland and rates of pay are high. Many of the Arabs, who own the large clove plantations, are backward in the systematic planting of new trees—the only means of indefinitely maintaining supplies, all land suitable for cloves being under cultivation. The average clove crop for the 20 years ending 1924 was 512,000 fraslas; the crop for 1924-5 was over 700,000 fraslas. (A frasla equals 35 lb. avoirdupois.) For copra the average yield for 10 years ending 1923 was 534,000 fraslas; in 1924 the yield was the highest recorded, being 988,000 fraslas. The copra, however, is generally of poor quality.

During 1920–5 improvements at Zanzibar harbour included the building of a concrete wharf 800 ft. long, and the erection of a clove depôt and goods sheds. The loss of part of its transit trade was shown in the shipping returns. The tonnage of shipping using the port was 1,503,000 in 1913 and 1,068,000 in 1924. The trade returns, with the rise in the price of commodities, showed an increase. Imports were valued at £1,103,000 in 1913 and at £2,223,000 in 1924. Exports in 1913 were valued at £1,048,000 and in 1924 at £2,286,000. Trade is mostly with India, Tanganyika and Great Britain. The chief source of revenue is the customs. Revenue increased from £275,000 in 1913 to £589,000 in 1923 and was £498,000 in 1924. Expenditure in 1913 was £248,000, in 1923 £480,000 and in 1924 £452,000.

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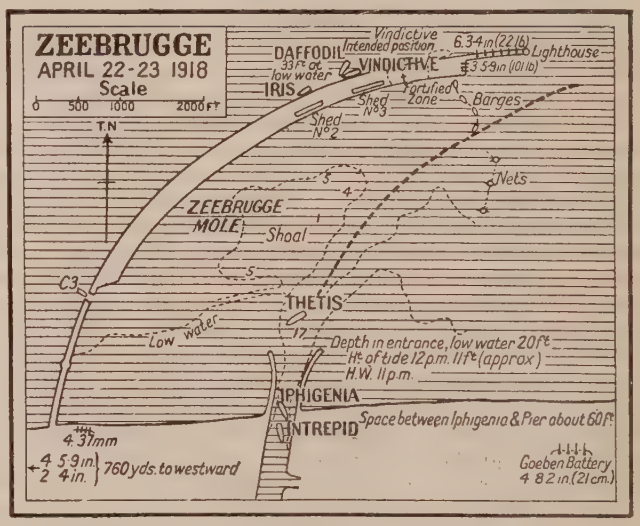
ZEEBRUGGE, ATTACK ON.—On April 22–3 1918, an attack was made by British forces on the German submarine bases at Zeebrugge and Ostend in order to block the entrance to the Bruges ship canal and bar all passage to the Flanders flotilla of submarines. At both Zeebrugge and Ostend the entrances are narrow (about 300 ft. wide) running between two piers. At Zeebrugge on the west side of the entrance a great mole sweeps out for 1½ m. to a lighthouse at the end where the Germans had erected a battery of three 5·9-in. and six 4-in. guns.

British Plan of Attack.—The general plan of attack was simple. Supported by the fire of two monitors, a cruiser was to assault the mole on its outer side and divert the German fire from three blocking ships which were to dash in and be scuttled in the entrance. A short viaduct joining the mole to the shore was to be blown up by a submarine. Ostend was to be blocked simultaneously by two blocking ships. The whole coast bristled with guns and the chance of success depended largely on an effective smoke screen.

The Attacking Forces.—The attacking force consisted of the old cruiser " Vindictive " (5,750 tons displacement, 320 ft. long, 24 ft. draught) armed with 10 6-in. guns and specially equipped with one 11-in. and two 7·5-in. howitzers, Stokes' mortars, flame throwers, Lewis guns and pom-poms. She was commanded by Capt. Alfred B. Carpenter (awarded V.C.); she carried a storming party of 1,030 sailors under Capt. Henry Halahan and 750 Royal Marines under Lt.-Col. Bertram Elliott; she was supported by two Liverpool ferry boats, the " Iris II. " (Comm. Valentine Gibbs) and " Daffodil " (Lt. Harold G. Campbell). Her task was to storm the mole. The blocking ships were the old cruisers " Thetis " (Comm. R. S. Sneyd), " Intrepid " (Lt. Stuart Bonham-Carter) and " Iphigenia " (Lt. E. W. Billyard-Leake). Behind them were 13 destroyers under Capt. Wilfred Tomkinson, 18 coastal motor boats (55 ft. long, 3 ft. draught, 35 knots, two 18-in. torpedoes) under Lt. Arthur Welman, and 33 motor launches for smoke screens and inshore rescue work. Submarine C. 3 (Lt. Richard Sandford) was to blow up the viaduct. In command was Rear-Adml. Roger Keyes with his flag in the destroyer " Warwick." At Ostend the blocking attempt was to be made by two old cruisers, the " Brilliant " (Comm. Alfred E. Godsal) and " Sirius " (Lt. Comm. H. N. Hardy) supported by five bombarding monitors, eight British and six French destroyers with 18 motor launches under Comm. Hamilton Benn.



The Attack.—The force started at 4:53 P.M. on Monday, April 22; the bombardment was to open at 11:20 P.M.; the smoke screen was to start at 11:40 P.M.; the "Vindictive" was to reach Zeebrugge mole at midnight; the first blocking ship was to pass the lighthouse at 12:25 A.M. Twelve miles from Zeebrugge, the force took up its formation for attack. The night was overcast with a light wind from the northeast; the small craft dispersed and soon a thick cloud of smoke began to roll down the coast, shrouding everything from sight. But as the " Vindictive " neared the shore, the wind shifted to the southward and the smoke screen drifted back. A glare of searchlights fastened on her and under a tornado of fire the storming party drawn up ready to rush ashore suffered heavily and lost both its leaders. The intention was to run alongside the mole close to the battery, but a sluicing tide carried the ship about 300 yd. farther on.

The Storming of the Mole.—It was one minute past midnight when the " Vindictive " ran alongside the mole. This was a critical moment, for the rush of the three-knot tide created a heavy swell which threw the ship off the mole, but the little " Daffodil" came up and, butting the ship bodily into the mole, enabled the storming party to get ashore. They got ashore but a mass of barbed wire lay between them and the battery. As they were gathering for the assault, a great sheet of flame rose with a roar into the sky. The viaduct had gone up. Lt. Sandford had jammed C.3 with 5½ tons of amatol successfully into it. It was 12:20 A. M. There was fighting on the mole and here Captain Bamford and able seaman Mackenzie won V.Cs. By 12:50 the blocking ships were in and the " Daffodil's " siren blared out the order to retire.

The Retirement.—The storming party retired in perfect order, bringing their wounded with them. Capt. T. M. Palmer refused to leave the shore and was subsequently numbered among the missing men for whom he had waited. The "Daffodil" pulled the "Vindictive's" bows off the mole. The "Iris II." came under a heavy fire; and her commander and Maj. Chas. Eagle were mortally wounded, but Lieutenant Spencer, himself seriously wounded, steered her clear, while motor-launch 558 hid her in a friendly cloud.

Action of the Blocking Ships.—Meanwhile the three blocking ships had passed in under a storm of shell. The "Thetis" fouled a net and ran aground. The "Intrepid" ran right into the canal and Lt. Bonham Carter blew the explosive charges, then with six others got on board a Carley raft and was picked up by M. L. 282 (Lt. Percy Dean, awarded the V.C.). The captain of the "Iphigenia" found himself heading for the western pier, but going hard astern managed to make the entrance, drove into the gap between the "Intrepid" and eastern bank, and blew the charges. The crews were saved by the motor launches. By 1:30 A.M. it was all over and the ships were on their way back. The destroyer "Morning Star" had come under a heavy fire and had to be abandoned and sunk.

The Ostend Operations.—At Ostend things had gone badly. The smoke cloud was blown back; the mark buoy had been moved and both blocking ships ran ashore three-quarter mile east of the entrance. On May 9–10 another attempt was made by Commander Godsal in the "Vindictive." Under a heavy fire in which the commander was killed, the ship under Lt. Victor Crutchly just made the entrance and grounded. The crew was saved by two motor launches, under Lt. Geoff. Drummond and Lt. Rowland Bourke, both of whom were awarded the V.C. The casualties in these two attempts amounted to 637 (killed 197, wounded 413, missing 27). Zeebrugge was closed for a time, the Flanders submarines received a check, and the measure of the enterprise lies in the nine V.Cs. which were awarded for it.

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ZEPPELIN, FERDINAND, COUNT VON (1838–1917), German airship inventor, was born at Constance, Baden, July 8 1838. He was educated for the army and received a commission at the age of 20. He served, as a volunteer, in the Federal army during the American Civil War and whilst in America made his first balloon ascent. Returning to Germany he saw active service in the Austrian War of 1866 and in the Franco-German War of 1870. In 1891 he retired from the army with the rank of general and thenceforth devoted his energies to the study of aeronautics. In 1900 he built an airship, which rose from the ground and remained in the air for 20 minutes, but was wrecked in landing. In 1906 he made two successful flights at a speed of 30 m. an hour, and in 1907 attained a speed of 36 miles. From that time onwards his airship construction made steady progress, and the success he had achieved was evidenced by the exploits of the Zeppelin airship in the World War (*see* AIRSHIP). He died at Charlottenburg March 8 1917.

ZEROMSKI, STEPHEN (1864–1925), Polish novelist, poet and dramatist, was born at Strawczyn Nov. 14 1864. Banished from Poland by the Russian Govt. early in his life, he first attracted attention by a collection of tragic tales entitled *The Ravens and the Crows are Picking us to Pieces* (1895, Eng. tr. 1906). In the publication of *The Homeless* (1900) Zeromski supplied a generic name for all his Polish heroes. His philosophy, full of symbolic pessimism, is clearly expounded in the novel *Aryman takes Revenge* (1904), while the triumph of evil over good is vividly treated in *The Story of Sin* (1906, 2 vol.) describing the slow and terrible downfall of a woman of culture. In his epic poem *Ashes* (1904, 2 vol.) he delineates the minds of the Polish people after the Partition and their efforts to liberate their country by serving in the Napoleonic legions. During the World War Zeromski published his great trilogy *The Fight with Satan—The Conversion of Judas* (1916), *The Blizzard* (1918), *Charitas* (1919)—a kind of epilogue and synthesis of his previous work and at the same time an autobiography of his own life. After the Polish achievement of national independence, Zeromski turned to the drama, finally producing *The Broken Spell* (1924) in which the hero dedicates himself to the services of a resuscitated Poland. He died Nov. 20 1925.

See S. Brzozowski, *O Stefan Zeromski* (Warsaw, 1905); W. Jampolski, *Stefan Zeromski, the Spiritual Leader of the Race* (Lwów, 1918).

ZICHY, EUGEN COUNT (1837–1906), Hungarian traveller (*see* 28.979), died at Merano, Italy, on Dec. 26 1906.

ZIEM, FÉLIX FRANÇOIS GEORGE PHILIBERT (1821–1911), French painter (*see* 28.979), died in Paris Nov. 11 1911.

ZIMMERMANN, ARTHUR (1859–), German diplomat was born May 8 1859 at Frankenstein. After having been vice-consul at Shanghai and acting consul in 1900 at Tientsin, he entered the Foreign Office in 1902 and rose by 1910 to be a director of the political section. In 1911 he was appointed under-secretary, and in Nov. 1916 secretary of state in succession to Von Jagow. In this capacity he addressed to America the note of Jan. 31 1917 on the subject of U-boat warfare. He was also the author of the invitation of Jan. 19 1917 to Mexico to enter into alliance with Germany and to sound Japan as to her willingness to co-operate. For Mexico the price of this alliance was to be the American States of New Mexico, Texas and Arizona. This proposal, which was sent through the medium of Von Eckhardt the German minister to Mexico, was intercepted in America and President Wilson was in a position to publish it on March 1 1917. The disclosure was one of the primary causes resulting in America's declaration of war upon Germany. Zimmermann retired on Aug. 5 1917, shortly after the resignation of Bethmann Hollweg.

ZINC (*see* 28.981).—The United States is the principal producer of both zinc ore and spelter. The Goplin area in Missouri is the principal region, but large deposits are worked in the Upper Mississippi region, Franklin Furnace (New Jersey) and, since the application of improved methods of zinc concentration, in the western States. Australia is next to the United States as a zinc producer, most of the ore being obtained from the Broken Hill district (New South Wales). Tasmania also has important deposits and occurrences are known in Queensland and Western Australia.

In Canada, the most important deposits of the metal occur in British Columbia and Quebec, these two provinces sharing practically the whole of the Canadian production in the proportions of four-fifths and one-fifth respectively. The principal countries in Europe participating in the zinc industry are Germany, Italy, Poland and Spain. For many years Germany ranked second only to the United States. Her most important deposits were in Upper Silesia, which yielded about three-fourths of the total German production. Before the War the European industry was almost wholly controlled by the German zinc convention, a widespread organisation for the control of production and selling prices.

In Italy the chief mines now worked are in Sardinia, though occurrences of ore are found in Lombardy, Piedmont and Tuscany. During the post-War period Poland produced more zinc ore than any other European country, her richest mines being situated in Silesia; her exports in 1923 amounted to 80,000 long tons. In Spain the chief zinc-mining centres are in the provinces of Santander and Murcia. The ores of Santander are mainly calamine, while those of Murcia are principally blende and galena. Mention should be made of the zinc-ores mined in the United Kingdom. These are almost invariably blende associated with galena, and occur chiefly in North Wales, the north of England, the Isle of Man and at Dumfries in Scotland. The ores occur in veins traversing the paleozoic rocks of those regions. The number of producing mines is considerable, but the output is small.

In the table on the following page the production of zinc in the principal countries of the world is set out for the three years, 1913, 1918 and 1923.

Long Tons

	1913	1918	1923
United States	309,532	462,435	455,745
Australia	4,121	9,444	41,153
Canada	..	11,227	26,972
Germany	279,000	232,000	39,400
Italy	..	1,169	3,622
Poland	10,331	..	90,000
Spain	5,907	15,644	10,746
United Kingdom	66,000	50,000	27,530
Belgium	200,938	9,096	144,677
France	66,799	18,052	48,541
Japan	..	39,203	13,671

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ZINOVIEV, GRIGORY EVSEEVICH (1883–), Russian politician, was born in Sept. 1883 at Elisavetgrad (Zinovievsk). He studied chemistry and later law at Bern University, Switzerland. He was active as a revolutionary before he was 20 and in 1903 met Lenin. He joined the Left or Bolshevik wing of the Russian Social Democratic party, of which Lenin was head. He was head of the Bolshevik party in Bern and during 1903–4 started Bolshevik propaganda in South Russia. Apart from his activities abroad, he came into prominence in Russia during 1906–8 as a member of the Bolshevik St. Petersburg committee of the R.S.D.P., by his organisation of the attempted Kronstadt rising after the dispersal of the first Duma, his editorship of the Bolshevik paper *Vpered* (Forward), and of *The Social Democrat*, the central organ of the party. In 1908 he was arrested and imprisoned but was released, the authorities being unaware of his identity. He then went abroad and did not return until the revolution in March 1917.

During these nine years Zinoviev did not cease to work for his party. He was a member of the central committee, co-editor of the principal Bolshevik publications, and representative of the party at the Copenhagen congress of the International. In 1912 he went with Lenin to Galicia to control from the nearest possible point the growing labour movement in Russia. In Galicia he founded the foreign bureau of the central committee, which guided the party work in Russia and the activities of the Bolshevik group in the Duma. During the World War the conflict between the Bolshevik party and the Social Democrats increased. Zinoviev edited with Lenin *Against the Tide*, a work of propaganda against the imperialist war; and at the Zimmerwald conference (1915) they began to organise the Communist International. On the outbreak of the March revolution (1917) they returned to Russia and at once set to work to prepare the way for the Nov. revolution. Zinoviev was co-editor of *The Pravda* and, after its suppression, of *The Proletarian* and *The Worker*. He thus became one of the leading figures in the Union of Socialist Soviet Republics. In 1919 he was elected president of the Communist International, and after the death of Lenin in 1924 was one of the most jealous upholders of pure "Leninism." His influence lasted until 1926, but in June of that year he was expelled from the political bureau. A prolific writer, he published many volumes of collected essays and speeches, which form a comprehensive guide to the problems of the revolution and of the reconstruction of Soviet Russia.

(Z. V.)

ZIONISM (*see* 28.986).—When the Zionist Organisation was founded in 1897, it set to work with a clear-cut programme. With the consent of the Powers, a charter for the colonisation of Palestine was to be obtained from the Sultan. The charter once secured, the Jews were to be systematically settled in Palestine *en masse*. Till then, the Zionist Organisation was to hold its hand and keep its resources intact. The Porte was duly approached and desultory negotiations followed. Opinion in the movement became sharply divided. The "practical" Zionists, who included most of the Zionist leaders in Russia, pressed for an immediate start to be made in Palestine.

The "political" Zionists whose strength was in Western and Central Europe, still clung to the charter as an essential prerequisite, protesting that Zionist resources should not be dissipated on petty colonisation. The "practical" Zionists won their first important success in 1908, when a Zionist agency was established at Jaffa. At the Tenth Zionist Congress, which met at Basle in 1911, they came for the first time into control, and they maintained their ascendancy at the Eleventh Congress—the last before the War—which met at Vienna in 1913. The political field was not abandoned, but the movement now threw itself more and more vigorously into the actual settlement of Jews on the soil of Palestine. For this purpose its main financial instrument was the Jewish National Fund, which in 1914 owned property in Palestine to the value of £144,000, as compared with £35,000 in 1909 and £11,000 in 1907, when its active operations began. The marked quickening of the pace which dates from 1910 reflects the change in the direction of Zionist policy, though the resources of the movement were still small in comparison with those which were lavished upon the Jewish settlements in Palestine by Baron Edmond de Rothschild.

I. FROM 1910 TO THE BRITISH MANDATE

Practical Zionism was at first inclined to concern itself solely with colonisation. But between 1910 and 1914 other aspects of the movement were beginning to come into the foreground. In 1913 the Eleventh Zionist Congress, while approving an ambitious programme of rural colonisation, resolved at the same time that steps should be taken towards the early establishment in Jerusalem of a Hebrew University. Almost immediately afterwards, the Zionist Organisation found itself drawn into the conflict precipitated by the policy of the Hilfsverein der Deutschen Juden, a German-Jewish body which controlled a number of educational institutions in Palestine. The Hilfsverein laid itself open to the charge of favouring German at the expense of Hebrew as the language of instruction. The teachers rebelled, and many of the schools had to close. At this point the Zionist Organisation stepped into the breach by opening Hebrew schools of its own, and on the eve of the War, the maintenance of these schools was the principal rallying-point of Zionist enthusiasm. Between 1910 and 1914 the Organisation considerably enlarged its commitments in Palestine, and its influence was much extended.

The War Period.—The outbreak of the World War in 1914, followed almost immediately by the intervention of Turkey on the side of the Central Powers, brought Zionist work in Palestine to a standstill and threatened the integrity of the Zionist Organisation itself. The movement was essentially international, and its complicated constitution was unworkable in a world at war. At the end of 1914, a Zionist Bureau was established on neutral soil at Copenhagen. Meanwhile, the American Zionists, acting on their own initiative, had already set up a "Provisional Executive Committee for General Zionist Affairs" under the chairmanship of Mr. (later Supreme Court Justice) L. D. Brandeis. This body remained active throughout the War and played a part of growing importance in the direction of Zionist policy. Other groups organised themselves as best they could elsewhere, but though the Organisation was thus kept in being, its machinery was thrown out of gear, and at the close of the War, it found that in the interval the balance of forces within the movement had completely changed.

A new world was in the making, and it was now at least conceivable that the Zionists might secure something like the charter

on which they had originally staked their hopes. Political Zionism was again in the ascendant. The initiative was taken by a group of Zionists in Great Britain, headed by Dr. Chaim Weizmann of Manchester University. Dr. Weizmann was soon to become the foremost figure in the Zionist movement and the president of the Zionist Organisation, but in 1914, though already prominent, he was not within the inner circle. Not long after the outbreak of war, Dr. Weizmann and his friends were brought into touch with a number of influential public men, including Mr. Lloyd George, Mr. Herbert Samuel, Mr. Balfour and Mr. C. P. Scott of the *Manchester Guardian*. What the Zionists proposed was, in effect, that Great Britain should make it an avowed part of her policy to provide in the peace settlement for the establishment in Palestine of a national home for the Jews. Their desire was that the national home should be under British protection. Palestine was still in Turkish hands, and Great Britain could not in any case think of moving in the matter without consultation with her Allies. There was, however, even at this early stage, a growing body of British opinion which was sympathetically interested in the Zionist view of the Jewish problem and of the part which Great Britain might play in solving it.

By the beginning of 1916 the British Govt. had come to the conclusion that there were other and more practical reasons for taking Zionism seriously. In a memorandum dated March 13 1916, the British Ambassador in Leningrad (Petrograd) informed the then Foreign Minister, M. Sazonov, that " the attention of His Majesty's Govt. had recently been drawn to the question of Jewish colonisation in Palestine " and that " a numerous and most influential section of Jewry in all countries would highly appreciate the proposal of an agreement concerning Palestine which would fully satisfy Jewish aspirations." This memorandum has, up to the present, only been published in an official collection of documents from the archives of the Russian Foreign Office, but there is no reason to doubt its authenticity. This was on the eve of the Anglo-French accord defining the sphere of interest of the two Powers in the Middle East. In the Sykes-Picot agreement, as it is commonly called, Zionist interests were disregarded, and when the Zionist leaders in England formally laid their proposals before the British Govt. in Oct. 1916, there was no immediate response.

The Balfour Declaration.—Meanwhile, a new situation was developing in the Eastern theatre of war, and a British conquest of Palestine was becoming a possibility of the near future. At the same time, the hour of decision was approaching in the United States, where there was a Jewish population of over 3,000,000, while Russia, where the Jews were still more numerous, was steadily drifting into chaos. A declaration in favour of Zionism would help to rally Jewish opinion throughout the world to the side of the Allies. Further, the settlement in Palestine of a Jewish population attached to Great Britain by ties of interest and sentiment might well be of value in guaranteeing the permanent security of the approaches to the Suez Canal. To these practical motives was added a genuine desire to contribute towards the solution of the Jewish problem, in which British statesmen had shown themselves sympathetically interested long before the War.

All these considerations played their part in bringing the British Govt. into closer relations with the Zionist leaders. With Sir Mark Sykes as the principal intermediary, an exchange of views began in Feb. 1917, with the result that on Nov. 2 the Foreign Secretary, Mr. Balfour, wrote to Lord Rothschild:—

Dear Lord Rothschild—I have much pleasure in conveying to you on behalf of His Majesty's Government the following declaration of sympathy with Jewish Zionist aspirations, which has been submitted to and approved by the Cabinet: " His Majesty's Government view with favour the establishment in Palestine of a national home for the Jewish people, and will use their best endeavours to facilitate the achievement of this object, it being clearly understood that nothing shall be done which may prejudice the civil and religious rights of existing non-Jewish communities in Palestine or the rights and political status enjoyed by Jews in any other country." I should be grateful if you would bring this Declaration to the knowledge of the Zionist Federation.

The Balfour Declaration, as it has come to be called, was the act of Great Britain, but it was issued with the knowledge and concurrence of the Allied Powers. The French Govt. had actually anticipated the Balfour Declaration by publicly expressing its general sympathy with Zionist aims as early as June 1917. France formally associated herself with the Declaration in Feb. 1918, and Italy in the following May. As for the United States, President Wilson had personally intervened to make it clear that he would welcome a British pronouncement in favour of Zionism, and soon after the Declaration was issued, he publicly expressed his satisfaction. In 1922 resolutions associating the United States with the policy embodied in the Declaration were unanimously adopted by both Houses of Congress. At the instance of Great Britain, a Zionist delegation was given a hearing by the Peace Conference in Paris on Feb. 27 1919, but it was not until April 24 1920 that the Supreme Council of the Allies, at its meeting at San Remo, formally agreed that Palestine should be placed under a British mandate and that Great Britain should be responsible for carrying the Balfour Declaration into effect.

British Mandate for Palestine.—In Dec. 1920, the proposed terms of the Palestine mandate were submitted by the British Govt. to the League of Nations for confirmation by the Council. There was a succession of unforeseen delays, but a slightly modified draft was eventually approved by the Council at its meeting in London on July 24 1922. A few weeks earlier, the British Govt. had issued a statement of British policy in Palestine, in which it interpreted the Balfour Declaration as meaning, " not the imposition of a Jewish nationality upon the inhabitants of Palestine as a whole, but the further development of the existing Jewish community, in order that it may become a centre in which the Jewish people, as a whole, may take, on grounds of religion and race, an interest and a pride."

The mandate came into full operation on Sept. 29 1923. In its final form, it recites the Balfour Declaration in the preamble, and includes among its provisions various articles dealing with Jewish immigration, the settlement of Jews on State and waste lands, the use of Hebrew as one of the official languages, and the status of the Zionist Organisation, which is recognised as a public body entitled to advise and co-operate with the mandatory government in matters affecting Jewish interests. The Organisation is, at the same time, required to take steps to secure the co-operation of all Jews who are willing to associate themselves with it in the establishment of the Jewish national home. With this end in view, the Organisation has opened negotiations with representative Jewish bodies in Great Britain, the United States and elsewhere, and in 1925 the Fourteenth Zionist Congress resolved that an immediate effort should be made to build up a Jewish agency for Palestine on the broadest possible basis. When the Balfour Declaration was issued, it was acclaimed with enthusiasm in almost every part of the Jewish world, but it caused some anxiety among a minority who feared that the establishment of a Jewish national home in Palestine might impair their status as citizens of their respective countries. These fears cannot be said to have been completely dispelled, but though there are still many Jews who hesitate to call themselves Zionists, there is a growing tendency among Jews of all shades of opinion to unite in the practical work which is being done in Palestine under Zionist auspices.

II. THE NEW RÉGIME IN PALESTINE

Although a Zionist commission was sent to Palestine, with the approval of the British Govt., in the spring of 1918, little practical work could be done until well after the close of the War. The foundation stone of the Hebrew University of Jerusalem was laid on Mount Scopus in July 1918, but the Zionist Commission was mainly pre-occupied with relief work in the liberated areas, where the Jewish settlements had suffered severely from the direct and indirect effects of the War.

Zionism at Work.—The return to normal conditions was marked by the San Remo decision of April 1920, which was followed by the establishment in Palestine of a civil administration in the following July. Subject to the general control of the

Government, the Zionist Organisation was now for the first time in a position to bring in immigrants and to purchase land. Between the close of the War and Sept. 30 1925, about 67,000 Jewish immigrants have entered Palestine, including 8,517 in 1921, 7,844 in 1922, 7,421 in 1923, 12,856 in 1924 and about 21,000 in the first nine months of 1925. During the same period there have been about 10,000 Jewish emigrants, of whom about two-fifths were pre-War settlers, leaving a net immigration of 57,000. The Jewish population, which was about 90,000 in 1914, was reduced during the War to about 55,000. It was found to be 84,000 at the census of Oct. 1922, was officially estimated at 108,000 in March 1925 and must have risen by the end of the year to close on 130,000 or nearly 16% of the total population.

In March 1925 the number of Jews on the land was estimated at 23,000 or 21% of the Jewish population, as compared with 15,000 or 18% in Oct. 1922. At the same date the total area of land in Jewish possession was 319 sq. m. as compared with 177 sq. m. in 1914. With the exception of about 20 sq. m. of State and waste lands, all the land acquired since the War has been bought, often at inflated prices, in the open market, and in addition to the heavy expenditure in which they have thus been involved, the Jewish National Fund and other Jewish bodies have had to sink large amounts of capital in improvements, including in particular the drainage of marshes. At the same time there has been considerable increase, which has been particularly marked since 1924, in the Jewish population of the three leading towns, Jerusalem, Jaffa and Haifa. In the neighbourhood of Jaffa, the Jews have built up the separate township of Tel Aviv, which had in Aug. 1925, a population of 34,000 as compared with 13,000 in Dec. 1922, and 2,000 in Aug. 1914. The rapid growth of the towns is connected with the industrial development of Palestine, which in turn is largely due to the influx of private Jewish capital. In March 1925, it was officially estimated that since the War 150 industrial enterprises had been established in Palestine, representing in the aggregate an investment of £1,200,000, of which more than 90% was Jewish. An important factor in the industrial and general development of Palestine is the Palestine Electric Corporation, which has been financed from Zionist and other Jewish sources and which is already supplying Jaffa with electric light and power.

Education.—Since the War, the Zionist Organisation has largely extended the scope of its educational work in Palestine. At the end of 1924 it controlled 132 schools of various grades, with 550 teachers and 13,000 pupils. A Jewish technical institute was opened at Haifa in Feb. 1925 and the Zionist Organisation also maintains an agricultural institute at Tel Aviv. In April 1925, Lord Balfour formally inaugurated the Hebrew University of Jerusalem, which consists at present of three research institutes, devoted respectively to chemistry, microbiology and tropical medicine and Jewish and Oriental studies. In all these institutions the language of instruction is Hebrew, which has already become the Jewish vernacular in Palestine and is the mother-tongue of the whole of the new generation. An important branch of Zionist work in Palestine is that represented by the Hadassah Medical Organisation, which at the end of 1924 maintained five hospitals and 39 clinics, five laboratories and a Röntgen Institute, with a total staff of 63 physicians and bacteriologists. In its maternity and infant welfare work, which forms an important part of its activities, the Hadassah co-operates with the Women's International Zionist Organisation.

The entire expenditure of the Zionist Organisation is defrayed by voluntary contributions from Jews in all parts of the world. On Nov. 30 1925 its total receipts since 1917 amounted to £3,000,002. During approximately the same period, the Jewish National Fund, which exists for the purchase of land in Palestine, raised independently a further £1,026,286, making a total of £4,026,288. Including the expenditure of other Jewish bodies, such as the Palestine Jewish Colonisation Association, and the investments of private individuals, the Jewish capital brought into Palestine since the War was officially estimated at the beginning of 1925 at a total of at least £6,000,000, to which about £2,000,000 must have been added in the course of the year.

Though substantial progress has thus been made, there are Zionists who consider that the pace is too slow and who divide the blame between the Zionist executive and the British Government. Disappointment on this score was expressed at the first two post-War Congresses in 1921 and 1923, and came to a head at the Fourteenth Congress in 1925, when the Zionist executive, headed by Dr. Weizmann, felt obliged to retire from office. There was, however, an immediate revulsion of feeling. Dr. Weizmann's leadership, though freely criticised, was felt to be indispensable, and his re-election by an almost unanimous vote implied acceptance of the cautious policy for which he had always stood. Caution is essential, if only in view of the presence of the Arabs, who still form more than 80% of the population of Palestine. The Arabs did not take kindly to the Balfour Declaration, which they not altogether unnaturally misconstrued, and for some time after the War there was a tense situation which might easily have become dangerous. There were anti-Jewish demonstrations in Jerusalem in 1920, and 95 Jewish and Arab lives were lost in six days' rioting in and near Jaffa in 1921. Since then, however, there has up to the present (1925) been no serious disturbance of the peace. Anti-Zionist agitation has continued, but even this has shown a tendency to die down.

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ZOBEIR RAHAMA (1830–1913), Egyptian pasha (*see* 28.992), died at Geili, near Khartoum, Jan. 5 1913.

ZOOLOGY (*see* 28.1022).—The scheme of classification proposed in 1910 requires but little modification except in the Vertebrata; in this group considerable advances have been made. (*See* Distribution of Animals.)

The biological exploration of the continents and oceans has been carried on in all parts of the world, and the great museums have been enriched with enormous collections of both recent and extinct animals. Thus the zoological specimens in the British Museum (Natural History) increased from 1,300,000 in 1882 to 3,000,000 in 1904, and in 1926 number more than 6,000,000, of which 4,000,000 are insects. The systematist not only has to study much larger collections than formerly, but he has also to master a vastly greater literature; in addition, a more detailed and critical analysis is now expected. Thus the tendency is towards an ever-increasing specialisation. Particular attention has been paid to certain groups that directly affect man's welfare, *e.g.*, as pests of crops or carriers of disease; thus protozoology (*q.v.*), parasitology (*q.v.*) and entomology (*q.v.*) have become independent branches. Marine biology also has made great strides, following the recognition of the fact that fishery development and fishery legislation must depend on knowledge of the conditions of life in the sea. Other branches that have attracted many workers in recent years are the experimental study of heredity (*q.v.*) and variation, cytology (*q.v.*) the physiology of development and animal behaviour.

The specialisation which is so characteristic of modern zoology cannot be avoided, but makes it difficult for a worker to keep in touch with the results obtained in other fields, and is partly responsible for the output of hypotheses without application.

Classification of Vertebrata

New methods, such as the study of the microscopic structure of scales and of teeth, have revealed unexpected relationships; the more detailed study of anatomy and the discovery of a multitude of extinct types hitherto unknown have made the lines of evolution more certain, but have shown that parallelism and convergence are much more widespread than had been supposed; as a result classification is more complex, and there is an increasing tendency to subdivision.

Sir Ray Lankester recognised (*see* 28.1022) five classes of craniate vertebrates, but was careful to say that the classification was that of the specialist contributors and did not always express his own views; elsewhere he has left us in no doubt as to his opinion that the Marsipobranchii (or Cyclostomata) form a class apart, and may be regarded as constituting a separate branch, the Monorhina, opposed to the remaining classes, which may be collectively termed Diplorhina. For some years the Selachians have been recognised as a class distinct from the bony fishes, since the differences between them are more fundamental than those that separate the bony fishes from the Batrachians. The arrangement of the Diplorhina in five classes only is wanting in balance; it would be more reasonable to place all the four-footed vertebrates in one class than to treat the fishes in this way. If we wished to emphasise the principal evolutionary steps we should divide the Diplorhina into two main groups, Selachians and Bony Vertebrates, and the latter again into two, Pisces and Tetrapoda. The acquisition of a bony exoskeleton, including dentigerous praemaxillaries and maxillaries forming a secondary upper jaw, paired frontal and parietal bones, etc., and the development of an air-bladder or lung, distinguish the Pisces from the Selachians and indicate their affinity to the Tetrapoda, which originated from the Pisces by the transformation of the paired fins into pentadactyle limbs.

Recent detailed work on the palaeozoic fish-like vertebrates by Kiaer and Stensio has cleared up their relationships, so that the systematic position of *Palaeospondylus* alone remains in doubt. The Anaspida and Cephalaspida are Monorhina, the Arthrodira and Antiarcha may either be included in the Selachii, the definition of which would then have to be modified, or may constitute a class apart, and the Heterostraci, as the only Diplorhina with gill-pouches, may also rank as a class. Thus nine classes of Craniate Vertebrates may be recognised, namely Monorhina, Heterostraci, Selachii, Placodermi, Pisces, Batrachia, Reptilia, Aves and Mammalia.

Monorhina.—The most important recent contribution to our knowledge of this group is that of Kiaer (1924), who made an elaborate study of the Silurian and Devonian Anaspida and has shown that these, and also the Cephalaspida, agree with the modern lampreys and hagfishes in having an unpaired nostril, and in the form and number of the branchial openings (*see* fig. 1).

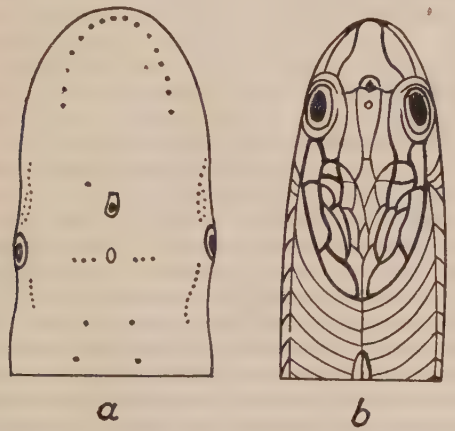

FIG. 1.—Upper view of head of *Petromyzon*. (a) compared with that of *Rhyncolepsis* (b). In both, the pineal organ is seen between the eyes, and the unpaired nostril in front of it. (From Kiaer, *Vidensk. Skrift.*, Kristiania, 1924).

The similarity of the microscopic structure of the bony armour of the Cephalaspida to that of the diplorhinal Antiarcha and Arthrodira is an extraordinary example of convergence.

Kiaer's researches give a new conception of the antiquity and diversity of the Monorhina. In the Anaspida the mouth was a terminal fissure with a distinct lateral cleft, and it may be inferred that the rounded mouth and the toothed protrusible tongue of the modern Cyclostomes are specialised features peculiar to them. Both the Anaspida and Cephalaspida had a complete exoskeleton of plates and scales, and the differences between them may be in great part due to the fact that the former were free-swimming, whereas the latter lived on the bottom; they parallel the differences between the sharks and the rays. It is probable that the Anaspida had no jaws homologous with those of the higher vertebrates, but some of them had the mouth margined above and below with paired plates, which must have functioned as jaws.

Selachii.—The Selachians (Regan, 1906) may be defined as follows: Craniate vertebrates with gills supported by visceral arches, one pair of which is modified into jaws. Nasal organs paired blind sacs; exoskeleton of dermal denticles, which are typically similar in structure to teeth; no dermal bones; endoskeleton cartilaginous; no air-bladder or lungs; fins with several layers of horny rays on each side; vertebral column with neural and haemal arches and intermuscular ribs; no supra-neural or infra-haemal arches.

Of the five sub-classes the palaeozoic Pleuropterygii and Acanthodii are more primitive than the rest in having no mixopterygia; the presence of these intromittent organs, which are paired appendages of the pelvic fins, indicates the derivation of the Ichthyotomi, Euselachii and Holocephali from a common stock. In the Holocephali the upper jaw is fused with the skull, but the hyoid arch has the same number of elements as the succeeding branchial arches, including a pharyngo-hyal; this primitive condition is a clear indication that in the common ancestor of the three sub-classes in which mixopterygia are developed the hyoid arch was not modified for the suspension of the jaws, and consequently that the condition in the Euselachii, in which the pharyngo-hyal has been lost and the hyomandibular (epi-hyal) articulates with the skull and supports the jaws, has been acquired independently and does not indicate relationship to the Pisces. Some authorities have expressed the view that the old division of the Euselachii into sharks and rays is unnatural, and have tried to improve upon it by a classification based upon supposed differences in the calcification of the vertebral centra; but a detailed anatomical study has revealed that the sharks and rays are well defined and natural divisions, and that the only group in which the structure of the centra is distinctive is the Galeoidea, in which there are four uncalcified areas radiating to the bases of the arches.

Euselachii.—The Euselachii may be classified as follows:—

Order 1. PLEUROTREMATA.—Gill openings lateral. Pectoral fins relatively narrow based; propterygial margin free. Pectoral radials typically simple and of few segments. Two halves of pectoral arch well separated above. Pterygo-quadrate attached to cranium. Hyomandibular supporting first hemibranch; ceratohyal unsegmented.

Sub-order 1. NOTIDANOIDEA. Families *Chlamydoselachidae, Hexanchidae.*

Sub-order 2. GALEOIDEA. Families *Odontaspididae, Lamnidae, Orectolobidae, Scyliorhinidae, Carchariidae.*

Sub-order 3. SQUALOIDEA. Families *Cochliodontidae, Hybodontidae, Heterodontidae, Protospinacidae, Pristiophoridae, Squalidae, Squatinidae.*

The position of the Petalodontidae is uncertain; they may not belong to the Euselachii.

Order 2. HYPOTREMATA.—Gill openings ventral. Pectorals broad-based; propterygial margin joined to side of body and head. Pectoral radials of many segments, distally bifurcated, extending to free edge of fin. Suprascapular cartilages united to vertebral column (Batoidea) or meeting above it (Narcobatoidea). Pterygo-quadrate not attached to cranium. Hyomandibular purely suspensory; ceratohyal of two or three segments.

Sub-order 1. NARCOBATOIDEA.—Family *Torpedinidae.*

Sub-order 2. BATOIDEA.—Families *Rhinobatidae, Pristidae, Raiidae, Trygonidae, Myliobatidae, Mobulidae.*

The Jurassic *Protospinax*, described by Smith Woodward (1918), appears to be ancestral to the *Pristiophoridae*, having the same relation to them that *Rhinobatus* has to *Pristis*. It is interesting to see in both the sharks and the rays the development of a long flat snout leading to a still longer projection armed with teeth on each side. The Torpedinidae are a good example of correlated adaptations, the development of the paired electric organs entailing considerable modifications of structure of the rostral and praeorbital cartilages and of the pectoral arch. The soft

smooth skin of these electric rays contrasts with the tough spinate skin of the other members of the order; evidently their power of giving electric shocks renders other means of defence superfluous.

The fact that in all three sub-orders of the Pleurotremata the pterygo-quadrate is as a rule only loosely attached by ligament to the cranium, but that in both the Notidanoidea and Squaloidea there are families in which there is a direct postorbital articulation (Hexanchidae, Hybodontidae), and in the Squaloidea also one (Heterodontidea) with a praeorbital articulation, between pterygo-quadrate and skull, points to the conclusion that in the Euselachii the purely hyostylic condition is primitive.

Placodermi.—Stensio (1925) has shown that in the Arthrodira the general characters of the neurocranium and brain are shark-like, and that although bony dermal plates are developed these fishes have no relationship to the Pisces, but are independently derived from primitive sharks. A thin layer of bone wholly or partly covers the inner and outer surface of the cartilaginous cranium, but there are no dermal bones on the ventral surface of the skull. Stensio regards the Antiarcha as rather closely related to the Arthrodira.

Pisces.—This class must have originated in Silurian times from primitive Selachians. Dermal ossification led to the formation on the body and tail of ganoid scales, rhombic plates arranged in parallel longitudinal and oblique series, and, where flexibility was not a requirement, to the development of bones, including primarily paired nasals, frontals, parietals and supratemporals on top of the cranium and a parasphenoid below, praemaxillaries and maxillaries forming a secondary upper jaw, and on each side ectopterygoid and mesopterygoid on the primary upper jaw, dentary, angular and praearticular sheathing the lower jaw, circumorbitals and praeoperculum covering the cheek, operculum, suboperculum and branchiostegals protecting the gill-chamber, and a series of bones overlying the pectoral arch and connecting it with the skull, post-temporal, supra-cleithrum, cleithrum and clavicle.

The fin-rays are ossified and segmented and form a single series on each side of the fin; these dermal rays have exactly the same relation to the muscles and the endoskeletal supports as the horny rays of the Selachians, and should be considered as homologous with them. Ossification also extended in some degree to the endoskeleton, for all bony fishes have a certain number of cartilage bones that must have been developed in their common ancestor, *e.g.*, articular, quadrate, metapterygoid. In addition to the ossified skeleton, the development of an air-bladder, or lung, the reduction of the interbranchial septa, etc., there is another very important feature that distinguishes the Pisces from the Selachii, namely the structure of the vertebral column, the Pisces having not only neural and haemal arches, but supraneural and infra-haemal arches as well; the last named are represented in the praecaudal region by pleural ribs. The typical structure may be obscured by union or loss of some of the elements, but it is well seen in the Sturgeons and Dipnoans.

Structure of Scales.—The work of Goodrich (1908) on the microscopic structure of the scales is of considerable importance in elucidating the relationships of the main divisions of the class Pisces. It is generally recognised that the primitive scales were thick rhombic juxtaposed bony plates—usually termed ganoid scales—and that thin rounded overlapping scales are more specialised. Goodrich has shown that the ganoid scales belong to three very distinct types. The first, found in the Palaeoniscidae and Polypterus, consists of parallel layers of ganoine, a glassy homogeneous substance, near the surface and of bone within, separated by cosmine, a vascular layer with bunches of minute tubules arising from the outer channels. The second, found in *Lepidosteus*, *Lepidotus*, *Pholidophorus*, etc., differs in that there is no layer of cosmine separating the layers of ganoine and bone.

The third type of scale, found in the Rhipidistia and Dipneusti, resembles the first, except that the cosmine has a very specialised and definite structure and is covered by only a thin layer of ganoine; whereas in scales of the first and second types growth is accompanied by the formation of successive layers of ganoine, in those of the third type the ganoine increases in area, but not much in thickness. The relationship of *Polypterus* to the Palaeoniscidae, first indicated by Goodrich, becomes apparent when its other characters are studied; for example, Budgett's researches on the development have shown that the pectoral fin is derived from the Palaeoniscid type; of great interest is the presence in Polypterus of an air-bladder which in structure, position and vascular supply is more primitive than that of any other fish. The close relationship of the Rhipidistia and Dipneusti was maintained by Dollo and his views are confirmed by Goodrich; from the work of Stensio (1923) it is clear that the Actinistia also are very near the Rhipidistia. We propose then to recognise only three sub-classes of the class Pisces, corresponding to the three types of scale-structure described by Goodrich, and to classify the Pisces as follows:—

Sub-class 1. PALAEOPTERYGII.—Scales, when ganoid, with a cosmine layer covered by several layers of ganoine. Dorsal and anal fins (except the dorsal of *Polypterus*) with dermal rays paired, more numerous than and not definitely articulated with their endoskeletal supports.

Orders *Archistia, Selachostomi, Belonorhynchii, Cladistia.*

Sub-class 2. NEOPTERYGII.—Scales without cosmine layer. Dorsal and anal fins with dermal rays united to form a median series of rays, each of which has its own endoskeletal support and forms a definite articulation with it.

Orders *Protospondyli, Ginglymodi, Halecostomi, Isospondyli, Haplomi, Niomi, Lyomeri, Osteriophysi, Apodes, Heteromi, Synentognathi, Microcyprini, Salmopercae, Anacanthini, Allotriognathi, Solenichthyes, Berycomorphi, Zeomorphi, Percomorphi, Scleroparei, Hypostomides, Heterosomata, Discocephali, Plectognathi, Xenopterygii, Haplodoci, Pediculati, Opisthomi, Symbranchii.*

Sub-class 3. *Crossopterygii.*—Scales, when ganoid, with a cosmine layer covered by a single layer of ganoine.

Orders *Rhipidistia, Dipneusti, Actinistia.*

Palaeoniscoids.—The Archistia (Palaeoniscoids) are in many respects the most generalised members of the class Pisces. The earliest fishes of this group were the Palaeoniscidae, swift-swimming predaceous fishes, with fins like those of the modern Polyodontidae of the order Selachostomi. In these the long based pelvic fins are essentially similar in structure to the dorsal and anal, being supported by a series of pterygiophores, segmented into two principal pieces, basals and radials, the latter contained in the well-developed muscular lobe at the base of the fin; some of the anterior basals may be united to form a pelvis. The pectoral fins are somewhat more specialised, the anterior basals forming a coracoscapular cartilage which is firmly rooted by dorsal and ventral outgrowths, the posterior forming a metapterygium. The primitive structure of the paired fins in the Palaeoniscidae and Polyodontidae makes it impossible to derive the Palaeopterygii from any known group of fishes except the Pleuropterygian sharks. The relationship of the Belonorhynchii to the Palaeoniscoids and Sturgeons has been insisted on by Stensio in his valuable account of the fishes of this order.

Neopterygii.—The sub-class Neopterygii includes most living fishes and its classification is a difficult matter; the different orders have been dealt with in a seaies of papers (Regan, 1902–25), and only a general sketch is necessary here. The Protospondyli, represented in the living fauna by *Amia*, began in the upper Permian with the Semionotidae, probably derived from the Palaeoniscidae; these were small-mouthed slow-swimming fishes feeding at the bottom on small invertebrates and many of their differences from the Palaeoniscidae may be interpreted as related to their different habits.

The Ginglymodi (*Lepidosteus*) and Halecostomi (Pholidoptoridae, Oligopleuridae) are offshoots of the Protospondyli. In these three orders the hypurals supporting the upper lobe of the caudal fin are attached to the upturned end of the vertebrae column. The Halecostomi are distinguished by their mouth structure, the jaws being delicate and feebly toothed and the praemaxillaries small and loosely attached, whereas in the Protospondyli and Ginglymodi the praemaxillaries are strong fixed bones that extend backwards to join the frontals and are perforated for the olfactory nerves. The Halecostomi are herring-like fishes, and were evidently plankton-feeders like the herrings, whose place they occupied in Triassic and Jurassic times. At the

end of the Jurassic they gave rise to the earliest Isospondyli, fishes almost identical with the modern Elopidae, larger and more active swimmers than the Halecostomi, with a more widely forked caudal fin, the upper lobe of which is supported by hypurals attached to a few paired bones—uroneurals—probably enlarged and displaced neural arches of posterior vertebrae, the centra of which have aborted; this caudal structure is characteristic of the remaining orders. The Isospondyli are physostomous, *i.e.*, the air-bladder has a pneumatic duct; of other fishes that agree with them in this respect it is easy to separate off the Ostariophysi, in which certain elements of the anterior vertebrae form a chain of ossicles connecting the air-bladder with the ear; and the apodes, or eels, in which the praemaxillaries are fused with the mesethmoid.

But the limits and contents of the order Isospondyli are a difficult question. In the Clupeoids, which include the Elopidae, the vertebral column is primitive, the parapophyses, or at least those of the anterior vertebrae, being separate bones wedged into pits in the centra; the Salmonoids and Stomiatoids agree with them in this, but the more specialised families of both these groups have lost the mesocoracoid, which was formerly considered diagnostic. Other fishes that have retained the mesocoracoid (Osteoglossoids, Mormyroids, etc.) have strong parapophyses ankylosed to the centra; these are provisionally classed in the Isospondyli, but should perhaps be separated as orders. The Haplomi (Esocidae, Umbridae, Dalliidae) differ from the Clupeoids in the loss of the mesocoracoid and in having the mesethmoid replaced by a pair of large dermal bones. The Iniomi (Scopeloids) are a large and varied group, the most primitive members of which are near the Elopidae, but differ in that the praemaxillaries exclude the maxillaries from the oral border, the parapophyses are not autogenous, and the mesocoracoid is absent The Lyomeri (*Saccopharynx*, *Gastrostomus*) are perhaps an offshoot from the Iniomi.

Of the physoclistic orders the first seven (Heteromi to Solenichthyes) are isolated groups that may have evolved independently from the Isospondyli or Iniomi; they agree in that the pelvic fins are formed of articulated rays and are abdominal in position, or if thoracic (Anacanthini, Allotriognathi) the pelvic bones are not directly attached to the cleithra. Jungersen (1908) has made a valuable contribution to our knowledge of the osteology and classification of the Solenichthyes. The Berycomorphi, which were abundant in Cretaceous seas, are evidently derived from clupeoid Isospondyli; in this group we see acquired features that are characteristic of the remaining orders, the anterior dorsal and anal rays and the outermost pelvic ray modified into spines and the pelvic bones directly attached to the cleithra. The Zeomorphi are related to the Berycomorphi, from which the Percomorphi also are derived; these are unknown before the basal Eocene; they differ from the Berycomorphi in the loss of orbtosphenoid, the reduction in number of the pelvic rays (never more than six), etc.; they are the dominant benthic fishes in the coastal waters of tropical and warm temperate seas and have branched out in all directions, giving rise to a number of more specialised groups, some of which, *e.g.*, Gobioids, Blennioids, are provisionally retained within the order, whereas ten others are given ordinal rank, including the Scleroparei, or mail-cheeked fishes; the Heterosomata, or Flatfishes; the Discocephali, or sucker-fishes; and the Pediculati, or angler-fishes. The position of the Hypostomides is somewhat uncertain, but Jungersen (1914) regards them as related to the Scleroparei.

Special Orders.—Some zoologists may be surprised at the large number of orders of the sub-class Neopterygii, if they have not realised that this group is much larger and more varied than either of the classes Aves or Mammalia. Attention may be called to three orders in which discoveries of special interest have been made, namely Microcyprini, Allotriognathi and Pediculati. The Microcyprini include the Cyprinodonts, a group of small brackish and fresh-water fishes that includes both oviparous and viviparous forms; in most of the oviparous species there are marked differences between the sexes, and in some of them courtship and pairing have been observed; viviparity has arisen independently three or four times in tropical America, accompanied by quite different modifications of the anal fin of the males for purposes of internal fertilisation; but in the viviparous Phallostethinae of Johore the uro-genital openings are remote from the anal fin, and the males are provided with a priapium, an extraordinary intromittent organ placed beneath the head and chest, with a special skeleton, muscles, glands and external appendages of its own, and involving remarkable modifications of the cleithra and of the anterior vertebrae and ribs for its attachment.

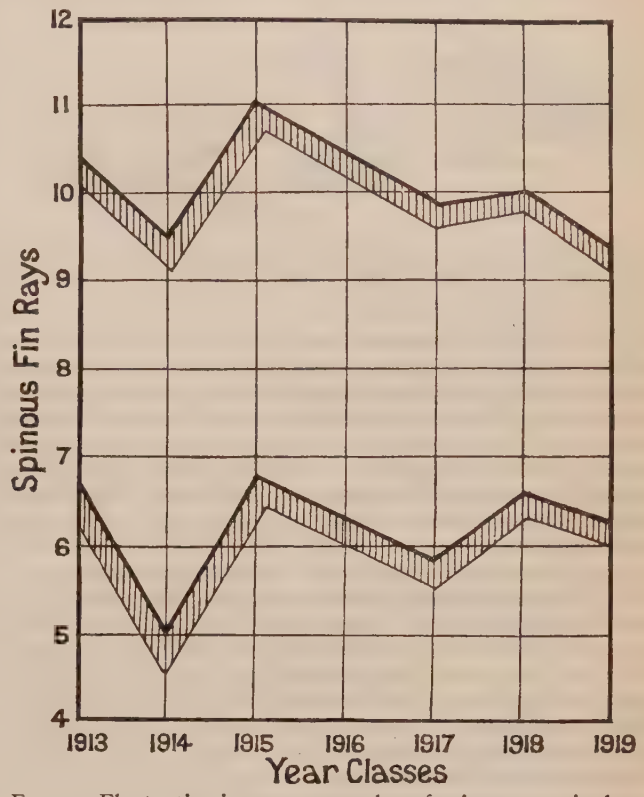

FIG. 2.—Fluctuation in average number of spinous rays in dorsal fin of *Zoarces viviparus* in successive year classes (excluding 1916) of two separate populations (after J. Schmidt).

The Allotriognathi, a small but isolated and particularly well defined group of oceanic fishes, are noteworthy for the difference in form and structure between the most generalised and the most specialised members of the order, the deep-bodied *Lampris* and the eel-shaped *Stylophorous*. In *Stylophorus* the eyes are telescopic that is to say they are large, cylindrical, placed close together and directed forwards; it may be inferred that *Stylophorus* uses binocular vision to find food; this would be captured by the sudden protrusion of the small toothless mouth, which is extraordinarily protractile. The very long lower jaw is articulated far behind the head, and by a downward movement of its anterior end pulls the upper jaw away from the head so that the mouth appears at the end of a long membranous pouch. The most interesting feature is that this protraction of the mouth would be downward, not forward, the direction in which the eyes have sighted something to be caught, were it not accompanied by an upward movement of the head, produced by the contraction of the muscles attached to the top of the skull; thus *Stylophorus* loses sight of its prey in the act of catching it. In the Pediculati, or angler-fishes, the first ray of the dorsal fin is placed on top of the head and is modified into a line and bait; there are three sub-orders, of which the Ceratioids are inhabitants of the middle depths of the ocean, from about 500 to 1,500 metres below the surface; they are uniformly pigmented and their bait is a luminous lure.

It has been discovered that in the Ceratioids the males are dwarfed and parasitic on the females, to which they are attached by outgrowths of the snout and tongue that unite with the skin

of the female in such a way that it is impossible to say where the one fish begins and the other ends (*see* fig. 3); the blood systems of the two fishes appear to be continuous, and it seems that the male must receive nutriment from the blood of the female, as the small toothless mouth is closed in front and the alimentary

FIG. 3.—*Edriolychnus schmidti*, male, attached to inner face of praeoperculum of female. Four times natural size. (From *Proc. Roy. Soc.*, (B), 97, 1925).

canal is vestigial. The evolution of males of this kind becomes intelligible when we consider that the Ceratioids are solitary, slow-swimming fishes that live in darkness and are necessarily few in number in comparison with the more active fishes on which they prey; in such circumstances the difficulty experienced by mature fishes in finding a mate may have led the males to form the habit of seeking for females as soon as they are hatched, when they are relatively numerous, and if they find one becoming attached to her.

Crossopterygii.—The Rhipidistia, which flourished in Devonian and Carboniferous times, are the most generalised order of the sub-class Crossopterygii; in the structure of the pectoral fins they are more specialised than the Archistia, none of the radials articulating with the pectoral arch and the segmented metapterygium projecting outwards, so that the lobe of the fin tends to separate from the body and to become narrow based; the pelvic fins appear to have been somewhat similar. The scales may easily have been derived from the Palaeoniscid type by reduction of the ganoine and specialisation of the cosmine. The Dipneusti, distinguished by fusion of the pterygo-quadrate with the skull and the reduction of the hyomandibular, doubtless originated from unknown early Devonian or pre-Devonian Rhipidistia; they are the only order of the sub-class with living representatives. The Actinistia (Devonian to Cretaceous) appear to be highly specialised Rhipidistia in which the lobes of the paired fins are shortened, the pectorals having about four radiating radials (one probably representing the metapterygium) that articulate directly with the pectoral arch; the hyomandibular (epi-hyal) is small and does not support the jaws (*cf.* Stensio). The skeleton of the head of the Rhipidistia is almost identical with that of the earliest Batrachians, and the pectoral fins are of a type that might easily have been transformed into pentadactyle limbs; the origin of the Batrachia from fishes of this order seems certain.

Batrachia.—Watson (1919) has made a detailed investigation of the structure of the Stegocephalia, from which he removes the Phyllospondyli (Branchiosauria) and Lepospondyli (Microsauria) as separate orders, and for the remainder uses the name Labyrinthodonta in an extended sense.

Labyrinthodonts.—There is a complete gradation of structure between the rachitomous and stereospondylous forms, which merely mark evolutionary stages. Watson's classification of the Labyrinthodonta is as follows:—

Order LABYRINTHODONTA.

Grade 1. EMBOLOMERI. Families *Anthracosauridae, Loxommidae, Cricotidae*, etc.
Grade 2. RACHITOMI. Families *Eryopidae, Rhinesuchidae, Dissorophidae, Trematopsidae, Micropholidae*, etc.
Grade 3. STEREOSPONDYLI. Families *Capitosauridae, Trematosauridae, Brachyopidae*, etc.

It has long been recognised that the current classification of the frogs and toads is unsatisfactory, but great progress towards a more natural arrangement has been made by Noble, who has followed up the work of Nicholls (1916) by a more extended investigation of the structure of the vertebral column, and has tested his results by detailed research on the thigh musculature. Noble's classification is as follows:—

Order SALIENTIA (Ecaudata).

Sub-order 1. OPISTHOCOELA. Families *Discoglossidae, Pipidae.*
Sub-order 2. ANOMOCOELA. Family *Pelobatidae.*
Sub-order 3. PROCOELA. Families *Bufonidae, Hylidae, Brachycephalidae.*
Sub-order 4. DIPLASIOCOELA. Families *Ranidae, Brevicipitidae.*

This scheme is perhaps not final, and the reduction in number of families which has followed the discovery that the characters supposed to be diagnostic were of little value may be replaced by an increase in number when further work clears up the relationships of the genera and enables natural groups to be defined. The Bufonidae, for example, appear to be a somewhat heterogeneous assemblage.

Reptilia.—In recent times our knowledge of extinct reptiles has been greatly advanced by a number of workers, especially Broom, Case, Williston and Watson; as a result many modifications of the classification have been proposed. There seems to be general agreement that the primary divisions should be termed sub-classes rather than orders, but none as to their number. The proposal to recognise only four or five sub-classes according to the number and position of the temporal vacuities has received considerable support, but appears to be open to the objections that apply to most classifications based on modifications of a single character—objections that are strengthened by the probability that the temporal vacuities are related to the jaw muscles in such a way that they either give exit to them upon the top of the skull or afford room for them at the sides (Gregory and Adams). We prefer for the present to retain the nine principal groups defined in 1910 (*see* 23.142), adding to them a tenth, the Cotylosauria, formed by the removal from the Anomodontia of those primitive reptiles in which the temporal region of the skull is completely roofed over.

In the following scheme of classification of the Reptilia only those orders are included whose position seems assured; a comparison of the recent classifications of Watson (1917) and Williston (1925) will show that there is some difference of opinion as to the groups that should be given ordinal rank and as to the relationships of many incompletely known extinct forms.

CLASS REPTILIA

Sub-class 1. COTYLOSAURIA.
  Orders *Seymouriamorpha, Diadectomorpha, Captorhinomorpha.*
Sub-class 2. ANOMODONTIA.
  Orders *Pelycosauria, Therapsida.*
Sub-class 3. CHELONIA.
  Orders *Pleurodira, Cryptodira.*
Sub-class 4. SAUROPTERYGIA.
  Orders *Nothosauria, Plesiosauria, Placodonta.*
Sub-class 5. ICHTHYOSAURIA.
Sub-class 6. SQUAMATA.
  Orders *Pythonomorpha, Lacertilia, Ophidia.*
Sub-class 7. RHYNCHOCEPHALIA.
  Orders *Thecodonta, Sphenodonta.*
Sub-class 8. CROCODILIA.
  Orders *Eosuchia, Thalattosuchia.*
Sub-class 9. DINOSAURIA.
  Orders *Theropoda, Sauropoda, Ornithopoda, Stegosauria, Ceratopsia.*
Sub-class 10. PTEROSAURIA.

The most important orders omitted are the Proganosauria and Thallatosauria, aquatic reptiles of uncertain relationships, but the former perhaps near the Ichthyosauria.

Some of the Cotylosauria are not easily distinguished from the contemporary Labyrinthodonts, and the classes Batrachia and Reptilia are no longer definable by skeletal characters. Some of the Therapsida approach the Mammalia, which are evidently derived from this group.

Chelonians.—The Chelonian genus *Dermochelys* was formerly isolated in a group Athecae, in opposition to the rest of the Chelonia, which were termed Thecophora; it is now included in the Cryptodira, the flattened ribs and modified vertebrae indicating its derivation from forms that possessed a carapace. Dollo pointed out that the chelonian carapace and plastron must have

originally been acquired as a protection by slow-moving terrestrial reptiles, and that in some late Cretaceous members of the group this armour was greatly reduced or was lost in relation to a pelagic life. If the descendants of such forms resorted to the coasts to breed they might have acquired a new armour not supported by the vertebrae and ribs, and if their descendants again became pelagic this also might have been reduced. He interpreted the numerous little smooth polygonal plates in the skin of the pelagic *Dermochelys* as the remnants of a secondary armour that was at one time strong and effective. In *Psephophorus* of the Oligocene and Miocene, related to *Dermochelys*, the plates were stronger than in that genus and were sculptured and Dollo considered that an Eocene genus must have existed in which they were larger and stronger than in *Psephophorus;* this has since been discovered in Eocene deposits of Nigeria and was described by C. W. Andrews as *Cosmochelys*, a leathery turtle with a strong epithecal shield with sculptured surface. It is of great interest that the soundness of Dollo's method of reasoning should have been confirmed by the discovery of this link in the chain.

Aves.—Little has been done since 1910 on the classification of birds, but the division of these into Ratitae and Carinatae is artificial and the grouping proposed by Pycraft (1899) is preferable. Pycraft showed that there are two types of palate, and he divided the Neornithes into two groups, the Palaeognathae (Ratitae+Tinamiformes) and the Neognathae. In the Palaeognathae the pterygoids are connected with the palatines by suture or ankylosis, in the Neognathae by means of opposed glenoid surfaces. The Tinamovs are the only modern birds with the primitive type of palate that have retained the keeled sternum.

Mammalia

The origin of the Mammalia from the Therapsid Reptiles is now generally accepted, and among these the Cynodonts make the nearest approach to the Mammals in skeletal structure. Broom (1912) has shown that in *Cynognathus* a considerable part of the articular surface for the lower jaw is formed by the squamosal, and that the posterior end of the dentary nearly takes part in the joint; there is thus no longer any difficulty in understanding how the quadrate-articular joint of reptiles has given rise to the squamosal-dentary joint of mammals. As the direct articulation of the dentary on the squamosal became more firmly established, the quadrate, articular and angular degenerated, and according to Broom might have been lost had not the attachment of the stapes to the quadrate compelled them to take on an auditory function, the quadrate becoming the incus, the articular the malleus and the angular the tympanic bone. Thus the vexed question of the homology of the mammalian auditory ossicles may be regarded as settled, palaeontology confirming the conclusions derived from embryology.

Another paper by Broom (1914) on the structure and affinities of the Multituberculata may be considered to have settled the long controversy as to the systematic position of these animals, which are definitely shown to be Prototheria and not Marsupials. The resemblances to the living Monotremes are so close that it is suggested that these are specialised and degenerate descendants of Jurassic Multituberculates.

Broom (1915, 1916) has studied the structure of the "Organ of Jacobson," and remarks:—

> "Changes in habit bring about the most marked alterations in teeth, bones and many viscera, but the delicate little cartilages in the nose are so little affected that we find almost the same type of structure in forms so dissimilar as the sheep, cat, hedgehog, bat and lemur. And as the arrangement is an extremely complicated one we seem justified in assuming that the similarity indicates affinity and common origin of these types, rather than independent developments of this remarkable structure."

So far as is known at present there are two types of structure of this organ in the Mammalia, the primitive or Marsupial type, found in *Dasypus*, *Orycteropus* and Rodents; and the higher Eutherian type, found in Ungulates, Carnivores, *Lemur* and *Procavia*. Broom has investigated this organ in Insectivores, and has shown that in *Macroscelides*, *Tupaia*, etc., it is formed as in Polyprotodon Marsupials, whereas in *Erinaceus*, *Gymnura*, etc., it is of the higher Eutherian type. Consequently he regards the Insectivores as an artificial group, and separates from them *Tupaia* and its allies to form the order Menotyphla. Further, as *Chrysochloris* has the organ of Jacobson of the primitive type, but with peculiarities of its own, and as this genus differs widely from the Menotyphla in other characters, he places it in a separate order Chrysochloroidea. *Centetes*, which had been considered to be related to *Chrysochloris*, was found to be a true insectivore, the organ of Jacobson resembling that of *Sorex* and *Talpa*.

The general result of other studies of the Mammalia has been to increase the number of orders; for example, giving ordinal rank to the groups formerly placed together under the headings "Edentata" and "Ungulata."

Comparable in importance with Broom's investigations on the organ of Jacobson are those of Carter (1917, 1922) on the microscopic structure of the teeth, which lead him to state that the enamel pattern, in conjunction with tube penetration of the enamel, suffices to discriminate between Multituberculates, Marsupials and Placentals, and the different groups of Placentals. He has found that Marsupial teeth are characterised by tubular penetration of the enamel, and his demonstration that the teeth of *Dasyurus* and *Thylacinus* are precisely similar in structure accorded with Regan's view (1914) of the close relationship of these genera, in opposition to American authorities (Gregory, Sinclair) who thought that *Thylacinus* was allied to that puzzling group of carnivorous mammals from the Miocene of Patagonia known as Sparassodontia. Whether these are Marsupials or Creodonts is still uncertain, for although Carter found in them tubular penetration of the enamel, his later researches led him to the conclusion that enamel pattern is more important than tubular penetration in determining affinities, and the enamel pattern of the Sparassodonts is Creodont:

A suggestion put forward by Wood-Jones that *Tarsius* should be regarded as more nearly allied than any other living animal to Man, led to a discussion at a meeting of the Zoological Society (1919) when the weight of opinion was against Wood-Jones, but seemed to favour the view that *Tarsius* was more nearly related to monkeys than to lemurs. Had Carter's results (1922) been available the debate would probably have run on quite different lines. He has shown that in the teeth of Primates the enamel pattern is of two distinct types—(1) In the Catarrhines and Mascarene Lemurs (and in the Eocene lemuroids *Notharctus* and *Pelycodus*) the prisms or rods of the enamel are of a somewhat granular structure, have straight, even margins and are separated by a slight amount of interstitial substance. (2) In the Platyrrhines, *Tarsius* (and the Eocene tarsioid *Hemiacodon*), Asiatic and African lemurs the prisms have undulating margins and are separated by a considerable amount of interstitial substance.

From this it is evident that the classification of the Primates will have to be revised, and that the evolution of the Anthropoidea, or Catarrhines, from the Lemuroidea, has been to some extent paralleled by the evolution of the Platyrrhines and Tarsioids from another group of Lemurs. There are plenty of comparable examples in other groups—for instance, the evolution in South America of the Litopterna, which show many resemblances to the Perissodactyla.

Human Descent.—Tarsius is thus clearly seen to be nowhere near the line of descent of Man, whose affinities to the anthropoid Apes have been made more certain in recent years by the discovery of extinct types of man possessing ape-like features that have been lost in modern man (Smith Woodward, 1925). Of these the most notable is the Piltdown Man, discovered in gravels of late Pliocene or early Pleistocene age at Piltdown in Sussex, combining a typically human skull with an ape-like lower jaw and large canine teeth that interlock in the true ape fashion.

This find gave rise to a great deal of discussion, and some were ready to maintain that the skull was that of a man and the lower jaw that of an ape, and that their association was accidental; the discovery of fragments of another skull associated with another ape-like canine tooth may be considered to have disposed of this idea. The Rhodesian skull, from a cave in the Broken Hill Mine,

Rhodesia, is of unknown age; it is remarkable for the enormous brow-ridges, more prominent than in any other human skull. In spite of this ape-like feature Smith Woodward maintains that the relationships of Rhodesian Man are with the Australian race, and he compares it especially with the fossil Australian skull from Talgai in Queensland rather than with the more primitive Neanderthal Man, to which at first sight it seems to bear more resemblance (*see* EVOLUTION OF MAN).

Vertebrate Classification. Publications: C. W. Andrews, "A Leathery Tortoise from the Eocene of Nigeria," *Proc. Zool. Soc.* (1919); R. Broom, "Mammalian Auditory Ossicles," *Proc. Zool. Soc.* (1912); *ibid.*, "Organ of Jacobson in the Insectivora," *Proc. Zool. Soc.* (1915); *ibid.*, "Structure and Affinities of the *Multituberculata*," *Bull. Amer. Mus.*, vol. 33 (1914); "Origin of Mammals," *Phil. Trans. R. Soc.* (B) vol. 206, (1915); J. S. Budgett, "Structure of larval *Polypterus*," *Trans. Zool. Soc.*, vol. 16 (1902); J. T. Carter, "Structure of Enamel in Marsupials," *Phil. Trans. R. Soc., Ser.* (B) vol. 208, (1917), and *J. Anat.* (1919); "Structure of Enamel in Primates," *Proc. Zool. Soc.* (1922); E. S. Goodrich, "Structure of Scales of Fish," *Proc. Zool. Soc.* (1907); W. K. Gregory, "Orders of Mammalia," *Bull. Amer. Mus.* vol. 27 (1910); W. K. Gregory and L. A. Adams, "Temporal Fossae of Vertebrates," *Science*, vol. 41 (1915); H. E. Jungersen, "Ichthyotomical Contributions," *Dansk. Vidensk. Selsk. Skrift*, vol. 6 (1908); "Anatomy of Pegasus," *Rep. Brit. Assn.* (1914); J. Kiaer, "Anaspida," *Vidensk. Skrift* (Kristiania, 1924); G. K. Noble, "Phylogeny of the Salientia," *Bull. Amer. Mus.*, vol. 46, (1922); W. P. Pycraft, "Palaeognathae and Neognathae," *Trans. Zool. Soc.*, vol. 15 (1899); C. T. Regan, papers on Classification of Fishes in *Ann. Mag. Nat. Hist.* (1902–25 especially 1909–13); "Classification of Selachians," *Proc. Zool. Soc.*, vol. 2 (1906); "Allotriognathi," *Proc. Zool. Soc.* (1908) and *Proc. R. Soc.*, (B) vol. 96 (1924); "Phallostethinae," *Proc. Zool. Soc.* (1916); *Lepidosteus* and Lower Neopterygian Fishes, *Proc. Zool. Soc.* (1923); "Dwarfed Males of Ceratioids," *Proc. R. Soc.*, (B) vol. 97 (1925); E. A. Stensio, *Triassic Fishes from Spitsbergen*, Pt. 1 (Vienna, Holzhausen, 1921): Pt. 2 in *Svensk. Vet. Akad. Handl.* (3) 2, (1925); "The Head of the Macropetalichthyids (Arthrodira). *Field Mus. Publ. Geol.* vol. 4, No. 4 (1925); D. M. S. Watson, "Evolution of Amphibia," *Phil. Trans. R. Soc.*, (B) vol. 209, (1919); "Classification of Pre-Jurassic Tetrapoda," *Proc. Zool. Soc.* (1917); S. W. Williston, *Osteology of Reptiles* (1925); A. S. Woodward, "New Elasmobranch Fishes from the Jurassic," *Proc. Zool. Soc.* (1918); "The Origin of Man," in *Phases of Modern Science* (Denny, 1925). (C. T. R.)

ZORN, ANDERS (1860–1920), Swedish artist was born at Mora, Sweden, Feb. 18 1860, of a family of farmers. He began his artistic career as a water colour artist, later transferred his attention to oil painting, and made his first attempt at etching in London in 1882. He afterwards achieved distinction as a sculptor. From 1881 he travelled extensively abroad, and in 1888 settled down in Paris, where he stayed about 10 years. In 1893 he became the Swedish commissioner at the Chicago World Exhibition. Zorn is renowned for his extremely characteristic and picturesque portraits, in which, owing to his sensitive study of values, he gives proper play to light and half tones. He was not only a master of oil painting, but one of the foremost etchers of his time, attaining great effects by simple means. Zorn, whose production was particularly abundant, passed his last years in Sweden and died in his native town on Aug. 22 1920.

ZUBATÝ, JOSEF (1855–), Czech philologist, studied classical, Slavonic and especially Sanskrit philology and in 1891 was appointed professor of Sanskrit and comparative philology at the Czech University of Prague. His numerous publications, which deal with the most varied aspects (etymology, grammar, phonetics and metrics) of Indo-European philology with special reference to Sanskrit and Balto-Slavonic, include: *On the Development of metrical form* (1886); *Contributions to the interpretation of Oscan inscriptions* (1886); *On the development of the Indian drama and its relation to Greek drama* (1887); *On Vedic literature* (1888); *On the Mahabharata* (1892); *On alliteration in Lettish and Lithuanian folk-songs* (1894). The above are all in Czech, but Zubatý wrote extensively in German, his most important work in this language being the etymological Lithuanian dictionary now in preparation (1926) for Streitberg's Indo-Germanic textbooks. He translated Kalidasa's dramas into Czech.

ZULOAGA, IGNACIO (1870–), Spanish painter (*see* 28.1049), had become by 1921 the head of a definite school of Basque and Castilian painters, whose work was marked by a realistic and decorative treatment of contemporary Spanish life, consciously based on Velasquez, El Greco and Goya. His art showed increasing emphasis on silhouette, simplification of form and use of broad masses of sombre colour relieved by splashes of more vivid tints. In his figure compositions a low horizon and a panoramic background were favourite devices for obtaining a decorative monumental effect. Women and the nude figure played an important part in Zuloaga's work. In his portraits, of which typical examples are "Lucienne Bréval in *Carmen*," "Cousin Candida," "The Duke of Alba" and "Countess Mathieu de Noailles," emphasis is on the type rather than the individual, and the combination of realism and simplification tends towards caricature. This also appears in his *genre* paintings of Spanish types, peasants, dancers, bullfighters, priests and beggars, such as "Old Castile," "The Bottleseller" and "The Witches of San Millan." His landscapes, mainly painted round Burgos, Salamanca and Segovia, have a similar bizarre, fantastic quality. His later work includes "My Uncle Danial and his Family" (1912), "A Cardinal" (1914), "Toreadors" (1914) and "Un Versolari" (1916). An important retrospective exhibition of his work was seen at the 1919 International Exhibition at Bilbao, and he was represented by three portraits in the 1920–1 Exhibition of Spanish Paintings at Burlington House.

See also: L. Bénédite, *Ignacio Zuloaga* (1912); Juan de la Encina, *El Arte de Ignacio Zuloaga* (1916).

ZULULAND (*see* 28.1050), has an area of 10,427 square miles. In 1921 the natives numbered 250,829; the white inhabitants 3,985. Although incorporated in Natal most of Zululand is held as native reserves. Since 1907 the country has been peaceful. European influence has modified native life, but the tribal system continues and although there is no longer an official recognised paramount chief the Zulu sense of nationality remains strong. This was shown at the indaba held in June 1925 in honour of the Prince of Wales, when 40,000 warriors assembled at Eshowe. On that occasion Solomon Dinizulu, a grandson of Cetewayo, though officially of no higher rank than other chiefs, was selected to address the Prince as the spokesman of the nation. Dinizulu, Cetewayo's son, had died in Oct. 1913. In 1905 the coast belt was opened to white planters for the cultivation of sugar cane; by 1923 some 70,000 ac. were under cane. Cotton cultivation has been taken up since 1922, in which year the Union Govt. had a survey made for a railway and harbour in Northern Zululand.

See *Official Year Book of the Union of South Africa* (Pretoria, 1925); and *The South and East African Year Book and Guide* (London, annually).

ZÜRICH, Switzerland (*see* 28.1057), a busy industrial city, with large silk manufactures and the financial centre of Switzerland, had a population of 207,161 in 1920. New quarters, with broad streets and fine buildings, have developed round the old town, and Zürich is now largely a modern city, with an admirable system of traffic control. The Pestalozzium, which contains educational exhibits and Pestalozzi's study, has been moved to a new building on the left bank of the Limmat, near the Urania bridge. A central library on the right bank, in which the libraries of the town and canton, and those of the legal, medical and natural history societies have been combined, was finished in 1916; it contains also collections of prints and engravings. The Zürich Society of Arts has thrown open the Kunsthaus, in the Heimplatz, with collections of pictures, sculpture and engravings; and in 1919 the Landolthaus, an interesting example of a nobleman's house in the Hirschengraben, was arranged as a museum by the same society. New municipal offices have been built, and a site was chosen in 1923 on the left bank of the river for a town hall. The state archives of the town are now kept in the old Prediger Kirche in the Zahringer Platz. The Frau Munster church, near the bridge of the same name, was modernised in 1912. The university, which is noted for its medical school and for the large numbers of women students, has been moved to a site south of the city. The new buildings, finished in 1914, consist of two wings connected by a massive tower.

ZURICH, UNIVERSITY OF (*see* 27.769).—There are curious but instructive fluctuations in the numbers of students at this ancient university. From 1910–4 there was a steady increase in men students while the women decreased in numbers. The War brought students to the university, the highest number being 1916 in the winter of 1916–7, including 289 women students. Numbers diminished after the War but rose again to 1730 in 1924–5, the women students totalling 262. New chairs have been founded in veterinary pathology, bacteriology and hygiene, mathematics, physical chemistry, art and living Oriental languages and Islamic studies. Developments of an important nature have taken place in view of the provision of new buildings for general purposes, a central university library, clinics for diseases of the eyes, ears, nose and throat. A notable benefaction is the Julius Claus Foundation in 1919 of Fr 1,274,052 for social anthropology and racial hygiene.

ZUYDER ZEE (*see* 28.1049).—After numerous plans had been drafted and various bills laid before the Dutch Chamber, Dr. C. Lely, Minister for Public Works, who for decades past had been the motive force in this direction, succeeded in 1918 in securing the passage of a Bill providing for the drainage of the Zuyder Zee at the expense of the State.

The Zuyder Zee at present covers an area of about 3,570 square kilometres. When drained, there will remain a fresh-water lake covering 1,450 square kilometres. The reclaimed land, divided into four polders by the new lake (to be called Yssel Lake), and the mouths of the Amstel and the Yssel, will cover an area of almost 2,112 sq. km., or seven times the area of the County of London. Of this land, 1,950 sq. km. will consist of exceedingly fertile soil, so that the Netherlands by peaceable conquest will have added 6% to its territory. To render this drainage possible, the Zuyer Zee must be separated from the North Sea by a dike. The construction of this dike, a stupendous work of hydraulic engineering, is to be completed in 1934. In 1918 the cost of this work was estimated by law at £5,500,000. The length of the dike will be 29.3 kilometres and the height (presumably) six metres above the water level. The top will be only two metres in width. On the inside berm, however, there will be room for a road 17 metres wide, over which a double-track railway will run. The dike will be equipped with 30 discharge sluices, each 10 metres wide and five metres deep. Further, there will be two locks, respectively 10 and six metres wide. These sluices and locks will maintain communication between the Yssel Lake and the North Sea. It is hoped that the north-western polder, covering an area of 220 sq. km., will be completed at the same time as the dike and that all four polders will be in exploitation by 1958.

In 1918, the cost of the drainage proper (cost of the dike excluded) was estimated at almost £13,000,000. A committee appointed in 1922 considered it probable that the proceeds from the sale of the land would cover all costs, assuming the value to be about £25,000 per square kilometre. Among the advantages resulting from the scheme will be the improved water discharge for the provinces which are now situated on the shores of the Zuyder Zee and the alleviation of the shortage of land, with a concomitant decrease of dependence on imports for food supply.

The drainage will exercise considerable influence on the aspect of the numerous Zuyder Zee fishing villages and small ports. Harderwyk, which in the Middle Ages was one of Holland's most important ports and one of the great Hansa towns, will be situated in the heart of the country. Assistance is to be provided by the State for that part of the population which the drainage will deprive of a means of livelihood. (*See* NETHERLANDS.)

(F.J.W.D.)

CHRONOLOGICAL TABLE OF EVENTS

JANUARY 1 1911—JULY 31 1926

This table, intended for rapid reference, gives dates of the principal events that have happened throughout the world during the period covered by the Three New Volumes of the ENCYCLOPÆDIA BRITANNICA

1911

JAN. 1—Diplomatic relations resumed between United States and Nicaragua (broken off in 1909).
JAN. 1—Proclamation issued in Australia accepting Canberra as site of new Federal capital.
JAN. 1—Francesco I. Madero, Jr., commences revolt in Mexico.
JAN. 3—First Postal Savings Bank opened in United States.
JAN. 9—First South American Postal Congress at Montevideo.
JAN. 9–17—Strike of 22,000 coal miners at Liége, Belgium.
JAN. 10—Commander Sims, U.S. Navy, reprimanded by President's instructions for stating in speech at Guildhall, London, that United States would at once and actively support British Empire against a menacing foe.
JAN. 12—Riots in Bombay at Mohurrum celebrations. Troops fired on crowd, killing and wounding 42 persons.
JAN. 20—Andrew Carnegie gave ten million dollars to the Carnegie Institute of Washington, D.C.
JAN. 21—Boundary Convention signed by United Kingdom and Liberia.
JAN. 21—Reciprocity Agreement signed by United States and Canada.
JAN. 23—International Opium Convention signed by Germany, United States, Great Britain, France, China, Italy, Japan, Holland, Persia, Portugal, Russia and Siam.
JAN. 25—Lord Curzon installed as Lord Rector of Glasgow University, Scotland.
JAN. 30—The Duke of Connaught appointed Governor-General of Canada.
JAN. 30—Eruption of Taal Volcano, Philippine Islands. About 1,300 persons killed.
JAN. 31—J. W. Lowther elected Speaker of British House of Commons for fourth time.
JAN. 31—Dynamite explosion in Jersey City, N.J. About 20 persons killed and much property damage.
FEB. 6—Ramsay MacDonald elected Chairman of British Labour Party.
FEB. 6—Great fire in Constantinople. Nearly whole of central portion of city destroyed.
FEB. 6—Missouri State Capitol at Jefferson City destroyed by lightning.
FEB. 13–17—Pan-American Commercial Conference in Washington.
FEB. 14—McCall Bill (Canadian Reciprocity) passes U.S. House of Representatives.
FEB. 19—Russian note to China demanding commercial facilities in Mongolia.
FEB. 24—United States ratifies new Commercial Treaty with Japan.
FEB. 28—First direct Primary held in Chicago, resulting in nomination of Carter H. Harrison (Dem.) and C. E. Merriam (Rep.) for Mayor.
MARCH 2—Lord Denman appointed Governor-General of Commonwealth of Australia.
MARCH 7—Resignation of Mr. Ballinger, U.S. Secretary of the Interior.
MARCH 7—Michelin prize of £4,000 won by Renaux for flight from Paris to Puy-de-Dôme, 210 miles in 5 hours.
MARCH 7—20,000 U.S. troops ordered to the Mexican border of Texas.
MARCH 10—Greenwich time adopted in France.
MARCH 11—Wales beats Ireland in International Rugby Football Match by 16 points to nil, thereby winning International Championship.
MARCH 13—U.S. Supreme Court upholds Corporation tax.
MARCH 15—Third reading of the Parliament Bill carried in the British House of Commons by 362 votes to 241.
MARCH 17—Law against opium-smoking comes into force in China.
MARCH 17—Cunard Steamship Company announces its acquisition of Thomson Line from London to Canada.
MARCH 24—Mexican Cabinet resigns.
MARCH 25—Great fire in New York blouse factory. 141 girls (chiefly Italian, Irish and Hungarian) killed.
MARCH 27—Giolitti Cabinet formed in Italy.
MARCH 28—China accepts all Russia's demands. (See Feb. 19.)
MARCH 28—Loss of Australian coastal steamer "Yongola" on Barrier Reef off Queensland. Crew of 70 and 68 passengers lost.
MARCH 29—State Capitol at Albany, N.Y., partly burnt down.
MARCH 31—Lötschberg Tunnel between Kandersteg and Rhone Valley completed.
MARCH 31—Japan ratifies Commercial Treaty with United States.
APRIL 1—Oxford wins University Boat Race by 2¾ lengths in record time of 18 min. 29 sec.
APRIL 3—Commercial Treaty signed between Great Britain and Japan.
APRIL 5—Announcement that the London *Observer* had been acquisited by W. W. Astor (now Lord Astor).
APRIL 12—Champagne riots in France renewed.
APRIL 13—Battle in Mexico between Government troops and rebels. U.S. troops cross border and put an end to fighting.
APRIL 15—American, British, French and German bankers sign agreement for loan of $50,000,000 to China.
APRIL 19—The "Fram" (Amundsen Antarctic Expedition) arrives at Buenos Aires on return journey.
APRIL 22—Armistice concluded by Mexican Government with rebels.
APRIL 26—Serious floods in Buenos Aires.
APRIL 28—Total eclipse of sun. Line of totality crossing South Pacific.
APRIL 30—Large part of Bangor, Maine, destroyed by fire.
MAY 1—May Day celebrations prevented in Paris by concentration of 12,000 troops.
MAY 3—Sale of letter from Martin Luther to Emperor Charles V. for 102,000 marks at Leipzig.
MAY 5—Ratifications exchanged of Anglo-Japanese Commercial Treaty of April 3.
MAY 8—Opium Agreement signed at Peking between China and Great Britain.
MAY 10—Fighting recommences in Mexico. Insurgents capture Juarez.
MAY 12—Henry L. Stimson appointed U.S. Secretary of War.
MAY 15—U.S. Supreme Court upholds decision for dissolution of Standard Oil Company.
MAY 15—Peace conference at Juarez, Mexico, between Madero and the Federal Government (see May 21).
MAY 16—Remains of Neanderthal man found in cave in Jersey, Channel Is.
MAY 16—Queen Victoria Memorial, London, unveiled by King, in presence of Emperor and Empress of Germany.
MAY 16—German Zeppelin "Deutschland" wrecked at Düsseldorf.
MAY 21—General Moinier's relief force enters Fez.
MAY 21—Madero, Mexican insurgent leader, signs a peace pact at El Paso.
MAY 22—Opening of New York Public Library on Fifth Avenue.
MAY 25—Resignation of Mexican President, Diaz.
MAY 25—De la Barra inaugurated provisional President of Mexico.
MAY 26—Committee of Imperial Defence meets in London.
MAY 26—Védrines flies from Paris to Madrid in 12 hr. 18 min. (actual flying time).
MAY 28—U.S. Supreme Court decrees dissolution of Tobacco Trust.
MAY 31—Fortress blown up at Laloma, Nicaragua. 150 persons killed.
MAY 31—"Derby" won by J. B. Joel's "Sunstar."
JUNE 2—Imperial Conference in London passes resolution in favour of Declaration of London, Australia not voting.
JUNE 7—Severe earthquake in Mexico City. 63 persons killed.
JUNE 10–JULY 3—Seamen's Strike in English, Belgian and Dutch ports.
JUNE 13—Morgan Shuster, American financial adviser, becomes Treasurer-General in Persia.
JUNE 17—Demonstration in London of 40,000 women in favour of Woman Suffrage.
JUNE 19—Republic proclaimed in Portugal. Recognition by United States.
JUNE 19—Imperial Conference in London passes resolution urging uniform laws on immigration.
JUNE 21—"Olympic" completes maiden voyage, Southampton to New York, in 5 d. 16 hr. 42 min.
JUNE 22—Coronation of King George V. and Queen Mary.
JUNE 26—Caillaux Cabinet formed in France.
JULY 1—Emigration of indentured Indians to Natal, South Africa, ceases to be lawful under Emigration Act of 1910.
JULY 1—Compulsory military service introduced in Australia.
JULY 1—Gordon-Bennett Cup for aerial speed won by C. T. Weymann (United States).
JULY 1—German warship "Panther" sent to Agadir to protect German interests in Morocco.
JULY 6—Resignation of Sir Eldon Gorst, British Agent and Consul-General in Egypt.
JULY 7—Fur Seals Convention prohibiting pelagic sealing till 1926 signed at Washington, between Gt. Britain, United States, Japan and Russia.
JULY 10–12—Severe forest fires in Northern Ontario. 400 lives lost.
JULY 13—Encounter between Mexican Federal Troops and followers of Madero. 40 killed.
JULY 13—Anglo-Japanese Treaty signed, prolonging Treaty of 1905 until July 1921.
JULY 15—Japan ratifies Treaty of June 24 with Germany.
JULY 16—Lord Kitchener appointed British Agent and Consul-General in Egypt.
JULY 17—Announcement that Germany had formulated demands for large territory in French Congo in return for non-interference in French action in Morocco.
July 20—House of Lords passes the Parliament Bill.
JULY 26—Bill for Reciprocity with Canada signed by U.S. President.
JULY 29—Canadian Parliament dissolved on question of Reciprocity policy with United States.
AUG. 1–11—Dockers strike in London.
AUG. 3—Anglo-American and Franco-American Arbitration Treaties signed at Washington.
AUG. 4—Metropolitan Art Museum, New York, acquires Carpaccio's picture "A Pieta" for 12,300 guineas.
AUG. 7—International Regatta held at Spithead, England. German Emperor's "Meteor" wins International Cup for Schooners.
AUG. 9—Wreck of S.S. "Fifeshire" off Cape Guardafui. 11 passengers and 14 of crew drowned.
AUG. 9—Announcement of appointment of General Sir John French as chief of Imperial General Staff in Great Britain.
AUG. 9—Temperature of 100° F. in shade at Greenwich, England—record for Great Britain.
AUG. 9—Collision in Straits of Gibraltar between French steamer "Emir" and British steamer "Silverton." 86 lives lost in the "Emir."
AUG. 12—U.S. Senate deletes clause in Anglo-American Arbitration Treaty giving conditional power to Commission of Inquiry to decide when arbitration is necessary.
AUG. 14—First appropriation (£252,000) in British House of Commons for payment of members.
AUG. 14—Russo-Japanese Agreement concerning railways in Manchuria.
AUG. 15—Serious riots in Liverpool in connection with strikes.
AUG. 17—Railway strike in Ireland begins.
AUG. 17—Russo-German agreement signed regarding railways in Russian sphere of influence in Persia.
AUG. 17–20—General Railway Strike in Gt. Britain.
AUG. 18—Parliament Act in Great Britain receives Royal assent.
AUG. 19—Fatal riot at Llanelly, Wales, in connection with strike. Soldiers fire on crowd. 2 deaths.
AUG. 20—Airman at Chicago establishes record by flying to height of 11,726 ft.
AUG. 21—British Government agrees to appointment of Special Commission to enquire into question of railway trouble.
AUG. 22—Discovery made at the Louvre, Paris, of theft of Leonardo da Vinci's "La Gioconda."

AUG. 24—British steamer "Foam Queen" seized by British Customs officials in belief that she was carrying men and war material to foreign revolutionists.
AUG. 24—Dr. Manual Arriaga elected President of Portuguese Republic.
AUG. 25—Aviator A. N. Wood completes a flight from St. Louis to N.Y. City in 28 hr. and 27 min. actual flight time.
AUG. 29—Death of H. H. the Nizam of Haiderabad.
SEPT. 1—National Gallery, London, acquires Jan Gossart's "Adoration of the Kings" for £40,000.
SEPT. 2—Agreement signed between China and Japan for extension of Peking-Mukden Railway line into Mukden.
SEPT. 5—South American Company's steamer "Tucapel" wrecked between Panama and Valparaiso. 81 persons drowned.
SEPT. 5–6—T. W. Burgess of Rotherham, England, swims English Channel from South Foreland to Cape Gris Nez.
SEPT. 9—First aerial post in Great Britain inaugurated between Hendon and Windsor.
SEPT. 10—Great eruption of Mt. Etna.
SEPT. 11—Portuguese Republic recognised by Great Britain, Germany, Austria-Hungary, Italy and Spain
SEPT. 11—Trials commenced in Madras High Court of 14 Indians accused of complicity in murder of Mr. Ashe.
SEPT. 14—Lord Rosebery installed as Lord Rector of St. Andrew's University, Scotland.
SEPT. 14—Russian Premier, M. Stolypin, fatally wounded by anarchist at Kieff.
SEPT. 21—General Election in Canada. Sweeping victory of Conservatives and defeat of Reciprocity policy with United States.
SEPT. 21—Death of Arabi Pasha, leader of Egyptian revolution 1881–2.
SEPT. 23—Great Anti-Home Rule Demonstration in Belfast, Ireland.
SEPT. 25—Explosion on French battleship "Liberté" in Toulon harbour. 226 deaths on various ships.
SEPT. 26—Suspension of payment by Bank of Egypt.
SEPT. 27—Italy presents ultimatum to Turkey stating that Tripoli will be immediately occupied by Italian troops.
SEPT. 29—Italy declares war on Turkey.
SEPT. 30—Towns of Austen and Costello, Pa., destroyed by bursting of dam. 150 lives lost.
OCT. 1—Coalition of Social Democratic Federation and other British Socialist groups, forming "British Socialist Party."
OCT. 1—General Madero elected President of Mexican Republic.
OCT. 4—End of railway strike in Ireland.
OCT. 5—Tripoli occupied by Italian troops.
OCT. 10—R. L. Borden becomes Prime Minister of Canada.
OCT. 10—Chinese rebellion against Manchu dynasty begins.
OCT. 11—Inauguration of Ontario Hydro-Electric Power Transmission system.
OCT. 12—Gustav Hamel flies across English Channel from Hardelot to Maidstone.
OCT. 20—Report of Railway Commission in Great Britain issued.
OCT. 21—Archduke Charles Francis Joseph of Austria married to Princess Zita of Parma.
OCT. 23—Winston Churchill becomes First Lord of the Admiralty in Gt. Britain.
OCT. 22—Opening of National Assembly in China.
OCT. 26—Failure of Turkish attack on Tripoli. Counter-attack by Italians.
OCT. 26—Proceedings begun by U.S. Attorney-General for dissolution of Steel Corporation.
OCT. 28—Dr. Bourne, Archbishop of Westminster, made a Cardinal.
OCT. 28—Earl of Minto elected Lord Rector of Edinburgh University; Mr. Birrell elected Lord Rector of Glasgow University.
OCT. 30—Edict issued from Throne in Peking, apologising for past neglect and granting immediate Constitution and free pardon to rebels.
NOV. 2—Largest fleet ever assembled in U.S. waters reviewed by President Taft in the Hudson.
NOV. 2—British Antarctic Expedition under Captain Scott starts for South Pole from McMurdo Sound, Ross Island.
NOV. 4—Two treaties signed between France and Germany regarding Morocco and respective possessions in Africa.
NOV. 5—Tripolitania and Cyrenaica formally annexed to Italy.
NOV. 7—Nobel Prizes for Chemistry and Literature awarded respectively to Madame Curie and M. Maurice Maeterlinck.
NOV. 8—A. J. Balfour resigns from leadership of British Unionist Party.
NOV. 9—Republic proclaimed at Canton, China.
NOV. 10—Great massacre by Manchus at Nanking.
NOV. 10—Prince Arthur of Connaught, Archbishop of Canterbury, Lord Chancellor, and Lord President of the Council nominated by King of England to be Counsellors of State to transact business during His Majesty's visit to India.
NOV. 11—King and Queen of England leave London for India.
NOV. 12—Ultimatum presented to Persia by Russia demanding withdrawal of Treasury gendarmes from property of Ex-Shah, and apology from Foreign Minister. Persia complied Nov. 23.
NOV. 13—A. Bonar Law elected leader of British Unionist Party.
NOV. 19—Diplomatic relations between Persia and Russia broken off.
NOV. 25—Russian troops concentrating on Persia ordered not to advance for present beyond Resht, in province of Gilan.
NOV. 25—Russia sends circular note to Powers regarding neutrality of Dardanelles.
NOV. 26—French Government issues decree regulating air traffic in France.
NOV. 27—German cruiser "Berlin" (sent to relieve "Panther" at Agadir) withdrawn.
NOV. 29—Russia sends new ultimatum to Persia demanding dismissal of Morgan Shuster, Treasurer-General.
NOV. 29—Announcement of Great Britain's assent to Franco-German Treaty regarding Morocco.
DEC. 1—Persia refuses to comply with Russia's demands. Russian troops ordered to advance into interior from Resht.
DEC. 1—International Opium Conference opened at The Hague.
DEC. 2—King and Queen of England arrive at Bombay.
DEC. 5—Brothers J. B. and J. J. McNamara sentenced in United States to imprisonment for life and for 15 years respectively, for dynamite outrages at Los Angeles.
DEC. 12—Coronation Durbar held at Delhi, India. Transfer of capital of India to Delhi announced.
DEC. 13—Loss of P. & O. Ship "Delhi" off Moroccan Coast. Passengers and crew saved, including Duke and Duchess of Fife.
DEC. 15—President Taft announces that United States intends to abrogate Treaty of 1832 with Russia.
DEC. 15—First stone of new capital of India laid at Delhi by King-Emperor.
DEC. 16—Amundsen reaches South Pole.
DEC. 18—Peace Conference between Imperialists and Republicans in China opened at Shangai.
DEC. 20—French Chamber ratifies Franco-German Treaty regarding Morocco.
DEC. 22—Cunard liner "Lusitania" arrives at Fishguard from New York, completing round trip from Liverpool in 12 days, 17 hours, 2 min.
DEC. 22—Election results in New Zealand show following figures; Ministerialists 37, Opposition 37, Labour and Socialists 4.
DEC. 24—Persia agrees to Russian demands, including dismissal of Morgan Shuster.
DEC. 26—Opening of Indian National Congress.
DEC. 27—Cotton trade lock-out begins in England.
DEC. 31—Dr. Sun Yat-sen, organiser of revolution in China, elected President of the Republic.

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JAN. 1—British telephone service passes under Post Office Control.
JAN. 4—New Mexico admitted as a State of the United States.
JAN. 6—Railway from Peking to sea occupied by troops of Foreign Powers.
JAN. 6—Establishment of Naval War Staff in Great Britain.
JAN. 9—Building of Equitable Life Insurance Co. in New York destroyed by fire. Seven lives lost; damage $5,000,000.
JAN 10—Miss Emily Davison, suffragist, sentenced in England to six months imprisonment for attempts to destroy contents of Post Office letter boxes.
JAN. 10—King George V. and Queen Mary leave India.
JAN. 12—General elections in Germany. Socialist victory.
JAN. 14—U.S. Supreme Court upholds constitutionality of Employers Liability Act.
JAN. 14—Poincaré Ministry formed in France.
JAN. 16—Cotton trade dispute in England settled. (See Dec. 27 1911.)
JAN. 16—Fire at Osaka, Japan; over 5,000 houses burnt; 30,000 persons homeless.
JAN. 16—President Taft warns Cuban Govt. that the United States will intervene if the military continues to interfere in politics.
JAN. 18—British Steamer "Wistow Hall" wrecked with loss of 53 hands.
JAN. 18—British Antarctic expedition, under Captain Scott, reaches South Pole.
JAN. 23—International Opium Convention signed at The Hague.
JAN. 26—British Anglican Cathedral at Khartum consecrated by Bishop of London.
JAN. 30—International Agreement signed regarding Commission of Bankers to receive Customs Revenue in China.
FEB. 1—Mexican insurgents proclaim Emilio Vasquez Gomez President.
FEB. 2—British submarine A3 collides and sinks during exercises off Isle of Wight with loss of 4 officers and 10 men.
FEB. 4—Return of King George V. and Queen Mary from India.
FEB. 7—Lord Haldane leaves England for Germany for purpose of unofficial discussions with German ministers.
FEB. 9—Official declaration in England regarding Lord Haldane's visit to Berlin.
FEB. 10—Death of Lord Lister, founder of antiseptic surgery.
FEB. 10—French Senate adopts Franco-German Treaty regarding Morocco.
FEB. 12—Abdication of Manchu dynasty in China. Republic formally inaugurated.
FEB. 14—Arizona admitted as a State of the United States.
FEB. 14—Resignation of Sun Yat-sen from Chinese Provisional Government. Yuan-Shih-Kai elected Provisional President on 15th
FEB. 15—Major-General Ainsworth. Adjutant-General U.S. Army suspended from duty for insubordinate reply to Secretary of War when ordered to report on Hay Army Bill. Subsequent resignation.
FEB. 17—Graham Gilmour killed while flying at Richmond, England.
FEB. 20—Appointment of Count Berchtold as Foreign Minister in Austria-Hungary.
FEB. 21—Houston, Tex. partly destroyed by fire.
FEB. 22—British Medical Association decides not to conform with National Insurance Act unless minimum demands of Association are met.
FEB. 24—Turkish gun-boat and destroyer sunk by Italian warships at Beirut.
FEB. 29—Coal strike in Great Britain begins.
MARCH 7—U.S. Senate strikes out Article III of Arbitration Treaties with Great Britain and France.
MARCH 7—Captain Amundsen arrives at Hobart, Tasmania, after reaching South Pole.
MARCH 7—Henri Salmet makes non-stop flight from London to Paris in 3 hr. 25 min.
MARCH 9—King George V. lays foundation stone of London County Hall.
MARCH 10—Mlle. Suzanne Bernard killed during flying tests in France.
MARCH 12—Ratifications exchanged of Franco-German Treaty of Nov. 4 1911.
MARCH 14—Attempted assassination of King Victor Emmanuel of Italy.
MARCH 16—Scotland beats England at Rugby Football by 8 points to 3, regaining Calcutta Cup.
MARCH 16—P.&O. Steamer "Oceana" sinks off Beachy Head, South Coast, England, in collision with German ship "Pisagua". Seven passengers and some members of crew lost.
MARCH 18—33 killed and 50 injured by boiler explosion at San Antonio, Cal. on Southern Pacific railway.
MARCH 18–24—Strike of 1,200 taxi-cab drivers in London.
MARCH 20—Explosion in Saubois Mine, Okla. 105 lives lost.
MARCH 20—Resignation of Sir Joseph Ward as Premier of New Zealand. Succeeded by Thomas Mackenzie.
MARCH 21—S.S. "Koombana" sunk in typhoon off West Australian coast. About 130 lives lost.
MARCH 23—Opening of first trial by jury in China.
MARCH 25—International Maritime Conference opens at St. Petersburg.
MARCH 27—Coal Mines (Minimum Wage) Bill passes in Great Britain.
MARCH 29—Approximate date of loss of Captain Scott's party on return from South Pole.
MARCH 30—Franco-Moroccan Treaty signed accepting French Protectorate of Morocco.
MARCH 31—Irish Home Rule Demonstration by Nationalists in Dublin.
APRIL 1—Oxford wins University Boat-race by 3 lengths, in 22 min. 5 sec.
APRIL 1—New Province of Bihar and Orissa formed in India. Sir C. S. Bayley becomes first Governor.
APRIL 3—Floods in Mississippi Valley. 30,000 persons rendered homeless.
APRIL 4—Ten boxes of gold, worth £50,000 recovered from wreck of "Oceana" on March 16.
APRIL 8—Nile excursion steamer in collision near Cairo. 200 reported drowned.
APRIL 9—Large demonstration at Belfast, Ireland, against Home Rule.
APRIL 9—Preferential trade agreement signed at Ottawa between Canada and West Indies (not including Jamaica and Bermuda).
APRIL 11—Coal strike in England ends. (See Feb. 29.)
APRIL 11—Irish Home Rule Bill introduced in British House of Commons.
APRIL 14—Strike of 1,200 Sheffield moulders settled, having lasted 7 weeks.
APRIL 14–15—White Star liner "Titanic" sunk on maiden voyage to New York, through collision with iceberg. 1,503 victims.
APRIL 17–18—Mutiny of Shereefian troops in Fez. Massacre of French officials.
APRIL 18—Forts at entrance to Dardanelles bombarded by Italians.
APRIL 23—Nationalist Convention at Dublin accepts Home Rule Bill.
APRIL 25—Anthracite Coal Strike in Pennsylvania settled.
APRIL 30—Turkish steamer "Texas" sunk by mine in Gulf of Smyrna. 68 lives lost.
MAY 1—Dardanelles reopened to neutral shipping.
MAY 4—Italians occupy Rhodes.
MAY 9—Irish Home Rule Bill passes second reading in British House of Commons.
MAY 10—Picture of "Mrs. Elizabeth Hay" by Raeburn realised 21,200 guineas in London.
MAY 10—Miss Kate Malecka, said to be British subject, convicted at Warsaw of belonging to revolutionary organisation. Sentenced to 4 years' penal servitude followed by deportation for life.
MAY 15—Boundaries of Quebec, Ontario and Manitoba extended.
MAY 18—Women's Suffrage Bill in Sweden defeated.
MAY 20—Turkish Council of Ministers decide on expulsion of all Italians from Turkey except artisans, widows and orphans and members of religious orders.
MAY 22—Count Tisza elected President of Austro-Hungarian Chamber.
MAY 22—Mr. and Mrs. Pethick Lawrence and Mrs. Pankhurst, English suffragists, sentenced to nine months' imprisonment for conspiracy.
MAY 23—Strike of London transport workers begins.
MAY 24—Entry into Fez of General Lyautey.
MAY 24—Report issued of British Commission on "Titanic" disaster.
MAY 27—Panic through fire in cinema near Castellon, Spain. 80 deaths.
MAY 28—Report issued of American Congressional Committee on "Titanic" disaster.
JUNE 3—Great fire at Constantinople renders 15,000 persons homeless.
JUNE 4–15—Radio-Telegraphic Conference held in London. Thirty countries represented.
JUNE 5—Derby won by W. Raphael's "Tagalie."

JUNE 5—U.S. Marines land in Cuba.
JUNE 8—First Aerial Derby (flight of 81 miles round London won by Gustav Hamel in 98 min. 46 sec.
JUNE 8—French submarine "Vendemaire" sunk in collision with battleship "St. Louis" with all hands.
JUNE 9–12—German Naval Squadron visits New York.
JUNE 10—Lord Haldane appointed Lord Chancellor of Great Britain to succeed Lord Loreburn.
JUNE 11—Miss Kate Malecka (see May 10) released by Imperial decree and expelled from Russia.
JUNE 12—Colonel Seely becomes British Secretary of State for War.
JUNE 18—Agreement signed between Great Britain, France, United States, Germany, Russia and Japan regarding Reorganisation Loan to China.
JUNE 18—National Republican Convention held at Chicago. President Taft and Vice President Sherman re-nominated for office, June 22.
JUNE 24—National Democratic Convention opens at Baltimore. Woodrow Wilson nominated for President with T. R. Marshall for Vice President July 2.
JUNE 25—Government of India Bill receives Royal assent.
JUNE 26–27—International Regatta held at Kiel.
JUNE 30—Cyclone at Regina, Canada, killed thirty-one persons and did much damage.
JULY 1—French Chamber ratifies Treaty with Morocco regarding Protectorate.
JULY 2—Congress of Universities of British Empire opened in London. 50 universities represented.
JULY 2—Dirigible balloon "Akron" catches fire at Atlantic City, New Jersey, at height of 1,000 ft. Crew of 5 killed.
JULY 3—Plot discovered at Cairo to murder Khedive, Prime Minister and Lord Kitchener. Several Nationalists arrested.
JULY 3—Mexican insurgents defeated at Chihuahua, losing 4,000 men.
JULY 4—Accident to express train at Corning, New York. 42 persons killed.
JULY 5—International Radio-Telegraph Convention signed in London by 46 countries.
JULY 6—Olympic Games open at Stockholm.
JULY 8—End of Camorra Trial at Rome. Sentences of imprisonment vary from four to thirty years.
JULY 8—British Government protests against U.S. Panama Canal Bill.
JULY 9–10—Resignation of T. MacKenzie, Prime Minister in New Zealand. W. F. Massey forms new ministry.
JULY 9—Explosion at Cadeby Colliery, Yorkshire, kills 86 men, including Chief Inspector of Mines for district.
JULY 11—R. L. Borden, Canadian Premier, confers with Committee of Imperial Defence in London on naval policy.
JULY 12—Preliminary agreement for loan of £10,000,000 to China signed by Great Britain and China.
JULY 13—Olympic Games closed. Sweden heads list of victors.
JULY 13—Casement Report on conditions in Putamayo issued.
JULY 15—National Insurance Act comes into force in Great Britain.
JULY 24—First International Eugenics Congress opened in London.
JULY 30—British report on loss of "Titanic" published. Court find that ship was being navigated at excessive speed.
JULY 30—Death of Mutsuhito, Emperor of Japan.
JULY 31—End of transport workers' strike in England. (See May 23.)
AUG. 1—G. E. Morrison, English journalist, appointed Political Adviser to Chinese President.
AUG. 7—National Progressive Convention held at Chicago nominates Theodore Roosevelt for President and Hiram W. Johnson for Vice President.
AUG. 7—Mrs. Mary Leigh and Miss Gladys Evans, suffragists, sentenced to 5 years' penal servitude for setting fire to Theatre Royal, Dublin.
AUG. 8—Announcement of Russo-Japanese Agreement delimiting respective spheres of influence in Mongolia and Manchuria.
AUG. 9—Earthquake at Constantinople and round Sea of Marmora. 6000 persons killed and 40,000 homeless.
AUG. 13—Three Nationalists in Egypt sentenced to fifteen years' imprisonment for conspiracy against lives of Khedive, Lord Kitchener and Prime Minister.
AUG. 14—Proclamation at Rabat of abdication of Sultan of Morocco, Mulai Hafid, and substitution for him of his brother Mulai Yusef.
AUG. 16—France and Russia sign naval convention at St. Petersburg.
AUG. 19—U.S. President sends message to Congress stating that Panama Canal Bill does not violate text of any existing treaty.
AUG. 20—Death of General Booth, founder of the Salvation Army.
AUG. 24—Panama Canal Bill signed by U.S. President. He adds Memorandum that it does not violate Hay-Pauncefote Treaty of 1900.
AUG. 29—Terrible floods in Wen-chau, China. 30,000 lives lost.
SEPT. 1—Explosion in La Clarence Mine, Bruny, France. 54 lives lost.
SEPT 10—Agreement signed increasing wages of Lancashire cotton-spinners by 10 per cent.
SEPT. 12—M. Paschitch becomes Prime Minister of Servia.
SEPT 14—Lord Denman inaugurates Trans-Australian Railway from Port Augusta to Kalgoorlie.
SEPT. 23—15th International Congress of Hygiene and Demography opened at Washington, D.C.
SEPT. 25—Terrible typhoon in Japan. Hundreds of lives lost. Damage exceeded £4,000,000.
SEPT. 28—Ulster Covenant signed at Belfast.
SEPT. 30—Formation of Balkan League by Bulgaria, Servia, Greece and Montenegro.
OCT. 1—Turkish Army mobilised against Balkan States.
OCT. 4—British submarine B2 cut in two by Hamburg-Amerika liner "Amerika." Crew of 14 lost.
OCT. 8—Montenegro declares war on Turkey.
OCT. 11—Select Committee appointed in London to enquire into Marconi contract.
OCT. 12—U.S. District Court at Hartford, Con., awards $250,000 damages in the Danbury Hatters' Case against the United Hatters Union.
OCT. 12—Germany, Austria, Great Britain, France and Russia send note to Turkish Government on subject of Balkan war.
OCT. 13—Bulgaria, Servia and Greece present identical notes to Turkey, demanding autonomy for Macedonia.
OCT. 15—Turkey replies to note from Powers, repudiating foreign intervention.
OCT. 14—Ex-President Roosevelt shot at by Socialist at Milwaukee during Presidential elections.
OCT. 16—Typhoon in Philippine Island 400 persons killed.
OCT. 17—Turkey declares war on Bulgaria and Servia. Greece declares war on Turkey on 18th.
OCT. 18—Peace Treaty between Italy and Turkey signed. (Treaty of Lausanne.)
OCT. 22—Resignation of F. D. Monk from Canadian Cabinet through disagreement with Borden naval policy.
OCT. 24—Capture of Kirk Kilisse by Bulgarians.
OCT. 26—Agreement between France and Spain regarding Morocco.
OCT. 27—Felix Diaz condemned to death by Court Martial at Vera Cruz.
OCT. 28—Protest against Salt Gabelle signed at Peking by eleven Powers, parties to the Peace Protocol, for presentation to Chinese Government.
OCT. 28—France and Italy sign declaration at Paris with reference to Morocco and Libya.
OCT. 30—Death of J. S. Sherman, U.S. Vice-President.
OCT. 30–NOV. 1—Anglo-German Conference in London, for promotion of better understanding between two countries.
OCT. 31—Main Turkish Army under Nazim Pasha defeated by Bulgarians.
NOV. 3—Agreement signed between Russia and Mongolia, under which Russia undertakes to support Mongolia in maintaining her autonomy.
NOV. 3—Turkey appeals to Powers for mediation in Balkan War.
NOV. 6—Woodrow Wilson elected President of the United States by large electoral majority over the Republican candidate.
NOV. 9—Greek army captures Salonika from Turks.
NOV. 11—Resignation of Rt. Hon. James Bryce, British Ambassador to United States. Succeeded by Sir Cecil Spring-Rice.
NOV. 11—British Government defeated in House of Commons on amendment to financial resolution of Irish Home Rule Bill.
NOV. 11–16—International Motor Show held at Olympia, London.
NOV. 12—Discovery of remains of Captain Scott and his companions (British Antarctic Expedition).
NOV. 12—Prime Minister of Spain, Senor Canalejas, assassinated in Madrid.
NOV. 13—Proclamation issued fixing rates of toll to be paid by vessels using Panama Canal.
NOV. 17—Battle of Chatalja between Turks and Bulgarians. Bulgarian attack repulsed.
NOV. 18—100 lives lost by hurricane and tidal wave in Jamaica.
NOV. 18—Naval contingents of Powers land at Constantinople to protect Embassies.
NOV. 18—Capture of Monastir by Servians.
NOV. 19—Balkan Allies inform Turkey that they are prepared to discuss terms for an armistice.
NOV. 21—Turkish cruiser "Hamidiyeh" sunk off Varna in naval action with Bulgarians.
NOV. 21—Turkey rejects Powers' suggestions for armistice.
NOV. 21—Greeks occupy Mytilene.
NOV. 24—Proclamation of union of Samos with Greece.
NOV. 24—Forty-one children killed at Bilbao, Spain, in panic caused by alarm of fire at cinematograph show.
NOV. 26—Andrew Carnegie announces that he has placed all his fortune, except 25 million dollars, in the Carnegie Corporation of New York.
NOV. 27—Treaty signed at Madrid between France and Spain regarding respective spheres of influence in Morocco.
NOV. 28—Proclamation of independence and neutrality of Albania.
DEC. 2—Flying record established by Corporal Fels, (Argentine Engineers), Buenos Aires to Montevideo in 2 hrs. 22 min.
DEC. 2—U.S. Supreme Court orders dissolution of Harriman Union Pacific and Southern Pacific Railway merger as a violation of the Sherman Anti-Trust Law.
DEC. 3—Armistice arranged at Chatalja between Turkey and Balkan States. (Greece not a party.)
DEC. 6—Announcement of appointment of Admiral Prince Louis of Battenberg as First Sea Lord of the Admiralty in Great Britain to succeed Admiral Sir Francis Bridgeman, resigned.
DEC. 7—Renewal of Triple Alliance between Germany, Austria-Hungary and Italy.
DEC. 10—Italian steamer "Derna" sinks off Portland with loss of 36 lives, in collision with H.M.S. "Centurion."
DEC. 12—Government Reform Bill passed in Denmark.
DEC. 14—General Botha, South African Premier, resigns, owing to differences with General Hertzog but is asked by Lord Gladstone to form new ministry.
DEC. 15—Death of Whitelaw Reid, U.S. Ambassador to Great Britain.
DEC. 16—Conference at London between representatives of the Porte and Balkan allies to discuss terms of peace.
DEC. 20—Nobel Prize for Literature awarded to Gerhardt Hauptman.
DEC. 20—Powers represented at Balkan Peace Conference accept principle of autonomy of Albania, and of Servia's commercial access to the Adriatic.
DEC. 23—Aswan Dam, Egypt, opened for traffic.
DEC. 23—Bomb thrown at Lord Hardinge, Viceroy of India, on occasion of his first entry into new capital, Delhi.
DEC. 28—Conviction at Indianapolis of 38 officials and members of unions in connection with the Los Angeles dynamite outrages in 1910.

1913

JAN. 1—Strike of London taxicab drivers begins.
JAN. 1—Parcel post system inaugurated throughout the United States.
JAN. 2—Turkish garrison of Chios surrenders to Greeks.
JAN. 5—Death of Zubeir Pasha, leading figure in Sudanese history.
JAN. 5—Herr von Jagow appointed Foreign Minister in Germany.
JAN. 6—London Peace Conference between Turkey and Balkan States suspended.
JAN. 9—Lord Willingdon appointed Governor of Bombay.
JAN. 13—U.S. Senate finds judge Aschhold guilty on five impeachment charges. He is removed from the bench.
JAN. 16—Irish Home Rule Bill passes third reading in British House of Commons.
JAN. 16—George Parrott, warrant officer in British Navy, sentenced to four years' penal servitude for espionage.
JAN. 17—M. Poincaré elected President of France.
JAN. 18—Greco-Turkish naval battle off Tenedos.
JAN. 18—British doctors released by British Medical Association from pledge of refusal to work under the Insurance Act.
JAN. 21—Briand Cabinet formed in France.
JAN. 23—Turkish coup d'état. Murder of Nazim Pasha. Resignation of Kiamil Pasha. New Ministry formed under Mahmoud Shevket Pasha.
JAN. 27—Franchise Bill withdrawn in British House of Commons.
JAN. 27—Viceroy of India opens first meeting of Legislative Council at Delhi.
JAN. 28—Suffragist demonstration in London owing to withdrawal of Franchise Bill.
JAN. 30—Irish Home Rule Bill rejected in British House of Lords.
FEB. 1—Opening of main portion of Grand Central Terminus of New York Central Railroad.
FEB. 3—Balkan war resumed. Bulgarians renew attack on Adrianople.
FEB. 3—U.S. Income Tax amendment to Federal constitution becomes law.
FEB. 5—Welsh Church Disestablishment Bill passes third reading in British House of Commons.
FEB. 9—Army revolt in Mexico against General Madero.
FEB. 11—Bill passes in Great Britain giving authority to Government to restrict aerial navigation.
FEB. 13—Welsh Church Bill rejected in British House of Lords.
FEB. 13—Agreement signed between France and United States extending arbitration convention of Feb. 10 1908, for 5 years.
FEB. 14—Greek flag hoisted at Suda Bay, Crete.
FEB. 15–19—Strike of 2,000 dockers at Grimsby, England, begins.
FEB. 17—Death of Joaquin Miller, "poet of the Sierras" at San Francisco.
FEB. 18—President Madero of Mexico deposed. General Huerta proclaimed Provisional President.
FEB. 20—Great fire at Tokyo; much damage done.
FEB. 20—Announcement of appointment of M. Delcasse as French Ambassador to Russia.
FEB. 23—Ex-President Madero and former Vice-President Suarez murdered in Mexico City.
MAR. 2—Skirmish between U.S. border patrol and Mexicans at Douglas, Arizona.
MAR. 3—First territorial Legislature of Alaska meets at Juneau.
MAR. 4—Woodrow Wilson inaugurated at Washington as president of the United States.
MAR. 6—Fortress of Yanina surrendered to Greeks.
MAR. 7—Explosion of dynamite at Baltimore. About 100 persons killed and wounded.
MAR. 7—French Chamber ratifies Franco-Moroccan Treaty.
MAR. 8—Town of Guajiniguilapa, Guatemala, destroyed by earthquake.
MAR. 11—Colombia refuses to accept U.S. proposals regarding inter-oceanic canal, coaling stations in Islands in Caribbean Sea, etc.
MAR. 11—Anglo-German agreement respecting settlement of frontier between Nigeria and Cameroons.
MAR. 11—French airman, Perreyon, reaches height of 19,686 feet.
MAR. 12—Foundation stone laid of Canberra, new capital of Commonwealth of Australia.
MAR. 13—Oxford beats Cambridge in University Boat Race by ¾ length in 20 min. 53 seconds.
MAR. 14—Balkan Allies accept mediation of Powers on conditions not acceptable to latter.
MAR. 14—Ratifications exchanged at Washington of Franco-American Agreement of Feb. 13.

MAR. 17—President Wilson calls special session of Congress to consider tariff question.
MAR. 18—King George of Greece murdered at Salonika. Crown Prince succeeds as Constantine I.
MAR. 19—Judgment given for Sir. R. Isaacs and Mr. H. Samuel (Attorney-General and Postmaster-General in Great Britain against French journal "Le Matin" in action for libel connected with Marconi contract.
MAR. 20—End of taxi-cab drivers' strike in London (see Jan. 1).
MAR. 20—United States announces its withdrawal from participation in Chinese Six-Power Loan.
MAR. 23—City of Omaha, Neb., partly destroyed by storm. Between 100 and 200 lives lost.
Mar. 25—Sir Rufus Isaacs gives evidence before Marconi Committee.
MAR. 25—Death of Field-Marshal Lord Wolseley, British military leader.
MAR. 26—Fall of Adrianople to Bulgarians.
MAR. 26—Meeting of Ambassadors accepts proposals regarding boundaries of Albania and Montenegro.
MAR. 31—Death of John Pierpont Morgan, American financier.
MAR. 31—Turkey unconditionally accepts recommendations of Powers for conclusion of Peace.
MAR. 31—Great Britain recognises Huerta Government in Mexico.
April 2—Spain ratifies Treaty with France of Nov. 27 1912, regarding Morocco.
APRIL 3—Canadian House of Commons passes Bill enabling Canada to join in Anglo-Japanese Treaty of 1911.
APRIL 3—Mrs. Pankhurst sentenced in England to 3 years' penal servitude for inciting persons to place explosives in Lloyd George's house.
APRIL 8—Opening of first Parliament of Chinese Republic.
APRIL 10—International Squadron declares blockade of Montenegrin Coast from Antivari to Drin River.
APRIL 11—Gustav Hamel flies from Dover to Dunkirk and back without alighting.
APRIL 12—Mrs. Pankhurst released on licence (see April 3).
APRIL 13—Attempted murder of King Alfonso of Spain in Madrid.
APRIL 15—Lower House of California Legislature passes Bill prohibiting aliens from acquiring land.
APRIL 16—Armistice signed by Turkey and Bulgaria.
APRIL 23—Coal mine explosion at Finlayville Pa., Over 70 lives lost.
APRIL 26—Contract for Chinese Loan signed by 5 Powers and China.
APRIL 28—Winston Churchill (British First Lord of the Admiralty) denies any connection with Marconi shares.
APRIL 30—London police raid headquarters of Women's Social and Political Union.
APRIL 30—Set of Burgundian tapestry realises 14,000 guineas at Christies, London.
MAY 2—United States and Mexico formally recognise Chinese Republic.
MAY 5—Price of *The Times*, London, reduced from 3d. to 2d.
MAY 6—King Nicholas yields Skutari to Powers. International contingent takes over town pending creation of Albanian administration.
MAY 6—Representation of the People (Women) Bill rejected in British House of Commons.
MAY 8—Tariff Bill passes U.S. House of Representatives.
MAY 9—Japan enters protest against Californian Alien Land Law Bill.
MAY 12—International Peace Conference meets at Washington, D.C.
MAY 13—Balkan States agree to cease hostilities and to send delegates to a Conference in London.
MAY 13–17—International Conference on Maritime Law at Copenhagen.
MAY 16—Canadian House of Representatives passes Naval Bill.
MAY 24—Announcement that a baronetcy has been conferred on Sir Chinubhai Madhowlal Runchorelal, first Hindu to receive this dignity.
MAY 24—Dr. W. H. Page arrives in London as U.S. Ambassador.
MAY 24—Collapse of pier at Long Beach, near Los Angeles. 30 killed.
MAY 26—First woman (Miss Emily Duncan) appointed a magistrate in England.
MAY 28—Death of Lord Avebury, British scientist, politician, etc.
MAY 29—Italy recognises Huerta Government in Mexico.
MAY 30—Canadian Senate rejects Naval Bill.
MAY 30—Peace Treaty between Turkey and Balkan States signed in London.
MAY 31—General election in Australia, results in defeat of Labour Ministry.
MAY 31—H. G. Hawker, British airman, reaches height of 11,450 feet.
MAY 31—Renewal of Anglo-American General Arbitration Treaty of 1908.
JUNE 1—Bombardier Wells knocked out by Georges Carpentier in Heavy Weight Boxing Championship of Europe.
JUNE 2—Trade agreement between Canada and West Indies comes into force.
JUNE 2—Death of Alfred Austin, English Poet Laureate.
JUNE 3—J. M. Barrie, British author, made a baronet.
JUNE 4—Derby won by A. P. Cunliffe's "Aboyeur," C. B. Ismay's "Craganour" being disqualified.
JUNE 7—Cecil Chesterton convicted of libel on Godfrey Isaacs in connection with Marconi Companies.
JUNE 9—Break up of Balkan Peace Conference, attempts to reach agreement over points not settled by Peace Treaty having failed.
JUNE 10—U.S. Supreme Court holds States have right to fix intra-state railroad rates if not confiscatory.
JUNE 11—Norwegian Storthing grants universal suffrage to women.
JUNE 11—Murder of Mahmoud Shevket Pasha Turkish Grand Vizier.
JUNE 12—Hamburg-American steamship "Imperator" (52,117 tons) leaves Spithead on maiden voyage to New York.
JUNE 12–16—Gen. Pershing wins victory over Moros in Philippines.
JUNE 13—Romney's portrait "Anne Lady de la Pole" sold at Christie's, London for 39,400 guineas.
JUNE 13—Report of Marconi Select Committee issued in London.
JUNE 14—Anglo-Portuguese Agreement signed for regulation of Opium Monopolies in Hong-Kong and Macao.
JUNE 17—Germany recognises Huerta Government in Mexico.
JUNE 17—Great eruption of Assamayama, volcano in Japan.
JUNE 18—Debate on Report of Marconi Committee opened in British House of Commons.
JUNE 21—Demonstration in Hyde Park, London, against the Welsh Church Bill.
JUNE 24–27—President Poincaré visits England.
JUNE 26—Bulgaria and Austria-Hungary sign Defensive Treaty.
JUNE 28—Rumania informs Bulgaria that she will not remain neutral in event of war.
JUNE 28—United States signs Arbitration Treaties with Portugal, Sweden and Japan, extending respective treaties which would expire in 1913.
JUNE 28—Loetschberg Tunnel, Switzerland, formally opened.
JUNE 30—Second Balkan War begins, former Balkan Allies being unable to settle their differences. Bulgarians attack Servian and Greek positions.
JUNE 30—Bill for considerable increase in German Army passes Reichstag.
JUNE 30—Strike of miners on Rand, S. Africa, begins.
JUNE 30—Salonika surrenders to Greeks.
JULY 1—Zanzibar re-incorporated with British East Africa. Administration transferred from British Foreign Office to Colonial Office.
JULY 1–9—International Opium Conference at The Hague.
JULY 2—Final sitting of Marconi Committee in London.
JULY 5—End of Rand strike. Situation remains serious till beginning of August.
JULY 5—Death of Alfred Lyttelton, former British Secretary for the Colonies.
JULY 6—Greece and Serbia break off relations with Bulgaria.
JULY 7—General von Falkenhayn becomes War Minister in Germany.
JULY 7—Irish Home Rule Bill passes British House of Commons.
JULY 8—Welsh Church Bill passes British House of Commons.
JULY 10—Rumania declares war on Bulgaria.
JULY 12—Turkey re-enters the field of war.
JULY 15—Irish Home Rule Bill rejected in British House of Lords.
July 17—Dr. Robert Bridges appointed Poet Laureate in Great Britain.
JULY 20—Turks re-capture Adrianople from Bulgarians.
JULY 20—Diplomatic relations re-opened between Greece and Turkey.
JULY 22—Welsh Church Bill rejected in British House of Lords.
JULY 23—Civil war in China between North and South. Martial law proclaimed.
JULY 23—Announcement that 616 Russian monks have been deported from Mount Athos to Southern Russia for heresy.
JULY 26—Swiss Airman, Oskar Bider, flies from Milan to Basle in 3¼ hours.
JULY 28—America wins Davis cup and World Lawn Tennis Championship at Wimbledon.
JULY 29—Meeting of Ambassadors of Powers regulates establishment of Albanian principality.
JULY 30—Ex-President Casho begins revolt in Venezuela.
JULY 31—Armistice signed by Balkan States at Bucharest.
AUG. 2—Riots at Cawnpore by Moslems owing to destruction of a mosque to make way for a road.
AUG. 2—U.S. Senate rejects plan for Nicaraguan Protectorate.
AUG. 4—Wilson, U.S. Ambassador at Mexico, resigns. Lind sent on special mission to city.
AUG. 6—International Congress of Medicine opened in London.
AUG. 6—Caraveli, South Peru, destroyed by earthquake.
AUG. 8—New Marconi Contract agreed to in British House of Commons.
AUG. 10—Peace signed at Bucharest between Balkan States.
AUG. 11—Alien Land Law Bill comes into effect in California.
AUG. 14—Death of Ferdinand August Bebel, founder, with Liebnecht, of German Social Democratic Party.
AUG. 15—American Ambassador to Britain unveils monument at Southampton, commemorating departure of Pilgrim Fathers in 1620.
AUG. 18—U.S. steamer "State of California" sinks in Gambier Bay with loss of 40 lives.
AUG. 27—U.S. President proclaims strict neutrality of United States in Mexico.
AUG. 27—Palace of Peace opened at The Hague.
AUG. 31—Last barrier at Pacific end of Panama Canal removed.
SEPT. 3—Fall of Nanking to Yuan Shih-Kai.
SEPT. 5–6—Town of Hot Springs, Arkansas, partly destroyed by fire. 2,000 persons homeless.
SEPT. 9—German Zeppelin Naval Airship L. I. destroyed in gale off Heligoland; 14 lives lost.
SEPT. 11—Japanese Government demands reparation from China for loss of lives and property of Japanese during recent Chinese rebellion.
SEPT. 13—China agrees to Japanese demands of Sept. 11.
SEPT. 16—Japanese flotilla sent to Yangtze river owing to China's failure to carry out agreement with regard to reparations to Japan.
SEPT. 18—Bulgaria and Turkey sign agreement regarding frontier in Thrace.
SEPT. 20—Second Aerial Derby over course of 94¼ miles round London won by Gustav Hamel.
SEPT. 24—Ulster Unionists appoint Provisional Government to come into effect on passage of Home Rule Bill.
SEPT. 25—Japan renews ultimatum to China regarding Japanese subjects at Nanking. Chinese apology to Japan on 28th.
SEPT. 29—Turkey and Bulgaria sign Peace Treaty (Treaty of Constantinople) delimitating their new frontiers.
OCT. 1—New express railway route from Tokyo to Peking opened.
OCT. 2—Piercing of Mont d'or Tunnel, Switzerland completed.
OCT. 3—U.S. President signs Tariff Bill.
OCT. 6—Yuan Shih-Kai elected President of Chinese Republic.
OCT. 10—British ship "Volturno" burnt in Mid-Atlantic. 136 lives lost.
OCT. 10—Mexican Congress dissolved by General Huerta.
OCT. 10—Galboa dike, last obstruction to inter-ocean navigation in Panama Canal, blown up.
OCT. 13—Announcement that Russian explorer Captain Willkitsky, had discovered new land in Siberia, enclosing Kara Sea.
OCT. 14—Explosion at Senghennyd Colliery, near Cardiff, Wales. 426 lives lost.
OCT. 15—Essad Pasha establishes Provisional Government for Central Albania in Durazzo.
OCT. 17—Governor Sulzer of New York State impeached.
OCT. 17—German Army Zeppelin airship L2 blows up at height of 650 feet. All but one of crew killed.
OCT. 17–18—Serbians invade Albania.
OCT. 19—Accident to troop train at Bucatunna, Alabama. Twenty soldiers killed.
OCT. 20—Sir Rufus Isaacs appointed Lord Chief Justice in Great Britain, and Sir John Simon Attorney-General.
OCT. 21—Unsuccessful Royalist rising in Portugal.
OCT. 26—Serbian troops in Albania withdrawn to frontier line fixed by London Conference.
OCT. 28—Great Britain, France and Germany agree not to recognise Huerta Government in Mexico until United States defines its policy.
OCT. 30—German General Liman von Sanders appointed to high command at Constantinople.
Nov. 3—United States demands withdrawal of General Huerta.
Nov. 4—Railway accident at Melun, France, on Paris-Lyons Railway. Nearly 50 persons killed.
Nov. 5—Prince Regent of Bavaria declared King as Louis III.
Nov. 5—Joint declarations signed by Russia and China recognising autonomy of Outer Mongolia and Chinese suzerainty over it.
Nov. 6—Arrest of Gandhi, leader of passive resistance movement among Natal Indians.
Nov. 7—Earthquake at Abançay, Peru. 200 killed. Thousands are rendered homeless.
Nov. 8–10—Street demonstration against officers in Zabern, Alsace.
Nov. 8—Herr Brandt, Managing director of Krupp firm, sentenced at Berlin to 4 months imprisonment for bribery.
Nov. 9–10—Storm on Great Lakes, North America. 279 lives lost.
Nov. 12—King Ludwig III. accedes to throne of Bavaria.
Nov. 13—Greco-Turkish Peace Treaty signed.
Nov. 13—Nobel Prize for Literature awarded to Rabindranath Tagore.
Nov. 17—First vessel passes through Panama Canal.
Nov. 17—Protocol for delimitation of boundaries between Turkey and Persia signed.
Nov. 21—Death of Prince Keiki Tokugawa, fifteenth and last of the Shoguns of Japan.
Nov. 23—Prince William of Wied selected as future Sovereign of Albania by Powers.
Nov. 24—Sultan ratifies Greco-Turkish Peace Treaty of Nov. 13.
Nov. 28—Renewed disturbance against officers in Zabern, Alsace.
DEC. 2—Anglo-German Commercial Agreement renewed till end of 1915.
DEC. 4—Naval Defence Bill in New Zealand passes third Reading.
DEC. 5—Proclamations issued in England forbidding importation of arms and ammunition into Ireland.
DEC. 6—Powers approve accession of Prince William of Wied to throne of Albania.
DEC. 8—Bombardier Wells knocked out by Carpentier in first round of International boxing match, London.
DEC. 9—Piercing completed of Canadian Northern Railway Tunnel at Montreal under Mount Royal.
DEC. 10—S. African Government decides to appoint commission to enquire into strike of Natal Indians and allegations of ill-treatment of Indians.
DEC. 10—New York, New Haven and Hartford Railway suspends payments.
DEC. 12—Announcement that Leonardo da Vinci's "Mona Lisa" (see Aug. 22 1911) has been recovered in Florence.
DEC. 14—Peace Treaty signed between the Netherlands and United States.
DEC. 14—Formal annexation of Crete to Greece.
DEC. 22—Great fire at Georgetown, Demerara. 23 lives lost. Damage £140,000.
DEC. 22—Death of Emperor Menelek of Abyssinia.
DEC. 23—Amended Currency Bill in United States signed by President.
DEC. 23—China and Germany sign agreement for construction of two railways in China. These are to be built by German engineers and financed with German capital.

DEC. 24—Panic through fire alarm at Calumet, Michigan. 72 deaths.
DEC. 27—French Airman Legagneux reaches height of 20,300 feet (record).
DEC. 29—French airman Védrines arrives at Cairo after flight from Paris, via Nancy, Prague, Vienna, Sofia, Constantinople, Konia, Beirut, Jaffa (3,500 miles).

1914

JAN. 1—Rt. Hon. James Bryce made a Viscount.
JAN. 1—Announcement of formal amalgamation of North and South Nigeria.
JAN. 5—Trial begins at Strasbourg of Colonel von Reuter and Lieut. Schad in connection with Zabern incidents. Acquitted Jan. 10.
JAN. 8—M. Calmette, editor of *Figaro* (Paris) makes serious charge against M. Caillaux, French Finance Minister, regarding a large estate. Charge denied.
JAN. 11—S.S. "Karluk" (Stefansson Arctic Expedition) sinks, after having been crushed by ice. Crew marooned on Wrangel Island.
JAN. 12—Eruption of volcano on Sakura Island, Japan. Three towns destroyed. Hundreds killed.
JAN. 12—French airman Pourpe arrives at Khartum from Cairo, having covered 1,350 miles in 19 hours.
JAN. 16—Loss of British submarine A7 with crew of 11.
JAN. 17—Karl Hopf convicted at Frankfort of murder of several of his relations by administering bacilli. Sentenced to death.
JAN. 21–28—Strike of 7,000 London coal porters.
JAN. 21—Death of Lord Strathcona, Canadian statesman.
JAN. 27—Revolt in Hayti. Abdication of Michael Oreste, President. American marines land at Port-au-Prince to prevent disorder.
JAN. 27—U.S. President signs Executive Order establishing permanent civil government in Panama Canal Zone, as from April 1. Colonel Goethals appointed first civil governor on Jan. 28.
JAN. 30—American steamer "Monroe" sinks in collision near mouth of Chesapeake Bay. 41 drowned.
FEB. 3—U.S. President removes embargo on shipment of arms to Mexico.
FEB. 4—U.S. House of Representatives passes Burnett Immigration Bill.
FEB. 4—Revolutionary outbreak in Peru. Premier Varela killed. President Billinghurst imprisoned. Governing Board named by Congress pending an election.
FEB. 7—Sir Ronald Munro-Fergusson appointed Governor-General of Australia.
FEB. 8—General Orestes Zamor elected President of Haiti.
FEB. 10—Contract signed between China and Standard Oil Company of New York, granting latter concession for 60 years to develop oil-fields of Shensi and Chihli.
FEB. 11—Airman Parmelin crosses Mont Blanc range in flight from Geneva to Turin.
FEB. 11—First direct wireless messages between U.S. and Germany sent and received at Sayville, L.I.
FEB. 11—Resignation of Viscount Gladstone as Governor-General of South Africa and appointment of Mr. Sydney Buxton to succeed him.
FEB. 12—United States formally recognises revolutionary government of Peru.
FEB. 15—Franco-German agreement regarding Baghdad Railway signed.
FEB. 17—William H. Benton, British subject, killed by Mexican revolutionists.
FEB. 21—U.S. Senate ratifies arbitration treaties with Great Britain, Norway, Sweden, Switzerland, Portugal, Spain, Italy and Japan.
FEB. 22—United States requested by British Ambassador thoroughly to investigate death of William H. Benton (see Feb. 17).
MARCH 1—Death of Earl of Minto, former Governor-General of Canada and Viceroy of India.
MARCH 1—Political unrest in Brazil results in state of siege in Rio de Janeiro.
MARCH 8—Elections in Spain result in victory for monarchist party.
MARCH 9—5,000 Mexican rebels defeat Federal troops at Altmira.
MARCH 9—Martial law proclaimed in Ceará, Brazil.
MARCH 10—Ceiba, Honduras, destroyed by fire.
MARCH 10—"Rokeby Venus" of Velasquez in National Gallery, London, damaged by suffragist, who is afterwards sentenced to 6 months' imprisonment.
MARCH 11—Engineer-Lieut. Briggs, R.N. reaches height of 15,000 ft. (record).
MARCH 12—Japanese protest to China against her recent agreement with Standard Oil Company. China refuses to modify concession.
MARCH 12—U.S. President signs bill authorising government construction of railway in Alaska.
MARCH 14—1,000 persons killed during storm on shore of Sea of Asov.
MARCH 14—Turco-Serbian Peace Treaty signed.
MARCH 15—Cunard liner "Lusitania" establishes world record by steaming 618 knots in 24 hours.
MARCH 16—M. Calmette fatally shot by Mme. Caillaux, owing to charges against her husband. Resignation of M. Caillaux.
MARCH 19—Ferry steamer at Venice run down by torpedo boat. 50 killed.
MARCH 19—South African elections result in victory for Labour Party.
MARCH 20—Robert Lansing nominated as U.S. Secretary of State.
MARCH 20—Salandra Ministry formed in Italy.
MARCH 21—England wins International Rugby Football Championship and Calcutta Cup, beating Scotland by 16 points to 15.
MARCH 25—Death of Frédéric Mistral, Provençal poet.
MARCH 28—Cambridge wins University Boat Race by 4½ lengths.
MARCH 31—New aeroplane height record established by German aviator Linnekogel (20,800 ft.).
MARCH 31—Disaster to Newfoundland Sealing Fleet.
MARCH 31—U.S. House of Representatives passes bill repealing tolls—exemption provision of Panama Canal Act of 1912. (See June 11.)
APR. 1—Permanent form of government for Panama Canal Zone comes into effect.
APR. 2—Fire at St. Augustine, Fla., destroys large part of water front.
APR. 5—Special Commission appointed by General Carranza reports on death of William Benton (see Feb. 17 and 22).
APR. 7—Completion of Grand Trunk Pacific Railway, Canada.
APR. 8—Treaty signed between Colombia and United States settling control of Panama Canal Zone.
APR. 10—Detachment of U.S. Marines, landing at Tampico for petrol, arrested by Mexican authorities.
APR. 14—U.S. President orders Atlantic Fleet to proceed to Tampico to enforce demands for salute of American flag as apology for incident of April 10.
APR. 18—U.S. ultimatum to Mexico regarding salute of American flag (see April 14).
APR. 21—U.S. forces take possession of Customs House at Vera Cruz following ultimatum to Mexico.
APR. 21—Fight between militiamen and strikers at Standard Oil Company's coalfields at Ludlow, Colorado. 45 killed.
APR. 22—Diplomatic relations between United States and Mexico broken off.
APR. 23—General Carranza demands withdrawal of U.S. forces from Vera Cruz.
APR. 23—President Wilson restores embargo on shipment of arms into Mexico.
APR. 28—Pit explosion at Eccles, West Virginia. 178 killed.
MAY 2—Death of Duke of Argyll; former Governor-General of Canada.
MAY 3—Leyland liner "Colombian" explodes with loss of 18 lives.
MAY 6—British House of Lords rejects Women's Enfranchisement Bill.
MAY 8—Earthquake between Catania and Mangano, Italy. Linera destroyed. 150 killed.
MAY 13—Mexican revolutionists capture Tampico.
MAY 18—Essad Pasha resigns post of War Minister in Albania, and leads revolt against Prince William of Wied.
MAY 18—Panama Canal opened for regular traffic.
MAY 20—Delegates from Argentine, Brazil and Chile meet at Niagara Falls to arbitrate between United States and Mexico.
MAY 22—Arrangement between British Govt. and Anglo-Persian Oil Co., whereby former acquires control of oil properties in Persian Gulf.
MAY 23—Prince William, Albanian ruler, seeks refuge from revolutionaries on Italian warship.
MAY 23—Japan ratifies Arbitration Treaty with United States.
MAY 23—Gustave Hamel lost while flying from Paris to Hendon. Not seen after Hardelot.
MAY 24—"Komagata Maru" arrives at Vancouver with 375 Indians on board. Latter not allowed to land.
MAY 27—Derby won by H. B. Duryea's Durbar II.
MAY 29—Wreck of C.P.R. liner "Empress of Ireland" in St. Lawrence river, with loss of 1,023 lives.
MAY 31—General Carranza assumes title of Provisional President of Mexico.
JUNE 1—Board of Enquiry begins investigation at Vancouver of claims of Indians on "Komagata Maru" to enter Canada.
JUNE 6—Aerial Derby of 94½ m. round London won by American, W. L. Brock, in 1 hr. 18 min. 54 sec.
JUNE 11—Delegates at Niagara Falls Conference (see May 20) announce agreement on transfer of authority in Mexico and establishment of new government. U.S. Senate passes Panama Repeal Bill.
JUNE 11—U.S. Senate passes bill repealing tolls—exemption provision of Panama Canal Act. (See Mar. 31.)
JUNE 13—Viviani Ministry formed in France.
JUNE 13—Formal annexation by Greece of Chios and Mitylene.
JUNE 15—Anglo-German Agreement regarding Baghdad Railway and Mesopotamia initialled in London.
JUNE 15—U.S. President signs Panama Repeal Bill.
JUNE 17—Opening of Hohenzollern Canal from Berlin to the Oder.
JUNE 19—Explosion in mine in Crow's Nest district, Alberta, Canada. 200 deaths.
JUNE 22—Earldom conferred on Lord Kitchener of Khartum.
JUNE 24—Three articles of a Peace Protocol signed at Niagara Falls Conference.
JUNE 24—Emperor of Germany formally opens reconstructed Kiel Canal.
JUNE 26—Great fire at Salem, Mass. 10,000 homeless.
JUNE 28—Assassination at Sarajevo of Archduke Francis Ferdinand of Austria and his wife.
JUNE 28—Benkulen, Southern Sumatra, destroyed by earthquake and cloudburst.
JULY 1—Niagara Falls Conference ends without positive result.
JULY 2—Death of Joseph Chamberlain, British statesman.
JULY 3—Order for deportation of 375 Hindus who had arrived at Vancouver on May 24.
JULY 5—General Huerta re-elected President of Mexico.
JULY 10—Ulster Provisional Government reaffirms Ulster's determination to resist imposition of Home Rule Parliament.
JULY 11—Court of Enquiry at Quebec on loss of "Empress of Ireland" exonerates Captain Kendall, Commanding Officer, from blame.
JULY 14—German aviator Olerich makes new height record of 24,000 ft.
JULY 15—Resignation of General Huerta, Mexican President. Señor Carbajal made Provisional President.
JULY 20–29—Visit of President Poincaré to Russia.
JULY 21—Vice-Admiral Sir John Jellicoe, appointed C. in C. British Home Fleets. On outbreak of war assumed Supreme Command of North Sea Fleet.
JULY 21–24—Representatives of British and Irish parties meet at Buckingham Palace, London. No agreement reached.
JULY 23—Presentation of Austro-Hungarian ultimatum to Serbia.
JULY 24—Sir Edward Grey proposes 4-Power mediation in Austro-Serbian controversy. Serbia appeals to Russia.
JULY 25—Austria states Serbian answer unsatisfactory. Austrian Minister leaves Belgrade. Both countries order mobilisation.
JULY 26—Austrian mobilisation on Russian frontier.
JULY 28—Madame Caillaux acquitted (see March 16).
JULY 28—Austria declares war on Serbia.
JULY 29—Cape Cod Canal opened for commerce.
JULY 30—Sir John French designated C. in C. of British Expeditionary Force.
JULY 30—Mobilisation of Russian army announced. Germany demands its cessation.
JULY 31—London and New York Stock Exchanges closed.
JULY 31—General mobilisation in Russia. Turkish mobilisation begins.
JULY 31—Germany declares state of war throughout German Empire.
AUG. 1—English Bank Rate advances to 10%.
AUG. 1—Germany declares war on Russia. France orders mobilisation. Italy declares neutrality.
AUG. 1—Turco-German Treaty signed at Constantinople.
AUG. 2—Russian forces enter East Prussia. Germany invades Russian Poland.
AUG. 2—German troops occupy Luxembourg and enter French territory. Germany asks for permission to pass through Belgium.
AUG. 3—Moratorium proclaimed in England.
AUG. 3—British mobilisation ordered.
AUG. 3—Germany declares war on France.
AUG. 3—Belgium refuses Germany's request of Aug. 2.
AUG. 4—Germany declares war on Belgium. German troops enter Belgian territory.
AUG. 4—Great Britain declares war on Germany. British Grand Fleet puts to sea.
AUG. 5—Lord Kitchener appointed Secretary for War in Great Britain.
AUG. 5—British cruiser "Amphion" destroys German mine-layer "Königin Luise."
AUG. 5—Austria declares war on Russia.
AUG. 6—"Goben" and "Breslau" escape to Dardanelles.
AUG. 6—British cruiser "Amphion" sunk by mine. 131 men lost.
AUG. 6—Serbia declares war on Germany.
AUG. 7—Montenegro declares war on Austria-Hungary.
AUG. 7—£1. and 10s notes issued in Great Britain.
AUG. 8—English Bank Rate is reduced to 5%.
AUG. 8—First British troops land in France. French enter Alsace.
AUG. 8—Portugal announces intention of supporting Great Britain.
AUG. 8—Togoland occupied by British and French.
AUG. 9—German submarine U15 sunk.
AUG. 10—France declares war on Austria.
AUG. 10—Liége occupied by Germans.
AUG. 12—Montenegro declares war on Germany.
AUG. 12—Great Britain declares war on Austria-Hungary.
AUG. 12—U.S. District Ct. declares International Harvester Company a monopoly—ordered to be dissolved.
AUG. 14—Russia promises autonomy to Poland in return for Polish loyalty.
AUG. 15—Formal opening of Panama Canal.
AUG. 15—Japanese ultimatum to Germany demanding evacuation of Kiau-Chow.
AUG. 15—U.S. announcement that Govt. would look with disfavour on loans by American bankers to any nation engaged in European War.
AUG. 16—Constitutionalist Army under General Obregon enters Mexico City unopposed.
AUG. 17—Belgian Govt. removed to Antwerp.
AUG. 18—Russian invasion of Galicia begins.
AUG. 19—French driven from Saarburg.
AUG. 20—Battle of Gumbinnen (East Prussia).
AUG. 20—Germans capture Brussels.
AUG. 20—Death of Pope Pius X.
AUG. 21—Total eclipse of the sun.
AUG. 21–22—Battle of Charleroi.
AUG. 22—Announcement that Duke of Connaught will continue as Governor-General of Canada during War.
AUG. 23—Battle of Mons.
AUG. 23—Japan declares war on Germany.
AUG. 23—Russian victory at Frankenau, East Prussia. Insterburg occupied.
AUG. 23—Fall of Namur.
AUG. 24—British retreat from Mons begins.
AUG. 25—Austria declares war on Japan.
AUG. 26—Battle of Le Cateau.
AUG. 26—Germans destroy Louvain.
AUG. 26—Reconstruction of French Cabinet on War basis.

AUG. 27—Germans occupy Lille.
AUG. 28—Russians defeated at Tannenberg.
AUG. 28—British naval victory in Bight of Heligoland.
AUG. 28—Austria declares war on Belgium.
AUG. 29—Apia, Samoa, surrendered to New Zealand force.
AUG. 31–SEPT. 11—Battle of Nancy.
SEPT. 1—Name of St. Petersburg changed to Petrograd by Imperial order.
SEPT. 1—All classes of reserves and territorials called up in France.
SEPT. 1—Russian forces repulsed in East Prussia.
SEPT. 2—Treaty signed at Panama whereby United States obtains control of harbors of Ancon and Colon.
SEPT. 2—Japanese land at Tsingtau.
SEPT. 2—Russians capture Lemberg, Galicia.
SEPT. 3—French government removed to Bordeaux.
SEPT. 3—Cardinal della Chiesa, Archbishop of Bologna, elected Pope as Benedict XV.
SEPT. 4—Rheims occupied by German troops.
SEPT. 5—End of British retreat from Mons.
SEPT. 5—Battle of the Ourcq begins.
SEPT. 5—France, Russia and Great Britain sign Pact of London, agreeing not to conclude separate peace.
SEPT. 6–10—First Battle of the Marne.
SEPT. 7—Fall of Maubeuge to Germans.
SEPT. 9—Turkey announces abolition of capitulations (from Oct. 1).
SEPT. 9—Germans fall back about 26 miles. British cross Marne.
SEPT. 11—Pope Benedict XV. issues appeal for peace.
SEPT. 12—Allied Note to Turkey regarding capitulations.
SEPT. 12—German cruiser "Hela" sunk by British submarine.
SEPT. 13–28—Battle of the Aisne.
SEPT. 14—Allied forces re-occupy Rheims.
SEPT. 15—Capitulation of German New Guinea.
SEPT. 15—Bill suspending operation of Irish Home Rule and Welsh Church Bills for duration of war passed in Great Britain.
SEPT. 15—U.S. President orders withdrawal of U.S. troops from Vera Cruz.
SEPT. 16—New battle begins over front of 90 m. from Noyon to the Meuse.
SEPT. 17—Fisher Cabinet formed in Australia.
SEPT. 18—Royal assent in Great Britain given to Government of Ireland and Welsh Church Acts.
SEPT. 18—Shackleton Transantarctic Expedition leaves London for South Polar regions.
SEPT. 18—U.S. steamer "Francis H. Leggett" founders near Astoria, Oregon. 70 lives lost.
SEPT. 19—Australian submarine lost with all hands.
SEPT. 19–20—Germans bombard Rheims Cathedral.
SEPT. 22—British air-raid on Düsseldorf.
SEPT. 22—Prince William of Wied abdicates Albanian throne.
SEPT. 23—British cruisers "Aboukir," "Hogue" and "Cressy" torpedoed by German submarines.
SEPT. 24—Germans occupy Peronne.
SEPT. 25–29—Battle of Albert.
SEPT. 25—U.S. Senate ratifies peace commission treaties of Sept. 15 with Great Britain, France, Spain and China.
SEPT. 26–28—Battle of the Niemen.
SEPT. 26—First Indian troops land at Marseilles.
SEPT. 27—Duala (Cameroons) surrenders to British and French.
OCT. 1—Turkey closes Dardanelles.
OCT. 3—Turkish ambassador to U.S. leaves Washington because of official dissatisfaction with his published views on U.S. affairs.
OCT. 4—Essad Pasha elected President of Albanian Provisional Government.
OCT. 6—Japanese take possession of Marshall Archipelago.
OCT. 6—Belgian Govt. removes from Antwerp to Ostend.
OCT. 8—Dr. Simon Flexner, N.Y. City, announces isolation of germ of infantile paralysis.
OCT. 9—Antwerp surrenders to Germans.
OCT. 10—Death of King Carol of Rumania. Succeeded by nephew, Ferdinand.
OCT. 12—Allies evacuate Ostend. Germans occupy Ghent.
OCT. 13—Belgian Govt. removes to Havre. Franco-British troops occupy Ypres.
OCT. 14—First Canadian troops land at Plymouth.
OCT. 15–20—First battle for Warsaw.
OCT. 17—British cruisers sink 4 German destroyers off Dutch Coast.
OCT. 17—Earthquake in Greece and Asia Minor. 3,000 peasants killed.
OCT. 19–NOV. 21—First battle of Ypres.
OCT. 19—U.S. Marines landed at Cape Haitien, Haiti, to maintain order.
OCT. 21—U.S. protest to Great Britain regarding neutral cargoes.
OCT. 21—Tsar of Russia declares perpetual prohibition on state sale of alcohol.
OCT. 23—U.S. President signs War Tax Bill.
OCT. 24—Germans cross Yser between Nieuport and Dixmude.
OCT. 24—President Poincaré and Earl Kitchener elected Lord Rectors of Glasgow and Edinburgh universities respectively.
OCT. 26—French steamer "Amiral Ganteaume" carrying French refugees, torpedoed by German submarine. 30 lives lost.
OCT. 27—Death from wounds of H.R.H. Prince Maurice of Battenberg.
OCT. 28—Mgr. Hayes consecrated Bishop of Tageste and auxiliary Bishop of New York.
OCT. 29—Lord Fisher becomes First Sea Lord in Great Britain.
OCT. 29—Turkey enters war on side of Central Powers.
OCT. 30—British hospital ship "Rohilla" runs on rocks near Whitby. 40 of crew drowned.
OCT. 31—Panama Canal closed because of earth movement in Culebra Cut.
OCT. 31—Crisis of Battle of Ypres.
NOV. 1—Battle of Coronel. British ships "Good Hope" and "Monmouth" sunk.
NOV. 1—British Ambassador leaves Constantinople.
NOV. 2—Great Britain announces that North Sea is closed to commerce.
NOV. 2—French and Russian Ambassadors leave Constantinople.
NOV. 3—Elections in United States. Large Republican gains.
NOV. 3—Appointment of General von Falkenhayn as Chief of Staff in Germany.
NOV. 4—British reverse at Tanga, E. Africa.
NOV. 5—France and Great Britain declare war on Turkey.
NOV. 5—Great Britain annexes Cyprus.
NOV. 7—Tsingtau surrenders to Anglo-Japanese force.
NOV. 7—Belgium declares war on Turkey.
NOV. 8—Protest from United States to Great Britain regarding contraband policy.
NOV. 9—Destruction of German Cruiser "Emden" by H.M.A.S. "Sydney."
NOV. 10—Germans capture Dixmude.
NOV. 11—Constitution of War Council of 5 announced in Great Britain.
NOV. 11—Resignation of Winston Churchill from British Cabinet.
NOV. 11—Announcement that British transport "Mercian" was attacked by submarine with loss of 100 lives.
NOV. 11—Nobel Prize for Physics for 1914 awarded to Professor M. von Laue, of Frankfurt-on-Main.
NOV. 14—Death of Earl Roberts in France.
NOV. 14—Turkey declares war on Russia.
NOV. 16—Federal Reserve Banks of U.S. commence business.
NOV. 18—Germans break Russian line at Kutno.
NOV. 21—Basra occupied by British forces from India.
NOV. 23—U.S. troops withdrawn from Vera Cruz.
NOV. 23—British warships bombard Zeebrugge.
NOV. 25—Austrians defeated at Tarnov.
NOV. 26—British battleship "Bulwark" blown to pieces at mouth of Thames with loss of 800 lives.
DEC. 1—Capture of General de Wet, leader of rebels in S. Africa.
DEC. 2—Austrians capture Belgrade. Re-captured by Serbians Dec. 14.
DEC. 7—British oil-tank steamer "Vedra" wrecked off Barrow and destroyed by fire. All but 2 of crew lost.
DEC. 7–26—Second battle for Warsaw.
DEC. 8—General Beyers drowned while escaping after defeat at Bothaville. Final collapse of S. African rebellion.
DEC. 8—Battle of Falkland Islands.
DEC. 10—French Govt. returns to Paris.
DEC. 13—Turkish battleship "Messudiyeh" sunk at mouth of Dardanelles by British submarine.
DEC. 14—New York Stock Exchange re-opened for regular trading.
DEC. 16—West Hartlepool, Whitby and Scarborough bombarded by German cruisers.
DEC. 17—British Protectorate proclaimed in Egypt.
DEC. 18—Deposition of Khedive of Egypt, Abbas Hilmi, his uncle Prince Husein Kemal appointed in his place, with title of Sultan. France recognises British Protectorate.
DEC. 23—Australian and New Zealand troops arrive at Cairo.
DEC. 24–25—Centenary of Treaty of Ghent observed in United States, England and Canada.
DEC. 24—Britain recognises French Protectorate in Morocco.
DEC. 25—British air and sea raid on Cuxhaven.
DEC. 28—Second U.S. Note to Great Britain regarding treatment of American commerce by British Fleet.

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JAN. 1—H.M.S. "Formidable" torpedoed in Channel with loss of 500–600 lives.
JAN. 2—Arrest of Cardinal Mercier, Primate of Belgium.
JAN. 3–4—Rebellion against Essad Pasha's government in Albania.
JAN. 4—London Stock Exchange re-opened.
JAN. 4—Lord Wimborne becomes Lord Lieutenant of Ireland.
JAN. 7—British preliminary reply to U. S. Note of Dec. 28 1914.
JAN. 7—Presidential decree signed prohibiting sale of absinthe and similar liquors throughout France.
JAN. 9—Two houses of U.S. Congress agree on Immigration Bill.
JAN. 9—Germans bombard Soissons Cathedral.
JAN. 10—British reply to U.S. Note (See Dec. 28 1924).
JAN. 12—U.S. House of Representatives defeats proposal to amend constitution so as to give suffrage to women.
JAN. 13—Earthquake in Italy destroys Avezzano and Sora.
JAN. 13—Resignation of Count Berchtold, Austrian Foreign Minister. Succeeded by Baron Burian.
JAN. 13—S. African forces occupy Swakopmund, German S.W. Africa.
JAN. 16—Best English wheat stands at 60s a quarter and best American wheat at 61s a quarter, compared with 36s and 37s a quarter respectively, on Jan. 16, 1914.
JAN. 19—German airships drop bombs on Yarmouth and King's Lynn, England.
JAN. 24—Battle of Dogger Bank. German armoured cruiser "Blücher" sunk.
JAN. 25—Transcontinental telephone communication established in United States—New York to San Francisco.
JAN. 27—Announcement of British loan of £5,000,000 to Rumania.
JAN. 28—U.S. President vetoes Immigration Bill.
JAN. 28—U.S. sailing-ship "William P. Frye" sunk by German auxiliary cruiser, "Prince Eitel Friedrich."
JAN. 29—Immigration Committee of U.S. House of Representatives decides to report Immigration Bill to House with recommendation that it be passed over President's veto.
JAN. 30—German submarine sinks three British merchant ships.
JAN. 30—German submarine U20 sinks 3 ships off Havre, without warning. First officially announced submarine attack without warning.
FEB. 2—German-American named Van Horn attempts to blow up bridge across St. Croix River, on U.S.-Canadian boundary.
FEB. 2—German loan of £3,000,000 to Bulgaria.
FEB. 2—Highest wheat prices recorded in Chicago since 1898.
FEB. 4—Announcement by British Foreign Office that any vessel carrying flour or corn to Germany will be seized.
FEB. 4—U.S. House of Representatives upholds President's veto on Immigration Bill.
FEB. 4—Germany declares blockade of Great Britain from Feb. 18.
FEB. 6—British liner "Lusitania" enters Liverpool flying American flag.
FEB. 9—West Yorkshire coalfield dispute settled. Men's demands granted during continuance of War.
FEB. 10—Bronze statue of Alexander the Great, believed to be the work of Lysippus, discovered at Cyrene.
FEB. 10—Chinese porcelain, collection of late J. P. Morgan, sold for £800,000 to Messrs. Duveen.
FEB. 11—U.S. note to Great Britain re use of U.S. flag on British merchant vessels, and U.S. note to Germany re sinking of neutral vessels.
FEB 12—French Chamber adopts absinthe Prohibition Bill.
FEB. 16—German reply to U.S. note (of Feb. 11) re sinking of neutral vessels.
FEB. 17—British answer to United States re seizures of American cargoes bound for neutral ports, published.
FEB. 17—Two German Zeppelins come down on Fano Island, Denmark. Crews interned.
FEB. 18—German blockade of England comes into force.
FEB. 19—British reply to U.S. note (of Feb. 11) re use of U.S. flags by British merchant vessels.
FEB. 19—Bombardment of Dardanelles forts by British and French fleets.
FEB. 20—President Wilson opens Panama-Pacific International Exposition at San Francisco, by pressing button at Washington.
FEB. 21—British merchant ships "Cambank" and "Downshire" sunk by German submarines, without warning.
FEB. 22—U.S. identical notes to Great Britain and Germany making proposals regarding contraband, neutral vessels, etc.
FEB. 25—Sale of Fragonard panels from J. P. Morgan collection to H. C. Frick for £285,000.
FEB. 25—Loss of H.M.S. "Clan McNaughton" with entire crew.
FEB. 27—American ship "Dacia" laden with cotton for Germany seized by French cruiser.
MARCH 2—German reply to U.S. note of Feb. 22.
MARCH 2—Gas explosion in mine at Leyland, West Virginia, causes over 100 deaths.
MARCH 4—German submarine sunk off Dover. Officers and men taken prisoners.
MARCH 5—German Zeppelin wrecked near Tirlemont.
MARCH 5—Resignation of M. Venizelos, Greek Prime Minister. Gournaris Ministry formed four days later.
MARCH 10–12—Battle of Neuve Chapelle.
MARCH 10—H.M.S. "Ariel" sunk German submarine.
MARCH 11—British Blockade of Germany comes into effect.
MARCH 14—Lincoln Bennett, aviator, killed at San Francisco Exposition.
MARCH 14—German ship "Dresden" sunk by H.M.S. "Glasgow," "Orama" and "Kent".
MARCH 15—British reply to U.S. note of Feb. 22.
MARCH 16—Rear-Admiral de Robeck succeeds Vice-Admiral Carden in command of British Fleet in Dardanelles.
MARCH 20—German Zeppelin attack on Paris.
MARCH 20—Major-General Sir William Robertson succeeds Major-General Murray as Chief of Imperial General Staff in Great Britain.
MARCH 22—Fall of Przemysl to Russians.
MARCH 25—German submarine sinks Dutch steamer "Medea" off Beachy Head.
MARCH 26—German submarine U29 sunk with all hands.
MARCH 28—Elder Dempster liner "Falaba" torpedoed. 111 killed.
MARCH 29—General Liman von Sanders appointed Commander-in-Chief of Turkish Army in Dardanelles.
MARCH 30—General de Wet committed for trial at Bloemfontein on charge of treason.
APRIL 3—U.S. note to Germany regarding sinking of "William P. Frye" (see Jan. 28). Indemnity demanded.
APRIL 5—Jack Johnson knocked out by Jesse Willard in world heavy-weight boxing championship.
APRIL 5—German answer to U.S. note of April 3.

APRIL 8—German cruiser "Prince Eitel Friedrich" interned by U.S. authorities.
APRIL 11—"Kronprinz Wilhelm," last of German Auxiliary cruisers, arrives in Hampton roads.
APRIL 14—Turks routed at Shaiba, Mesopotamia.
APRIL 14—Dutch steamer "Katwyk" sunk without warning by German submarine.
APRIL 16—German Zeppelin bombs Lowestoft and Southwold.
APRIL 18—British submarine lost in Dardanelles.
APRIL 19—Field-Marshal von der Goltz appointed Commander-in-Chief of Turkish First Army.
APRIL 20—Chicago, Rock Island and Pacific Railway goes into receiver's hands.
APRIL 22—Second battle of Ypres begins.
APRIL 24—Battle of St. Julien.
APRIL 25—Landing of Anglo-French forces on Gallipoli Peninsula begins.
APRIL 26—Secret Convention signed by Triple Entente with Italy.
APRIL 26—U.S. Navy Dept. announces battleship "California" will be electrically propelled—first in world.
APRIL 26—German cruiser "Kronprinz Wilhelm" interned at Newport News.
APRIL 26-27—French armoured cruiser "Leon Gambetta" torpedoed by Austrian submarine. 600 lives lost.
APRIL 27—International Congress of Women opened at The Hague.
APRIL 28—German offensive at Ypres definitely checked.
APRIL 30—German warning against sailing in S.S. "Lusitania" published in U.S. Press.
APRIL 30—Fire in Colon, Panama, property loss $3,500,000, 11 lives lost.
APRIL 30—Wireless communication perfected between Washington and Panama Canal Zone.
APRIL 30—Australian submarine sunk by Turkish warships in Dardanelles.
MAY 4—Italy denounces Triple Alliance.
MAY 7—Japanese ultimatum to China regarding concessions. China agrees to demands.
MAY 7—Sinking of Cunard Liner "Lusitania" by German torpedoes. 1,134 lives lost.
MAY 9-25—Battle of Festubert.
MAY 10—Zeppelin drops nearly 100 bombs on Southend.
MAY 12—General Botha's troops occupy Windhuk, German S.W. Africa.
MAY 13—Orders given for arrest of alien enemies in London of military age.
MAY 13—H.M.S. "Goliath" torpedoed in Dardanelles.
MAY 13—King George V. orders that names of German and Austrian Emperors, King of Würtemberg, German Crown Prince, etc., be struck off roll of Knights of the Garter.
MAY 13—Protest from United States to Germany concerning sinking of "Lusitania."
MAY 14—Insurrection in Portugal. Resignation of Cabinet.
MAY 15—U.S. Interstate Commerce Commission holds that railroads cannot own steamship lines on Great Lakes.
MAY 15—United States sends identical notes to China and Japan regarding her Treaty rights in Japan.
MAY 15—Resignation of Lord Fisher, British First Sea Lord.
MAY 17—Zeppelin raid on Ramsgate.
MAY 21—Austrian Foreign Minister sends note to Italian Ambassador in Vienna stating that Austria cannot admit nullification of Triple Alliance as Italy has agreed to adhere to 12 months' notice being given before termination.
MAY 22—Disaster to troop train near Gretna Green, Scotland. 157 killed.
MAY 23—Italy declares war on Austria-Hungary.
MAY 24—Austrian air-raid on Venice.
MAY 24—Pan-American Financial Congress meets at Washington.
MAY 25—Argentine, Brazil and Chile sign Arbitration Treaty at Buenos Aires.
MAY 25—H.M.S. "Triumph" sunk off Gallipoli Peninsula by submarine.
MAY 26—Constitution of new Coalition Cabinet announced in Great Britain. Lord Balfour becomes First Lord of the Admiralty. R. McKenna becomes Chancellor of Exchequer, succeeding D. Lloyd George.
MAY 27—H.M.S. "Majestic" torpedoed off Gallipoli Peninsula.
MAY 27—Appointment of Admiral Sir Henry Jackson, as First Sea Lord of the Admiralty, succeeding Lord Fisher, resigned.
MAY 28—German reply to U.S. protest of May 13.
MAY 29—Senhor Braga elected President of Portugal.
MAY 31—First Zeppelin attack on London.
JUNE 2—U.S. President issues proclamation warning leaders in Mexico that United States will intervene unless improvement takes place.
JUNE 3—Amarah, Mesopotamia, surrenders to British troops.
JUNE 3—Przemysl recaptured by German and Austrian armies.
JUNE 4—Directors of Ford Motor Company increase capital stock from 2 millions to 100 millions.
JUNE 5—King of Denmark signs law instituting woman suffrage.
JUNE 7—Zeppelin raid on East Coast of England. 5 deaths.
JUNE 8—Resignation of W. J. Bryan, U.S. Secretary of State.
JUNE 9—British Ministry of Munitions Bill receives Royal Assent.
JUNE 9—Second U. S. note to Germany regarding sinking of "Lusitania."
JUNE 9-11—Serious industrial riots at Moscow.
JUNE 10—Russian victory over Germans and Austrians on the Dniester.
JUNE 13—General election in Greece. Victory to Veniselos Party.
JUNE 15—Battle of Givenchy.
JUNE 15—Zeppelin raid on Northeast Coast, England. 15 deaths.
JUNE 15—"Derby" run at Newmarket. Won by S. B. Joel's "Pommern."
JUNE 15—Allied airmen bombard Karlsruhe.
JUNE 16—D. Lloyd George appointed Minister of Munitions in Great Britain.
JUNE 16—Panama Canal used for first time by U.S. battleships.
JUNE 18—Appointment of Departmental Committee for maintaining production of food in England.
JUNE 21—General de Wet sentenced at Bloemfontein to 6 years' imprisonment and £2,000 fine.
JUNE 22—Austrians recapture Lemberg.
JUNE 23—Robert Lansing appointed U.S. Secretary of State.
JUNE 23—German Social Democratic Party issues manifesto calling on government to open negotiations for peace. Published in "Vorwärts."
JUNE 25—Lieut.-Commander M. E. Nasmith, R.N., receives V.C. for destroying Turkish ships in Sea of Marmora by submarine.
JUNE 26—German Socialist paper "Vorwärts" suppressed.
JUNE 28—Generals Huerta and Pasquale Orozco arrested for violation of American neutrality laws.
JUNE 8—Anglo-French forces occupy Ngaundere in Central Cameroons.
JULY 2—British Munitions of War Bill receives Royal Assent.
JULY 2—German battleship "Pommern" torpedoed by British submarine.
JULY 4—German cruiser "Königsberg" destroyed in Rufigi river.
JULY 5—Lord Fisher becomes Chairman of Inventions Board in Great Britain.
JULY 6—Cargo of "Dacia" declared a prize. (See Feb. 27.)
JULY 8—German reply to U.S. note of June 9.
JULY 8—Italian cruiser "Amalfi" torpedoed in Upper Adriatic.
JULY 9—German forces in S.W. Africa surrender to Union troops under General Botha.
JULY 12—German Government assumes control of coal industry throughout country.
JULY 14—British National Registration Bill passes through all stages.
JULY 21—Third U.S. note to Germany regarding sinking of "Lusitania."
JULY 24—U.S. excursion steamer "Eastland" capsizes in Chicago river, with loss of 852 lives.
JULY 27—Direct wireless communication established between United States and Japan.
JULY 27-29—Revolution in Haiti. American marines and sailors assume control at Port au Prince.
AUG. 4—National Ministry formed in New Zealand, composed of 5 representatives from each party.
AUG. 4—Arrest in New York of Tribich Lincoln, former British Liberal M.P., for forgery.
AUG. 4—Seizure of "Dacia" declared by French Prize Court to be legal.
AUG. 5—Germans enter Warsaw.
AUG. 6—New landing of allied troops at Suvla Bay, Gallipoli.
AUG. 6—Senhor Bernardino Machado elected President of Portugal.
AUG. 9—Turkish battleship "Hairredin Barbarossa" sunk by British submarine.
AUG. 9—U.S. assumes control of Haitian affairs.
AUG. 9—Air-raid on East Coast, England, 14 killed.
AUG. 14—British transport "Royal Edward" sunk by submarine in Aegean Sea with loss of 1,000 lives.
AUG. 15—National Register taken throughout Great Britain.
AUG. 16-17—Storm on coast of Texas causes nearly 200 deaths.
AUG. 17—Zeppelin raid on Eastern Counties, England. 10 killed.
AUG. 19—Germans capture Novo-Georgievsk.
AUG. 19—White Star Liner "Arabic" sunk by German submarine with loss of 33 lives.
AUG. 20—Italy declares war on Turkey.
AUG. 21—Cotton declared contraband by Great Britain and France.
AUG. 22—Veniselist Ministry formed in Greece.
AUG. 25—Emperor Francis Joseph of Austria-Hungary celebrates his 85th birthday.
AUG. 25—Germans capture Brest-Litovsk.
AUG. 29-30—Russian victory in Galicia.
SEPT. 4—Allan liner "Hesperian" torpedoed and sunk with loss of 32 lives.
SEPT. 7—Russian victory over Germans in Galicia.
SEPT. 7—Trades Union Congress in Great Britain passes resolution upholding voluntary system of enlistment, and protesting against campaign for compulsory service.
SEPT. 7—Zeppelin raid on Eastern Counties, England, 7 killed.
SEPT. 9—United States asks Austria to recall Dr. Dumba, her ambassador to New York, for complicity in attempts to stir up industrial strife in United States.
SEPT. 10—American authorities order extradition of Tribich Lincoln. (See Aug. 4.)
SEPT. 13—Admiral Sir Percy Scott appointed to take charge of aircraft defence of London.
SEPT. 14—British casualties for first year of war are 381,982, including killed, wounded and missing.
SEPT. 16—Treaty signed by United States with Haiti, under which former acquires financial protectorate over island for 10 years, and recognises Dartiguenave Government.
SEPT. 18—Germans capture Vilna.
SEPT. 19—British transport "Ramazan" sunk by shell-fire from submarine in Aegean Sea. Loss of 300 Indian troops.
SEPT. 21—Stonehenge, England, sold by auction to Mr. C. H. E. Chubb, for £6,600.
SEPT. 22—Dynamite explosion in subway excavation, 7th Av., N.Y. City, kills 7, injures 100.
SEPT. 22—Indian legislative Council passes motion that India be officially represented at next Imperial Conference.
SEPT. 22—Subscriptions to third War Loan close in Great Britain. Amount raised: £601,500,000.
SEPT. 23—Mobilisation of Greek Army begins.
SEPT. 25—Great Allied advance in France.
SEPT. 25-28—Battle of Loos.
SEPT. 27—New Zealand National Registration Bill passed unanimously.
SEPT. 28—Capture by British of Kut-el-Amara.
SEPT. 29—Tropical hurricane in Louisiana and Mississippi kills 549 and causes 12 million dollars damage.
SEPT. 29—Terms of U.S. loan of $500,000,000 to Great Britain and France announced in New York.
OCT. 4—Russian ultimatum to Bulgaria demanding withdrawal within 24 hours of German and Austrian officers in Bulgaria.
OCT. 5—Landing of Allied troops at Salonika.
OCT. 5—Dr. Dumba, Austrian Ambassador to United States recalled (see Sept. 9).
OCT. 6—Bulgarian reply to Russian ultimatum. Not considered satisfactory. Diplomatic relations broken off.
OCT. 9—Austro-German troops occupy Belgrade.
OCT. 9—Conference of Latin American countries recognises General Carranza as chief of de facto Government in Mexico.
OCT. 10—United States recognises Carranza Government in Mexico as from Oct. 19th.
OCT. 11—Bulgarians open hostilities on Serbia at 4 A.M.
OCT. 12—Negative Greek reply to Serbian appeal for military aid against Bulgaria under Serbo-Greek Treaty of 1913.
OCT. 12—Allies decide to assist Serbia and uphold Treaty of Bucharest (Aug. 10 1913).
OCT. 12—Execution of Edith Cavell at Brussels.
OCT. 13—American Loan Bill receives Royal Assent in Great Britain.
OCT. 13—Resignation of M. Delcassé, French Foreign Minister.
OCT. 13—Air-raid on London. 41 civilians killed.
OCT. 14—Bulgaria notifies Greece of state of war between her and Serbia as from 8 A.M.
OCT. 15—Anglo-French Loan Contract with United States signed.
OCT. 15—Great Britain declares war on Bulgaria.
OCT. 16—France declares war on Bulgaria.
OCT. 18—General Sir C. C. Monro succeeds General Sir Ian Hamilton as Commander of Mediterranean Expeditionary Force.
OCT. 19—Japan adheres to Pact of London (see Sept. 5 1914).
OCT. 19—U.S. recognises Gen. Carranza in Mexico.
OCT. 19—Italy declares war on Bulgaria.
OCT. 20—Great Britain declares Article 57 of Declaration of London as no longer binding.
OCT. 20—United States declares embargo on export of arms to Mexico, except in territory controlled by Carranza forces.
OCT. 23—Parade of 25,000 women at New York as demonstration in favour of woman suffrage.
OCT. 23—Death of W. G. Grace, English cricketer.
OCT. 26—Andrew Fisher resigns premiership of Australia and becomes High Commissioner in London. Succeeded by W. M. Hughes.
OCT. 20—General election in S. Africa. Ministerialists in a minority in the House.
OCT. 28—Resignation of Viviani Ministry in France. Briand forms Cabinet Oct. 29.
OCT. 28—H.M.S. "Hythe" sunk in collision off Gallipoli Peninsula. 150 lives lost.
OCT. 29—Memorial service for Edith Cavell held at St. Paul's Cathedral, London.
NOV. 2—Sir F. E. Smith succeeds Sir Edward Carson as Attorney-General in Great Britain.
NOV. 5—Bulgarians capture Nish.
NOV. 5—Majority of provinces in China vote for establishment of Monarchy with Yuan Shih-Kai as Emperor.
NOV. 6—Skouloudis Ministry formed in Greece. Benevolent policy to Allies announced.
NOV. 7—Italian liner "Ancona" torpedoed by Austrian submarine, with loss of 194 lives.
NOV. 12—Gilbert and Ellice Islands annexed to British Empire at their own request.
NOV. 12—Haiti approves treaty with United States creating virtual U.S. protectorate.
NOV. 12—Greek Parliament dissolved by King.
NOV. 13—Resignation of Winston Churchill from British Cabinet.
NOV. 17—British hospital ship "Anglia" strikes mine with loss of 100 lives.
NOV. 22—Battle of Ctesiphon. Defeat of Turks.
NOV. 23—Fall of Mitrovitza and Prishtina. Serbian Army in retreat towards Albania.
NOV. 24—Serbian Government moves to Skutari.
DEC. 1—Italy adheres to Pact of London. (See Sept. 5 1914.)
DEC. 3—German Naval and Military attachés at Washington asked to leave United States.
DEC. 3—General Townshend reaches Kut-el-Amara after 90-mile retreat.
DEC. 4—Anglo-French War Conference at Calais.
DEC. 9—U.S. note to Austria protesting against sinking of "Ancona."
DEC. 10—British withdrawal from Suvla and Anzac (Gallipoli) begins.

DEC. 11—General de Castelnau appointed Chief of Staff in French Army.
DEC. 14—Austrian reply to U.S. note of Dec. 9 delivered.
DEC. 16—Sir Douglas Haig becomes Commander-in-Chief of British forces in France and Flanders. Sir John French created a Viscount and appointed Commander-in-Chief of troops in U.K.
DEC. 19—Second U.S. protest to Austria against sinking of "Ancona."
DEC. 20—Withdrawal from Anzac and Suvla (Gallipoli) completed.
DEC. 20—General de Wet and 118 others sentenced for high treason, are pardoned.
DEC. 21—Lieut-Gen. Sir William Robertson becomes Chief of Imperial General Staff in Great Britain.
DEC. 28—British Cabinet agrees upon principle of compulsory service for the army.
DEC. 30—P. & O. liner "Persia" sunk by torpedo off Crete. Loss of 200 lives.
DEC. 30—Austrian reply to U.S. note of Dec. 19.
DEC. 31—H.M.S. "Natal" blown up in port. Loss of 300 lives.

1916

JAN. 1—W. Waldorf Astor raised to the British peerage.
JAN. 2—Russian offensive in the Bukovina begins.
JAN. 2—Glen Line passenger steamer "Glengyle" and P. & O. liner "Geelong" sunk in Mediterranean.
JAN. 3—Price of bread in London increased to 9d. for the 4 lb. loaf.
JAN. 4—U.S. note to Great Britain protesting against British search of neutral mails for contraband.
JAN. 7—Count Bernstorff offers U.S. government reparation for damages caused by submarines to American citizens.
JAN. 8—Evacuation of Gallipoli Peninsula completed.
Jan. 10—Sir Percy Lake assumes command of Mesopotamian forces.
JAN. 10—19 American employees of mining company taken from train and shot near Chihuahua, Mexico, by Villa's bandits.
JAN. 11—Sir John Simon resigns British Home Secretaryship, objecting to Military Service Bill; succeeded by Herbert Samuel.
JAN. 13—Death of General Huerta, Mexican Dictator.
JAN. 13—Miners' Federation of Great Britain resolves to oppose Military Service Bill.
JAN. 14—Austrian cruiser sunk off Cattaro by French submarine "Foucault."
JAN. 14—Lord Chelmsford appointed Viceroy of India.
JAN. 15—British S.S. "Appam" captured by Germans.
JAN. 15—U.S. submarine E2 sunk by explosion in Brooklyn Navy Yard. 4 killed, 12 injured.
JAN. 15—Papers seized on Captain von Papen, former German Military Attaché at Washington, published.
JAN. 17—General Rodriques and Colonel Bacavalles executed by General Carranza in connection with outrages of Jan. 10 in Mexico.
JAN. 19—Russian victory in the Caucasus.
JAN. 19—Allied War Council meets in London.
JAN. 23—German air raid over Kent. 7 casualties.
JAN. 24—U.S. Supreme Court holds Income Tax law constitutional.
JAN. 27—Labour Party Congress at Bristol votes against Conscription and Military Service Bill, but decides not to agitate for repeal of measures when it becomes law.
JAN. 27—Royal Assent given to British Military Service Bill.
JAN. 28—Great dam bursts at San Diego, California. 50 drowned. Enormous damage.
JAN. 28 United States sends note to belligerents on principles of submarine attacks on merchant vessels, and enquires if belligerents will subscribe to same.
JAN. 29—Zeppelin raid on Paris. 50 killed and wounded.
JAN. 31—Price of 4 lb. loaf in London rose to 9½d.
JAN. 31—Zeppelin raid over Eastern, North Eastern and Midland counties of England. 70 killed.
FEB. 1—British ship "Appam" arrives at Norfolk, Va., with German prize crew. (See Jan. 15.)
FEB. 2—British Ambassador at Washington demands release of "Appam." German note to United States on subject.
FEB. 3—Parliament Buildings, Ottawa, Canada, destroyed by fire.
FEB. 8—French Cruiser "Admiral Charner" torpedoed off Syrian coast. 374 lives lost.
FEB. 9—British Military Service Act comes into force.
FEB. 10—Resignation of L. M. Garrison, U.S. Secretary of War. (See Mar. 7.)
FEB. 10—General Smuts appointed to East African command.
FEB. 14—Allies renew and enlarge engagements entered into with Belgium guaranteeing her independence. Belgium guaranteed a place in peace negotiations.
FEB. 16—Erzerum captured by Russians.
FEB. 16—U.S. Govt. refuses to recognise German claim to sink armed merchantmen without warning.
FEB. 18—U.S. Senate ratifies treaty with Nicaragua regarding construction of canal across Nicaragua.
FEB. 18—Cameroons campaign completed with surrender of German garrison at Moca Hill.
FEB. 21—Battle of Verdun opens.
FEB. 21—German Zeppelin brought down in flames in France.
FEB. 22—Russian Duma opened by Tsar in person for first time since inauguration.
FEB. 23—Lord Robert Cecil appointed Minister of Blockade in Great Britain with Cabinet rank.
FEB. 26—French transport "Provence II" sunk in Mediterranean. 930 lives lost.
FEB. 27—P. & O. liner "Maloja" mined off Dover. 155 lives lost.
FEB. 28—U.S. Senate ratifies treaty with Haiti.
FEB. 29—Issue in Great Britain of first "Black List."
FEB. 29—German order to sink armed merchantmen at sight comes into force.
MAR. 1—Bonaventure (Grand Trunk) railway station, Montreal, destroyed by fire.
MAR. 2—Capture of Bitlis by Russians.
MAR. 2—U.S. answer to German note of Feb. 2 regarding S.S. "Appam."
Mar. 5—Zeppelin raid over Eastern counties of England. 70 casualties.
MAR. 5—Spanish steamer "Principe de Asturias" strikes rock and sinks near Ponta Boi, Sao Sebastiao, Brazil. 400 lives lost.
MAR. 7—U.S. House of Representatives supports President's attitude on armed merchantmen question.
MAR. 7—Newton D. Baker appointed U.S. Secretary of War in succession to L. M. Garrison.
MAR. 9—Columbus, New Mexico, attacked by General Villa.
MAR. 9—W. P. Hughes, Australian Premier, attends British Cabinet meeting.
MAR. 9—Germany declares war on Portugal. "National" Ministry in Portugal formed under Ar. Almeida.
MAR. 13—Court of Appeal in Great Britain allows appeal in Slingsby legitimacy case, and finds child illegitimate.
MAR. 13—U.S. note to Mexican Government accepts Mexican offer of permission to pursue bandits into Mexican territory in return for reciprocal permission for Mexican troops in American territory.
MAR. 15—U.S. punitive expedition against General Villa enters Mexico.
MAR. 16—Austria-Hungary declares war on Portugal.
MAR. 16—Admiral von Capelle succeeds Admiral von Tirpitz as German Minister of Marine.
MAR. 17—Strike of British munition workers in Clyde area begins.
MAR. 19—German sea-plane raid over East Kent. 11 killed. 31 injured.
MAR. 19—Russians capture Ispahan.
MAR. 20—65 allied aeroplanes bombard Zeebrugge.
MAR. 20—Viceroy of India intimates proposed abolition of system of Indian indentured labour.
MAR. 24—British cross-channel steamer "Sussex" torpedoed off Dieppe. Many Americans among 50 passengers drowned.
MAR. 24—General Sir A. Murray appointed to command British forces in Egypt.
MAR. 25—British seaplanes attack German airship sheds in Schleswig-Holstein.
MAR. 27—First War Conference of all Allies opened in Paris. M. Briand presides.
MAR. 29—Three express trains in wreck on New York Central Railroad at Amherst, O. 26 killed.
MAR. 30—U.S. House of Representatives passes Burnett Immigration Bill by 308 votes to 87. Bill prohibits admission of immigrants unable to read.
MAR. 31—Zeppelin raid on east and north-east counties of England. 43 killed. Zeppelin L15 destroyed.
APRIL 1—Establishment of Ministry of Blockade in France under Denys Cochin.
APRIL 1—Zeppelin raid on north-east coast of England. 17 killed, 100 injured.
APRIL 2—Powder factory explosion in Kent, England. 200 casualties.
APRIL 3—Great Britain replies to U.S. protest regarding seizure of mails and maintains right to examine mails and confiscate packages containing contraband.
APRIL 4—Strike of British munition workers on Clyde ends (see Mar. 17).
APRIL 6—Kwang-tung Province, including City of Canton, joins revolt against Yuan Shih-Kai's government, in China.
APRIL 9—German attacks before Verdun partially successful.
APRIL 10—Germany disclaims to U.S. government all responsibility for torpedoing of "Sussex."
APRIL 11—Nicaragua ratifies Treaty with United States. (See Feb. 18.)
APRIL 14—British naval aeroplanes bombard Constantinople and Adrianople.
APRIL 15—Panama Canal re-opened, after being closed 7 months.
APRIL 17—Attachés of German Embassy, in Washington, indicted by U.S. Federal jury for conspiracy to destroy Weiland Canal.
APRIL 18–19—U.S. Government informs Germany that diplomatic relations will be broken off if submarine attacks on merchantmen carrying Americans continue.
APRIL 21—Sir Roger Casement lands in Ireland. Arrested on 24th.
APRIL 21—Japanese Government protests against certain provisions in U.S. Immigration Bill.
APRIL 23—Tercentenary of the death of Shakespeare.
APRIL 24—Sinn Fein rebellion in Dublin begins. (Easter Rebellion.)
APRIL 25—German squadron bombards Lowestoft and Yarmouth.
APRIL 25—"Anzac Day," anniversary of landing of Australian and New Zealand contingents in Gallipoli, celebrated in London.
APRIL 27—H.M.S. "Russell" mined in Mediterranean. 124 men lost.
APRIL 27—Martial law proclaimed throughout Ireland.
APRIL 29—Dublin Post Office burnt by Sinn Feiners.
APRIL 29—Fall of Kut-el-Amara to Turks.
MAY 1—Extradition of Tribich Lincoln affirmed by U.S. Supreme Court.
MAY 1—End of Sinn Fein Rebellion in Ireland.
MAY 2—Mexican bandits kill and wound a number of U.S. citizens in border raids.
MAY 3—Principal Irish rebel leaders tried by court-martial and shot.
MAY 4—German note to America regarding U-boat war.
MAY 8—"Anzacs" arrive in France, taking over portion of British front.
MAY 10—Resignation of Lord Wimborne, Lord Lieutenant of Ireland.
MAY 10—German note to United States admitting having torpedoed "Sussex." (See March 24 and April 10.)
MAY 16—U.S. Senate Committee on Immigration agrees to amendment Bill to meet Japanese objections (see April 21).
MAY 17—New British Air Board constituted. President: Lord Curzon.
MAY 17—United States declines Germany permanent asylum in American port for S.S. "Appam."
MAY 17—Victor Louvet, Italian airman, beats world's height record near Turin reaching 20,500 ft.
MAY 17—Sir Roger Casement committed for trial on charge of high treason.
MAY 22—Mexican government asks United States to withdraw troops from Mexico.
MAY 24—U.S. notes to France and Great Britain protesting further against searching of mails.
MAY 25—Military Service Bill No. 2 receives Royal Assent in Great Britain.
MAY 30—New Derby won at Newmarket by Sir E. Hulton's "Fifinella."
MAY 30—John MacNeill, President of Sinn Fein Volunteers, sentenced to penal servitude for life.
MAY 31—Battle of Jutland.
MAY 31—Sir Ernest Shackleton reaches Falkland Is. from Southern exploring expedition.
JUNE 2—Third Battle of Ypres.
JUNE 3—Allies establish martial law at Salonika.
JUNE 5—Lord Kitchener drowned by sinking of H.M.S. "Hampshire" off Orkney Islands.
JUNE 9—Revolt of Grand Sharif of Mecca against Turkish Government.
JUNE 9—Italian transport "Principe Umberto" torpedoed in Adriatic. Large loss of life.
JUNE 9—Allied War Council meets in London.
JUNE 10—Bill for compulsory military service passed in New Zealand.
JUNE 10—Republican National Convention at Chicago nominates C. E. Hughes as candidate for Presidential election.
Progressive (Republican) National Convention nominates T. Roosevelt for Presidency.
JUNE 12—Resignation of Salandra Cabinet in Italy.
JUNE 12—British column, under Sir P. Sykes, enters Kerman, S. Persia.
JUNE 13—General Smuts' troops capture Wilhemsthal, German East Africa.
JUNE 14—Allied Economic Conference opens in Paris.
JUNE 15—Boy Scouts of America incorporated.
JUNE 15—Woodrow Wilson re-nominated for Presidency of United States by Democratic National Convention at St. Louis.
June 17—Coalition Government formed in Italy under Signor Boselli.
JUNE 20—United States refuses Mexican request of May 22.
JUNE 21—Battle of Carrizal between United States and Mexican troops.
JUNE 23—Greece accepts Allies' demands for demobilisation.
JUNE 23—Convention of Ulster Nationalists adopts proposal to exclude Ulster under Government of Ireland Act.
JUNE 23—Great Eastern Railway Co.'s steamer "Brussels" captured by Germans in North Sea and taken to Zeebrugge.
JUNE 24—Allied embargo on Greek shipping suspended.
JUNE 25—U.S. note to Mexico regarding release of American prisoners taken at Carrizal.
JUNE 26—Theodore Roosevelt declines Progressive (Republican) nomination for the Presidency.
JUNE 28—Duke of Devonshire appointed Governor-General of Canada.
JUNE 29—Sir Roger Casement sentenced to death for high treason.
JULY 1—Franco-British offensive on the Somme begins.
JULY 3—Wertheimer Collection of Sargent portraits bequeathed to British nation.
JULY 3—Report of Royal Commission on Irish rebellion issued.
JULY 6—D. Lloyd George appointed British Secretary for War, and Lord Derby Under-Secretary.
JULY 7—General Smuts occupies Tanga, German East Africa.
JULY 8—British Order in Council and French decree issued abandoning Declaration of London of Feb. 25 1909.
JULY 9—E. S. Montagu becomes Minister of Munitions in Great Britain.
JULY 9—German commercial submarine "Deutschland" reaches Norfolk, Va., with 1,000 ton cargo. U.S. Customs state she complies with all requirements of merchantman.
JULY 10—First of American-Mexican informal conferences begun at Washington in endeavour to adjust differences between two governments.
JULY 14–15—Allied Economic Conference held at Paris.
JULY 18—A. I. Elkus appointed U.S. Ambassador to Turkey.
JULY 23—Great Britain replies to U.S. protest regarding seizure of neutral mails and upholds legality of principles involved.
JULY 25—Re-constituted Serbian Army in action on Salonika front against Bulgarians.

JULY 26—Declaration by Swedish, Danish and Norwegian governments on abandonment of Declaration of London by Britain and France.
JULY 26—United States protests against British "black list" forbidding commercial dealings with certain U.S. firms and individuals.
JULY 27—Captain Charles Fryatt of S.S. "Brussels" executed by Germans (see June 23).
JULY 28—United States agrees to Mexican proposal to set up Commission for settlement of disputes.
JULY 29—U.S. Federal Court's decision regarding S.S. "Appam" in favor of British owners.
JULY 29–30—Forest fires in Ontario. 700,000 acres burned. 300 lives lost.
JULY 31—H. E. Duke appointed Chief Secretary for Ireland.
AUG. 2—Italian Dreadnought "Leonardo da Vinci" sunk by explosion. Loss of 247 lives.
AUG. 3—Sir Roger Casement executed.
AUG. 4—Turkish offensive in Sinai Peninsula defeated by British.
AUG. 4—Danish-American Treaty signed, involving sale of Danish West Indian Is. to United States.
AUG. 7—British protest to Germany regarding execution of Captain Fryatt.
AUG. 9—Gorizia captured by Italians.
AUG. 15—Severe hurricane in Jamaica.
AUG. 15—Australian Federal Govt. orders registration of men of military age fit for service.
AUG. 19—Sortie of German High Seas Fleet.
AUG. 19—British submarine torpedoes German battleship "Westfalen" in North Sea.
AUG. 20—General allied offensive in Macedonia.
AUG. 21—Explosion at munitions factory, Yorkshire. 39 killed, 60 injured.
AUG. 23—German commercial submarine "Deutschland" reaches Weser (Germany) on return from United States (see July 9).
AUG. 24—Zeppelins raid outskirts of London. 8 killed. 21 injured. Much damage to property.
AUG. 27—Rumania declares war on Austria-Hungary.
AUG. 28—Germany declares war on Rumania. Italy declares war on Germany.
AUG. 29—U.S. cruiser "Memphis" wrecked in San Domingo harbour. 36 lost.
AUG. 29—Rumanian offensive in Transylvania begins.
AUG. 29—Autonomy Bill for Philippine Islands passed in United States.
AUG. 30—Turkey declares war on Rumania.
AUG. 30—F.-M. von Hindenburg appointed Chief of German General Staff.
SEPT. 1—Bulgaria declares war on Rumania.
SEPT. 2—13 German airships attack London and Eastern counties.
SEPT. 6—Compulsory Military Service Bill passed in New Zealand.
SEPT. 6—U.S. and Mexican Commission meet at New London, Conn., in first conference.
SEPT. 7—U.S. Senate ratifies treaty with Denmark for purchase of Dutch West Indies.
SEPT. 11—Central span of Quebec Bridge collapses an hour after it has been hoisted into position. 11 persons killed.
SEPT. 15—First use of "tanks" by British.
SEPT. 15—V.C. conferred on Jack Cornwell (died on June 2) for conspicuous bravery at Battle of Jutland.
SEPT. 23—12 Zeppelins raid London and eastern counties. 30 killed, 110 injured.
SEPT. 24—Krupp's works, Essen, bombed by French airmen.
SEP. 27—Rumanian Army occupies one-third of Transylvania after one month of war.
SEPT. 30—M. Veniselos, Admiral Condouriotes and General Danglis form Provisional Greek Govt. in Crete. Removed to Salonika on Oct 9.
OCT. 2–5—Rumanian offensive against Mackensen in Dobruja.
OCT. 4—Austro-German counter-offensive in Rumania begins.
OCT. 4—French auxiliary cruiser "Callia" torpedoed in Mediterranean. 600 troops lost.
OCT. 5—Germany and Austria agree to reconstitute independent Kingdom of Poland with hereditary monarchy and constitution.
OCT. 8—German U-boat, reaches Rhode Island, New York, and sinks 9 ships in vicinity.
OCT. 10—Royal Commission on Wheat control and supply appointed in Great Britain.
OCT. 10—Allied ultimatum presented to Greece.
OCT. 10—United States refuses Allies' proposal that neutral governments exclude belligerent submarines from neutral waters.
OCT. 11—Greek Govt. accepts Allies' ultimatum demanding handing over of Greek Fleet and arsenal at Keratsini Gul.
OCT. 13—Norway prohibits belligerent submarines entering Norwegian waters except under stress of weather.
OCT. 14—Rumanians withdraw from Transylvania.
OCT. 16—Price of 4 lb. loaf in London reaches 10d.
OCT. 16—Fresh Allied note to Greek Government. Allied force occupies Athens for preservation of order.
OCT. 19—Franco-British Conference at Boulogne. Veniselist Govt. recognised.
OCT. 20—Storm on Lake Erie wrecks four steamers with loss of over 50 lives.
OCT. 20—Mackensen resumes attack in Dobruja.
OCT. 20—German protest to Norway against Norwegian order of Oct. 13.
OCT. 21—Assassination of Count Stürgkh, Austrian Premier.
OCT. 21—British minesweeper "Genista" torpedoed; all officers and 73 men lost.
OCT. 25—Greek Govt. agrees to disband Class 13, and to transfer two Army Corps to Peloponnesus.
OCT. 28—Australian referendum re compulsory military service results in majority of 61,000 against it.
OCT. 28—Provisional Greek Govt. of M. Veniselos installed at Salonika.
OCT. 28—Sir D. Haig unanimously elected Lord Rector of St. Andrews University, Scotland.
NOV. 1—German commercial submarine "Deutschland" reaches United States on second trip (see July 9 and Aug. 23).
NOV. 6—General Sir R. Wingate appointed High Commissioner for Egypt to take effect on Jan. 1 1917.
NOV. 6—Sir Bryan Mahon appointed Commander in Chief in Ireland.
NOV. 6—Price of 4 lb. loaf in London raised to 10½d.
NOV. 6—P. & O. liner "Arabia" torpedoed and sunk in Mediterranean.
NOV. 7—S.S. "Columbian" (U.S.) sunk by German submarine off Spanish coast.
NOV. 7—Woodrow Wilson re-elected President of United States with largest vote recorded, 8,563,750.
NOV. 7—Miss Jeanette Rankin returned by Montana as first woman member of Congress.
NOV. 9—Nobel Prize for Literature for 1915 awarded to Romain Rolland.
NOV. 10—Count von Tarnowski appointed Austro-Hungarian Ambassador to United States.
NOV. 13—Battle of the Ancre.
NOV. 13—Cardinal Mercier, Belgian Primate, issues protest to world against deportation of Belgians for forced labour in Germany.
NOV. 14—British answer to U.S. note regarding "black list."
NOV. 15—Wireless communication established across Pacific from San Francisco to Tokyo (5,440 miles) with relay at Hawaii.
NOV. 15—Allied Conference in Paris.
NOV. 16—British troops repulse raid by Mohmands near Peshawar, India, using aeroplanes for first time in Indian warfare.
NOV. 17—Fresh note from Allies to Greece demanding delivery of war material.
NOV. 19—Monastir occupied by French and Serbs.
NOV. 21—British hospital ship "Britannia" sunk by mine in Aegean Sea. 100 lives lost.
NOV. 21—German commercial submarine "Deutschland" starts from United States on second return voyage to Germany (see Aug. 23).
NOV. 21—Death of Emperor Francis Joseph of Austria.
NOV. 21—Resignation of Herr von Jagow, German Foreign Minister; succeeded by Herr Zimmermann.
NOV. 22—Belgian protest to neutral governments against deportations of Belgians. (See Nov. 13.)
NOV. 23—Accession of Emperor Charles I. of Austria.
NOV. 24—Protocol signed by American and Mexican Commissioners at Atlantic City, N.J.
NOV. 28—U.S.A. S.S. "Chemung" carrying contraband, sunk by Austrian submarine off Spanish coast.
NOV. 29—U.S. protest to Germany against Belgian deportations. (See Nov. 13.)
NOV. 29—Vice-Admiral Sir David Beatty becomes C. in C. of British Fleet. Admiral Sir John Jellicoe becomes First Sea Lord.
NOV. 29—British Govt. takes possession of a S. Wales coalfield under Defence of Realm Act.
DEC. 1—Fighting in Athens owing to landing of Allied troops.
DEC. 3—Portuguese port of Funchal bombarded by German submarine.
DEC. 4—J. H. Thomas, M.P., elected Secretary of National Union of Railwaymen in Great Britain.
DEC. 4—Pope Benedict creates 10 new cardinals, 7 Italian, 3 French.
DEC. 5—Resignation of H. H. Asquith, British Prime Minister.
DEC. 6—Explosion at British munition factory; 26 women killed, 30 injured.
DEC. 6—Germans capture Bukarest.
DEC. 7—D. Lloyd George becomes Prime Minister in Great Britain.
DEC. 10—"Deutschland" arrives in German port, completing second return voyage. (See Aug. 23.)
DEC. 10—Allied note to Greece demanding complete demobilisation, restoration of Allied control over posts, telegraphs and railways and release of Veniselists.
DEC. 11—New Ministry announced in Great Britain. War Cabinet formed consisting of D. Lloyd George, Lord Curzon, A. Henderson and Lord Milner.
DEC. 11—German reply to U.S. note regarding Belgian deportations.
DEC. 12—French War Ministry formed under M. Briand.
DEC. 12—U.S. Senate passes Immigration Bill carrying literacy test and amendment to meet Japanese criticism.
DEC. 12—German Peace Note addressed to Allies.
DEC. 13—General Nivelle in command of French forces on Western front.
DEC. 14—People of Denmark vote by large majority to sell Danish West Indian Is. to United States.
DEC. 15—Greek Govt. accepts Allied ultimatum of Dec. 10.
DEC. 18—General Carranza refuses to sign protocol of Nov. 24 with United States. Submits counter statement.
DEC. 19—British Govt. decides to take over control of shipping and mining, to institute National Service, and to call Imperial Conference. Neville Chamberlain appointed Director-General of National Service.
DEC. 20—U.S. President addresses Peace Note to all belligerent Powers.
DEC. 21—Bill for sale of Danish West Indies to United States passes Danish Landsthing.
DEC. 22—Switzerland identifies herself with U.S. Peace Note.
DEC. 25—British Dominion Premiers invited to Special War Conference of Empire.
DEC. 26—German and Austrian replies to U.S. Peace Notes.
DEC. 27—Norway, Sweden and Denmark send identic Peace Notes to belligerents.
DEC. 28—German reply to Swiss Peace Note.
DEC. 30—Spanish Govt.'s reply to U.S. President's Peace Note.
DEC. 30—Reply of 10 Allied nations to U.S. President's Peace Note of Dec. 20, handed to American Ambassador in Paris.
DEC. 31—Austrian answer to Peace Note of Scandinavian countries of Dec. 27.
DEC. 31—Allied ultimatum to Greece.

1917

JAN. 1—Baking of standard bread becomes compulsory in England.
JAN. 1—New railway regulations in Great Britain: 50 per cent increase in fares; fewer and slower trains.
JAN. 1—Great Britain, France and Italy recognise new Kingdom of Hejaz.
JAN. 1—Newfoundland adopts prohibition.
JAN. 1—Turkey denounces Treaty of Paris (1856) and Treaty of Berlin (1878).
JAN. 1—British transport "Ivernia" torpedoed in Mediterranean. 153 missing.
JAN. 2—Bratiano Cabinet formed in Rumania.
JAN. 5—Fall of Braila, Rumania, to Germans and Bulgarians. Allies evacuate Dobruja.
JAN. 5—Battle of Kut-el-Amara begins.
JAN. 6—General Emiliano Chamorro becomes President of Nicaragua.
JAN. 8—Renewed Allied ultimatum to Greece; 48 hours time limit. (See Dec. 31 1916.)
JAN. 9—Ellerman liner "Lesbian" torpedoed. Capt. Fry taken prisoner by Germans.
JAN. 9—H.M.S. "Cornwallis" torpedoed in Mediterranean. 13 men lost.
JAN. 10—Qualified Greek acceptance of Allied demands of Dec. 31 1916.
JAN. 10—Allied reply to President Wilson's Peace Note of Dec. 20 1916 published.
JAN. 10—German Consul-General at San Francisco and 4 employees found guilty of violating American neutrality by plots to destroy munition shipments to Entente.
JAN. 11—German-Austrian notes to neutral governments declare Entente reply of Jan. 10 to peace overtures excludes answer.
JAN. 11—New British War Loan issued at 5 per cent and 4 per cent.
JAN. 14—Japanese battleship "Tsukuba" destroyed by explosion in Yokosuba harbour. 153 lives lost.
JAN. 15—American-Mexican Joint Commission dissolved after 4 months' ineffectual discussion. (See Sept. 6 1916.)
JAN. 16—Greek Govt. accepts Allied demands completely.
JAN. 17—Mackensen's advance in Rumania checked.
JAN. 17—U.S. assumes sovereignty of Danish West Indies.
JAN. 19—Explosion in munitions factory in East end of London. Casualties 450, including 69 killed.
JAN. 23—British Labour Party Conference at Manchester approves acceptance of Ministerial office by Labour members.
JAN. 28—Gen. Pershing ordered to withdraw from Mexico. (See Feb. 5.)
JAN. 31—German declaration to neutrals announces policy of unrestricted naval warfare.
JAN. 31—German Ambassador at Washington orders sabotage of German ships in U.S. ports in anticipation of rupture.
FEB. 3—Diplomatic relations broken off between United States and Germany. United States seizes interned German cruisers and Hamburg-Amerika liners.
FEB. 3—U.S.S. "Housatonic" torpedoed in daylight off Scilly Isles.
FEB. 4—U.S. Note to neutrals suggesting their rupture of diplomatic relations with Germany.
FEB. 5—Act regulating immigration to and residence of aliens in United States passed over President's veto.
FEB. 5—U.S. expeditionary force withdraws from Mexico.
FEB. 6—Neville Chamberlain announces National Service Scheme for Great Britain.
FEB. 7—Anchor liner "California" torpedoed. 43 missing.
FEB. 8—Neutral governments address Germany refusing to recognise submarine blockade as legal.
FEB. 11—Germany attempts, through Swiss Govt., to re-open negotiations with United States.
FEB. 12—President Wilson refuses to re-open negotiations with Germany until she abandons unrestricted naval warfare.
FEB. 14—German Ambassador von Bernstorff leaves U.S. for Germany.
FEB. 15—War Govt. formed in Australia; Mr. Hughes Prime Minister.
FEB. 15—Board of Trade takes control of all United Kingdom coalfields for war period.
FEB. 20—U.S. Note to Austria-Hungary enquiring attitude of Austria on unrestricted naval warfare.
FEB. 22—7 Dutch ships from Falmouth attacked by German submarine in error, Germany having guaranteed security. 3 sunk. Reparation by Germany.
FEB. 24—Great German withdrawal on Ancre.
FEB. 24—Kut-el-Amara taken by Sir Stanley Maude.
FEB. 25—Cunard S.S. "Laconia" torpedoed without warning. 12 lives lost, including 3 Americans.

FEB. 27—U.S. Govt. regards sinking of "Laconia" as an "overt act" by Germany. (See Feb. 25.)
MARCH 1—German proposal for alliance with Mexico and Japan against United States revealed.
MARCH 1—British Govt. accepts India's offer of £100,000,000 towards general cost of war.
MARCH 2—Japan and Mexico deny all knowledge of German proposal for alliance against United States.
MARCH 5—Austro-Hungarian reply to U.S. note of Feb. 20. Germany's submarine policy supported.
MARCH 6—U.S. Supreme Court confirms "Appam" decision in favour of British owners. (See July 29 1916.)
MARCH 8—President Wilson decides to arm merchant ships against submarines, without recourse to special authorisation of Congress.
MARCH 8—American marines land at Santiago, Cuba, at request of civil government.
MARCH 11—Spring campaign in Macedonia begins. Second battle of Monastir.
MARCH 11—British capture Baghdad.
MARCH 11—Mexican Presidential election. Carranza elected without opposition.
MARCH 12—Tsar of Russia suspends Duma. Russian revolution begins.
MARCH. 14—Resignation of General Lyautey, French War Minister.
MARCH 14—British Government increases duty on cotton goods imported into India from 3½% to 7½%.
MARCH 14—Constitution of Russian Provisional Govt. announced.
MARCH 15—Tsar of Russia abdicates for himself and Tsarovitch, and names Grand Duke Michael as Regent.
MARCH 17—Admiral von Tirpitz resigns as German Secretary for Navy. Admiral von Capelle succeeds.
MARCH 17—British capture Bapaume.
MARCH 18—Russian Provisional Govt. issues manifesto.
MARCH 18—British occupy Peronne. French occupy Noyon.
MARCH 19—U.S. Supreme Court upholds Adamson Law granting railwaymen 8 hours' day.
MARCH 19—Ribot Cabinet formed in France. M. Painlevé becomes War Minister.
MARCH 19—French battleship "Danton" torpedoed in Mediterranean. 296 lives lost.
MARCH 19—Allies raise Greek blockade. Allied ministers return to Athens.
MARCH 20—British hospital ship "Asturias" torpedoed. 43 drowned, 39 injured.
MARCH 20—First meeting of Imperial War Cabinet in London. Dominion and Indian representatives attend.
MARCH 21—Arrest of ex-Tsar of Russia. Interned at Tsarkoye-Selo March 22.
MARCH 24—Russian Provisional Govt. recognised by Great Britain, France and United States.
MARCH 26–27—First battle of Gaza. Sir A. Murray defeats Turks and captures 900 prisoners, including General and Divisional Staff of 53rd Turkish Division.
MARCH 30—Russian Provisional Govt. guarantees independence of Poland.
MARCH 31—U.S. takes possession of Danish West Indies, renaming them the Virgin Islands.
APRIL 2—U.S.S. "Aztec" sunk by German submarine.
APRIL 2—President Wilson addresses special sitting of Congress and asks for declaration of existence of state of war with Germany.
APRIL 5—British Bank rate reduced from 5½% to 5%.
APRIL 6—United States declares war on Germany at 3 A.M.
APRIL 7—Cuba declares war on Germany.
APRIL 8—Austria-Hungary breaks off relations with United States.
APRIL 8—Panama decides to assist United States to defend Panama Canal.
APRIL 9—Battle of Arras. Canadians take Vimy Ridge.
APRIL 9—Brazil breaks off diplomatic relations with Germany.
APRIL 9—Price of cotton on N.Y. Exchange 21¼ cents per lb.—highest price since the Civil War.
APRIL 10—British hospital ship "Salta" mined in Channel: 52 missing.
APRIL 12—Costa Rica places territorial waters and ports at disposal of United States.
APRIL 13—Bolivian Govt. hands German Minister his passport.
APRIL 13—Allied Naval Conference held at Washington.
APRIL 14—British and French aeroplanes bombard Freiburg, Germany, as reprisal for attacks on British hospital ships.
APRIL 14—U.S. House of Representatives authorises "Old Glory Loan" issue of $7,000,000,000 bonds.
APRIL 15—Austria makes quasi-official offer to Russia for separate peace.
APRIL 16—Second Battle of the Aisne begins.
APRIL 16—First French tanks in action on Chemin-des-Dames, Western Front.
APRIL 16—Food strikes in Berlin and other German towns.
APRIL 17—U.S. Senate passes bill authorising national loan of $7,000,000,000 for war purposes. (See April 14.)
APRIL 17—British hospital ships "Donegal" and "Lanfranc" torpedoed in Channel. 75 lost.
APRIL 18—U.S. Emergency Fleet Corporation established with capital of £10,000,000 by U.S. Shipping Board.
APRIL 19—U.S. Govt. seizes docks and piers of Hamburg-Amerika and N. German Lloyd lines at Hoboken, N.J.
APRIL 20—Raid on Dover by 6 German destroyers. Calais shelled by German destroyer.
APRIL 20—Diplomatic relations severed between United States and Turkey.
APRIL 23—British mission, headed by A. J. Balfour, arrives at Washington.
APRIL 23—2nd phase of Battle of Arras begins.
APRIL 27—Guatemala breaks off diplomatic relations with Germany.
APRIL 28—3rd stage of Battle of Arras begins.
APRIL 28—U.S. Congress passes Army Bill and decides for conscription.
APRIL 28—Neutrality decree issued by Brazil. (See June 2.)
APRIL 29—General Pétain appointed Chief of French General Staff.
APRIL 30—Rhodesian Legislative Council votes for administration of N. and S. Rhodesia as one territory.
APRIL 30—Turkish Army defeated by General Maude at Shatt-el-Adhaim.
MAY 1—Ex-premier Viviani of France addresses U.S. Senate.
MAY 2—British destroyer mined in Channel. 62 lives lost.
MAY 3—British attack at Arras (4th battle) begins. Hindenburg line broken.
MAY 4—British transport "Transylvania" torpedoed in Mediterranean. 413 men lost.
MAY 4—Sir John Jellicoe appointed Chief of War Staff, British Admiralty.
MAY 5—Australian Federal Parliament elections result in Nationalist majorities in both Houses.
MAY 5—French capture crest of Craonne ridge, including Chemin des Dames.
MAY 5—A. J. Balfour addresses U.S. House of Representatives. President Wilson present.
MAY 6—Allied War Council held in Paris.
MAY 8—Liberia breaks off relations with Germany.
MAY 8—Mr. A. J. Balfour addresses U.S. Senate.
MAY 11—Senator Root heads U.S. mission to Russia.
MAY 14—10th Isonzo Battle: Italian attack.
MAY 15—Death of Joseph Choate, American statesman.
MAY 15—German Socialists are refused passports for Stockholm Conference.
MAY 15—General Pétain becomes French C. in C. General Foch becomes Chief of Staff to succeed General Pétain.
MAY 16—Russian Coalition Cabinet formed.
MAY 16—Lloyd George proposes immediate Home Rule for Ireland and suggests Convention.
MAY 16—Major-General J. L. Van Deventer appointed to command British East-African forces.
MAY 17—Flotilla of U.S. destroyers arrives in England.
MAY 17—Honduras severs diplomatic relations with Germany.
MAY 18—Maj-General Pershing placed in command of U.S. Expeditionary Force.
MAY 18—Complete unit of U.S. Medical Corps arrives in England.
MAY 18—President Wilson signs Selective Military Conscription Bill.
MAY 19—New Russian Coalition Govt. declares against separate peace.
MAY 19—Nicaragua severs diplomatic relations with Germany.
MAY 19—H. Hoover appointed Food Controller in United States.
MAY 22—Resignation of Count Tisza, Hungarian Prime Minister.
MAY 23—Constitutional crisis in China. Dismissal of Premier Tuan-chi-Fui. Wu-Ting-Fang appointed acting Premier. Revolt of eleven Chinese provinces.
MAY 25—Air raid over Folkestone. 95 killed, 192 injured.
MAY 26—British hospital ship "Dover Castle" torpedoed in Mediterranean. 7 missing.
MAY 29—Arthur Henderson leaves for Russia on special mission for British Government.
MAY 29—A. J. Balfour addresses both Houses of Canadian Parliament.
JUNE 2—Brazil revokes her neutrality proclamation and seizes German ships in Brazilian waters.
JUNE 3—Austrians repulsed east of Gorizia and open great counter-attack on Carso.
JUNE 3—Proclamation of Albanian independence under protection of Italy.
JUNE 6—Announced that Lord Northcliffe would succeed A. J. Balfour as head of British Mission to United States.
JUNE 7—City of San Salvador destroyed by earthquake. Santa Tecla also ruined.
JUNE 7—British capture Messine-Wytschaete ridge.
JUNE 8—Explosion and fire in copper mine, Butte, Mont. Kills over 140 workmen.
JUNE 8—Maj.-General Pershing and staff arrive in London.
JUNE 10—Serious Sinn Fein riots in Dublin: Count Plunkett arrested.
JUNE 11—Sailors and Firemen's Union in Great Britain refuses to let Ramsay MacDonald and colleagues sail for Russia.
JUNE 11—Conscription Bill introduced in Canada.
JUNE 11—Constitution of Irish Convention announced: 101 members.
JUNE 12—Abdication of King of Greece in favour of his second son, Alexander.
JUNE 13—Maj.-Gen. Pershing, U.S.A., and staff arrive in Paris.
JUNE 13—Daylight air-raid on London. 162 killed. 432 injured.
JUNE 14—Senator Root and U.S. Mission arrive in Petrograd.
JUNE 15—British Govt. grants general amnesty to prisoners confined in connection with Irish rebellion of 1916.
JUNE 15—Lord Rhondda appointed Food Controller in Great Britain.
JUNE 16—First All-Russian Congress of Soviets held.
JUNE 17—Portuguese troops in action for first time on Western Front.
JUNE 18—General Smuts invited to attend War Cabinet meetings while in England.
JUNE 19—British Royal Family relinquishes German names and titles and adopts British surnames. King confers peerages on members of the Teck and Battenberg families.
JUNE 24—P. & O. liner "Mongolia" mined off Bombay. 24 lives lost.
JUNE 24—Ukraine Rada proclaims autonomy.
JUNE 24—Mutiny of Russian Black Sea Fleet at Sebastopol.
JUNE 25—Dato Ministry in Spain suspends constitutional guarantees with King's approval.
JUNE 26—First Division U.S.A. arrives at St. Nazaire, France.
JUNE 26—M. Veniselos becomes Greek Premier.
JUNE 27—British transport "Armadale" torpedoed in Atlantic.
JUNE 29—General Allenby appointed to command in Egypt and Palestine.
JUNE 29—Greece severs relations with Central Powers.
JULY 1—General Brusilov begins Russian offensive in Galicia.
JULY 7—Air raid over London. 57 killed, 193 injured.
JULY 9—H.M.S. "Vanguard" blows up at anchor. 97 survivors.
JULY 9—President Wilson places fuel, oils, flour, meats, etc., under government control.
JULY 12—Austen Chamberlain resigns as Secretary of State for India.
JULY 14—Herr von Bethmann Hollweg resigns German Imperial Chancellorship; succeeded by Herr Michaelis.
JULY 16—M. Kerensky forms new Russian Government.
JULY 17—Coalition Ministry in Newfoundland, Sir E. Norris Premier.
JULY 17—British Royal Family adopts name of Windsor at Special Privy Council meeting.
JULY 19—German counter-offensive in Galicia. (See July 1.)
JULY 20—Corfu Pact (Union of Serbs, Croats and Slovenes) signed.
JULY 20—E. S. Montagu becomes Secretary of State for India.
JULY 20–25—Russian retreat in Galicia.
JULY 25—First Meeting of Irish Convention held. Sir Horace Plunkett appointed Chairman.
JULY 31—Third Battle of Ypres begins.
JULY 31—The New Derby won by Mr. Fairie's "Gay Crusader."
AUG. 3—Allied offensive in German East Africa begins.
AUG. 8—Allied Conference, recently held in Paris, resumes meetings in London.
AUG. 9—Canadian Conscription Bill passes both Houses of Parliament. (Assented to Aug. 20.)
AUG. 10—Special Conference of British Labour Party accepts invitation to Stockholm Conference, if conference "consultative, not mandatory."
AUG. 11—Arthur Henderson resigns from British War Cabinet; succeeded by G. N. Barnes.
AUG. 13—British, U.S., French and Italian Governments decide to refuse passports to delegates to Stockholm Conference.
AUG. 13—Revolutionary outbreak in Spain. Martial law proclaimed.
AUG. 14—China declares war on Germany and Austria-Hungary.
AUG. 14—Publication of Papal Peace Note to belligerent governments.
AUG. 15—U.S. troops inspected by King George V. on march through London.
AUG. 16—Ypres battle: second attack by British.
AUG. 21—German attack begun on Riga front.
AUG. 25–28—All-Russia Conference at Moscow held.
AUG. 26—Captain Laureati flies from Turin to Naples and back (960 miles) without descending, breaking world's flight record.
SEPT. 2—Indefinite postponement of Stockholm International Socialist Peace Conference convened for Sept. 9th.
SEPT. 3—Air-raid over Sheerness-Chatham area, England, 132 killed, 96 injured—mostly naval ratings.
SEPT. 3—Russians evacuate Riga.
SEPT. 4—British Trades Union Congress vetoes further consideration of Stockholm Conference.
SEPT. 6—War Loan Bill to raise £80,000,000 introduced by Australian Government.
SEPT. 8—General Kornilov dismissed from post of Russian C. in C. marches on Petrograd.
SEPT. 8—Allies agree to postponement of Chinese Boxer indemnity payments for 5 years.
SEPT. 9—Painlevé Cabinet formed in France.
SEPT. 9—United States publishes Luxburg disclosures re German Legation at Buenos Aires.
SEPT. 12—Argentine Govt. hands passports to Count Luxburg, German Minister at Buenos Aires.
SEPT. 15—Russian Republic under M. Kerensky declared.
SEPT. 20—Central span of Quebec Bridge placed in position.
SEPT. 20—Parliamentary franchise extended to women in Canada.
SEPT. 24—Air-raid over southeast coast of England and London. 21 killed; 70 injured.
SEPT. 25—Senate High Court of Impeachment, Texas, removes James L. Ferguson as Governor.
SEPT. 27—Terms of new loan issue called National War Bonds announced in England.
SEPT. 29–OCT. 1—Hostile aeroplanes attack London district 3 nights in succession. Total casualties 39 killed, 166 injured.
OCT. 1—Violent typhoon over Tokyo. Serious damage to rice crops. Heavy death roll. 100,000 homeless.
OCT. 3—Sir W. Laurier announces resignation of leadership of Canadian Liberal party.
OCT. 5—Sir Arthur Lee presents estate of Chequers as official country residence for Prime Ministers.
OCT. 5—Critical situation between Germany and Argentina over Luxburg incident. (See Sept. 9.)

OCT. 7—M. Kerensky forms Coalition Government in Russia.
OCT. 8—Severe floods in China cause greatest devastation ever recorded.
OCT. 9—Death of Husein Kemal, 1st Sultan of Egypt: succeeded by Prince Ahmed Fuad.
OCT. 12—Count Luxburg interned by Argentina. (See Sept. 12.)
OCT. 12—Sir R. L. Borden forms Coalition Government in Canada.
OCT. 18—Termination of suspension of Spanish constitutional guarantees. (See June 25.)
OCT. 18—British Govt. accepts statue of Abraham Lincoln as gift from people of the United States.
OCT. 21—Fall of Gorizia.
OCT. 22—Soviet (Russian Workmen's and Soldiers' delegates) meeting passes resolution to propose immediate armistice to all nations.
OCT. 22—Trans-Australian Railway (Kalgoorlie to Port Augusta) opened for traffic.
OCT. 23—Great French victory on the Aisne.
OCT. 24—Austro-German attack breaks through Second Italian Army. Italian rout.
OCT. 26—Brazil declares war on Germany.
OCT. 28—Signor Orlando becomes Italian Premier. Baron Sonnino becomes Foreign Minister.
OCT. 30—Italian retreat to River Tagliamento.
OCT. 30—Resignation of Herr Michaelis, German Chancellor. Count Von Hertling succeeds on Nov. 1.
NOV. 1—French success on Aisne. German retreat on 12-mile front.
NOV. 2—Publication of American-Japanese agreement on their respective interests in China.
NOV. 2—Balfour declaration regarding Palestine.
NOV. 3–4—French and British troops arrive in Italy to stem Italian retreat on Tagliamento.
NOV. 3—U.S. troops have their first engagement with Germans.
NOV. 4—Franco-British mission to Italy concerning Italian retreat and unification of Allied command.
NOV. 5—General Maude defeats Turks at Tekrit.
NOV. 6—Canadians capture Passchendaele Ridge.
NOV. 6—John F. Hylan elected Mayor of New York City, together with entire Tammany ticket.
NOV. 7—Lenin's coup d'état at Petrograd against Kerensky.
NOV. 8—Nobel Prize for literature for 1917 divided between Danish authors Karl Gjellerup and Henrik Pontoppidan.
NOV. 8—M. Lenin becomes Chief of "Commissaries of People" in Russia. M. Trotsky Foreign Minister. Proclamation of new Russian policy includes offer of immediate democratic peace. Flight of Kerensky.
NOV. 8—Colonel House's mission arrives in London from United States.
NOV. 9—Rapallo Conference decides on formation of Supreme Allied War Council.
NOV. 11—Italians fall back to River Piave.
NOV. 13—Count Luxburg released by Argentine Govt.; to sail for Amsterdam. (See Sept. 12, Oct. 12.)
NOV. 13—M. Kerensky defeated by Bolsheviks at Tsarkoe-Selo.
NOV. 14—General Villa revolts against Carranza in Mexico.
NOV. 14—Italian stand from Trentino to middle Piave.
NOV. 15—Heavy fighting begun on Asiago Plateau and between Upper Brenta and Piave rivers.
NOV. 16—Clemenceau Cabinet formed in France.
NOV. 18—Death of Sir Stanley Maude in Mesopotamia.
NOV. 20—Surprise British advance at Cambrai.
NOV. 20—Ukrainian Republic proclaimed. M. Golubovitch chosen President.
NOV. 24—General Marshall succeeds late General Maude in Mesopotamian command.
NOV. 25–DEC. 4—British driven back after their advance at Cambrai.
NOV. 28—Petrograd Soviet notifies Central Powers of its readiness for armistice and peace.
NOV. 29—Supreme Allied War Council inaugurated at Versailles.
DEC. 1—German East Africa cleared of German troops.
DEC. 2—Meeting opened at Brest-Litovsk between German and Russian peace delegates.
DEC. 3—Bulgaria declares readiness to negotiate war settlement with Allies.
DEC. 4—New Quebec Bridge opened for traffic.
DEC. 5—Elder-Dempster liner "Apapa" torpedoed and sunk. 80 lives lost.
DEC. 5—German-Russian delegates at Brest-Litovsk sign armistice for 7 days from Dec. 7.
DEC. 6—Finnish Republic proclaimed.
DEC. 6—Explosion of 3,000 tons of high explosives kills 150, seriously injures 4,000 in Halifax, N.S., and neighbourhood. Great property loss.
DEC. 7—United States declares war on Austria-Hungary.
DEC. 9—Central Powers and Rumania sign Armistice at Foscani.
DEC. 9—Turks surrender Jerusalem to Sir E. Allenby.
DEC. 10—Nobel Peace Prize for 1917 awarded to International Red Cross Committee of Geneva.
DEC. 11—Entry of General Allenby into Jerusalem.
DEC. 15—Armistice concluded at Brest-Litovsk between Central Powers and revolutionary government of Russia for one month from Dec. 17.
DEC. 17—Canadian General Election: victory for Unionists, Sir R. Borden Premier.
DEC. 19—Ukrainian Republic demands recognition.
DEC. 19—Republic of Caucasus proclaims autonomy.
DEC. 20—Second Australian Referendum on conscription. Majority against 200,000.
DEC. 21—Peace negotiations opened at Brest-Litovsk between Russia and Central Powers.
DEC. 22—H.M. armed boarding steamer "Stephen Furness" torpedoed in Irish Channel. 101 lives lost.
DEC. 28—Brest-Litovsk Conference adjourned till Jan. 5 1918.
DEC. 28—Bessarabia declares independence as Moldavian Republic.
DEC. 28—Estonia proclaims her independence.
DEC. 28—U.S. Government assumes control of Railroads, W. G. McAdoo becoming director-general.
DEC. 29—Guatemala City virtually destroyed by earthquake.
DEC. 31—Canadian Prohibition Law comes into force.

1918

JAN. 1—Great fire at Norfolk, Va.
JAN. 2—Summary of confidential report of Colonel House's mission to Great Britain and France, published at Washington.
JAN. 4—Russia recognises independence of Finland.
JAN. 4—British Red Cross ship "Rewa" sunk in British Channel.
JAN. 5—Sweden recognises independence of Finland.
JAN. 6—Germany and France recognise independence of Finland.
JAN. 7—Maj.-Gen. G. W. Goethals appointed Acting Quartermaster-General of U.S. Army.
JAN. 7—Lord Reading appointed High Commissioner and Special Ambassador in United States.
JAN. 8—President Wilson's message to U.S. Congress specifying 14 conditions necessary for world peace.
JAN. 12—Explosion at Podmore Hall Colliery, Staffs., England. 155 men killed.
JAN. 14—Arrest of M. Caillaux, former Prime Minister of France, on charge of treason.
JAN. 14—Bombardment of Yarmouth by German ships.
JAN. 16—Secret correspondence between Von Bernstorff and Berlin made public.
JAN. 18—Opening of Russian Constituent Assembly in Petrograd. Dissolved by Bolshevik Govt. on 19th.
JAN. 20—Naval battle at entrance to Dardanelles. "Breslau" sunk. "Goeben" badly damaged.
JAN. 21—Sir Edward Carson resigns from British War Cabinet.
JAN. 21—H.M. armed boarding steamer "Louvain" torpedoed and sunk in Mediterranean. 7 officers and 217 men lost.
JAN. 24—German Chancellor replies to British and American peace terms in speech before Main Committee of Reichstag.
JAN. 24—Mine explosion at Stellarton, Nova Scotia; 89 deaths.
JAN. 24—Speech by Count Czernin making detailed reply to President Wilson's peace proposals.
JAN. 27—Soviet Russia denounces Anglo-Russian Treaty of 1907.
JAN. 28—Aeroplane raid on London. 67 killed; 166 injured.
JAN. 30—Agreement reached between United States and Great Britain, making draft laws applicable to aliens.
FEB. 5—Russian Soviet issues decree separating Church from State.
FEB. 5—Anchor liner "Tuscania" carrying U.S. troops, torpedoed off Irish coast. 166 lives lost.
FEB. 6—British Military Service Bill receives Royal Assent.
FEB. 6—German ultimatum to Rumania.
Feb. 9—Peace signed between Central States and the Ukraine at Brest-Litovsk.
FEB. 10—President of Russian delegation at Brest-Litovsk declares end of state of war with Central Powers. No formal Peace Treaty signed.
FEB. 10—Lord Beaverbrook appointed Minister in Charge of Propaganda in Great Britain.
FEB. 11—U.S. President's address to Congress restating war aims and laying down four principles for peace.
FEB. 14—Bolo Pasha and his Italian confederate Cavallini condemned to death in Paris for high treason.
FEB. 14—Fire at orphanage and hospital, Montreal. 50 children killed.
FEB. 15—U.S. President issues proclamation making all foreign trade subject to Government Control under a license system.
FEB. 16—General Sir Henry Wilson becomes Chief of Imperial Staff in Great Britain.
FEB. 16—Dover bombarded by enemy submarine.
FEB. 16–17—Air raids on London. 21 killed.
FEB. 18—Lord Northcliffe appointed British Director of Propaganda in enemy countries.
FEB. 18—Hostilities re-opened between Germany and Russia.
FEB. 19—U.S. President signs Daylight Saving Bill.
FEB. 19—Prince of Wales takes his seat in House of Lords.
FEB. 20–23—Inter-Allied Labour and Socialist Conference in London.
FEB. 21—British troops occupy Jericho.
FEB. 24—Steamer "Florizel" goes ashore at Cape Race. 102 lives lost.
FEB. 25—Rationing of meat, butter and margarine comes into force in London and Home Counties.
FEB. 26—H.M. hospital ship "Glenart Castle" sunk in Bristol Channel. 162 lives lost.
FEB. 28—Sir G. Cave declares in British House of Commons that M. Litvinoff, Bolshevist Ambassador to London, is not an ambassador of any recognised government.
MARCH 1—Armed mercantile cruiser "Calgarian" sunk by German submarine off Irish coast. 66 lives lost.
MARCH 2—Rumania accepts demands of Central Powers as basis of peace negotiations.
MARCH 3—Treaty of Peace between Central Powers and Bolshevist Government of Russia signed at Brest-Litovsk.
MARCH 5—Preliminary Peace Treaty signed between Rumania and Central Powers.
MARCH 7—Treaty of peace signed between Germany and Finland.
MARCH 7—Entente note sent to Holland demanding use of Dutch shipping in Allied ports.
MARCH 8—Resignation of M. Trotzky, Russian Foreign Minister. Succeeded by M. Tchitcherin.
MARCH 9—Seat of Russian Government transferred from Petrograd to Moscow.
MARCH 11—U.S. Senate votes to authorise Government to sell German property in United States.
MARCH 11—Price of London *Times* raised to 3d.
MARCH 11—Congress of Russian Soviets at Moscow ratifies Treaty of Peace with Central Powers. (See March 3.)
MARCH 13—German and Austrian troops occupy Odessa.
MARCH 15—Explosion in Courneuve district, near Paris. 30 killed; 1,500 injured.
MARCH 18—Allied Premiers and Foreign Ministers at London refuse to acknowledge Treaty between Russia and Central Powers of March 3.
MARCH 19—New "Curfew" regulations announced in Great Britain.
MARCH 20—Sir Robert Borden introduces Bill in Canadian House of Commons for enfranchisement of women, except those married to enemy aliens.
MARCH 20—U.S. President issues proclamation directing seizure (with compensation) and utilisation of Dutch vessels in U.S. ports.
MARCH 21—U.S. President signs Bill bringing railways under government control until 21 months after end of War.
MARCH 21—Second battle of the Somme begins.
MARCH 23—Germans shell Paris with gun from distance of 75 miles.
MARCH 24—Violent earthquake in Perugia, Italy.
MARCH 24–25—Germans occupy Peronne and Bapaume.
MARCH 25–27—Inter-Allied Conference on Food Supplies held in Paris.
MARCH 29—Germany ratifies Brest-Litovsk treaty with Russia. Turkey ratifies treaties of peace with Russia and Ukraine.
MARCH 29—75 deaths in Paris church on Good Friday by explosion of shell from German long-range gun.
MARCH 29—General Foch made generalissimo of Allied armies in France.
APRIL 1—Royal Air Force formed in Great Britain.
APRIL 1—Control of Quebec City taken over by troops owing to riots in connection with working of Military Service Act.
APRIL 3—Third Liberty Loan launched in United States.
APRIL 5—Final meeting of Irish Convention held at Dublin.
APRIL 8–10—Conference held in Rome by representatives of Czechoslovaks, Rumanians, Yugoslavs and Poles. Italian, French, British and American representatives present.
APRIL 9—Bessarabian National Assembly votes for union with Rumania.
APRIL 9–29—Battle of the Lys.
APRIL 12—Charles M. Schwab appointed Director-General of U.S. Emergency Steel Corporation.
APRIL 13—Report of the Irish Convention published.
APRIL 14—Turks occupy Batum.
APRIL 14—British and French Governments agree to General Foch being entitled C. in C. of Allied Armies in France.
APRIL 14—Germans occupy Helsingfors, Finland, Bolshevik Govt. having withdrawn.
APRIL 15—Resignation of Count Czernin, Austrian Foreign Minister. Succeeded by Baron Burian.
APRIL 17—Execution of Bolo Pasha (see Feb. 14).
APRIL 18—British Military Service (Man-Power) Bill receives Royal Assent.
APRIL 19—Following appointments made in Great Britain: Viscount Milner, as Secretary of State for War; Austen Chamberlain as a member of the War Cabinet.
APRIL 21—Baron Manfried von Richthofen, famous German aviator, killed over British lines.
APRIL 22—Blocking of entrance to Bruges Canal at Zeebrugge by sinking of two British cruisers laden with concrete.
APRIL 29—End of great German offensive on Western Front.
MAY 1—U.S. troops join Amiens front.
MAY 1—Arrangement arrived at for exchange of French and German prisoners through Switzerland.
MAY 1—Opening of Fifth Inter-Allied War Council in France.
MAY 5—F.M. Viscount French appointed Lord-Lieutenant of Ireland, succeeding Lord Wimborne (resigned).
MAY 7—Treaty of Peace signed at Bukarest between Rumania and four Central Powers, supplementing agreement of March 5.
MAY 10—H.M.S. "Vindictive" sunk across entrance of Ostend Harbour in order to block it.
MAY 12—German and Austrian Emperors meet at German Main Headquarters and arrange new Austro-German alliance.
MAY 14—Death of James Gordon Bennett, proprietor of New York *Herald*, etc.
MAY 14—U.S. House of Representatives passes Overman Bill, empowering President to reorganise executive departments.
MAY 15—Regular air mail service inaugurated between Washington and New York, via Philadelphia.

MAY 15—Duval condemned to death in Paris for receiving £40,000 of German money for carrying on defeatist campaign in his newspaper, the *Bonnet Rouge*. (Executed at Vincennes July 17.)
MAY 15—Chino-Japanese Agreement regarding Far East signed at Peking.
MAY 17–18—Proclamation issued in Ireland declaring existence of Pro-German conspiracy. Several Sinn Fein leaders arrested.
MAY 18—Powder explosions in factory near Pittsburgh, Penn. 100 killed.
MAY 18—British airmen bomb Cologne in daylight.
MAY 19—Air-raid on London; 49 killed, 177 injured. Four hostile aeroplanes brought down.
MAY 22—U.S. President signs Sedition Bill.
MAY 23—H.M. armed mercantile cruiser "Moldavia" torpedoed and sunk. 56 American troops lost.
MAY 23—Diplomatic relations severed between Cuba and Mexico.
MAY 23—Georgia (Caucasus) proclaims its independence.
MAY 23—Regulation of U.S. Provost Marshal issued, requiring all men of draft age either to fight or work as from July 1.
MAY 25—Members of Joint U.S. and Canadian Fisheries Commission reach agreement.
MAY 26—H.M. Transport "Leasowe Castle" sunk in Mediterranean by enemy submarine; loss of 101 lives.
MAY 27—British aeroplanes bomb Durazzo, Albania; Austrian torpedo boat sunk.
MAY 28—Armenians in Transcaucasia proclaim independence.
MAY 28—U.S. troops capture Cantigny from Germans.
MAY 29—Germans capture Soissons.
MAY 29—Great Britain and Allies sign Commercial and Navigation Agreement in London with Sweden.
MAY 29—U.S. President creates War Industries Board.
MAY 29—Peace Treaty signed between Austria-Hungary and Finland.
MAY 31—Racing in England confined to Newmarket by War Cabinet decision.
MAY 31—U.S. Transport "President Lincoln" torpedoed and sunk. 23 of crew lost.
JUNE 3—Explosion at munition works at Beausenq, France. 100 killed.
JUNE 3—New postal rates in Great Britain come into force. Ordinary letter rate raised to 1½d.
JUNE 3—Opening of 6th session of Inter-Allied War Council
JUNE 4—New Derby, run at Newmarket, won by Lady Jane Douglas's Gainsborough.
JUNE 4—Ukraine Govt. recognised by Central Powers.
JUNE 6—U.S. troops employed in front line west of Chateau-Thierry.
JUNE 8—New star of first magnitude discovered.
JUNE 8—Anglo-German Conference opened at The Hague on question of exchange of Prisoners of War. (See July 14.)
JUNE 9–13—New German Offensive towards Compiegne.
JUNE 10—Battle of Bélleau Wood commences.
JUNE 11—First meeting of Imperial War Cabinet in London.
JUNE 12—Maharajah of Patiala and Sir S. P. Sinha arrive in London as representatives of India at Imperial War Cabinet.
JUNE 12—Germans occupy Tiflis.
JUNE 13—Dutch States-General passes bill for damming of Zuyder Zee.
JUNE 14—Turks occupy Tabriz.
JUNE 14—Provisional Treaty signed between Russia and Ukraine.
JUNE 15—Explosion in munitions factory at Mainz, Germany. Many victims.
JUNE 15–23—Second Battle of the Piave.
JUNE 17—Second meeting of Imperial War Cabinet held in London.
JUNE 21—British Govt. announces abandonment for present of Home Rule and conscription for Ireland.
JUNE 22—Railway collision near Hammond, Indiana. 78 killed.
JUNE 24—First aerial mail in Canada inaugurated. Special bag carried from Montreal to Toronto.
JUNE 24—Captain Amundsen leaves Christiania on N. Polar expedition.
JUNE 24—United States ratifies agreement with Great Britain permitting American citizens resident in Great Britain to be drafted into British Army and vice versa.
JUNE 27—H.M. hospital ship "Llandovery Castle" torpedoed by enemy submarine. About 230 lives lost.
JUNE 30—Eugene V. Debs arrested at Cleveland, O., on charge of violating Espionage Act.
JULY 1—Explosion at shell-filling factory in Midlands, England. 100 lives lost; 150 injured.
JULY 4—New provisional government of Siberia established at Vladivostok by Czechoslovaks.
JULY 4—Independence Day celebrated in London, Paris and Rome, as well as in United States.
JULY 5—Treaty of Peace with Rumania passes German Reichstag (see May 7).
JULY 5—U.S. Excursion Steamer "Colombia" overturns in Illinois river, 175 drowned.
JULY 6—Report on Indian Constitutional Reforms (Montagu-Chelmsford) published in England.
JULY 6—Count Mirbach, German Ambassador in Russia, assassinated at Moscow.
JULY 9—Railway collision near Nashville, Tenn., 100 killed.
JULY 9—Opening of Conference at Salzburg regarding economic relations of Central Powers.
JULY 10—J. R. Clynes appointed Food Controller in Great Britain.
JULY 11—U. S. supply ship "Westover" torpedoed in European waters. 10 men lost.
JULY 12—General Cadorna, formerly C. in C. of Italian forces, placed on retired list with loss of rank and pay, owing to defeat on the Isonzo in 1917.
JULY 12—Japanese battleship "Kawachi" blows up in Tokuyama Bay. 500 lives lost.
JULY 14—Messageries Maritime S.S. "Djemnah" torpedoed in Mediterranean. 442 lives lost.
JULY 14—Anglo-German Conference at The Hague closes. Provisional agreement signed (see June 8).
JULY 15-AUG. 4—Second Battle of the Marne.
JULY 16—Increased maximum coal prices fixed by order of Board of Trade in Great Britain.
JULY 16—Ex-Tsar of Russia, Nicholas Romanoff and family, shot by order of the Ural Regional Council at Ekaterinburg.
JULY 16—Trial begun in France of M. Malvy, former Minister of Interior, on charge of treason. (See Aug. 6.)
JULY 18—G.C.B. conferred on General Pershing, C. in C. of U.S. Expeditionary Force in France, by King George V.
JULY 18—Great Allied counter-attack begun in France.
JULY 19—U.S. armoured cruiser "San Diego" sunk off New York.
JULY 19—G.C.M.G. conferred on Vice-Admiral Sims by King George V.
JULY 19—Sir L. Worthington Evans appointed British Minister of Blockade. Lord Robert Cecil becomes Assistant Secretary of State for Foreign Affairs.
JULY 23—U.S. President directs that all telephone and telegraph systems shall come under government control at midnight on July 31.
JULY 23—Meeting in London of Allied Food Controllers.
JULY 24—Dr. Helfferich appointed German Ambassador to Russia to succeed Count Mirbach (see July 6).
JULY 28—End of drought in New South Wales; 2,000,000 sheep and lambs lost.
JULY 30—Assassination of Field-Marshal von Eichhorn, German military dictator in the Ukraine.
JULY 31—Sir Charles Fielding becomes Director General of Food Production in Great Britain.
AUG. 1—*The Evening Post*, New York, bought by T. W. Lamont.
AUG. 2—Re-capture of Soissons by French.
AUG. 2—Allied Forces land at Archangel.
AUG. 3—Australia House, London, opened by King George V.
AUG. 3—British Ambulance transport "Warilda" torpedoed and sunk. 116 drowned.
AUG. 3—British force lands at Vladivostock.
AUG. 6—M. Malvy sentenced to five years' banishment (see July 16).
AUG. 6—Debate in both Houses of British Parliament on Montagu-Chelmsford Report on Indian Constitutional Reforms.
AUG. 8—Education Bill in Great Britain receives Royal assent.
AUG. 8–12—Second Battle of Amiens.
AUG. 11—Karlsruhe bombed by British airmen.
AUG. 11—First Japanese contingents arrive at Vladivostok.
AUG. 12—Formation of First American Army in France under General Pershing.
AUG. 13—Czechoslovakia recognised as a nation by British Government.
AUG. 15—Subscriptions to British National War Bonds reach £1,000,000,000.
AUG. 15—U.S. troops from Philippines land at Vladivostok to co-operate with Allied forces under General Otani.
AUG. 15—Diplomatic relations severed between United States and Bolshevist Govt. of Russia.
AUG. 21—British air raids on Frankfort, Cologne, Mannheim and Treves.
AUG. 21–31—Battle of Bapaume.
AUG. 24—Treaty signed at Washington providing for drafting of Americans in Italy and Italians in United States.
AUG. 27—Three treaties supplementing Brest-Litovsk agreement (of March 3) signed at Berlin by Germany and Russia.
AUG. 27—Resignation of Walter Page, U.S. Ambassador in London.
AUG. 29—French capture Noyon. British capture Bapaume.
AUG. 30—Attempted assassination of M. Lenin.
AUG. 31—U.S. President signs Man-Power Bill. Proclamation issued fixing Sept. 12 as registration day.
AUG. 31—Bolshevist troops attack British Embassy at Petrograd. Captain Cromie, Naval Attaché, killed.
SEPT. 3—United States formally recognises Czechoslovakia.
SEPT. 4—Hsu Shi-Chang elected President of Chinese Republic.
SEPT. 5—Leon Trotzky elected President of Supreme War Council in Russia.
SEPT. 5—U.S. transport "Mount Vernon" (formerly German liner "Kronprinzessin Cecilie") torpedoed off French coast. 35 men killed.
SEPT. 6—U.S. forces reach the Aisne on Western Front.
SEPT. 6—Japanese forces occupy Bolshevist-German base at Khabarovsk, on Ussuri Branch of Trans-Siberian Railway.
SEPT. 7—First instalment of Russian War Indemnity to Germany paid.
SEPT. 10—Mahommedan riots in Calcutta.
SEPT. 12—First great American offensive at St. Mihiel.
SEPT. 12—Union Castle liner "Galway Castle" torpedoed. 154 persons reported missing.
SEPT. 12—Eugene V. Debs convicted in Cleveland, O., of violating Espionage Act (see June 30).
SEPT. 14—Austro-Hungarian Govt. invites belligerent governments to take part in discussion on neutral territory with a view to peace.
SEPT. 14—British evacuate Baku.
SEPT. 15—Stonehenge presented to British nation by Mr. C. H. E. Chubb (see Sept. 21 1915).
SEPT. 16—U.S. President refuses Austro-Hungarian suggestion of Sept. 14. Great Britain and other Allies had all refused by Sept. 18.
SEPT. 17—Death of Cardinal Farley, Archbishop of New York.
SEPT. 18—John W. Davis, U.S. Solicitor General, appointed Ambassador to London, succeeding W. H. Page.
SEPT. 19—General Allenby opens offensive in Palestine.
SEPT. 22—Turkish resistance in Palestine collapses.
SEPT. 22—Retail price of meat raised 2d. per lb. in England.
SEPT. 23—Prilep taken from Bulgarians by French. Bulgarians in full retreat.
SEPT. 23—U.S. House of Representatives approves measure making national prohibition effective on July 1 1919.
SEPT. 23—OCT. 4—Influenza epidemic in United States camps reaches height.
SEPT. 25—British troops enter Bulgaria at Kosturino, Bulgarian Military Authorities ask for 48-hour armistice. Request refused.
SEPT. 26–29—Great American attack between the Meuse and Argonne.
SEPT. 26—U.S.S. "Tampa" sunk off British coast. 112 of crew lost.
SEPT. 26—British enter Strumitza.
SEPT. 29—Belgians capture Dixmude.
SEPT. 29—Bulgaria signs armistice with Allied Powers.
SEPT. 30—Capitulation of Bulgaria.
OCT. 1—French capture St. Quentin.
OCT. 1—British and Arab forces occupy Damascus.
OCT. 4—Abdication of King Ferdinand of Bulgaria in favour of his son, Crown Prince Boris.
OCT. 4—Prince Max of Baden appointed Imperial Chancellor in Germany and Prussian Foreign Minister.
OCT. 4—German and Austrian note to President Wilson through Switzerland asking for immediate armistice and opening of peace negotiations.
OCT. 4—Japanese steamer "Hiramo Maru" torpedoed and sunk off Irish cost. 292 lives lost.
OCT. 6—U.S. freighter "Ticonderoga" sunk by German submarine. 243 lives lost.
OCT. 6–12—Second Battle of Le Cateau.
OCT. 6—Collision between H.M. armed mercantile cruiser "Otranto" and S.S. "Kashmir," both carrying American troops. 431 persons missing.
OCT. 8—Sir Eric Geddes arrives in Washington at head of British Naval Mission.
OCT. 8—President Wilson's reply to German note of Oct. 4. German retreat to own territory required before armistice can be considered.
OCT. 10—Hsu Shi-Chang inaugurated President of China.
OCT. 10—Influenza epidemic in South Africa reaches height.
OCT. 10—Irish mail boat "Leinster" torpedoed and sunk. 450 lives lost.
OCT. 12—Germany's reply to President Wilson's Note of Oct. 8. Demands agreed to.
OCT. 12—Serbians capture Nish.
OCT. 12–13—Disastrous forest fire in Northern Minnesota. Nearly 1,000 deaths.
OCT. 13—Capture of Laon by French.
OCT. 14—Capture of Durazzo, Albania, by Italians.
OCT. 17—Capture of Lille by British.
OCT. 17—Sir Roger Keyes occupies Ostend.
OCT. 17—Republics of Czechoslovakia and Yugoslavia formally established.
OCT. 19—Belgian troops occupy Zeebrugge and Bruges.
OCT. 22—Severe influenza epidemic in England reaches its height.
OCT. 23–24—Debate in British House of Commons on Indian Constitutional Reforms.
OCT. 25—Canadian Pacific Steamer "Princess Sophia" wrecked off Alaska. 343 lives lost.
OCT. 26—Occupation of Aleppo by General Allenby's advance cavalry.
OCT. 27—Austro-Hungarian Government accepts all President Wilson's conditions. Commencement of independent Peace negotiations sought.
OCT. 30—Allied governments sign armistice with Turkey at Mudros Island. Hostilities cease at noon on Oct. 31.
OCT. 31—Assassination of Count Tisza.
NOV. 1—Supreme War Council meets at Versailles.
NOV. 1—Railway accident at Brooklyn, N.Y. 89 killed.
NOV. 1—Serbians re-enter Belgrade.
NOV. 3—Armistice signed between Allies and Austria-Hungary. Hostilities cease at noon on Nov. 4.
NOV. 4—Inter-Allied Conference at Versailles unanimously agrees upon terms of armistice to be offered to Germany.
NOV. 5—Elections to Congress in United States result in Republican majority in House of 43. A. E. Smith, Democrat, elected governor of New York.
NOV. 5—United States informs Germany of conditions of armistice.
NOV. 6—Polish People's Republic proclaimed at Cracow.
NOV. 6—American Army occupies Sedan.
NOV. 8—German armistice plenipotentiaries receive conditions of armistice from General Foch, to be accepted by 11 A.M. on Nov. 11.
NOV. 8—Capture of Maubeuge by British.
NOV. 9—Revolution in Bavaria. Republic proclaimed under Presidency of Herr Kurt Eisner.
NOV. 9—Decree issued in Germany announcing abdication of Emperor Wilhelm II.
NOV. 10—Flight of German Emperor to Holland.
NOV. 11—Armistice between Allies and Germany signed at 5 A.M. Hostilities cease on all fronts at 11 A.M.
NOV. 12—Abdication of Emperor Charles of Austria.

Nov. 13—Allied fleets arrive at Constantinople.
Nov. 13—Soviet Govt. of Russia annuls treaty of Brest-Litovsk.
Nov. 14—British Labour Party decides on severance from Coalition Government. Members to be withdrawn from Government.
Nov. 14—Republic of German-Austria proclaimed in Vienna.
Nov. 14—W. G. McAdoo resigns as Secretary of Treasury and Director General of Railroads.
Nov. 15—Professor Masaryk elected first President of Czechoslovak Republic.
Nov. 16—Hungarian Republic formally proclaimed at Budapest.
Nov. 18—Independent Republic of Latvia proclaimed.
Nov. 18—Belgian troops enter Brussels and Antwerp.
Nov. 18—Mosul occupied by British.
Nov. 19—French occupy Metz.
Nov. 20—Twenty German submarines surrender at Harwich.
Nov. 21—5 German battle cruisers, 9 battleships, 7 light cruisers and 49 destroyers surrender off Firth of Forth.
Nov. 21—Bill making women eligible as Members of British Parliament receives Royal assent.
Nov. 21—U.S. President signs Food Stimulation Bill with its provision for prohibition from June 30 1919 until demobilisation of army.
Nov. 21—Resignation of W. McAdoo, U.S. Secretary of Treasury.
Nov. 21—U.S. troops enter Luxembourg.
Nov. 22—King Albert of Belgium enters Brussels after 4 years' exile.
Nov. 22—Coalition Manifesto issued in Great Britain by D. Lloyd George and A. Bonar Law.
Nov. 23—J. R. Clynes and Lord Robert Cecil resign offices of Food Controller and Assistant Foreign Secretary respectively in Great Britain.
Nov. 23—Proclamation of Union of South Slav States with Serbia and Montenegro by South Slav National Assembly at Agram.
Nov. 25—British Parliament dissolved.
Nov. 25—Marshal Foch enters Strasbourg.
Nov. 27—Last German troops leave Belgium.
Nov. 28—German Emperor formally abdicates Crown of Prussia and Imperial Crown of Germany.
Nov. 29—Republic of Lithuania proclaimed at Riga.
Nov. 29—R. Lansing, Colonel House, Henry White and General Bliss announced as President Wilson's Colleagues at forthcoming Peace Conference.
Dec. 1—Iceland becomes a Sovereign State. Country to have same sovereign as Denmark.
Dec. 1—King and Queen of Rumania formally enter Bucharest.
Dec. 1—Crown Prince of Prussia issues formal renunciation of his Royal and Imperial rights.
Dec. 1—British and American forces cross German frontier.
Dec. 4—President Wilson leaves United States for Europe to attend conferences on treaty of peace.
Dec. 5—Definite statement by British Prime Minister that ex-Emperor of Germany must be prosecuted by International Court.
Dec. 6—British Govt. concedes principle of 8-hour day to railwaymen.
Dec. 6—Advanced British troops enter Cologne.
Dec. 6—U.S. troops occupy Mainz.
Dec. 8–9—President Poincaré makes official entry into Metz and Strasbourg.
Dec. 13—President Wilson lands at Brest (see Dec. 4).
Dec. 14—Maharajah of Bikanir and Sir S. P. Sinha arrive in London to represent India on Imperial Cabinet and at peace negotiations.
Dec. 14—General election takes place in Great Britain, certain classes of women exercising franchise for the first time.
Dec. 14—Assassination of Senhor Sidonio Paes, President of Portugal.
Dec. 14—President Wilson arrives at Paris.
Dec. 15—Armistice renewed to Jan. 17 1919.
Dec. 20—Berlin Conference of Workers' and Soldiers' Delegates passes resolution in favour of socialisation of industries.
Dec. 21—Death of Walter H. Page.
Dec. 26—President Wilson arrives in London.
Dec. 28—Results of General Election in Great Britain announced. Large majority to Coalition Government.
Dec. 30—M. Clemenceau informs French Chamber that old system of alliances or "balance of power" will be his guiding thought at Peace Conference.

1919

Jan. 1—British naval steam yacht "Iolaire" goes ashore outside Stornoway harbour. Nearly 200 lives lost.
Jan. 2—Fighting at Bratislava (Pressburg) between Czechs and Magyars.
Jan. 2—New air height record (30,500 ft.) established by Captain A. Lang and Lieut. Blowes (England).
Jan. 3—H. Hoover (U.S.A.) appointed Director-General of international organisation for relief in Europe.
Jan. 4—Riga taken by Bolshevik troops.
Jan. 6—Death of Theodore Roosevelt, ex-President of United States.
Jan. 7—British Labour Party resolves to act as opposition in Parliament.
Jan. 8—Turks complete evacuation of Caucasus.
Jan. 9—General strike in Buenos Aires. Serious street fighting.
Jan. 9—Strike of marine workers ties up Port of New York.
Jan. 10—Constitution of new British Government announced.
Jan. 10—Administration of Baghdad Railway taken over by British military authorities.
Jan. 11—Walker D. Hines succeeds W. G. McAdoo as Director General of Railroads.
Jan. 11—Rumanian decree, definitely attaching Transylvania to Rumania, published.
Jan. 12—Resignation of T. W. Gregory as U.S.A. Attorney General.
Jan. 13—U.S. House of Representatives passes Bill providing $100,000,000 for relief in Europe.
Jan. 13—Diamond weighing 388¼ carats found in Jagersfontein Mine, Kimberley, S. Africa.
Jan. 13—Madina capitulates to the King of Hejaz.
Jan. 15—Karl Liebknecht and Rosa Luxemburg, Spartacist leaders, killed in Berlin.
Jan. 16—Prohibition amendment to the U.S. Constitution ratified by last of necessary 36 states.
Jan. 16—Convention signed at Treves extending armistice until Feb. 17.
Jan. 17—M. Paderewski becomes Prime Minister of Poland.
Jan. 18—First meeting of Paris Peace Conference. M. Clemenceau elected Chairman.
Jan. 18—Subscriptions to British National War Bonds closed. Total amount exceeded £1,600,000,000.
Jan. 19–25—Bolsheviks attack Allies at Shenkursk, 180 miles south of Archangel; Allies withdraw.
Jan. 19-Feb. 2—Monarchist rising in Portugal. Provisional Government formed at Oporto, and Monarchy proclaimed.
Jan. 21—Declaration of Independence adopted by Sinn Fein Congress at Dublin.
Jan. 23—Result of German elections announced. Victory to Majority Socialists.
Jan. 24–29—Poles beaten in Galicia by Czechoslovaks.
Jan. 24—Greco-Turkish fighting at Smyrna.
Jan. 25—Principle of League of Nations adopted by Paris Peace Conference.
Jan. 28—Execution of four Russian Grand Dukes by order of Revolutionary Tribunal in Petrograd.
Jan. 29—United States recognises provisional Polish Government.
Jan. 30—Peace Conference delegates come to decision regarding German colonies, and occupied territory in Asiatic Turkey.
Feb. 1—Fourth series of National War Bonds issued in Great Britain.
Feb. 3—Eamon de Valera, Sinn Fein M.P. for East Clare, Ireland, escapes from Lincoln prison.
Feb. 3–9—Bolsheviks routed in N. Caucasus by General Denikin.
Feb. 3—League of Nations Commission holds first meeting in Paris. President Wilson presides.
Feb. 3—Opening of International Socialist Conference at Berne.
Feb. 3—Bolshevists capture Kiev.
Feb. 11—Herr Ebert elected first President of German Republic. Provisional Constitution published.
Feb. 12—Defeat of Bolsheviks by Ukrainians near Kiev.
Feb. 14—President Wilson lays League of Nations Covenant before Peace Conference.
Feb. 14—Republic again proclaimed at Oporto. Arrest of Royalist leader.
Feb. 14—Resignation of W. G. Sharp as U.S. Ambassador to France.
Feb. 14—Bolsheviks invade Estonia.
Feb. 15—Hugh Wallace appointed U.S. Ambassador to France.
Feb. 16—Further renewal of Armistice signed at Treves.
Feb. 16—Charges of disloyalty and sedition against Senator La Follette dismissed in U.S. Senate.
Feb. 17—Death of Sir Wilfred Laurier, Canadian statesman.
Feb. 20—Murder of the Ameer (Habibulla) of Afghanistan, Nasrullah Khan, his brother, assumes throne.
Feb. 21—Senator Borah attacks proposed League of Nations in U.S. Senate.
Feb. 21—Herr Kurt Eisner, Bavarian Premier, shot and killed in Munich.
Feb. 23—Great Britain recognises independence of Poland and Paderewski Government.
Feb. 23—Plot to murder U.S. President discovered in New York. Arrest of 14 Spanish anarchists.
Feb. 24—President Wilson arrives at Boston, Mass., from Europe.
Feb. 26—Bill to set up Coal Commission in Great Britain receives Royal Assent.
Feb. 26—Bishop P. J. Hayes appointed Archbishop of New York.
Feb. 27—A. Mitchell Palmer appointed U.S. Attorney-general.
Feb. 28—Campaign against League of Nations opened in United States by Senator Lodge.
Feb. 28—Lord Reading arrives in New York.
March 1–9—Fighting S.E. of Archangel. Withdrawal of Allied forces.
March 1—Price of meat in England reduced by 2d. per lb.
March 2—H. Hoover appointed Director-general of American relief in Europe.
March 4—Harbour traffic in New York at standstill owing to dock strike.
March 4—Coal Commission in England holds first sitting (Chairman: Mr. Justice Sankey).
March 4—U.S. House of Representatives adopts resolution favouring self-government for Ireland.
March 5—President Wilson leaves New York for Europe to attend Peace Conference.
March 8—Arrest of Zaghlul Pasha and other Nationalist leaders in Egypt. Deported on 9th.
March 9—Grand Trunk Pacific Railway goes into receiver's hands.
March 9—Attempted assassination of M. Trotsky.
March 10—U.S. Supreme Court sustains conviction of Eugene V. Debs found guilty of violating Espionage Act, and sentenced to 10 years imprisonment.
March 10—Riots in Cairo, following arrest of Nationalist leaders.
March 12—Clash between American and Japanese soldiers at Tientsin, China.
March 14—President Wilson reaches Paris.
March 16—New German-Austrian Government established at Vienna. Dr. Renner Chancellor.
March 18—Murder by natives in Upper Egypt of 8 British officers and other ranks.
March 20—Wireless telephone communication established between Ireland and Canada.
March 21—River Danube thrown open to navigation.
March 21—General Sir E. Allenby appointed special High Commissioner in Egypt.
March 22—Soviet Government formed at Budapest. Bela Kun becomes Foreign Minister.
March 24—Restrictions on sale of tea in Great Britain removed.
March 25—Peace Conference accepts Covenant of League of Nations.
March 25—Attack on foreign policy of M. Clemenceau made in French Chamber by M. Franklin-Bouillon.
March 25—Central Committee of Peace Conference reduced to four:—President of United States and Prime Ministers of Great Britain, France and Italy.
March 26—Spanish Government declares Raisuli a rebel.
March 29—Italian forces occupy Adalia (Asia Minor).
March 31—Jimmy Wilde (British) defeats Joe Lynch (U.S.) in boxing match in London.
March 31—First issue published of London Labour newspaper, *Daily Herald*.
April 3—Spain notifies desire to join League of Nations.
April 4—Delegation of Filipinos presents memorial to U.S. Secretary of War from Philippine Legislature, asking for complete independence.
April 5—Dail Eireann choose new Sinn Fein Executive, Eamon de Valera President.
April 7—Evacuation of Odessa by Allies.
April 7—Soviet Republic proclaimed in Bavaria.
April 8—Bolsheviks enter Crimea.
April 10–14—Serious riots in India, especially in Punjaub.
April 11—Referendum held in New Zealand results in majority against prohibition.
April 11—Geneva selected as headquarters of League of Nations.
April 13—Nasrullah Khan (see Feb. 20) found guilty of instigating murder of late Amir of Afghanistan. Sentenced to life imprisonment.
April 18—Mr. Ghandi advises suspension of passive resistance in India.
April 19—First non-stop flight between Chicago and New York made by Capt. E. F. White.
April 20—Montenegrin Shupshtina pronounces dethronement of King Nicolas and votes for union with Serb-Croat-Slovene Kingdom.
April 21—Rumanian advance in Hungary begins.
April 22—United States recognises British Protectorate over Egypt.
April 23—Eight-hour Labour Bill becomes law in France.
April 23—Mexican Department of Foreign Relations announces that Government will not recognise Monroe Doctrine.
April 23—Bolsheviks invade Bessarabia.
April 25—Australian and New Zealand troops march through London.
April 26—U.S. naval seaplane remains in air for 20 hours at speed of 60 m.p.h. breaking all records for endurance flights.
April 28—Revised Covenant of League of Nations adopted at 5th Plenary Session of Peace Conference.
April 28–29—Arrival in Paris of German delegates to Peace Conference.
April 30—Council of Three at Peace Conference gives Shantung agreement in favour of Japan.
May 1—Great Strike in Winnipeg begins.
May 1—Munich captured by troops of Bavarian Government.
May 3—12,000 Dominion troops march through London.
May 5—Official statement regarding Shantung issued by Japanese delegate at Peace Conference.
May 6—British Government recognises de jure independence of Finland.
May 6—Peace Conference settles question of disposal of German colonies.
May 7—Chinese delegate at Peace Conference instructed not to sign Treaty owing to Shantung Clause.
May 7—Peace terms presented to German delegates at Versailles by Allied and Associate Powers.
May 8—End of Rumanian advance in Hungary (see April 21).
May 8—German protest against Peace Terms.
May 8—Armed bodies of Afghans cross N.W. Indian frontier.
May 13—British troops cross Afghan border and occupy Dakka fort.
May 14—Austrian Peace delegates arrive in Paris.
May 14—Sir D. Haig installed as Lord Rector of St. Andrews University, Scotland.
May 15—Greek troops land at Smyrna.
May 17—U.S. seaplane NC4 reaches Azores, after flight of 15 hours, 18 min. from Newfoundland.
May 18—M. Paderewski resigns premiership of Poland.
May 18—Eruption of volcano of Kalut, Java. 5,100 deaths.
May 21—Mohamed Said Pasha forms ministry in Egypt.
May 22—German troops re-occupy Riga.
May 22—Reply of Allies to German protest of May 8.
May 24—British aeroplanes bomb fort at Kabul.

MAY 24—French aviator, Roget, flies from Paris to Rabat, Morocco.
MAY 25—Rising in Kurdistan. Capture of British officers.
MAY 25—Announcement that United States would keep all German ships seized in her ports.
MAY 27—U.S. seaplane NC4 arrives at Lisbon completing first Atlantic crossing by air.
MAY 27—Russia recognises sovereign rights of Afghanistan.
MAY 29—Total eclipse of the sun, track of totality crossing S. America and Africa.
MAY 29—German Government makes counter-proposals to Allied Peace Terms.
MAY 29—Announcement that oil had been struck at Chesterfield, England.
MAY 30—Belgo-British Agreement regarding transfer to Belgium of part of German S.W. Africa.
JUNE 2—Draft peace terms presented to Austrian delegates at Paris.
JUNE 2—De jure recognition of Serb-Croat-Slovene Kingdom by Great Britain.
JUNE 3—British reinforcements reach Archangel.
JUNE 4—U.S. Senate adopts woman-suffrage amendment to Constitution.
JUNE 4—Derby won by Lord Glanely's "Grand Parade."
JUNE 5—Powder explosion in coal mine at Wilkes-Barre, Pa. 90 deaths.
JUNE 6—Finland declares war on Bolshevist Russia.
JUNE 6—De jure recognition of Serb-Croat-Slovene Kingdom by France.
JUNE 7—French aviator, Casale, makes new height record, 33,100 ft.
JUNE 7—Second Pan-American Commercial Congress at Washington.
JUNE 8—Nicaragua asks U.S. for troops to protect her from Costa Rica.
JUNE 10—Protest of Austrian delegates to Peace Conference against Peace Terms.
JUNE 10—Resolution introduced in U.S. Senate by Senator Knox laying down conditions on which Peace Treaty would be acceptable, separation of League Covenant being one.
JUNE 13—Great demonstration in support of League of Nations held at the Albert Hall, London.
JUNE 13—Announcement of terms of new Government Loan (Victory Loan) in Great Britain.
JUNE 14–15—*Daily Mail* prize of £10,000 won by Captain Alcock and Lieut. Whitten Brown, who cross Atlantic from Newfoundland to Clifden, Ireland, in 16 hours, 12 min.
JUNE 15—U.S. troops cross Mexican border to protect El Paso, Texas, during fighting between Villa and Carranza forces.
JUNE 15—End of Winnipeg strike (see May 1).
JUNE 16—Allies' reply to German counter-proposals (see May 29) presented.
JUNE 19—Convocation at Oxford University reject proposal to abolish compulsory Greek in Responsions examination.
JUNE 20—Scheidemann Cabinet in Germany decides not to sign Peace Treaty. Fall of Cabinet.
JUNE 21—Bauer Cabinet formed in Germany.
JUNE 21—German fleet at Scapa Flow sunk by crews.
JUNE 21—Aerial Derby won by Captain Gathergood, flying twice round London at average speed of 129 miles per hour.
JUNE 22—German National Assembly authorises signature of Peace Treaty.
JUNE 22—Tornado destroys business section of Fergus Falls, Minn. 60 deaths.
JUNE 23—Report of Sankey Coal Commission published in Great Britain.
JUNE 24—Allied advance on N. Dvina River.
JUNE 25—Dr. Addison appointed first Minister of Health in Great Britain.
JUNE 27—Bolsheviks abandon Kharkov.
JUNE 28—Peace Treaty between Germany and Allied and Associated Powers (China excepted) signed at Versailles.
JUNE 28—Anglo-French and Franco-American Treaties signed guaranteeing assistance to France in event of unprovoked attack by Germany.
JUNE 29—Earthquakes in Tuscany, Italy. 127 deaths.
JUNE 30—Log of H.M.S. "Victory" bought for £5,000 by Mr. J. Buchanan and presented to British Museum, London.
JULY 2—Peace proclaimed in London.
JULY 3—Bill for carrying Peace Treaty into effect introduced in British House of Commons; also Bill for approving Treaty with France, of June 28. (See Oct. 10.)
JULY 4—Sir Joshua Reynolds' picture of Mrs. Siddons as "The Tragic Muse" sold at Christie's, London, for 52,000 guineas.
JULY 4—Jack Dempsey wins World Heavy Weight Boxing Championship at Toledo, Ohio, beating Jess Willard.
JULY 4—Coup d'état in Peru. Senor Leguia declared President.
JULY 5—Mlle. Suzanne Lenglen wins Ladies' lawn tennis championship at Wimbledon, England.
JULY 6—U.S. Navy transport "Great Northern" arrives at New York, having established new record for transatlantic round trip (12 days, 1 hour, 35 min.).
JULY 6—British airship R34 lands at New York after crossing Atlantic in 108 hours.
JULY 8—President Wilson arrives in New York from Europe.
JULY 9—Peace Treaty ratified by German National Assembly.
JULY 10—President Wilson presents Peace Treaty to U.S. Senate.
JULY 10—U.S. President nominates H. Percival Dodge as Minister to Serb-Croat-Slovene Kingdom.
JULY 12—Disastrous floods in Buenos Aires.
JULY 12—Close of Victory Loan in Great Britain. Total amount subscribed £708,000,000.
JULY 12—French and British Governments authorise resumption of commercial relations with Germany.
JULY 12—Sir Edward Carson demands repeal of Home Rule Act, and threatens to call out Ulster volunteers.
JULY 13—British airship R34 lands in Norfolk, having flown from New York in 75 hours.
JULY 15—Wreck of British airship NS11. 7 lives lost.
JULY 17—Finland's democratic Republican Constitution becomes law.
JULY 19—Peace celebrations throughout the United Kingdom.
JULY 20—Final terms of Peace Treaty handed to Austrian delegates in Paris.
JULY 23—Postal censorship for British control cables and wireless telegraphs ceases at midnight.
JULY 25—Professor Stahlberg elected President of Finland.
JULY 26—Peace Conference opened at Rawal Pindi between Indian Government and Afghan delegates.
JULY 27–31—Serious race riots in Chicago.
JULY 29—U.S. President submits Treaty with France of June 28 to Congress.
JULY 31—German National Assembly passes Constitution Bill.
AUG. 1—Restrictions on sale of bread in Great Britain abolished.
AUG. 1—Chinese Parliament passes Bill declaring state of war with Germany at an end.
AUG. 1—Overthrow of Bela Kun and Socialist regime in Hungary.
AUG. 2—Airplane from Venice to Milan falls from height of 3,000 ft. 15 deaths.
AUG. 2—1,800 Indian Army troops march through London.
AUG. 4—Rumanians enter Budapest.
AUG. 5–7—W. L. MacKenzie King elected leader of Liberal Party in Canada.
AUG. 5—Prince of Wales leaves England in H.M.S. "Renown" for Canada and United States.
AUG. 6—Fall of Hungarian Provisional Cabinet. Archduke Joseph becomes "state governor."
AUG. 7—Announcement of sinking of Bolshevik submarine "Ersh" by British destroyers.
AUG. 8—Peace signed between Government of India and Afghanistan.
AUG. 8—U.S. Senate orders investigation of Mexican outrages on U.S. citizens and property.
AUG. 9—Anglo-Persian Agreement signed at Teheran. (Denounced by Persian Mejliss in June 1921.)
AUG. 10—Anglo-Russian forces defeat Bolsheviks on N. Dvina river.
AUG. 10—Treaty of Sévres signed.
AUG. 11—Death of Andrew Carnegie.
AUG. 14—New constitution of Bavaria comes into being.
AUG. 15—Lord Lee of Fareham appointed President of Board of Agriculture in Great Britain and Sir Eric Geddes, Minister of Transport.
AUG. 15—Prince of Wales lands in Canada.
AUG. 16—Decision to organise Coal Controller's department on permanent basis announced.
AUG. 16—King of Spain signs law authorising acceptance of League of Nations and Labour sections of Peace Treaty.
AUG. 18—Two Russian battleships sunk in Gulf of Finland by British Naval Force.
AUG. 21—Prince of Wales at Quebec.
AUG. 22—Quebec Bridge opened by Prince of Wales.
AUG. 22—Break up of Coalition Cabinet in New Zealand. Resignation of Sir Joseph Ward.
AUG. 23—Archduke Joseph relinquishes authority in Hungary on demand of Allies.
AUG. 23—Foreign Relations Committee of United States Senate rejects Shantung Clause of Peace Treaty.
AUG. 25—Daily London to Paris air service inaugurated.
AUG. 26—Prince of Wales at Toronto.
AUG. 26—Belgian Senate ratifies Peace Treaty.
AUG. 28—Resignation of Dr. Paul Reinsch, American Minister to China.
AUG. 28—Prince of Wales at Ottawa.
AUG. 30—H.M. destroyer "Vittoria" sunk by torpedo in Baltic Sea.
AUG. 30—General Smuts agrees to form new Ministry in S. Africa.
AUG. 30—Anglo-Russian successes in N. Russia.
AUG. 30—Senator Knox denounces Peace Treaty in U.S. Senate and declares for separate peace with Germany.
AUG. 31—Press censorship abolished in Ireland.
SEPT. 1—Price of quartern loaf in Great Britain raised to 9½d.
SEPT. 1—Prince of Wales lays cornerstone of new Houses of Parliament at Ottawa.
SEPT. 2—General Denikin's forces enter Kiev.
SEPT. 2—Prince of Wales at Montreal.
SEPT. 2—New Zealand Parliament ratifies Peace Treaty.
SEPT. 4—President Wilson opens tour in Western United States on behalf of Peace Treaty.
SEPT. 5—Foreign Relations Committee of U.S. Senate returns Peace Treaty to Senate with 4 amendments and various reservations.
SEPT. 10–12—Canada and South Africa ratify Peace Treaty.
SEPT. 10—Allied and Associated Powers sign treaty of peace with Austria at St. Germain-en-Laye.
SEPT. 12—Italian force, under Signor d'Annunzio, enters Fiume.
SEPT. 14—Hurricane and tidal wave at Corpus Christi, Texas. More than 300 deaths.
SEPT. 15—Fire at Brooklyn, New York, owing to explosion of oil tanks. £300,000 damage.
SEPT. 18—New World's altitude record established by Roland Rohlfs, near New York (34,610 feet).
SEPT. 19—Australian House of Representatives ratify Peace Treaty.
SEPT. 20—Sinn Fein newspaper offices in Dublin raided by police and military.
SEPT. 22—Strike of 284,000 steel-workers at Pittsburgh and other U.S. towns.
SEPT. 23—Announcement of formation of mission under Lord Milner to proceed to Egypt to enquire into disorders.
SEPT. 24—De facto recognition of Lithuanian Government by Great Britain.
SEPT. 25—Supreme Council of Peace Conference grants sovereignty over Spitzbergen to Norway.
SEPT. 26—Illness of President Wilson compels him to abandon tour (see Sept. 4).
SEPT. 27—British troops evacuate Archangel. British Naval base closed.
SEPT. 30—U.S. President nominates Brand Whitlock as first Ambassador to Belgium.
OCT. 1—King and Queen of the Belgians arrive in New York.
OCT 2—French Chamber ratifies Peace Treaty by 372 votes to 53.
OCT. 5–6—Norway votes in favour of prohibition of sale of liquor.
OCT. 5—Spanish forces take the Fondak of Wad Ras (Morocco), chief fortress of Raisuli.
OCT. 9—U.S. House of Representatives passes bill repealing Canadian Reciprocity Act of 1910, which Canada had never ratified.
OCT. 10—Negotiations completed for purchase of Grand Trunk Railway by Canadian Government.
OCT. 10—Referendum in Luxembourg (held on Sept. 28) results in favour of monarchical government and economic union with France.
OCT. 10—Bill for carrying Peace Treaty into effect receives Royal Assent.
OCT. 10—British troops withdraw from Murmansk.
OCT. 13—Dockers' strike in New York brings all work in harbour to standstill. Strike ceases following day.
OCT. 13—Admiral of the Fleet Lord Beatty becomes First Sea Lord in Great Britain.
OCT. 16—General Hertzog, at Free State Nationalist Congress, claims right of S. Africa to separate from throne.
OCT. 17—Austrian Government ratifies Treaty of St. Germain.
OCT. 17—Theatrical production of "Chu Chin Chow" in England establishes world's record run by celebrating its 1,467th performance.
OCT. 18—F.M. Viscount Allenby appointed High Commissioner for Egypt and the Sudan.
OCT. 19—New Zealand House of Representatives authorises acceptance of mandate for Samoa.
OCT. 24—Earl Curzon of Kedleston becomes British Foreign Secretary.
OCT. 25—A. Bonar Law elected Lord Rector of Glasgow University, Scotland.
OCT. 27–28—U.S. President vetoes Prohibition Enforcement Bill. House of Representatives and Senate pass Bill over President's veto.
OCT. 29—International Labour Conference established by Peace Treaty opens in Washington.
OCT. 30—Japan ratifies Peace Treaty.
OCT. 31—Strike of 435,000 miners in United States begins.
OCT. 31—King and Queen of the Belgians leave United States.
NOV. 6—Bank rate in England raised from 5% to 6%.
NOV. 7—Supreme Council demands withdrawal of Rumanian troops from Hungary.
NOV. 8—Czechoslovakian National Assembly ratifies Peace Treaty.
NOV. 10—Air mail service begins between London and Paris.
NOV. 11—Prince of Wales at Washington.
NOV. 11—Two minute silence observed throughout Great Britain at 11 A.M. on first anniversary of Armistice.
NOV. 13—U.S. Senate passes reservation to Article X of League of Nations Covenant, which amounts to rejection of Peace Treaty.
NOV. 14—Rumanian troops evacuate Budapest.
NOV. 17—Final report of Dardanelles Commission issued in Great Britain.
NOV. 18—Prince of Wales at New York.
NOV. 19—Switzerland decides to join League of Nations.
NOV. 19—U.S. Senate declines to ratify Treaty of Versailles.
NOV. 20—United States demands release of her consular agent at Puebla, Mexico, imprisoned by Mexican authorities.
NOV. 21—Supreme Council decides to give mandate over Galicia for 25 years to Poland.
NOV. 21—Removal of U.S. embargoes on wheat and flour announced for Dec. 15.
NOV. 24—Coalition Cabinet formed in Hungary by M. Huszar.
NOV. 23—International Labour Conference at Washington recognises 8-hour day and 48-hour week.
NOV. 25—Prince of Wales leaves Halifax on completion of visit to Canada and United States.
NOV. 27—Treaty of Peace between Allied Powers and Bulgaria signed at Neuilly.
NOV. 27—Resignation of M. Paderewski, Prime Minister of Poland.
NOV. 28—Latvia declares war on Germany.
NOV. 28—Lady Astor (Coalition-Unionist) wins bye-election in Sutton division of Plymouth, and becomes first woman to sit in British House of Commons.
NOV. 29—U.S. Senator Newberry indicted by Federal Grand Jury charged with corruption, fraud and conspiracy relating to his election.
DEC. 1—Prince of Wales arrives in England.
DEC. 2—Mail aeroplane establishes record flight of 138 miles per hour from Washington to New York.

DEC. 4—Carpentier (France) beat Beckett (England) in boxing match for heavy-weight championship of Europe.
DEC. 5—Release of U.S. consular agent, Puebla, Mexico. (See Nov. 20.)
DEC. 5—Serb-Croat-Slovene State accedes to Austrian and Bulgarian Peace Treaties.
DEC. 9—American delegation leaves Paris Conference.
DEC. 9—Attack by Waziris, near Thal, Indian N.W. frontier, announced. 36 casualties.
DEC. 9—End of coal strike in United States (see Oct. 31).
DEC. 9—Rumania accedes to Austrian and Bulgarian Peace Treaties.
DEC. 10—Captain Ross Smith and his brother Lieut. Keith Smith complete flight from London to Australia in 28 days and win £10,000 prize offered by Australian Government.
DEC. 13—Soviet troops capture Kharkoff and Poltava from Denikin.
DEC. 13—General election in Australia. W. L. Hughes returned.
DEC. 15—Publication of Dublin newspaper, *The Freeman's Journal*, stopped by Irish Government.
DEC. 15—Fiume declares her independence.
DEC. 17—Soviet troops capture Kiev.
DEC. 19—Defeat of Sir Joseph Ward and Liberal Party in New Zealand elections.
DEC. 19—Heavy British casualties in unsuccessful campaign against Mahsuds and Waziris on Indian frontier.
DEC. 20—French airman, Lieut. Roger, reaches record height of 6,000 metres.
DEC. 20—U.S. House of Representatives adopts drastic amendments to Immigration Law.
DEC. 24—Presidential proclamation issued in United States terminating government control over railways on March 1 1920.
DEC. 27—All-British air route from Cairo to the Cape available for traffic.
DEC. 29—Surrender of Mahsuds on Indian frontier.
DEC. 29—Coal Strike Settlement Commission holds first meeting in Washington.
DEC. 31—Agreement regarding East Siberia made between Great Britain, United States and Japan.

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JAN. 1-2—Federal agents arrest 2,000 Reds in raids in 33 cities of U.S.
JAN. 5—Dvinsk captured from Bolshevists by Poles and Letts.
JAN. 8—Bolshevists defeat Admiral Koltchak at Krasnoyarsk. Collapse of Koltchak opposition.
JAN. 8—Lieuts. Parer and McIntosh leave Hounslow, England, on aeroplane flight to Australia.
JAN. 8-16—Supreme Allied Council meets in Paris.
JAN. 10—Ratifications of Treaty of Versailles exchanged in Paris by Allies and Germany. War between Allies and Germany ends. Mandatory system comes into effective legal being. Covenant of League of Nations comes into force.
JAN. 10—Eupen and Malmedy united to Belgium under authority of League of Nations.
JAN. 12—Bulgarian Sobranje ratifies Treaty of Neuilly.
JAN. 13—Argentine Republic admitted to League of Nations.
JAN. 16—First meeting of Council of League of Nations held in Paris.
JAN. 16—Supreme Allied Council demands surrender of German Emperor by Netherlands Government.
JAN. 16—Eighteenth (Prohibition) Amendment to U.S. Constitution becomes effective.
JAN. 17—M. Deschanel elected President of French Republic.
JAN. 19—Second Pan-American Financial Conference opens in Washington.
JAN. 23—Netherlands Government declines to surrender ex-Kaiser to Allies.
JAN. 27—G. N. Barnes resigns from British Cabinet.
JAN. 28—Turkish National Pact of Angora signed at Constantinople.
JAN. 29—Henry P. Fletcher, U.S. Ambassador to Mexico, resigns.
FEB. 1—Soviet Russia authorises Central Union of Russian co-operatives to resume commerce with Allies.
FEB. 2—Estonian-Russian peace treaty signed at Dorpat. Estonia declared independent.
FEB. 5—Severe blizzard sweeps Mass., N.Y. and New Jersey shores with great consequent damage.
FEB. 7—Admiral Koltchak murdered at Irkutsk by Bolshevists.
FEB. 8—Bolshevist troops capture Odessa.
FEB. 9—Treaty signed in Paris between Allies and Norway ceding Spitzbergen to Norway.
FEB. 10—Plebiscite in Schleswig northern zone favours Denmark.
FEB. 13—Robert Lansing, U.S. Secretary of State, resigns.
FEB. 13—Switzerland admitted to League of Nations (with neutrality reservations).
FEB. 14—Allies request Netherlands Government to intern ex-Kaiser Wilhelm II. (see Jan. 23).
FEB. 19—Grand Trunk Railway shareholders ratify agreement for sale of Grand Trunk Railway to Canadian Government.
FEB. 20—Rear Admiral R. E. Peary, U.S.N., died at Washington, D.C.
FEB. 24—Charles R. Crane appointed U.S. Minister to China.
FEB. 25—Bainbridge Colby appointed U.S. Secretary of State (see Feb. 13).
FEB. 26—Russian Soviet Government sends new peace offer to Allies.
FEB. 27—Decree filed in the District of Columbia Supreme Court compelling the packers to abstain from all business not directly relating to the packing of meat. Affects 87 corporations.
FEB. 27—Major R. W. Schroeder, at McCook Field, Dayton, Ohio, establishes new world's record for aeroplane altitude, 36,020 feet.
FEB. 27—Lloyd George announces in British House of Commons Allies' decision to allow Turkey to keep Constantinople. Dardanelles to be under international control.
FEB. 29—Czechoslovakian Constitution adopted.
MARCH 1—Admiral Horthy elected Regent of Hungary.
MARCH 1—U.S. Supreme Court declares United States Steel Corporation not to be a trust in restraint of trade within the Sherman Act.
MARCH 1—Sir Auckland Geddes appointed British Ambassador to United States.
MARCH 4—Allied Supreme Council decides to permit Germany to float internal loan.
MARCH 5—Netherlands Govt. agrees to subject freedom of ex-Kaiser Wilhelm to necessary limitations.
MARCH 5—Norway admitted to League of Nations.
MARCH 5—Supreme Council recognises Rumania's sovereignty over Bessarabia.
MARCH 8—Syrian Congress at Damascus proclaims national independence.
MARCH 8—Denmark admitted to League of Nations.
MARCH 10—Ulster votes to accept Home Rule Bill.
MARCH 10—U.S. Senate adopts reservation against 6 votes allotted British Empire on League of Nations Council.
MARCH 10—Netherlands admitted to League of Nations.
MARCH 10—General election in South Africa. General Smuts sustained.
MARCH 11—Emir Feisal proclaimed King of Syria.
MARCH 13—Kapp coup d'etat in Berlin. President Ebert calls general strike to defeat Kapp movement.
MARCH 14—Plebiscite in Schleswig middle zone, including port of Flensburg, results in favour of Germany.
MARCH 16—Constantinople occupied by Allied troops under General Milne.
MARCH 16—Prince of Wales leaves England in H.M.S. "Renown" on tour to Australia and New Zealand.
MARCH 17—Revolt fails in Germany. General strike ends (see March 13).
MARCH 19—Final rejection of Versailles Peace Treaty by U.S. Senate.
MARCH 19—Sir R. Horne appointed President of British Board of Trade.
MARCH 20—U.S. Senator Newberry and 16 others found guilty at Grand Rapids of election frauds. (See May 2 1921.)
MARCH 20—Van Ryneveld and Brand reach Cape Town on completion of flight from England.
MARCH 23—Henry Morgenthau nominated U.S. Ambassador to Mexico.
MARCH 24—British Royal Commission on Decimal Coinage reports against change in existing system.
MARCH 26—Prince of Wales arrives at Barbadoes.
MARCH 27—Oxford and Cambridge University boat-race won by Cambridge by 4 lengths.
MARCH 28—Severe tornado over Middle West, U.S., including Chicago. Over 100 lives lost.
MARCH 28—Bolshevists capture Novorossisk, Black Sea. Collapse of Denikin's army.
APRIL 1—The N.Y. Assembly expels five Socialist members, after an all night debate.
APRIL 3—Sir L. Worthington-Evans appointed Minister without portfolio in British Cabinet in succession to G. N. Barnes, resigned.
APRIL 6—French troops occupy Frankfurt, Darmstadt and Hanau pending withdrawal of German troops from Ruhr.
APRIL 7—Prince of Wales arrives at San Diego, California.
APRIL 9—U.S. House of Representatives passes peace resolution declaring state of war with Germany ended and repealing all special war time legislation.
APRIL 16—Viscount Jellicoe appointed Governor-General of New Zealand.
APRIL 16—Peace Conference between Latvia and Soviet Russia opened.
APRIL 19—British House of Commons ratifies Treaties of Peace with Austria and Bulgaria.
APRIL 22—M. Caillaux sentenced to 3 years' imprisonment by French Senate on charge of corresponding with enemy during war. Subsequently released.
APRIL 24—Prince of Wales lands at Auckland, New Zealand.
APRIL 25—Supreme Allied Council assigns "A" mandates for Mesopotamia and Palestine to Great Britain, Syria and Lebanon to France.
APRIL 27—James Larkin convicted at New York of having attempted to overthrow the U.S. Government. Sentenced to 5 years imprisonment.
MAY 5—Secretary Wilson rules that Communist Labour Party of America does not come within the scope of the Deportation Laws.
MAY 7—Chinese consortium loan completed by acceptance of terms by Japan.
MAY 7—Mexican revolutionaries occupy Mexico City. Flight of President Carranza.
MAY 8—Poles and Ukrainians enter Kiev.
MAY 11—Statute admitting women to degrees at Oxford University passed by Convocation.
MAY 13—Socialistic National Convention at New York nominates E. V. Debs for Presidentt.
MAY 14—Prince of Wales arrives at Christ Church, New Zealand.
MAY 15-17—Allied Conference at Hythe, Kent.
MAY 15—U.S. Senate passes Knox peace resolution terminating state of war with Germany.
MAY 16—Plebiscite in Switzerland results in favour of Switzerland's entry into League of Nations.
MAY 17—French evacuate Frankfurt and occupied towns in Ruhr (see April 6).
MAY 21—Murder of General Carranza, President of Mexico, by revolutionaries, near Tlaxcaltenango, Puebla.
MAY 21—U.S. House of Representatives passes Knox peace resolution terminating state of war with Germany.
MAY 25—Adolfo de la Huerta elected provisional President of Mexico.
MAY 26—Issue of Hunter Committee Report on riots at Amritzar, Punjab, in 1919. General Dyer censured and retired.
MAY 26—Prince of Wales arrives in Melbourne, Australia.
MAY 27—U.S. President vetoes peace resolutions of Senate and House of Representatives terminating state of war with Germany.
MAY 27—M. Krassin, Soviet Government delegate, arrives in London.
MAY 31—Opening of Trade Conference at Ottawa between Canadian and West Indian Governments.
JUNE 1—New postage rates in Great Britain in force. Letter rate raised from 1½d. to 2d.
JUNE 2—The Derby won at Epsom by Captain G. Loder's "Spion Kop."
JUNE 4—Treaty of Peace between Allies and Hungary signed at the Trianon, Versailles.
JUNE 7—U.S. Supreme Court declares Federal Prohibition Amendment and Volstead Enforcement Bill constitutional.
JUNE 8—Sir Herbert Samuel appointed British High Commissioner in Palestine.
JUNE 8—Republican National Convention opened at Chicago. Warren G. Harding and Calvin Coolidge nominated for President and Vice-President (June 12).
JUNE 8—Lt. John Wilson, U.S. Air Service, creates new record in parachute drop of 19,800 feet from aeroplane, at San Antonio, Texas.
JUNE 14—Parliament of free city of Danzig meets for first time.
JUNE 14—Lord Forster appointed Governor-General of Australia.
JUNE 15—Estonian Constituent Assembly passes Estonian constitution.
JUNE 15—Dame Melba broadcasts songs from Chelmsford, England, to audience spread over greater part of Europe.
JUNE 16—Prince of Wales arrives at Sydney, New South Wales.
JUNE 16—Commission of international jurists meets at The Hague to form International Court of Justice for League of Nations.
JUNE 18—Samuel Gompers re-elected president of the A.F. of Labour at Montreal.
JUNE 18—Canadian-West Indian Trade Agreement signed.
JUNE 21—Prince of Wales lays foundation stone of new capital of Australia at Canberra.
JUNE 22-25—British Labour Party Conference at Scarborough. Motion favouring direct action heavily defeated.
JUNE 23—Prince Arthur of Connaught appointed Governor-General of South Africa.
JUNE 24—Greece begins offensive, authorised by Allies, against Turkish Nationalists under Mustapha Kemal, in Asia Minor.
JUNE 24—Greeks defeat Turks at Alashehr, east of Smyrna.
JUNE 24—Appointment of Sir P. Cox as British High Commissioner in Mesopotamia.
JUNE 25—League of Nations Council selects The Hague as seat of Permanent Court of International Justice.
JUNE 28—Democratic National Convention opened at San Francisco. Gov. J. M. Cox of Ohio nominated for President July 5, and Franklin D. Roosevelt for Vice President, July 6.
JUNE 30—Lord d'Abernon appointed British Ambassador at Berlin.
JULY 1—Sir R. L. Borden resigns Canadian premiership owing to ill-health.
JULY 1—Prince of Wales arrives at Perth, Western Australia.
JULY 4—Death of Major-General Gorgas, ex-Surgeon-General, U.S. Army, and foremost sanitary engineer of Panama Canal.
JULY 5-16—Spa Conference between Allies and Germany.
JULY 5—Schleswig Treaty, transferring Schleswig to Denmark, signed by Allies and Denmark.
JULY 7—U.S. Government lifts ban on trade with Russia, except as to munitions.
JULY 8—British annex East Africa Protectorate under name of Kenya Colony.
JULY 8—Greek Army enters Brusa. Kemal's defeat completed.
JULY 10—Arthur Meighen becomes Canadian Prime Minister.
JULY 11—Allenstein and Marienwerder (Poland) vote for union with Germany in plebiscite.
JULY 11—Allies call on Soviet Government to conclude immediate armistice with Poland and suggest London conference.
JULY 12—Treaty of Peace between Russia and Lithuania signed at Moscow.
JULY 12—Prince of Wales arrives at Adelaide, South Australia.
JULY 12—Anglo-Japanese Treaty of Alliance renewed.
JULY 13—Greek campaign in Asia Minor concluded after complete Turkish defeat.
JULY 15—Farmer Labour convention at Chicago nominates P. P. Christensen for President and Max S. Hayes for Vice-President.
JULY 15—French troops begin hostilities against Emir Feisal on his refusal to recognise French mandate for Syria.
JULY 16—Austrian Peace Treaty comes into force. Rumanian, Czechoslovakian and S.C.S. minorities treaties come into force.

JULY 18—Soviet Russia rejects Allies' suggestion of armistice between herself and Poland, and of London conference. (See July 11.)
JULY 19—Prince of Wales arrives in Tasmania.
JULY 21–23—Rioting in Belfast between Unionists and Sinn Feiners. 18 killed, 200 injured.
JULY 21—Emir Feisal accepts French terms. (See July 15.)
JULY 24—F. T. Courtney wins British Aerial Derby; 205 miles in 1 hr., 18 min., 12 sec.: average speed, 153 m.p.h.
JULY 25—Allied Mission under General Weygand arrives in Warsaw.
JULY 25—Damascus occupied by French troops. Greek troops under King Alexander occupy Adrianople.
JULY 27—Bolshevists take Pinsk and cross Polish boundary.
JULY 27—U.S. yacht "Resolute" wins America Cup.
JULY 27—Prince of Wales arrives at Brisbane, Australia.
JULY 27—St. Gaudens statue of Abraham Lincoln, gift of United States, presented by Elihu Root, and unveiled in London by Duke of Connaught.
JULY 28—Teschen Agreement between Czechoslovakia and Poland signed at Paris and comes into force.
JULY 29—New York-San Francisco air mail route opened.
JULY 30—Poland asks for armistice with Russia.
JULY 31—German Reichstag passes bill abolishing compulsory military service.
AUG. 2—Lieuts. Paker and McIntosh reach Port Darwin, Australia, on aeroplane flight from England. (See Jan. 8.)
AUG. 5–7—Imperial Press Conference at Ottawa.
AUG. 8–9—Franco-British Conference at Hythe, Kent, to consider Polish situation.
AUG. 8—Soviet Government rejects second proposal for armistice between Russia and Poland.
AUG. 9—British labour organisations appoint "Council of Action" to arrange general strike if Great Britain declares war on Soviet Russia.
AUG. 9—General Villa surrenders to Mexican Government.
AUG. 10—New States Treaty between Italy, Rumania, Czechoslovakia and Poland signed.
AUG. 10—Certain Frontiers Treaty between Principal Allies, Rumania, Czechoslovakia and S.C.S. Kingdom signed.
AUG. 10—Secret Military Convention between Belgium and France signed.
AUG. 10—Tripartite Agreement between Great Britain, France and Italy re Anatolia, signed.
AUG. 10—Greco-Italian Treaty ceding Dodecanese to Greece signed.
AUG. 10—Greece Minorities Treaty signed.
AUG. 11—Lettish Govt. concludes Treaty of Peace with Russia.
AUG. 14—Convention of Alliance is signed at Belgrade between Yugoslavia and Czechoslovakia.
AUG. 14–17—Poland defeats Bolshevists on Warsaw front.
AUG. 15—Lord Sinha appointed Lt.-Governor of Province of Bihar and Orissa.
AUG. 17—Lord Mayor of Cork, Terence McSwiney, convicted of possessing seditious documents, deported to Brixton Prison, London.
AUG. 18—Milner-Zaghlul conversations concluded in London, providing for recognition of independence and sovereign status of Egypt.
AUG. 19—Polish army enters Brest-Litovsk.
AUG. 22—General Lord Rawlinson appointed C. in C. in India.
AUG. 27—Prince of Wales lands at Samoa.
AUG. 30—Serious rioting between Orangemen and Sinn Feiners in Belfast, Ireland.
SEPT. 5—General Obregon elected President of Mexico. (See May 25.)
SEPT. 7—Severe earthquake in Tuscany, Italy: heavy loss of life.
SEPT. 10—Negotiations suspended between Great Britain and Russia owing to Soviet Government's attempt to subsidise London *Daily Herald*.
SEPT. 11—First regular trans-continental mail aeroplane, New York-San Francisco, arrives at San Francisco, taking 4 days in transit.
SEPT. 15—Aerial mail service inaugurated from Copenhagen to Hamburg, Amsterdam and London.
SEPT. 16—M. Deschanel, President of France, resigns owing to ill-health.
SEPT. 16—Explosion in Wall St., N.Y. City, kills 34, wounds 130, of whom several died later, and damages buildings. Blasting gelatine used as explosive.
SEPT. 21—Woman Suffrage Amendment to the U.S. Constitution ratified by list of necessary 36 states.
SEPT. 22—Prince of Wales lands at Georgetown, British Guiana.
SEPT. 23—M. Millerand elected President of French Republic.
SEPT. 24—M. Georges Leygues becomes French Premier and Foreign Minister.
OCT. 9—Railway accident at Houilles, near Paris. 45 killed, 100 injured.
OCT. 12—Armistice and preliminary peace treaty signed between Poland and Soviet Russia.
OCT. 14—Peace treaty between Soviet Russia and Finland signed at Dorpat.
OCT. 20—Tariff Treaty signed between China and United States.
OCT. 25—Death of Terence McSwiney, Sinn Fein Lord Mayor of Cork, after 73 days hunger-strike, in Brixton Prison, London.
OCT. 25—Death of King Alexander of Greece.
OCT. 27—Treaty between Poland and Free City of Danzig signed (effective Nov. 9.)
OCT. 27—League of Nations' headquarters removed from London to Geneva.
OCT. 28—Admiral Coundouriotis elected Regent of Greece.
OCT. 29—Emergency Powers Bill receives Royal assent.
OCT. 30—Lloyd George elected Lord Rector of Edinburgh University.
OCT. 30—Nobel Prize for Literature awarded to Knut Hamsun, Norway.
NOV. 2—Warren G. Harding, Republican candidate for the United States presidency, elected by large majority. Gov. Al. Smith defeated in New York.
NOV. 7–DEC. 21—Famine in China reaches its height. 15,000,000 reduced to actual starvation.
NOV. 11—Armistice Day celebrated in London. King George V. unveils Cenotaph in Whitehall in its permanent form. Body of Unknown Warrior buried in Westminster Abbey.
NOV. 12—Rapallo Treaty signed by Italy and S.C.S. Kingdom. Italy obtains Istria and cedes Dalmatia. Fiume becomes independent.
NOV. 14—Sebastopol captured by Red Troops.
NOV. 14—M. Veniselos defeated in Greek elections.
NOV. 15–DEC. 18—First session of League of Nations Assembly held at Geneva. M. Hymans, Belgium, elected president of Assembly.
NOV. 15—Danzig formally declared a free city. Sir Reginald Tower appointed High Commissioner.
NOV. 17—Dowager Queen Olga becomes Regent in Greece.
NOV. 19—Nicaragua, Honduras and Costa Rica sign agreement at Amapala, Guatemala, for boundary settlement and protection, looking forward to unified Central America.
NOV. 20—10 persons killed and 50 wounded in fighting between soldiers and civilians at Croke Park, Dublin.
NOV. 26—Note sent to Great Britain by United States claiming equal rights with Britain and France to explore for oil in Mesopotamia and other Mandated Countries.
NOV. 26—Italian Chamber ratifies Treaty of Rapallo.
NOV. 27—League of Nations to send an international force to keep order in Vilna during plebiscite.
DEC. 1—Constitution of Permanent Mandates Commission approved by League of Nations Council.
DEC. 3—Peace treaty between Armenia and Turkey signed at Alexandropol.
DEC. 4—Argentine Delegation withdraws from League of Nations Assembly on account of its proposed amendments being postponed.
DEC. 5—Plebiscite in Greece favours return of King Constantine.
DEC. 8—Cambridge University Senate rejects proposals for admission of women to full membership.
DEC. 9—Milner report on Egypt signed.
DEC. 10—Nobel Peace Prizes for 1919–1920 awarded to Woodrow Wilson and Leon Bourgeois respectively.
DEC. 11—Series of reprisal fires in Cork, Ireland, chief public buildings being destroyed. Damage estimated at £3,000,000.
DEC. 12—Martial law declared in counties of Cork, Tipperary, Kerry and Limerick, Ireland.
DEC. 15—Austria admitted to League of Nations.
DEC. 16—Protocol establishing Permanent Court of International Justice signed at League of Nations Assembly at Geneva.
DEC. 16—Bulgaria, Costa Rica, Finland and Luxembourg admitted to League of Nations.
DEC. 17—Albania admitted to League of Nations.
DEC. 19—King Constantine arrives at Athens.
DEC. 23—Franco-British Convention re boundaries of Syria and Palestine signed.
DEC. 23—Government of Ireland Bill receives Royal assent.
DEC. 29—French Socialist Congress votes for adhesion to Moscow International.

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JAN. 1—U.S. representative withdraws from Council of Ambassadors at Paris, thus severing U.S. participation in European Councils.
JAN. 2—Spanish vessel, the "Santa Isabel," strikes a reef off the coast of Galicia. Only 56 out of 300 passengers and crew saved.
JAN. 3—U.S. Supreme Court declare that, under Clayton Act, inciting to boycott is unlawful.
JAN. 4—Martial law in Ireland extended to Clare, Kilkenny, Waterford and Wexford.
JAN. 6—New Government of Fiume formed.
JAN. 7—First woman elected as foreman of a jury in Great Britain.
JAN. 8—Lord Reading appointed Viceroy of India.
JAN. 10—Opening of Leipzig War Trials.
JAN. 14—U.S. Senate votes for reduction of regular army to 150,000 enlisted men.
JAN. 16—Briand Cabinet formed in France.
JAN. 17—Samuel Gompers re-elected President of Pan-Amer. Fed. of Labor at Mexico City.
JAN. 17—Agreement between American Federal Telegraph Company and Chinese Government for construction of high-power wireless station at Shanghai.
JAN. 20—U.S. Senate Committee on Foreign Relations reports in favour of Borah resolutions on naval disarmament.
JAN. 22—Ludwig Martens, so-called Ambassador from Soviet Russia to United States, deported.
JAN. 25—U.S. Senate unanimously adopts Borah resolution for six months suspension of naval building pending investigations of Committee on Naval affairs.
JAN. 25—Women sat for first time on the jury in the Divorce Court in England.
JAN. 26—Supreme Council recognises *de jure* independence of Estonia and Latvia.
JAN. 29—Agreement reached at meeting of Supreme Council in Paris, regarding method of payment of Germany's war debt, etc.
FEB. 1—U.S. Senate approves Bill authorising President to declare embargo on exportation of oil.
FEB. 2—Treaty of Rapallo of Nov. 12 1920 comes into force.
FEB. 2—Senatorial recount of ballots in Michigan election 1918 gives Newberry majority of 4,334 over Henry Ford.
FEB. 4—Sir James Craig elected leader of Ulster Unionists.
FEB. 5—M. Tchitcherin denies Russian anti-British propaganda in Asia, and objects to preamble of draft trade agreement with Britain.
FEB. 8—South African Elections. General Smuts has majority of 20.
FEB. 9—Treaty of Peace between Poland and Soviet Russia signed at Riga.
FEB. 9—The two new representative Indian Chambers—the Council of State and the Legislative Assembly—inaugurated at Delhi.
FEB. 9—The Stock Exchange and Ministry of Foreign Affairs at Rio de Janeiro injured by bombs thrown by anarchists.
FEB. 12—Winston Churchill becomes Secretary of State for Colonies in British Cabinet.
FEB. 15—Foundation Stone of new Indian Houses of Parliament laid at Delhi by the Duke of Connaught.
FEB. 18—U.S. Representative on Reparation Commission withdrawn.
FEB. 19—Political and economic agreement signed between France and Poland.
FEB. 21—Conference opened at London to discuss modification of Treaty of Sevres. (See Mar. 12.)
FEB. 23—Air mail from San Francisco to New York makes new record of 33 hours 20 minutes.
FEB. 25—Bolsheviks occupy Georgia.
FEB. 26—Russia and Persia sign political Treaty at Moscow.
FEB. 27—U.S. destroyer "Woolsey" sunk in collision off Pacific coast of Panama.
FEB. 28—All restrictions and regulations on importations, etc., of sugar withdrawn in England.
FEB. 28—Miners' wage advance in Great Britain secured under strike settlement, cancelled owing to reduced output.
FEB. 28—Riots in Florence and other Italian towns between Communists and Nationalists.
FEB. 28—Treaty signed between Russia and Afghanistan.
MARCH 1—U.S. Senate passed Edge resolution re conference on naval reduction between U.S., Japan and Gt. Britain.
MARCH 1—Inland coal in Great Britain decontrolled.
MARCH 1—Treaty of defensive alliance signed between Angora Government and Afghanistan.
MARCH 3—Military convention signed between Poland and Rumania.
MARCH 4—Warren G. Harding inaugurated President of the United States in succession to Woodrow Wilson.
MARCH 5—Costa Rica and Panama warned by U.S. to stop fighting and arbitrate their boundary question.
MARCH 7—Archbishop Dougherty of Philadelphia created a Cardinal.
MARCH 8—Düsseldorf, Duisberg and Ruhrort occupied by Allied Troops.
MARCH 8—Lord Reading resigns Lord Chief Justiceship of England.
MARCH 8—Prime Minister of Spain, Senor Dato, assassinated in Madrid.
MARCH 10—U.S. railways announce nearly 25% reduction in wages.
MARCH 10—Frontier convention signed between Austria and Czechoslovakia.
MARCH 11—A. Bonar Law installed as Lord Rector of Glasgow University, Scotland.
MARCH 12—Close of Conference in London. Supreme Council's terms for settlement handed to Greek and Turkish delegates.
MARCH 13—Economic Agreement signed in London between Italy and Angora government.
MARCH 15—Territory of Ruanda (E. Africa) ceded to Great Britain by Anglo-Belgian Convention.
MARCH 16—Treaty signed by Soviet Russia with Angora Government.
MARCH 16—Agreement signed at London between Great Britain and Soviet Russia for opening of trade relations.
MARCH 17—A. Bonar Law resigns leadership of Unionist party in British House of Commons.
MARCH 18—Treaty of Peace between Poland and Russia signed at Riga.
MARCH 19—Daily air service resumed between London and Paris with state assistance.
MARCH 20—Polling in Upper Silesia. Majorities for union with Germany in most districts.
MARCH 21—Austen Chamberlain elected leader of Unionist Party in British House of Commons.
MARCH 22—Soviet Russia requests U.S. to resume trade relations.
MARCH 23—Germany announces herself unable to pay £600,000,000 due to Reparation Commission on May 1, and fails to pay £50,000,000 required to date.
MARCH 24—Mrs. Ralph Smith becomes a Cabinet Minister without portfolio in British Columbia.
MARCH 24—Serious Communist disturbances in Hamburg, Germany.
MARCH 24—Greeks begin offensive on Anatolian front against Turks.
MARCH 25—United States refuses to resume trade relations with Soviet Russia until a system of productive order is established in Russia.
MARCH 28—Rejection by Independent Labour Party of Great Britain of affiliation with Moscow Communist International.
MARCH 31—Serious strike of miners in Great Britain.

APRIL 1—Following Cabinet appointments made in Great Britain: Sir Robert Horne, Chancellor of the Exchequer; Stanley Baldwin, President of the Board of Trade.
APRIL 5—Defeat of Greek troops at Eskishehr. General retreat of Greek Army.
APRIL 5—Zaghlul Pasha, Egyptian leader, returns from exile.
APRIL 6—Myron T. Herrick appointed U.S. Ambassador to France.
APRIL 9—Agreement concluded between France and Germany relating to sections 3 and 4 of Part X of Versailles Treaty.
APRIL 12—President Harding declares that United States could have no part in present League of Nations.
APRIL 16—Seventy-five persons killed in tornadoes in United States.
APRIL 16—Appointment of Colonel George Harvey, U.S. Ambassador to London, confirmed by Senate.
APRIL 19—U.S. note delivered at The Hague demanding equal opportunity for Americans in oil-fields in Djambi, Sumatra.
APRIL 19—Government of Ireland Act comes into operation.
APRIL 21—General Pershing appointed head of Staff in U.S. Army.
APRIL 23—Defensive Treaty signed at Bukarest between Czechoslovakia and Rumania.
APRIL 24—Plebiscite in Tyrol favours union with Germany.
APRIL 25—Resignation of J.W. Lowther, Speaker of British House of Commons.
APRIL 26—New reparation proposals made by Germany admitting liabilities up to £10,000,000,000.
APRIL 27—J. H. Whitley elected Speaker in British House of Commons.
APRIL 28—Bank rate in England reduced from 7% to 6½%.
MAY 1—U.S. Navy opens commercial wireless communication with Indo-China.
MAY 1—Government control of liquor traffic in Quebec becomes effective.
MAY 1—Polish insurrection in Upper Silesia. State of siege declared.
MAY 2—Orders for mobilisation of French troops to occupy Ruhr.
MAY 2—U.S. Supreme Court reverses conviction of Senator Newberry of Michigan for alleged election frauds. (See Mar. 20 1920.)
MAY 4—General Wood and Cameron Forbes of United States arrive at Manila on official mission.
MAY 5—Supreme Council presents ultimatum to Germany stating that Valley of the Ruhr will be occupied if she fails to fulfil terms of Peace Treaty by May 12.
MAY 6—Treaty of Peace signed between Germany and Russia.
MAY 6—Australian Government remove all restrictions on exports from the Commonwealth.
MAY 8—Bill passed in Sweden abolishing capital punishment.
MAY 10—German Reichstag votes for acceptance of allied terms.
MAY 11—Installation of Rev. W. T. Manning as Protestant Episcopal Bishop of New York.
MAY 11—Germany accepts allied ultimatum of May 5.
MAY 12—Unfavourable reply sent from Holland to United States re Djambi oil concessions.
MAY 17—R. Washburn Child appointed U.S. Ambassador to Italy.
MAY 19—President Harding signs Immigration Restriction Law.
MAY 19—First electrically-propelled vessel built in America, the "Eclipse," returns from 26,500 mile voyage.
MAY 19—Death of Chief Justice White of the U.S. Supreme Court.
MAY 20—Agreement signed between Germany and China re-establishing friendly relations.
MAY 21—Commercial Treaty signed between Rumania and Poland.
MAY 23—Egyptian Nationalist riots at Alexandria. 37 deaths, 151 other casualties.
MAY 24—British Admiralty announces its policy of building ships to burn oil fuel only.
MAY 25—Customs House at Dublin, Ireland, destroyed by fire by Sinn Feiners.
MAY 26—Sentence of 10 months imprisonment passed at Leipzig on German soldier, Karl Heinen, for cruelty to British prisoners.
MAY 27—British troops arrive in Upper Silesia.
MAY 30—Plebiscite in Salzburg favours union with Germany.
MAY 30—A bust of George Washington, presented to Britain by various American organisations, unveiled in the crypt of St. Paul's Cathedral.
MAY 30—German Captain, Emil Muller, sentenced to 6 months' imprisonment for cruelty to prisoners of war.
JUNE 1—Race for the Derby in England won by J. B. Joel's Humorist.
JUNE 1—U.S. Senate passes Naval Appropriation Bill, with Borah amendment for conference on naval expenditure.
JUNE 3—Lord Byng of Vimy appointed Governor-General of Canada.
JUNE 3—Flood on Arkansas River causes great loss, partly destroying Pueblo, Cal. 1,500 killed or missing.
JUNE 4—Lieut.-Commander Neumann acquitted at Leipzig, having admitted torpedoing British hospital ship "Dover Castle."
JUNE 5—Agreement signed by Italy, Serbia, Yugoslavia and Fiume, by which port of Fiume is to be controlled by a consortium, on which each state will appoint two members.
JUNE 7—United States announces that recognition cannot be given Mexico until she binds herself to discharge primary international obligations.
JUNE 7—First Parliament of Northern Ireland opened.
JUNE 7—Rumania and S.C.S. Kingdom sign defensive Treaty at Belgrade.
JUNE 8—U.S. Secretary Denby demands explanation from Admiral Sims of London remarks regarding Irish in America.
JUNE 19—Census taken in Great Britain.
JUNE 19—Great Britain, France and Italy offer to mediate in Greco-Turkish question.
JUNE 20—Imperial Conference opens in London.
JUNE 21—Second Congress of International Chamber of Commerce opens in London.
JUNE 21—Charles G. Dawes appointed U.S. Director of the Budget.
JUNE 22—Labour Conference of Great Britain declines affiliation with Communists.
JUNE 23—English Bank rate reduced from 6½% to 6%.
JUNE 24—Rear-Admiral Sims publicly reprimanded by U.S. Secretary Denby for remarks on Irish sympathisers in America.
JUNE 24—Aaland Islands awarded to Finland by Council of League of Nations.
JUNE 25—Samuel Gompers re-elected President of American Federation of Labour for the 40th time.
JUNE 25—Greek Government refuses offer of allied mediation in her dispute with Turkey.
JUNE 28—Coal-owners and miners in Great Britain come to final agreement. House of Commons sanctions grant of £10,000,000 for temporary period to coal industry.
JUNE 30—Ex-President Taft becomes Chief-Justice of U.S. Supreme Court.
JULY 2—President Harding signs Joint Resolution of Congress declaring peace with Germany and Austria.
JULY 2—French boxer, Carpentier, knocked out by Dempsey (American) in fight for world heavyweight championship at Jersey City.
JULY 6—U.S. warships sent to Tampico to protect U.S. citizens.
JULY 7—Rumania and Serb-Croat-Slovene Kingdom sign Treaty of Alliance.
JULY 8—French mission and witnesses recalled from Leipzig Supreme Court owing to General Stenger being acquitted on a charge of shooting prisoners.
JULY 8—United States refuses to surrender its rights in China under a contract between that country and Federal Telegraph Company.
JULY 8—Reparation Commission agrees that Bulgarian Government shall postpone for one year its payment of sums due for reparations.
JULY 10—President of United States invites Gt. Britain, France, Italy and Japan to Disarmament Conference.
JULY 11—U.S. President signs Naval appropriation Bill including Borah amendment.
JULY 11—Truce comes into operation between British Government and Sinn Fein.
JULY 14—D. Lloyd George and E. de Valera commence discussion on Irish question.
JULY 15—Arthur Meighen, Prime Minister of Canada, enrolled a Freeman of the City of London.
JULY 16—German officers who fired on lifeboats of hospital ship "Llandovery Castle" sentenced at Leipzig to 4 years imprisonment each.
JULY 16—Turks defeated by Greeks at Kutahia.
JULY 19—Provisional Council in Mesopotamia accepts Emir Feisal as King.
JULY 21—Bank rate in England reduced from 6% to 5½%.
JULY 21—Spanish troops defeated at Anual in Morocco. Suicide of General Silvestre and other officers.
JULY 23—Convention signed for internationalisation of the Danube.
JULY 25—Economic Convention signed between Belgium and Luxembourg.
JULY 26–29—International Conference on Tuberculosis held in London.
JULY 26—Treaty of Trianon comes into force.
JULY 29—All-India Congress Committee passes resolution boycotting visit of Prince of Wales.
AUG. 1—British schooner "Henry L. Marshall" carrying liquor seized by American authorities beyond three-mile limit.
AUG. 2—Reparation Commission agrees that sum of 124,000,000 gold marks, which Commission had in hand on May 1 1921, be paid to Great Britain towards costs in arrears of her Army of Occupation.
AUG. 7—U.S. vessel "Alaska" founders in fog off Californian coast. Loss of 47 lives.
AUG. 7—France and Switzerland conclude convention regarding free frontier zones.
AUG. 9—Governor Small of Illinois arrested on charge of embezzling public funds and conspiracy to defraud.
AUG. 10—Allies proclaim neutrality towards Greco-Turkish conflict.
AUG. 11—Official invitation sent by President to Great Britain, France, Italy, Japan and China, to take part with United States in conference on Far East and limitation of armaments. All subsequently accept.
AUG. 12—Supreme Council refers Upper Silesian question to League of Nations.
AUG. 13—Supreme Council agrees that economic sanctions against Germany shall be removed if she fulfils certain conditions.
AUG. 14—Committee of National Assembly of Church of England urges division of dioceses in England and creation of twelve new dioceses.
AUG. 15—International Conference of Red Cross Societies in Geneva entrust Dr. Nansen and H. Hoover with supreme control of relief work in Russia.
AUG. 15—Government control of railways in United Kingdom terminates.
AUG. 18—U.S. famine relief in Russia agreed to by Soviet officials.
AUG. 23—Dail Eireann rejects British Government's peace offer.
AUG. 23—Emir Feisal crowned King of 'Iraq, in Baghdad.
AUG. 24—Riots of Moplahs in Malabar quelled by British soldiers.
AUG. 24—Treaty of Peace between United States and Austria signed at Vienna.
AUG. 24—British airship R38 wrecked. Five men saved out of a total of 49. 17 U.S. officers and men killed.
AUG. 25—Treaty of Peace signed at Berlin by United States and Germany.
AUG. 26—Italian airman flies at rate of over 209 miles an hour, establishing a record.
AUG. 28—President Harding opens new all-American cable service between America and Porto Rico.
AUG. 29—Treaty of Peace signed between Hungary and the United States.
AUG. 29—American Relief Administration workers arrive at Moscow.
AUG. 30—Section for Hungary created in Reparations Commission.
AUG. 31—N.Y. State Court of Appeals holds Soldier Bonus Act unconstitutional.
SEPT. 1—Several members of Borough Council of Poplar, London, imprisoned for refusing to levy certain rates.
SEPT. 2—General Leonard Wood appointed Governor-General of the Philippines.
SEPT. 2—French Cabinet decides that Convention reached by Inter-Allied Conference in Paris cannot be accepted.
SEPT. 3—U.S. oil men sign agreement with Mexican Government regarding oil taxes.
SEPT. 9—Constitution of Central American Union signed at Tegucigalpa, Honduras, by republics of Guatemala, Honduras and San Salvador.
SEPT. 10—Large part of San Antonio, Texas, destroyed by cloudburst. Much loss of life.
SEPT. 10—Battle of Angora between Greeks and Turks. Heavy losses on both sides.
SEPT. 12—War declared in Bessarabia by Russia against Rumania.
SEPT. 17—The "Quest" leaves London for the Antarctic under command of Sir Ernest Shackleton.
SEPT. 21—Hundreds killed and injured in explosion of factory of Badische Anilin and Sodafabrik at Appau, near Mannheim, Germany.
SEPT. 22—Estonia, Latvia and Lithuania admitted to League of Nations.
SEPT. 26—Lecointe, French airman, flies at rate of over 205 miles an hour.
SEPT. 26—Attack on a British post in Sudan. Two British officials killed.
SEPT. 26—U.S. submarine sinks at San Pedro, California.
SEPT. 28—Fire in Paris destroys Grands Magazins au Printemps.
SEPT. 28—World's height record broken at Dayton, Ohio, by Lieut. John Macready, who reaches height of 40,800 ft.
SEPT. 29—Fierce fight in Morocco between Spaniards and Riffs. Spaniards fight their way through to Feizan.
SEPT. 30—Commercial agreement signed between Austria and Rumania.
OCT. 5—Collision between two trains in Batignolles Tunnel, Paris, results in over 100 persons being killed and injured.
OCT. 6—M. Loucheur and Dr. Rathenau sign protocol of Franco-German agreement for supply of reparations in kind by Germany.
OCT. 9—U.S. Senate passes Bill exempting American coastwise vessels from payment of Panama Canal tolls.
OCT. 10—Great Britain signs agreement with France for conveyance of mails by aeroplane.
OCT. 11—Conference between British Government and Sinn Fein opens in London.
OCT. 12—Borough councillors of Poplar, London, released from prison. (See Sept. 1.)
OCT. 13—Treaty signed between Turkey and Caucasian republics regulating frontier questions.
OCT. 15—Ambassadors' Conference adopts decision of League of Nations regarding Upper Silesia.
OCT. 18—Russian Central Executive Committee grants independence of Crimea.
OCT. 19—Attempted assassination of Myron T. Herrick, U.S. Ambassador in Paris.
OCT. 19—Revolution in Lisbon. Senhor Granjo assassinated.
OCT. 20—Convention signed guaranteeing non-fortification and neutralisation of Aaland Islands. (See April 6 1922.)
OCT. 20—Commercial Treaty signed between Czechoslovakia and Poland.
OCT. 20—Franco-Turkish Agreement signed at Angora.
OCT. 20—University of Cambridge rejects proposal to admit women students to limited membership.
OCT. 21—Maneyrolle, French aviator, establishes record by keeping monoplane glider in air for 3 hours, 22 min. Wins Daily Mail £1,000 prize.
OCT. 24—Economic Conference held at Riga between Russia, Finland, Estonia, Latvia and Lithuania.
OCT. 25—Belgium and France sign Convention concerning reparation regulations.
OCT. 25—Polish Government accepts Upper Silesian award.
OCT. 27—Germany formally announces acceptance of Allied conditions.
OCT. 27—Both Houses of Parliament in Queensland, Australia, pass bill abolishing Legislative Council.
OCT. 29—Serious floods in British Columbia.
NOV. 1—Prince of Wales opens first session of newly constituted Maltese Parliament.
NOV. 3—Ex-Emperor Karl of Austria-Hungary exiled to Madeira, after two abortive attempts to regain throne.
NOV. 3—Bank rate in England reduced from 5½ to 5%.
NOV. 4—Japanese Prime Minister Hara assassinated.
NOV. 5—Greatest wireless station hitherto in the world opened at Rocky Point, Long Island, New York.

Nov. 5—Russia and revolutionary government of Mongolia sign political agreement.
Nov. 6—Political Treaty signed between Poland and Czechoslovakia.
Nov. 8—John F. Hylan, Dem., re-elected Mayor of New York by large majority.
Nov. 9—T. Murphy, Union leader and ex-state representative, found guilty at Chicago of plotting mail robbery.
Nov. 11—America's Unknown Warrior buried at Arlington Cemetery, Va.
Nov. 12—Conference opened at Washington on Limitation of Armaments.
Nov. 12—Payment completed of one milliard gold marks by Germany under Art. 5 of Schedule of Payments.
Nov. 12—Albanian Government formally recognised by Great Britain, France, Italy and Spain.
Nov. 17—Prince of Wales lands at Bombay.
Nov. 21—Brigadier-General the Hon. Charles Bruce accepts command of Mount Everest Expedition.
Nov. 22—Treaty of friendship signed at Kabul between Great Britain and Afghanistan.
Nov. 29—General Wood's report on the Philippine Islands published, advocating retention of the islands by United States and more authority for the Governor.
Nov. 29—Australian House of Representatives supports continuance of Government Steamship Line.
Dec. 2—J. H. Thomas, M.P., awarded £2,000 against National Labour Press, Ltd., of England, for libel.
Dec. 4—Full diplomatic relations resumed between United States and Bulgaria.
Dec. 6—General Elections in Canada. Overwhelming defeat of Conservative Party.
Dec. 6—Treaty signed between Great Britain and Ireland according Ireland Dominion status.
Dec. 7—Austria and Soviet Russia resume political and commercial relations.
Dec. 7—Government of Guatemala overthrown.
Dec. 7—Riot in Chicago of packing-house strikers. 100,000 involved.
Dec. 10—Nobel Peace Prize for 1921 awarded to M. Brantung, Prime Minister of Sweden, and M. Christian Lange, Secretary-General of the Inter-Parliamentary Bureau, Geneva.
Dec. 11—C. R. Das, President of Indian National Congress, arrested by British.
Dec. 12—United States and Japan reach agreement regarding island of Yap.
Dec. 13—Treaty signed at Washington between United States, British Empire, France and Japan regarding their insular possessions and dominions on the Pacific.
Dec. 14-17—Oedenburg plebiscite held. Majority in favour of union with Hungary.
Dec. 15—Germany applies for moratorium regarding reparation payments.
Dec. 15—Sir James Craig protests against terms of Irish agreement.
Dec. 16—British Parliament ratifies Treaty with Ireland.
Dec. 19—At Washington Conference France accepts proposed naval ratio regarding capital ships.
Dec. 21—Reconstruction of Australian Federal Cabinet. Wm. Hughes becomes Prime Minister and Minister for External Affairs.
Dec. 22—British plea for total abolition of submarines made at Washington Conference.
Dec. 23—Zaghlul Pasha arrested on his refusal to refrain from political activities.
Dec. 23—Central Railway Wages Board in England agrees to reduction of railwaymen's wages by 4/- a week to date from Jan. 1 1922.
Dec. 23—U.S. President signs Bill for $20,000,000 Russian famine relief (passed H. of Rep. Dec. 17, Senate Dec. 20).
Dec. 23—U.S. President commutes sentence of E. V. Debs.
Dec. 24—American proposal at Washington Conference reducing British and American submarine tonnage to 60,000 tons each, allotting 36,000 tons each to France and Italy.
Dec. 24—Storm in Eastern Arkansas, Northern Mississippi and Louisiana kills 44 persons and destroys 1,000,000 dollars worth of property.
Dec. 24—Prince of Wales arrives at Calcutta.
Dec. 27—Commercial agreement signed between Italy and Russia at Rome.
Dec. 28—French delegation at Washington Conference announces that France will insist on building submarines up to 90,000 tons.
Dec. 29—United States, British Empire, France, Italy and Japan sign Treaty at Washington for limitation of Naval Armament.
Dec. 29—Mackenzie King Cabinet in Canada formed.

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Jan. 2—Prince of Wales lands at Rangoon.
Jan. 3—Henry P. Fletcher appointed U.S. Ambassador to Belgium.
Jan. 4—Fire at West Hartlepool, England. Hundreds of people homeless.
Jan. 5—Death of Sir Ernest Shackleton in the "Quest" off South Georgia.
Jan. 6-12—Cannes Conference held.
Jan. 7—Dail Eireann votes approval of Treaty between Great Britain and Ireland.
Jan. 8—Elections to Vilna Parliament result in large majority for union with Poland.
Jan. 9—Dail Eireann defeats (by majority of 2) the motion for re-election of De Valera as President.
Jan. 10—Arthur Griffith elected head of provisional government of Southern Ireland.
Jan. 10—Strike in Rand gold mines, S. Africa, begins. Over 20,000 men affected.
Jan. 12—King George V. grants general amnesty for offences committed in Ireland before truce of July 11 1921.
Jan. 12—Resignation of M. Briand, Prime Minister of France, as result of hostility towards his attitude at Cannes.
Jan. 12—U.S. Senate decides T. H. Newberry of Michigan is entitled to his seat.
Jan. 13—Prince of Wales arrives at Madras.
Jan. 15—Dail Eireann ratifies Treaty between Great Britain and Ireland. Provisional Government formed under Michael Collins.
Jan. 15—Poincaré Ministry formed in France.
Jan. 17—Secretary Hughes suggests an International Board of Reference at Pekin to maintain open door for China.
Jan. 18—Guatemala withdraws from Central American Union.
Jan. 18—Germany pays first amount due under Cannes agreement (£1,500,000).
Jan. 19—Unionists of South and West Ireland decide to support Provisional Government.
Jan. 21—Presidential decree issued in Mexico abolishing passports for U.S. citizens.
Jan. 22—Death of Pope Benedict XV.
Jan. 26—Legislative Council of Southern Rhodesia accepts draft constitution conferring self-government on the country.
Jan. 26—American Marines at Camaguay, Cuba, ordered to withdraw.
Jan. 28—About 120 persons killed as the result of collapse of roof of Knickerbocker Theatre, Washington.
Jan. 31—U.S. Senate passes Foreign Debt Refunding Bill.
Feb. 1—Washington Conference on Limitation of Armaments approves Treaties limiting capital ships, restricting submarine warfare and use of poison gas.
Feb. 3—Sirdar Abdul Hadi Khan, first Afghan Minister to Great Britain, arrives in London.
Feb. 4—Shantung Treaty between China and Japan signed at Washington.
Feb. 6—Washington Arms Conference closes.
Feb. 6—Cardinal Ratti, Archbishop of Milan, elected Pope (Pius XI.) in succession to Benedict XV.
Feb. 7—A. B. Houghton nominated as U.S. Ambassador to Germany.
Feb. 9—U.S. President signs Foreign Debt Refunding Bill.
Feb. 10—P. C. Larkin appointed to succeed Sir George Perley as High Commissioner for Canada in London.
Feb. 11—Yap Treaty signed at Washington by United States and Japan.
Feb. 11—Honduras resumes her status as an independent republic.
Feb. 13—Strike of 75,000 textile workers in New England against reduction of wages by 20%.
Feb. 15—First Session of Permanent Court of International Justice opens at The Hague.
Feb. 16—Bank rate in England reduced from 5% to 4½%.
Feb. 21—Names of members of U. S. Foreign Debt Funding Commission announced.
Feb. 21—Thirty-four lives lost by destruction by fire of U.S. airship "Roma" at Hampton, Va.
Feb. 21—British Government proclaims end of British protectorate in Egypt, and declares Egypt an independent sovereign state.
Feb. 25—Landru, convicted of murdering 10 women and a boy, executed at Versailles.
Feb. 27—U.S. Supreme Court holds Suffrage Amendment to the Federal Constitution valid.
March 1—U.S. Government's guarantee of 6% return to railroads expires.
March 1—U.S. Senate ratifies Treaty with Japan regarding Yap.
March 1—Commercial Agreement signed between Russia and Sweden.
March 3—Sir Gordon Hewart appointed Lord Chief Justice of England.
March 3—City Hall, Montreal, destroyed by fire.
March 3—Zaghlul Pasha sent to the Seychelles.
March 6—U.S. President prohibits export of arms to China.
March 6—Price of *The Times* (London) reduced from 3d. to 1½d.
March 9—Resignation of Hon. E. S. Montagu, British Secretary of State for India.
March 10—Martial law proclaimed in Johannesburg.
March 10—Lock-out of Members of Amalgamated Engineering Union in Great Britain.
March 15—Fire in Chicago warehouse district causes $5,000,000 loss.
March 15—Agreement regarding deliveries in kind and modifying Wiesbaden Agreement of Oct. 6 1921, signed by France and Germany. (Gillet Agreement.)
March 16—Sultan of Egypt proclaimed King with title of Fuad I.
March 17—Political agreement signed at Warsaw between Estonia, Finland, Latvia and Poland. Finland did not ratify.
March 17—Felix Diaz assassinated near Ortez, Mexico.
March 18—Gandhi, leader of non-co-operation movement in India, sentenced to six years' imprisonment.
March 18—Viscount Peel appointed Secretary of State for India.
March 19—Stefansson announces having taken possession of Wrangel Island in Sept. 1921.
March 20—U.S. President orders return of remaining American troops on the Rhine.
March 20—Indian Legislative Assembly rejects Government's proposals regarding cotton excise and salt tax.
March 21—U.S. Government calls attention to discovery of and claim to Wrangel Island made by Americans in Aug. 1881.
March 22—Governor Robertson, of Oklahoma, arrested for bribery.
March 23—Bill for enfranchisement of women rejected in South Africa.
March. 24—U.S. Senate ratifies Four-Power Pacific Treaty.
March 25—350,000 gallons of alcoholic liquor dumped into Chicago river by dry law agents.
March 27—General Bruce and party start from Darjeeling on Mount Everest expedition.
March 28—American steam yacht "Edith" seized by New York officials and her cargo of liquor valued at $300,000 confiscated.
March 29—U.S. Senate ratifies naval limitation treaty and treaty regulating submarines and poison gas.
March 30—U.S. Senate ratifies remaining Washington Treaties.
March 31—Reparations Commission approves the various agreements for deliveries in kind (Oct. 6 1921 and March 15 1922) subject to certain conditions.
April 1—Death of Ex-Emperor Karl at Madeira.
April 1—Coal strike in United States begins.
April 1—Government of Union of South Africa denounces Mozambique Convention. Negotiations for new agreement initiated.
April 6—Aaland Isles Convention of Oct. 20 1921 comes into force.
April 6—Prince of Wales arrives at Hong Kong.
April 7—Right of Standard Oil Company to explore for oil in Palestine conceded by Great Britain.
April 10—Genoa Conference opens.
April 12—Prince of Wales lands in Japan.
April 12—Treaty signed between Germany and Denmark regarding retrocession of North Schleswig to Denmark.
April 13—Bank rate in England reduced from 4½% to 4%.
April 15—Thousands of homes destroyed by floods in Southern Illinois.
April 16—German-Soviet Reciprocity Treaty signed at Rapallo.
April 16—Germany pays 18,000,000 gold marks to Reparations Commission.
April 18—Chief of Polish party in Gleiwitz, Upper Silesia, assassinated. State of siege proclaimed.
April 19—Fierce tornado in Illinois, Indiana and Arkansas.
April 22—A. B. Houghton, U.S. Ambassador to Germany, arrives at Berlin.
April 26—United States recognises Government of Egypt.
April 30—Typhus germ reported to have been discovered and isolated at Moscow by a woman, Dr. N. Kritch.
May 1—"Mauretania" reaches Southampton from New York in 5 days, 8 hours, 56 min. (record).
May 4—French Cabinet decides to agree to proposed pact of non-aggression, provided her rights under Peace Treaty are guaranteed.
May 7—Trinity Church, Broadway at Wall St., N.Y. City, celebrates the 225th anniversary of the granting of its Charter by King William III. of England.
May 10—Agreement concluded at Genoa between Russia and the Vatican.
May 15—Conference opened at Washington between Chile and Peru on Tacna-Arica dispute.
May 15—Agreement signed by Germany and Poland at Geneva, regarding Upper Silesia.
May 15—U.S. Supreme Court declares the Federal Child Labour Law unconstitutional.
May 16—White Star liner "Majestic," largest vessel hitherto built, completes her first voyage from Southampton to New York in 5 days, 14 hours, 45 min.
May 16—A first folio Shakespeare sold for £8,600 in London.
May 19—House of Lords reverses its decision of March 2 1922, and reports against the petition of Lady Rhondda for a writ of summons to Parliament.
May 20—P. & O. Liner "Egypt" sinks in collision off Ushant with loss of 87 lives.
May 21—Three members of Mount Everest expedition reach height of 26,800 ft.
May 24—Italy and Russia sign Commercial Treaty at Genoa.
May 24—Bankers' Committee appointed by Reparations Commission to investigate the question of an international loan for Germany.
May 24—U.S. Interstate Commerce Commission orders general reduction of 10% on railroad freight rates.
May 28—U.S. Railway Labour Board orders reduction by 13% in wages of 400,000 maintenance-of-way men.
June 2—Agreement concluded between Reparations Commission and German Government relating to application of Part VIII. of Versailles Treaty.
June 2—Shantung Treaty of Feb. 4 comes into force.
June 5—Two Portuguese airmen arrive in seaplane at Pernambuco after crossing Atlantic by stages.
June 5—First medal ever given by U.S. Govt. to any community presented by Ambassador Herrick to Verdun in name of Congress and U.S. people.
June 5—U.S. Supreme Court, in Coronado Coal case holds that actions can be brought against unions for damages caused by strikes.
June 6 and 9—Ruppel-Gillet Agreement signed by French and German representatives, being protocol to Agreement of March 15 1922.
June 7—Mt. Everest expedition makes attempt to reach summit, but is overwhelmed on North Col. Seven native porters lose their lives.
June 8—Conference on Tacna-Arica dispute between Chile and Peru reaches deadlock.
June 10—Bankers' Committee of Reparation Commission decides not to recommend international loan to Germany.

JUNE 12—Terrible storms rage from Ohio to Massachusetts. 75 lives lost in New York.
JUNE 13—Dispute between employers and members of Amalgamated Engineering Union in Great Britain settled.
JUNE 15—Bank rate in England reduced from 4% to 3½%.
JUNE 15—Two members of Mt. Everest expedition camp at 27,300 ft.
JUNE 15—Permanent Court of International Justice holds first (ordinary) session.
JUNE 15—Disastrous fire visits summer resort at Arverne, L.I. Over $2,000,000 damage.
JUNE 16—San Salvador partially destroyed by flood.
JUNE 16—Elections in Irish Free State show majority in favour of Treaty of Dec. 6 1921 with Great Britain.
JUNE 16—U.S. Railroad Labor Board orders reduction in pay of railway clerks and station employees amounting to $26,500,000 a year.
JUNE 16—Agreement signed at New York by bankers and Mexican Finance Minister as to Mexican external and railway debts.
JUNE 17—Fighting in Canton. Reunion of North and South China proclaimed.
JUNE 18—Two British officers murdered in Southern Kurdistan.
JUNE 20—U.S. House of Representatives passes measure providing independent citizenship for women marrying aliens.
JUNE 20—Prince of Wales arrives in England after his Far Eastern tour.
JUNE 21—Hague Conference on Russian problem opened.
JUNE 21—Shah of Persia opens first Mejliss since 1915.
JUNE 22—Resignation of C. G. Dawes, U.S. Director of the Budget. Succeeded by Brig.-Gen. Lord.
JUNE 24—Governor Small acquitted on charge of conspiracy to defraud State of Illinois.
JUNE 24—Dr. Rathenau, German Minister for Foreign Affairs, assassinated.
JUNE 28—British Labour Party Conference declines to reconsider British Communist Party's request for affiliation.
JUNE 30—Conference of Ambassadors recognises *de jure* independence of Lithuania.
JUNE 30—Rebel forces in Dublin surrender to Free State troops.
JULY 1—Strike of Railway Shopworkers throughout United States begins.
JULY 6—Army rebellion in Rio de Janeiro crushed by Brazilian Government.
JULY 7—Agreements completed between Mexican Finance Minister and American oil producers for exploitation of petroleum in Mexico.
JULY 8—Chile and Peru agree to arbitrate Tacna-Arica dispute.
JULY 13—Bank rate in England reduced from 3½% to 3%.
JULY 13—Conference held between Canada and United States regarding armaments on the Great Lakes.
JULY 13—Great Britain pays $12,000,000 to United States, settling claims for use of American ships during and after War.
JULY 14—Serious railway accident outside the Gare du Nord, Paris. Over fifty persons injured.
JULY 14—Cotton Schedule of Tariff Bill in United States defeated in Senate by Democrats.
JULY 17—Fight between strikers and police in West Virginia. Sheriff and 11 men killed.
JULY 17—Inter-Allied Commission in Upper Silesia comes to an end.
JULY 20—Council of League of Nations approves mandates for Togoland, Cameroons and Tanganyika.
JULY 20—President of Argentina arrives in London on official visit.
JULY 21—Protocol signed by Chile and Peru accepting arbitration of U.S. President Harding in Tacna-Arica dispute.
JULY 24—League of Nations passes mandates for Palestine and Syria.
JULY 26—Commission appointed in United States to direct distribution of coal during strike.
JULY 26—Dr. Paul S. Reinsch, former American Minister to China, appointed financial adviser to China.
JULY 28—United States recognises *de jure* independence of Latvia and Lithuania, Albania and Estonia.
JULY 30—Greek proclamation of autonomy in Anatolia.
AUG. 1—U.S. President proposes settlement of railway strike on basis of obedience to Labor Board's decisions.
AUG. 1—Britain, France and Italy notify Greece that she will not be permitted to occupy Constantinople.
AUG. 1—Balfour Note sent by Great Britain to Allied Governments respecting inter-Allied debts.
AUG. 2—Thousands of lives lost by typhoon and tidal wave in Swatow, China.
AUG. 4—Fascist and Socialist fights in Milan and other Italian cities.
AUG. 6—Italian provinces of Genoa, Milan, Parma, Ancona and Leghorn placed under martial law.
AUG. 8—Fascisti in Italy ordered by Signor Mussolini to demobilise.
AUG. 10—City of Cork, Ireland, captured from rebels.
AUG. 10—Agreement signed at Berlin between United States and Germany regarding American war claims.
AUG. 12—Death of Arthur Griffith, President of Irish Republic.
AUG. 13—Strikers on U.S. railways refuse to accept President's plan for settlement.
AUG. 15—End of strike in soft coalfields in United States.
AUG. 15—Dr. Millsbaugh (economic adviser to U.S. Department of State) made Administrator-General of the finances of Persia.
AUG. 20—Nicaragua, Honduras and Labrador renew 1907 treaty of peace with U.S.
AUG. 21—U.S. House of Representatives passes bill to set up commission to investigate coal industry.
AUG. 21—Snowfall in the Adirondack Mountains, N.Y.
AUG. 22—Michael Collins, Chairman of Irish Provisional Government, killed in ambush.
AUG. 24—Student named Hentzen from Hanover remains in air on glider for 3 hours 10 min.
AUG. 24—Eight Communists arrested in Chicago for carrying on revolutionary propaganda.
AUG. 24—Arab Congress at Nablus decides to reject British Mandate for Palestine.
AUG. 25—Turkish Nationalists begin offensive on Greek positions in Asia Minor.
AUG. 26—Military in France called out owing to serious strike of metal workers at Havre.
AUG. 29—Chilean steamer "Itata" founders near Coquimbo with loss of 316 lives.
AUG. 31—Treaty of Alliance between Czechoslovakia and Serb-Croat-Slovene Kingdom signed at Marienbad.
AUG. 31—Reparations Commission adopts Belgian proposal that Germany should pay instalments due until end of year with 6 months Treasury Bills.
SEPT. 2—Severe earthquake in Island of Formosa.
SEPT. 2—General retreat of Greek troops in Asia Minor.
SEPT. 2—End of anthracite coal strike in United States.
SEPT. 4—Certificate of master of S.S. "Egypt" suspended for six months and chief officer severely censured.
SEPT. 6—George Sutherland appointed to U.S. Supreme Court.
SEPT. 7—Celebrations in Brazil of its hundred years of independence from Portuguese rule.
SEPT. 7—U.S. Senate passes Coal Distribution and Price Control Bill.
SEPT. 8—Bolshevists execute Mgr. Benjamin, Metropolitan of Petrograd,
SEPT. 9—W. T. Cosgrave elected President of Irish Free State.
SEPT. 9—Smyrna taken by Turkish forces.
SEPT. 9—Commercial agreement signed at Berlin between Soviet and British representatives.
SEPT. 11—British Mandate proclaimed in Palestine. Arabs declare day of mourning.
SEPT. 14—Smyrna almost destroyed by fire.
SEPT. 16—Ford factories close in Detroit and other American cities owing to coal strike.
SEPT. 18—Hungary admitted as a member of the League of Nations.
SEPT. 21—U.S. President signs Fordney-McCumber Tariff Bill.
SEPT. 21—Total eclipse of the sun on a belt of the earth stretching from Somaliland across Indian Ocean and Australia.
SEPT. 23—Allied note sent to Angora Government and to Greece proposing military conference at Mudania.
SEPT. 24—Georges Carpentier knocked out by Battling Siki in boxing contest for the light heavy weight championship of the world at Paris.
SEPT. 26—Lord Rothermere becomes principal proprietor of *The Daily Mail*, London, and associated newspapers.
SEPT. 27—Fall of Greek Cabinet following revolt of naval and military forces. Abdication of King Constantine, in favour of his son, George.
SEPT. 29—Greece and Turkey accept Allied proposal for military conference.
SEPT. 30—Conscription introduced in Russia.
SEPT. 30—King Constantine leaves Greece.
OCT. 2—M. Krokidos becomes acting Prime Minister of Greece.
OCT. 3—Mrs. W. H. Felton appointed U.S. Senator for Georgia. First occasion upon which a woman has occupied such a position.
OCT. 4—League of Nations adopts scheme for financial reconstruction of Austria.
OCT. 5—Serious forest fires in North Ontario. Town of Haileybury destroyed.
OCT. 5—Order issued by President that no U.S. ship should carry any liquor, and that no foreign ships should bring liquor within 3-mile limit.
OCT. 6—Lieuts. Macready and Kelley (U.S.A.) break record for non-stop airplane flight (35 hours, 18 min., 30 sec.).
OCT. 6—Soviet Government refuses to ratify commercial agreement of Sept. 9.
OCT. 10—Coal Commission appointed in United States.
OCT. 11—Conference at Mudania between Allies and Turkey ends in agreement regarding neutral zones. Thrace to be evacuated by Greece within fifteen days.
OCT. 16—Payment by Great Britain to United States of $50,000,000 instalment of interest on War debt.
OCT. 16—Great Britain refuses consent to search by U.S. officials of British ships for liquor smugglers outside 3-mile limit.
OCT 18—John Hays Hammond elected Chairman of U.S. Coal Commission.
OCT. 19—Resignation of D. Lloyd George, British Prime Minister.
OCT. 23—A. Bonar Law becomes Prime Minister of Great Britain.
OCT. 23—Treaty of Santa Margherita signed at Rome between Italy and Serb-Croat-Slovene Kingdom.
OCT. 25—Viscount Cave appointed Lord Chancellor of Great Britain.
OCT. 25—Announcement made that John Walter and Major the Hon. J. J. Astor had acquired shares of the late Lord Northcliffe in the *Times*.
OCT. 26—Fascisti rising in Italy. Resignation of Cabinet on 27th.
OCT. 26—Vehicular tunnel beneath Hudson river between Jersey City and Manhattan, commenced.
OCT. 27—Rhodesian referendum results in majority for responsible government.
OCT. 28—Frontiers between Hungary and Czechoslovakia fixed by Boundary Commission.
OCT. 30—Fascist Ministry formed in Italy under Mussolini.
NOV. 1—Commission appointed to discuss American War Claims from Germany begins work.
NOV. 5—Ex-Kaiser William of Germany marries Princess Hermine von Reuss at Doorn.
NOV. 7—Elections to Congress in United States. Republican majority greatly reduced.
NOV. 7—Ex.-Gov. Al. Smith elected Governor of New York State.
NOV. 10—Severe earthquake in Chile, about 1,000 lives being lost.
NOV. 11—Rudyard Kipling elected Lord Rector of St. Andrews University, Scotland.
NOV. 13—U.S. Supreme Court decides that Japanese are not entitled to U.S. citizenship, since they are not of the white race.
NOV. 15—General elections held in England. Unionists obtain working majority.
NOV. 15—Great Britain pays 50,000,000 dollars to United States, second instalment of interest on War debt.
NOV. 16—British note sent to Greek government urging clemency towards ex-Ministers.
NOV. 17—Government of Far Eastern Republic of Siberia abolished. Assembly votes for union with Russia.
NOV. 17—Abdication of Mohamed VI., Sultan of Turkey.
NOV. 20—New British Parliament meets. J. H. Whitley re-elected as speaker.
NOV. 24—Execution in Ireland of Robert Erskine Childers.
NOV. 25—U.S. Ambassador Child at Near Eastern Peace Conference, Lausanne, demands open door in Turkey, protesting against secret agreements.
NOV. 28—Six Greek Ex-Ministers found guilty of treason and shot.
NOV. 30—British Post Offices in China closed in accordance with agreement reached at Washington Feb. 6 1922.
DEC. 1—Impeachment charges made in U.S. House of Representatives against Atty.-Gen. Daugherty.
DEC. 2—Prince Andrew of Greece deprived of military rank and banished for life.
DEC. 3—Proposal in Switzerland for a capital levy rejected by large majority on referendum.
DEC. 4—Timothy Healy becomes first Governor-General of Irish Free State.
DEC. 4—Central American Conference on Disarmament at Washington.
DEC. 4—First International Postal Conference opens at Ottawa between United States and Canada.
DEC. 6—Irish constitution formally ratified.
DEC. 7—First Parliament of Irish Free State meets and re-elects W. T. Cosgrave as President.
DEC. 7—Northern Ireland Parliament votes for non-inclusion in Irish Free State.
DEC. 7—General Election in New Zealand. Government majority reduced.
DEC. 10—Duke of Abercorn sworn in as Governor of Northern Ireland.
DEC. 10—Nobel Peace Prize for 1922 awarded to Dr. Fridtjof Nansen.
DEC. 15—British Parliament removes embargo on Canadian cattle.
DEC. 15—Trade agreement signed between Canada and France.
DEC. 16—General elections in Australia result in Nationalists securing 27 seats, Labour Party 29 and Country Party 14.
DEC. 16—M. Narutowicz, President of Poland, assassinated.
DEC. 17—Last detachment of British troops evacuate Irish Free State.
DEC. 21—Dearborn street Station, Chicago, destroyed by fire.
DEC. 22—Postal Convention concluded between United States and Canada at Washington.
DEC. 26—Council of American Assn. for the Advancement of Science, at Cambridge, Mass., affirm belief in organic evolution.
DEC. 31—New record for aerial speed established by Sadi Lecointe who attains average speed of 217 miles an hour.

1923

JAN. 1—Alfred E. Smith assumes office as Governor of New York State.
JAN. 1—French and Japanese Post Offices withdrawn from China.
JAN. 2—Resignation of Albert Bacon Fall, U.S. Secretary of Interior.
JAN. 8—Part of performance at Covent Garden of "The Magic Flute" broadcasted. (First broadcasting of opera in England.)
JAN. 8—First meeting of Anglo-American Debt Commission in New York City.
JAN. 9—Reparation Commission declares Germany in wilful default on 1922 coal deliveries.
JAN. 9—Judiciary Committee U.S. House report against impeachment of Atty.-Gen. Daugherty.
JAN. 10—U.S. President orders complete evacuation from Germany of U.S. Army.
JAN. 11—French occupation of the Ruhr begins. Essen occupied.
JAN. 15—Memel captured by Lithuanians.
JAN. 19—Germany refuses to permit further deliveries in kind to France.
JAN. 20—Arrest by French of 6 German industrial magnates in Ruhr district.
JAN. 23—U.S. troops withdrawn from Germany.
JAN. 25—U.S. House of Representatives exonerates Atty.-Gen. Daugherty from impeachment charges.
JAN. 25—Question of Mosul frontier referred to League Council by Great Britain.
JAN. 26—Reparation Commission refuses Germany's request for moratorium and declares her in general default regarding reparations.

JAN. 27—Coblentz area of Germany occupied by U.S. troops handed over to the French.
JAN. 27—Farm of Ellisland, near Dumfries, Scotland, where Robert Burns wrote some of his poems, presented to the nation by G. Williamson.
JAN. 28—Ruhr district completely encircled by French.
JAN. 29—M. Maneyrol, French aviator, remains in air for 8 hr. 3 min. on glider, at Vauville, near Jersey.
JAN. 30—Turkey and Greece sign Conventions for exchange of populations, and exchange of prisoners of war.
JAN. 30—N.Y. Court of Appeals holds that sinking of the "Lusitania" was an act of war.
JAN. 31—Terms of Commission for funding British debt to United States accepted by British Government.
JAN. 31—Draft Treaty communicated to Turks at Lausanne.
JAN. 31—Export of coal and coke from Ruhr to unoccupied districts of Germany prohibited by France.
JAN. 31—U.S. House of Representatives passes Federal Radio Control Bill.
FEB. 1—Allied ultimatum to Lithuania to evacuate Memel by Feb. 8.
Feb. 2—General Treaty of Peace and Amity signed at Washington by Central American republics. (See Dec. 4 1922.)
FEB.. 2—Stanley Bruce becomes Prime Minister of Australia.
FEB. 3—Lassen Peak, Cal., the only active volcano in U.S., in eruption for 12 hours.
FEB. 4—Near East Conference at Lausanne breaks down, owing to Turkish refusal to accept Draft Treaty.
FEB. 8—Coal mine explosion at Dawson, N.M.; 122 miners buried.
FEB. 9—U.S. House of Representatives passes British Debt Funding Bill.
FEB. 9—Irish Free State Government offers general amnesty to rebels who hand in arms at once.
FEB. 15—Germany sends note to French Government protesting measures taken by France in Ruhr.
FEB. 16—U.S. Senate passes British Debt Funding Bill.
FEB. 16—Memel assigned to Lithuania by Conference of Ambassadors, with certain conditions safeguarding interests of Poland.
FEB. 16—Sealed chamber of Tutankhamen's tomb at Luxor opened.
FEB. 19—Decisions by U.S. Supreme Court that Hindus are not entitled to citizenship.
FEB. 24—President Harding sends message to U.S. Senate urging adherence to protocol establishing International Court at The Hague.
FEB. 24—American Labor Party, in convention at N.Y. City, repudiates Soviets.
FEB. 28—President Harding signs British Debt Funding Bill.
MARCH 2—Canada signs independent Convention with United States for preservation of halibut fishery in North Pacific Ocean.
MARCH 2–3—Resignation of Charles B. Warren, U.S. Ambassador to Japan. Succeeded by Cyrus E. Woods.
MARCH 3—U.S. Senate rejects proposal to join International Court of Justice.
MARCH 6—Turkish National Assembly rejects Lausanne Peace Treaty.
MARCH 9—Counter-proposals sent to Allies by Angora Government.
MARCH 10—Chinese note to Japan declaring abrogation of Chino-Japanese Treaties of May 25 1915.
MARCH 11—Arrest and transportation to Ireland of over 100 Irish persons in England and Scotland at request of Free State Government.
MARCH 14—Ambassadors' Conference assigns E. Galicia and Vilna to Poland.
MARCH 14—Japanese reply to Chinese note of March 10 declaring China's attempt to abrogate valid treaties contrary to accepted principles of international intercourse.
MARCH 15—First payment of $4,128,075.74 to United States by Great Britain under terms of War Debt Agreement.
MARCH 21—Secretary Hughes states that U.S. will not recognise Soviet Republic unless it recognises its foreign debt and restores alien property.
MARCH 23—43 cases of sleeping sickness notified in England and Wales during week.
MARCH 24—University Boat Race won by Oxford by ¾ length, in 20 min. 54 sec.
MARCH 25—Fifth Pan-American Conference opens at Santiago, Chile.
MARCH 26—Death sentence imposed by Soviet authorities on Archbishop Ciepliak and Mgr. Butkevitch.
MARCH 30—Termination of American-Chinese Agreement of Nov. 2 1917.
MARCH 31—German workmen at Krupp's factory, Essen, fired on by French. 11 killed.
MARCH 31—Partial renewal of Mozambique Convention between Mozambique and Union of S. Africa. (See April 1 1922.)
APRIL 1—New customs duties in Irish Free State come into operation.
APRIL 1—Allied reply to Turkey (see March 9) published.
APRIL 3—Execution of Mgr. Butkevitch. Sentence on Archbishop Ciepliak commuted to ten years' imprisonment. (See March 26.)
APRIL 10–12—Capture of Miss MacSwiney, Count Plunkett, and other leading Irish rebels by Free State authorities.
APRIL 10—Turkish National Assembly ratifies Chester Concession granting certain railway, mining and oil rights to a U.S. syndicate. French protest on April 11.
APRIL 11—British Government defeated in House of Commons.
APRIL 11—Labour Demonstration in British House of Commons. Adjournment.
APRIL 13—Conference held between French and Belgian Ministers at which they decided to increase pressure on Germany in the Ruhr.
APRIL 13—Announced that photographs taken of sun and surrounding stars in eclipse of Sept. 21 1922 confirmed Einstein theory of relativity.
APRIL 15—American-Japanese Agreement of 1917 re China, cancelled. (Lansing-Ishii Agreement.)
APRIL 17—Two airmen at Dayton, Ohio, remain in air 36 hr., 5 min. 20 sec.; covering 2,541 m. over triangular course of 31⅛ m. and establishing world record.
APRIL 20—Irish Free State applies for membership of League of Nations.
APRIL 20—Prohibition Bill introduced by Mr. Scrymgeour, rejected in British House of Commons.
APRIL 25—Announcement of Henry P. Davison Scholarship Fund, establishing 6 scholarships for students from Oxford and Cambridge at Yale, Harvard and Princeton.
APRIL 26—Marriage of Duke of York and Lady Elizabeth Bowes-Lyon.
APRIL 27—De Valera issues proclamation in Ireland offering cessation of hostilities on certain terms.
APRIL 28—Wembley Stadium, London, used for first time in final round of Football Association Cup Competition. Enormous crowds cause disturbance.
APRIL 29—Convention signed at Angora putting into effect Chester concession. (See April 10.)
APRIL 30—Ruling by U.S. Supreme Court that neither American nor foreign ships should carry intoxicating liquor into U.S. territorial waters.
APRIL 30—Irish rebels suspend offensive operations.
MAY 2—Allied Governments receive new German offer regarding reparations. 30,000,000,000 gold marks suggested as reparation total.
MAY 3—Fifth Pan-American Conference closes (see March 25). Four conventions signed.
MAY 3—Mr. Baldwin announces British policy on 'Iraq in House of Commons.
MAY 6—French and Belgian reply issued rejecting German offer received on May 2.
MAY 6—Chinese bandits derail Shanghai-Peking express train at Lincheng and capture 150 passengers.
MAY 6—Georges Barbot crosses English Channel twice in motor glider, winning prize of 25,000 f. from *Le Matin*.
MAY 8—British Note to Soviet Government requesting cessation of anti-British propaganda, etc.
MAY 10—Assassination at Lausanne of M. Vorovsky, Soviet agent in Italy and delegate at Lausanne.
MAY 14—Soviet reply received to British note of May 8.
MAY 14—Opening of Mexican-American Conference at Mexico City.
MAY 16—Announcement that British Government has agreed to recognise independent Government in Transjordania subject to approval of League of Nations Council.
MAY 20—Resignation of Andrew Bonar Law, British Prime Minister.
MAY 22—Stanley Baldwin invited to form Ministry in Great Britain.
MAY 23—Communist disorders at Dortmund, Ruhr district.
MAY 23—Further Soviet Note to Great Britain yielding on certain points and requesting conference on other points at issue.
MAY 25—Agreement signed at Paris between Great Britain, France, Italy and Belgium with United States for reimbursement of costs of U.S. Army on Rhine.
MAY 26—Agreement reached at Lausanne between Greece and Turkey on reparation question.
MAY 28—Stanley Baldwin elected leader of British Conservative Party.
MAY 29—Palestine Constitution suspended by Order in Council, owing to refusal of Arabs to co-operate. Elections delcared null and void.
MAY 31—British Note to Moscow agreeing to conference subject to agreement of other Powers.
JUNE 1—Governor of New York signs Bill repealing New York States Prohibition Enforcement Act.
JUNE 1—Mrs. Hilton Philipson returned as Conservative M. P. for Berwick-on-Tweed, becoming 3rd woman member of British Parliament.
JUNE 4—Price of London *Times* and *Daily Telegraph* raised from 1½d to 2d.
JUNE 4—Cardinal Archbishop Soldevla of Saragossa shot dead by Syndicalists.
JUNE 6—Race for the Derby won by B. Irish's "Papyrus."
JUNE 8—Bill giving equality in divorce suits to women read third time in British House of Commons.
JUNE 8—Danish Riksdag ratifies trade agreement with Russia of April 23.
JUNE 9—Coup d'etat in Bulgaria. Stambulisky Government replaced by Coalition.
JUNE 11—Germany and S. C. S. Kingdom sign agreement for providing reparations in kind.
JUNE 13—Great Britain accepts Russian offers of a conciliatory nature and ends Russian controversy. (See May 8, etc.)
JUNE 15—Third session of Permanent Court of International Justice opened.
JUNE 15—M. Stambulisky killed in attempt to escape from captors.
JUNE 16—Submarine XI launched in Great Britain. Largest under water craft in world
JUNE 15–22—Eruption of Mount Etna. Many villages submerged.
JUNE 19—Anglo-American War Debt Agreement signed.
JUNE 23—Anglo-American agreement signed in Washington renewing for 5 years the arbitration treaty of April 4 1908.
JUNE 26—Germany and Estonia sign Commercial Treaty.
JUNE 26—British Labour Party at annual Conference rejects affiliation of Communist Party by majority of 2½ million (card vote).
JUNE 26—Tornado at Brooklyn, N.Y., does much damage to residences there and in Flatbush. 500 trees blown down in Prospect Park.
JUNE 27—Fire in Peking, destroying several buildings and a valuable library.
JUNE 29—Meeting of experts opened at British Foreign Office on Tangier question.
JULY 2—Dockers' strike begun in Hull, Grimsby, Cardiff and Bristol, spreads to London.
JULY 5—Bank rate in England raised from 3% to 4%.
JULY 6—Accidents to Auckland-Wellington express near Taumaranui, New Zealand. 14 killed.
JULY 7–9—French Chamber ratifies Washington Four-Power Pacific Treaty and Agreement for limitation of Naval Armaments.
JULY 10—U.S. Inter-State Commerce Commission orders investigation into all rates for transportation of anthracite in United States, and also into foreign anthracite trade.
JULY 13—Mining towns of Mace and Burke (Idaho) destroyed by forest fires. 1200 people homeless.
JULY 13—Bill prohibiting sale of intoxicating liquor to persons under 18 passes third reading in British House of Commons.
JULY 18—British Matrimonial Causes Bill (giving women equal divorce rights with men) receives Royal Assent.
JULY 20—Mexican raider, Villa, killed in ambush at Parral, Mexico.
JULY 20—British Government's draft note to Germany regarding German reparation proposal of June 7, sent to Allied Governments.
JULY 23—Captain F. L. Barnard makes record flight from Croyden, England, to Cologne, flying 325 miles in 2 hr., 25 min.
JULY 23—Poland signs Treaty of Friendship and Commercial Convention with Turkey at Lausanne.
JULY 23—Joint resolution by both Houses of U.S. Congress demanding recall of Governor-General Wood from Philippine Islands.
JULY 24—Treaty of Peace signed at Lausanne between Greece, Turkey and Allies.
JULY 28—Serious colliery disasters at Maltbym Yorkshire, and Kilsyth, Scotland. 35 deaths.
JULY 30—French and Belgian replies to British draft note of July 20 delivered.
AUG. 2—German bank rate raised to 30% from 18%.
AUG. 2—Death of Warren G. Harding, President of United States, at San Francisco.
AUG. 3—Calvin Coolidge sworn in as 30th President of United States.
AUG. 6—Turkish-American Treaties of amity and commerce signed at Lausanne.
AUG. 10–13—Serious strikes and riots in Germany, due to discrepancies between wages and prices.
AUG. 10—Note sent to Chinese Government signed by 16 governments demanding compensation for victims of Lincheng outrage. (See May 6.)
AUG. 11—British reply to French and Belgian notes of July 30. French Government informed that Ruhr occupation not authorised by Versailles Treaty.
AUG. 12—Argentine swimmer, Sebastian Tiraboschi, swims English Channel in 16 hr. 33 min. beating record of Captain M. Webb in 1875.
AUG. 12—Fire in Montreal causes $4,000,000 damages.
AUG. 13—Mustapha Kemel elected President of Turkey by Angora Assembly.
AUG. 15—American-Mexican Agreement signed by joint Commission at Mexico City.
AUG. 15—Tidal wave on northwest coast of Korea causes over 346 deaths and destroys 600 houses.
AUG. 15—Arrest of De Valera by troops of Irish Free State.
AUG. 17—Ratifications exchanged by all signatory Powers of Naval Disarmament and Pacific Treaties signed at Washington. End of Anglo-Japanese Alliance.
AUG. 17—Permanent Court of International Justice at The Hague gives decision in S.S. "Wimbledon" case (of 1921), establishing freedom of navigation in Kiel Canal.
AUG. 19–23—Sharp fighting in Morocco between Spanish and Rif forces.
AUG. 20—Launching of U.S. navy rigid dirigible, ZR1.
AUG. 20—End of London dock strike. (See July 2.)
AUG. 22—French reply to British Note of Aug. 11 received.
AUG. 23—Finnish athlete, Paavo Nurmi, beats world's running mile record at Stockholm, in 4 min. 10⅖ sec.
AUG. 23—Japan and United States renew treaty of arbitration of May 5 1908, for further 5 years.
AUG. 23—Treaty of Lausanne (of July 24) ratified by Angora Assembly.
AUG. 24—President Coolidge appoints Gov. Pinchot of Pennsylvania mediator in Coal Dispute. (See Aug. 29.)
AUG. 26—Belgian reply to British Note of Aug. 11 received.
AUG. 26—Greece ratifies Treaty of Lausanne of July 24.
AUG. 27—General elections in Irish Free State. Government obtains 63 seats, Republicans 44.
AUG. 28—Neville Chamberlain becomes Chancellor of the Exchequer in Great Britain.
AUG. 29—U.S. Army airplane, piloted by Capt. Lowell H. Smith and Lieut. John P. Richter makes new world record for sustained flight of 37 hrs. 15 min. 14 sec.
AUG. 29—Italian note to Greece regarding murder of Italian military men on Greek territory on Aug. 27.
AUG. 29—Gov. Pinchot suggests plan to avert Anthracite Coal Strike. (See Sept. 7.)
AUG. 31—United States formally recognises Republic of Mexico.
AUG. 31—Italian troops occupy Corfu.

AUG. 31–SEPT. 17—Strike of anthracite coal miners in United States.
SEPT. 1—News received at Vancouver of total loss of Canadian expedition to Wrangel Island, led by Alan Crawford.
SEPT. 1—Greece appeals to League of Nations in dispute with Italy.
SEPT. 1—Earthquake shocks in Japan completely destroy Yokohama and practically destroy Tokyo. Estimated loss of life nearly 200,000.
SEPT. 5—Prince of Wales leaves England to visit his ranch in Alberta, Canada.
SEPT. 7—Anthracite Coal miners accept Gov. Pinchot's plan, men getting 8-hour day, 10% wage increase, recognition of union and arbitration.
SEPT. 7–9—Greece and Italy accept Note presented to them by Ambassadors' Conference.
SEPT. 8—U.S. State Department signs agreement with Mexico. (See Aug. 15.)
SEPT. 9—Seven U.S. destroyers go ashore near Santa Barbara, Cal. All total losses. 25 deaths.
SEPT. 10—Irish Free State admitted to League of Nations.
SEPT. 12—Prince of Wales lands at Quebec.
SEPT. 13—Revolt of army in Spain.
SEPT. 13—Settlement of Greco-Italian dispute criticised by League Assembly.
SEPT. 14—King of Spain agrees to appointment of Military Directorate in place of Cabinet. General Primo de Rivera appointed President of Directorate on Sept. 15.
SEPT. 15—German bank rate raised to 90%.
SEPT. 17—Italian Military Governor established in Fiume.
SEPT. 17—Fire sweeps Berkeley, Cal., causing $10,000,000 damage.
SEPT. 19—W. T. Cosgrave re-elected President of Irish Free State.
SEPT. 21—Trials by jury abolished by Royal decree in Spain.
SEPT. 26—German Government withdraws ordinances regarding passive resistance in the Ruhr.
SEPT. 26—Greece pays £500,000 to Italy through Ambassadors' Conference.
SEPT. 27—Proclamation issued establishing martial law throughout Germany.
SEPT. 27—Italian troops withdrawn from Corfu. (See Aug. 31.)
SEPT. 28—Abyssinia admitted to League of Nations.
SEPT. 28—Schneider International Seaplane Race at Cowes, I. of W., won by U. S. Navy Seaplane piloted by Lieut. D. Rittenhouse.
SEPT. 29—Financial Committee of League of Nations authorised to formulate plan for financial reconstruction of Hungary.
OCT. 1—Opening of Johore Causeway (3,455 ft. long) connecting island of Singapore with mainland.
OCT. 1—Responsible Government inaugurated in Southern Rhodesia.
OCT. 1—Opening in London of Imperial Conference. Imperial Economic Conference opened on Oct. 2.
OCT. 2—Evacuation of Constantinople by Allied troops.
OCT. 5—Mr. Lloyd George arrives at New York City.
OCT. 9—Am. Federation of Labor Convention, Portland, Ore., votes against forming a labour party.
OCT. 11—German Mark reaches 19,000,000,000 to the pound sterling.
OCT. 11—Robbers hold up San Francisco express in Siskiyou Mountains, shoot 4 train hands, dynamite mail car and escape with large sum of money.
OCT. 13—Angora becomes new capital of Turkey.
OCT. 16—Floods in Oklahoma City destroy homes of 15,000 persons.
OCT. 18—U.S. and Brazil accord each other most-favoured-nation treatment in customs matters.
OCT. 20—American three-year-old colt "Zev" beats English Derby winner "Papyrus" in International Cup Race at Belmont Park Race Track, New York City.
OCT. 20—Return of Prince of Wales to England. (See Sept. 5.)
OCT. 23—Gov. Walton of Oklahoma suspended from office by State Senate, the lower House having presented a vote of impeachment against him.
OCT. 25—Lloyd George arrives at Washington.
OCT. 25—Foundation laid of Sukkur barrage scheme, India. (Largest in the world.)
OCT. 25—Nobel Prize for Medicine for 1923 awarded to Drs. F. G. Banting and J. R. MacLeod of Toronto, Ont. for discovery of insulin.
OCT. 27—Earl of Athlone appointed Governor-General of Union of South Africa.
OCT. 30—Republic proclaimed in Turkey. Mustapha Kemal, President.
OCT. 30—France, Belgium and Italy accept a British proposal for joint economic conference of experts on German reparations.
Oct. 30—Death of A. Bonar Law.
OCT. 31—U.S. Court of Enquiry, investigating wreck of destroyers on Sept. 9, reports disaster caused by faulty navigation.
Nov. 4—World's speed record broken by U.S. aviator Lieut. A. J. Williams, flying at average speed of 266·68 miles per hour.
Nov. 7—Lord Birkenhead installed as Lord Rector of Glasgow University.
Nov. 8—Monarchist coup in Munich. General Ludendorff proclaimed military dictator.
Nov. 9—United States refuses to take part in proposed economic conference if discussion is limited to Germany's present capacity to pay.
Nov. 9—Collapse of rising in Munich. Ludendorff arrested.
Nov. 12—Fourth (Extraordinary) Session of Permanent Court of International Justice opened.
Nov. 13—Nobel Prize for Physics for 1923 awarded to Dr. R. A. Millikan of Pasadena, Cal., who first isolated and measured the electron.
Nov. 14—Nobel Prize for Literature for 1923 awarded to W. B. Yeats.
Nov. 15—$110,000 is realised at sale in New York of 30 original MSS. and printed books of Joseph Conrad.
Nov. 16—New currency system inaugurated in Germany.
Nov. 16—British Parliament dissolved.
Nov. 19—J. C. Walton, Governor of Oklahoma, removed from office by State Senate sitting as an Impeachment Court.
Nov. 21—Dr. Frederick A. Cook, polar explorer, found guilty at Fort Worth, Tex., of fraud.
Nov. 23—Doors of shrine within tomb of Tutankhamen at Luxor, opened.
Nov. 30—Reparations Commission decides to appoint two Committees to consider financial state of Germany.
DEC. 2—Great dam at Lake Gleno, Northern Italy, gives way owing to floods. Two Alpine valleys of Scalve and Camonica flooded. Several hundred deaths.
DEC. 6—Revolt against Obregon Government breaks out in Mexico.
DEC. 6—General election in Great Britain. Mr. Baldwin's protective tariff policy defeated. 8 women elected.
DEC. 8—United States signs treaty of friendship, commerce, and consular rights with Germany, to replace pre-War treaty.
DEC. 11—U.S. Senate confirms appointment of Frank Kellogg as Ambassador to Great Britain.
DEC. 14—President Obregon of Mexico begins attack on Guadalajara.
DEC. 15—Mexican Federal troops evacuate Puebla.
DEC. 15—President Coolidge pardons all persons remaining in prison convicted under Espionage Act.
DEC. 16—General Elections in Greece. Great majority to Veniselists and Republicans.
DEC. 16–18—U.S. President refuses a Russian Soviet proposal for negotiations leading to recognition.
DEC. 17—King George II. of Greece deposed by Army.
DEC. 18—Great Britain, France and Spain sign Convention at Paris re Tangier Zone.
DEC. 19—Secretary Hughes publishes alleged directions of Communist International for raising red flag over White House in near future.
DEC. 20—Admiral Koundouriotis sworn in as Regent of Greece.
DEC. 21—New York *Evening Post* bought by Cyrus H. K. Curtis.
DEC. 22—Puebla recaptured by Mexican Federal troops.
DEC. 22—Special Service Squadron of British Fleet arrives at Cape Town.
DEC 26—Reparation Commission nominates 15 delegates representing Great Britain, United States, France, Italy and Belgium, on two committees of experts. (See Nov. 30.)
DEC. 29—Sir Esme Howard appointed British Ambassador at Washington.
DEC. 29—Price of coal in London raised by 1/- a ton.
DEC. 29—United States agrees to sell army rifles, munitions and airplanes to Obregon Government in Mexico.

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JAN. 3—Howard Carter opens doors of 3 remaining shrines in tomb of Tutankhamen and discovers sarcophagus.
JAN. 4—M. Veniselos arrives at Athens.
JAN. 7—Direct communication by trans-Atlantic cable and land wire opened by Western Union Telegraph Company between London and Chicago.
JAN. 8—J. H. Whitley re-elected Speaker of British House of Commons.
JAN. 9—German Separatist leader, Heintz, shot dead in hotel at Speyer Palatinate.
JAN. 10—Submarine L24 rammed in manoeuvres off Portland, England, with loss of all hands.
JAN. 11—Veniselos accepts Premiership of Greek National Assembly.
JAN. 14—Reparation Commission's Expert Committee No. 1 holds first meeting in Paris; General C. G. Dawes (U.S.) president.
JAN. 16—Great Britain recognises new Greek Government.
JAN. 21—Reparation Commission's Expert Committee No. 2 holds first meeting in Paris.
JAN. 21—Death of Nikolai Lenin, Dictator of Soviet Russia.
JAN. 21—Ratifications exchanged of Anglo-French agreement re boundaries of Sudan and French Equatorial Africa.
JAN. 22—Resignation of Baldwin Ministry in England, Ramsay MacDonald forms first Labour Ministry.
JAN. 23 — Anglo - American Liquor Treaty signed.
JAN. 25—Treaty between France and Czechoslovakia signed in Paris.
JAN. 27—Adriatic Treaty signed between Italy and S. C. S. Kingdom at Rome.
JAN. 29—United States resumes diplomatic relations with Greece (broken off 1920).
JAN. 31—U.S. Senate urge action to cancel Doheny and Sinclair Oil Land leases in Wyo. and Cal.
FEB. 1—Great Britain recognises Soviet Russia *de jure* and proposes London Conference.
FEB. 3—Death of Woodrow Wilson, President of United States 1912–20.
FEB. 3—M. Rykoff elected President of Council of Peoples' Commissars, Russia.
FEB. 4—Bombay Government releases Gandhi, Indian Nationalist leader, for reasons of health.
FEB. 4—Veniselos resigns Greek premiership owing to ill-health.
FEB. 7—Italy accords *de jure* recognition to Soviet Russia.
FEB. 11—Mr. Baldwin confirmed as leader of Unionist Party.
FEB. 11—U.S. Senate calls on President Coolidge to demand resignation of Secy. of Navy Denby on account of his connection with oil leases.
FEB. 16–26—Dockers strike in England. 120,000 men affected.
FEB. 16—J. P. Morgan announces his gift of his father's library for the use of the public.
FEB. 18—Edwin Denby, U. S. Secretary of Navy, resigns.
FEB. 21—Charles Beecher Warren nominated U.S. Ambassador to Mexico.
FEB. 21—Austria recognises Soviet government.
FEB. 23—William Phillips appointed U.S. Ambassador to Belgium.
MARCH 3—Germany and Turkey sign Treaty of peace and friendship at Angora.
MARCH 3—Caliph Abdul Majid deposed by Turkish National Assembly. Mustapha Kemal President of Turkish Republic.
MARCH 6—Official opening by Egyptian Government of Tutankhamen tomb.
MARCH 7—Hussein, King of the Hejaz, accepts offer of Turkish Caliphate.
MARCH 13—U.S. Senate ratifies Liquor Treaty with Gt. Britain.
MARCH 24—Curtis Dwight Wilbur, Chief Justice of California, appointed U.S. Secretary of the Navy.
MARCH 15—Sweden recognises Soviet Russia *de jure*.
MARCH 16—King Victor Emmanuel of Italy formally enters Fiume for purpose of annexing city to Italy.
MARCH 16—Ogden Mills Reid announces purchase of *New York Herald* by *New York Tribune*.
MARCH 17—Members of U.S. Army Air Service under Major Frederick L. Martin commence world flight, from Santa Monica, California.
MARCH 18—British Government decides to abandon Singapore naval base scheme.
MARCH 24—Pope Pius XI. confers rank of Cardinal on Archbishops P. J. Hayes of New York, and G. W. Mundelein, of Chicago.
MARCH 25—Members of British A. S. under Squadron-Leader A. S. MacLaren begin British world-flight from Calshot, near Southampton.
MARCH 25—King George of Greece deposed and Republic proclaimed, subject to plebiscite to be held April 13.
MARCH 26—Mount Everest Expedition starts from Darjeeling.
MARCH 28—U.S. Attorney-General Harry Daugherty resigns at President Coolidge's request.
APRIL 1—General Ludendorff acquitted of high treason charge arising out of Nationalist revolt at Munich, Nov. 1923.
APRIL 5—Oxford and Cambridge University Boat-Race won by Cambridge by 4½ lengths in 18 min., 41 sec. (Time only once beaten.) (See April 1 1911.)
APRIL 9—Reports of two Expert Committees on Reparations (Dawes and McKenna Reports) issued.
APRIL 9—Harlan F. Stone sworn in as U.S. Attorney-General.
APRIL 10—Death of Hugo Stinnes, German industrial magnate.
APRIL 10—A. J. Cook elected Secretary of Miners' Federation in Great Britain.
APRIL 11—U.S. House of Representatives adopts new Immigration Restriction Bill.
APRIL 12—H.M.A.S. "Australia" scuttled off Sydney Heads, New South Wales, in accordance with terms of Washington Treaty.
APRIL 13—Greek Plebiscite results in favour of a Republic.
APRIL 14—Anglo-Soviet Conference in London opens.
APRIL 17—Reparation Commission votes approval of Dawes plan.
APRIL 17—Centenary of Byron's death celebrated in England and at Missolonghi, Greece.
APRIL 18—U.S. Senate passes Immigration Restriction Bill.
APRIL 23—Anglo-Spanish Trade Treaty (of Oct. 31 1922) ratified.
APRIL 23—King George V and Queen Mary open British Empire Exhibition, Wembley.
APRIL 23—Great Britain formally recognises Greek republic.
APRIL 24—Abortive Irish boundary conference in London.
APRIL 24–MAY 1—Court of Inquiry into miners' wages in Great Britain holds session.
APRIL 29—First general election held in Southern Rhodesia under self-government.
MAY 1—Alan Cobham returns to London having left on Feb. 25 and made tour of 12,000 miles through Europe, Egypt, Palestine, N. Africa and Spain, winning Britannia Trophy.
MAY 4—General election in Germany.
MAY 4—Serious disturbances at Kirkuk, north of Baghdad between members of levy force and townspeople. Over 100 killed.
MAY 5—Rebel factions in Honduras sign peace treaty with Central American nations.
MAY 8—Convention assigning Memel to Lithuania signed by Great Britain, France, Italy, Japan and Lithuania.
MAY 9—Report of Court of Inquiry into miners' wages in Great Britain issued.
MAY 15–30—International conference on immigration at Rome.
MAY 19—Pan-American Treaty signed, to avoid or prevent conflicts between the American States.
MAY 22—Exchange of ratifications of Anglo-American liquor traffic bill.
MAY 26—President Coolidge signs U.S. Immigration Restriction Bill.
MAY 26—Resignation of Marx ministry in Germany, following breakdown of negotiations for forming joint Cabinet between Nationalist and Middle Parties.
MAY 28—Italy and Czechoslovakia sign Treaty of Alliance.
MAY 28–31—Japan protests against U.S. Immigration Restriction Bill.
MAY 29—British coal miners accept provisional agreement on wages, minimum wage to be 33⅓% above standard.

MAY 31—Russo-Chinese Agreement signed. China recognises Russia.
JUNE 3—Ministerial crisis in Germany. Marx forms new cabinet on June 4.
JUNE 4—The Derby won by Lord Derby's "Sansovino"; first time in 137 years that holder of Derby title wins race founded by his family.
JUNE 5—Mr. Justice Feetham of South-African Supreme Court appointed Chairman of Irish Boundary Commission.
JUNE 5—U.S. Senate Committee on Naval Oil Leases exonerate late Sec. of Navy Denby and Asst. Sec. Roosevelt of collusion in fraud.
JUNE 6—Treaty signed at Washington by U.S. and Canada for suppression of liquor and drug smuggling.
JUNE 9—Lieutenant P. D'Oisy arrives at Tokyo, completing his 12,000 mile flight from France.
JUNE 10—Italian Socialist deputy, Matteotti, abducted in streets of Rome. His dead body found on 13th.
JUNE 10—Republican National Convention opened at Cleveland, O. President Coolidge nominated for President and C. G. Dawes for Vice President June 12.
JUNE 11—M. Millerand resigns French presidency. M. Doumergue elected on 13th.
JUNE 11—Baghdad Assembly accepts Anglo-'Iraq Treaty.
JUNE 12—Explosion on U.S. battleship "Mississippi" during target practice off Californian coast. 48 killed.
JUNE 13–14—Formation of Herriot ministry in France.
JUNE 18—British Government severs diplomatic relations with Mexico owing to treatment of British Agent, H. A. C. Cummins.
JUNE 19—News received in England of deaths of G. L. Mallory and A. C. Irvine, Mount Everest Expedition, in attempt to climb mountain.
JUNE 23—Lieutenant R. L. Maughan, U.S. Army Air Service, flies across American continent, New York, to San Francisco (2,570 miles) in 21 hours, 44 minutes.
JUNE 23—Zaghlul Pasha announces that Egypt will insist on complete British evacuation of Sudan.
JUNE 23—Resignation of Smuts ministry in South Africa following general election on June 17. Formation of Hertzog ministry.
JUNE 24—Democratic National Convention opened at N.Y. City. J. W. Davis nominated for President on 103rd ballot, July 9, and Charles W. Bryan for Vice President.
JUNE 25—Lord Parmoor announces that British Government does not intend to abandon Sudan. Zaghlul Pasha offers resignation on 26th. Refused by King Fuad.
JUNE 28—Hurricane on southern shore of Lake Erie; over 300 lives lost.
JUNE 30—France and United States sign ship-liquor treaty.
JUNE 30—Albert B. Fall, former U.S. Secretary of Interior, Harry F. Sinclair and E. L. Doheny indicted for bribery and conspiracy in U.S. naval oil reserve transactions.
JULY 1—Committee of Imperial Defence (Great Britain) decides against Channel Tunnel scheme.
JULY 1—U. S. Immigration Restriction law becomes effective.
JULY 4—U.S. Senator R. M. LaFollette of Wis. will run for U.S. Presidency as an independent.
JULY 5—Ramsay MacDonald refuses to sign Treaty of Mutual Assistance prepared by League of Nations.
JULY 5—Conference for Progressive Political action at Cleveland, O., indorses Senator La Follette's candidature. (See July 4.)
JULY 5—Olympic Games open at Colombes Stadium, Paris, in presence of President of French Republic and Prince of Wales.
JULY 6—General Plutarco Calles elected President of Mexico.
JULY 8—Press Law becomes effective in Italy by Order in Council.
JULY 11–15—Rioting between Hindus and Moslems at Delhi; British troops summoned to quell disorder.
JULY 11—E. H. Liddell (Great Britain) wins final heat of 400 metres in Olympic Games in 47⅘ seconds, creating new world's record.
JULY 12—Attempted assassination of Zaghlul Pasha, Egyptian Premier.
JULY 15—Treaty between Italy and Great Britain re East African Boundaries signed.
JULY 16—E. de Valera released from prison by Irish Free State Government. (See Aug. 15 1923.)
JULY 16—U.S. Army airmen, on world-flight, reach London Terminal Aerodrome, Croydon. (See March 17.)
JULY 17—French airmen, Coupet and Drouhin, create new world's duration record, remaining in air 37 hours, 59 min., 10 sec.
JULY 18—Death of Major R. W. Imbrie, U.S. Consul in Teheran, Persia, as result of attack by fanatical mob.
JULY 21—Norwegian Storthing ratifies Spitzbergen Treaty.
JULY 21—U.S. Secretary of State Hughes addresses convention of British and Canadian Bars in Westminster Hall, London.
JULY 22—Revival of Bayreuth Musical Festival after 10 years' interval.
JULY 27—Olympic Games conclude at Colombes Stadium; United States secures first place in aggregate, winning in all more than twice the number of points of any other country.
JULY 31—Persia accedes in full to American demands regarding death of Major Imbrie. (See July 18.)
AUG. 2—Mrs. Rosalie Evans, British subject, murdered by Mexican agrarians near Texmelucan, Puebla.
AUG. 4—Major A. S. MacLaren, on British world-flight, forced to abandon flight at Nikolski, Komandorski Islands, Siberia, owing to damaged machine.
AUG. 6—Boundary Commission Bill to legalise sitting of Irish Boundary Commission without Ulster representative introduced in British House of Commons.
AUG. 6—Lausanne Treaty of July 1923 and Greece Minorities Treaty become effective.
AUG. 8—Treaties between British and Soviet Governments signed, after protests in both Houses of Parliament. (See Nov. 21.)
AUG. 10–11—Insubordinate soldiers of Egyptian Railway Battalion fired on by Egyptian Mounted Infantry at Port Sudan and Atbara, Sudan. Four killed.
AUG. 13—Great floods in provinces of Chihli, Honan, Hunan and Kwantung, China. Known deaths: 13,115.
AUG. 16—Close of Inter-Allied Conference in London on German Reparations. Final protocol and four agreements initialled.
AUG. 16—French and German delegates at London Conference agree on evacuation of Ruhr, to be completed within a year.
AUG. 18—French troops begin evacuation of Ruhr.
AUG. 23—Prince of Wales leaves Southampton in S.S. "Berengaria" on visit to U.S. and Canada.
AUG. 26–27—French Chamber and Senate ratify Lausanne Treaty.
AUG. 29—Prince of Wales arrives at New York.
AUG. 30 — Agreements effectuating Dawes report, accepted by German Reichstag on August 29, signed at London.
AUG. 30—Owen D. Young takes up duties as Agent-General of Reparation Payments.
SEPT. 1–OCT. 2—5th Assembly of League of Nations held at Geneva. M. Motta (Swiss) elected President. Geneva Protocol prepared.
SEPT. 9—American, British, Japanese and Italian marines are landed at Shanghai. Shanghai volunteers mobilised.
SEPT. 10—U.S. Marines landed at Ceuba, Honduras, to protect U.S. Consulate.
SEPT. 13–15—Anglo-American international polo match. U.S. team wins first match by 16 goals to 5, and second match by 14 goals to 5, retaining cup.
SEPT. 17—Italy abrogates Treaty of Rapallo (between Italy and S.-C.-S. Kingdom) of Nov. 12 1920.
SEPT. 20—Great Britain brings Mosul Controversy before League of Nations. Turkey demands a plebiscite.
SEPT. 25–OCT. 3—Zaghlul Pasha, Prime Minister of Egypt, holds discussions in London with Ramsay MacDonald.
SEPT. 28—First air flight round world officially ends at Seattle, Washington. Two U. S. Army aeroplanes complete journey flying 27,000 miles since March 17.
SEPT. 29—Dedication of monument of Balboa at Panama as memorial of 400th anniversary of discovery of Pacific Ocean.
SEPT. 29—German Note presented to 10 Powers on League Council stating conditions on which she will join League of Nations, a permanent seat on Council being one.
SEPT. 29—San Domingo admitted to League of Nations.
OCT. 3—Prince of Wales arrives at Vancouver, British Columbia.
OCT. 3—King Husein abdicates throne of the Hejaz in favour of eldest son, (Ali).
OCT. 8—British reply to German note of Sept. 29, welcoming Germany's application for membership of League on condition she adheres to conditions of Versailles Treaty, etc.
OCT. 8—Japan and Mexico sign a treaty of peace, commerce and navigation.
OCT. 8—British Labour Govt. defeated in House of Commons by 364 votes to 198 on question of prosecution of editor of *Workers' Weekly*. Parliament dissolved Oct. 9th.
OCT. 9—Irish Free State (Confirmation of Agreement) Bill receives Royal assent in Great Britain.
OCT. 10—International bankers sign contract in London for loan of 800,000,000 gold marks to Germany.
OCT. 10—M. Callizo, French airman, reaches altitude of 39,587 ft. creating world record.
OCT. 15–17—Prince of Wales visits Toronto and Ottawa.
OCT. 15—Troops of Wahabi Sultan of Njed enter Mecca.
OCT. 15—German airship Z3, delivered to United States as part of Germany's reparation payment, lands at Lakehurst, New Jersey, having left Friedrichshafen on Oct. 12 —journey occupying 81 hours.
OCT. 17—Irish Free State (Confirmation of Agreement) Bill passes Dail Eireann.
OCT. 21—Ratifications exchanged at Washington of the U.S.-Canada Halibut Treaty.
OCT. 23—Troops of General Feng-Yu-hsuang enter Peking.
OCT. 24—Publication by British Foreign Office of Zinovieff letter containing revolutionary propaganda and of British Foreign Office's protest to Russia.
OCT. 24—J. R. Fisher appointed by British Government representative of Northern Ireland on Boundary Commission. Ulster declares herself in no way responsible for any engagements entered into by him.
OCT. 25—Resignation of Tsao Kun, President of China.
OCT. 28—France recognises Soviet Russia *de jure*.
OCT. 29—British Labour Government defeated in general election; Conservatives obtain large majority.
OCT. 29—Peter Veregin, Doukhobor leader, killed in explosion on C. P. R. train near Nelson, B.C.
OCT. 29—Great Britain and Turkey accept provisional boundary line of 'Iraq adopted by League Council.
NOV. 1—E. de Valera sentenced to one month imprisonment at Belfast for entering Northern Ireland after prohibition order.
NOV. 1—British Empire Exhibition at Wembley closes.
NOV. 4—Resignation of MacDonald ministry in England.
NOV. 4—Calvin Coolidge elected President of United States, and Charles G. Dawes Vice-President. Gov. Smith re-elected Governor of N.Y. and Mrs. (Ma) Ferguson elected Governor of Texas.
NOV. 6—Formation of Baldwin ministry in England.
NOV. 8—Viscount Cecil of Chelwood elected Lord Rector of Aberdeen University.
NOV. 9—Death of Senator Henry Cabot Lodge, American politician.
NOV. 13—Nobel Prize for Literature for 1924 awarded to Wladislaw Stanislaw Reymont.
NOV. 14—U.S. and Poland sign agreement refunding Polish debt to the United States.
NOV. 15—Treaty of Alliance with Greece of May 19 1913 denounced by S.-C.-S. Kingdom.
NOV. 15—Spanish troops withdrawn from Wad-Lau River region in Morocco.
NOV. 16—Two Mexicans, Francisco Ruis and Aldjo Garcia, sentenced to death for murder of Mrs. Rosalie Evans. (See Aug. 2.)
NOV. 20—Sir Sefton Brancker leaves London on aeroplane piloted by Alan Cobham, to survey airship route to India.
NOV. 20—Death of Sir Lee Stack, Sirdar of Egyptian Army and Governor-General of the Sudan, from wounds inflicted by assassins in Cairo on Nov. 19.
NOV. 21—Great Britain informs Russian Soviet government that it will not proceed with Treaties negotiated by British Labour Government.
NOV. 22—British Government presents ultimatum to Egypt regarding murder of Sir Lee Stack.
NOV. 22—Royal Commission on Food Prices set up in England. Sir Auckland Geddes, chairman.
NOV. 24—Egyptian Government fails to comply with all British demands regarding murder of Sir Lee Stack, causing resignation of Zaghlul ministry. Formation of Ziwar ministry.
NOV. 25—Political control of states in Kathiawar, Cutch and Palanpur formally transferred from Bombay Govt. to Govt. of India.
NOV. 27–29—Arrest of several leading Egyptians by British authorities. Handed over to Egyptian authorities. Mutiny at 'Khartum of Sudanese native troops.
NOV. 28—Senators La Follette, Ladd, Brookhart and Frazier read out of the Republican Party.
NOV. 28—E. de Valera released from Belfast gaol.
NOV. 30—Ahmed Ziwar Pasha, Egyptian Premier, accepts remaining British terms.
NOV. 30—Successful experiments completed by Radio Corporation of America for transmission of photographs by wireless telegraphy from London to New York.
DEC. 1—West Indian "All Red" cable service linking Jamaica, Barbados, Trinidad and British Guiana, opened.
DEC. 2—Anglo-German Commercial Agreement signed.
DEC. 2—J. H. Whitley re-elected Speaker of British House of Commons.
DEC. 3—First public trial of "rotor" system of wind-power drive for seagoing vessels takes place in Kiel Bight.
DEC. 4—First annual award of Woodrow Wilson Peace Prize ($25,000) made to Lord Cecil of Chelwood.
DEC. 9—Provisional Government in China recognised *de facto* by United States, Great Britain, France, Belgium, Italy, Japan and Netherlands.
DEC. 12—German note to League of Nations regarding her entry into the League.
DEC. 13—Death of Samuel Gompers, President of the American Federation of Labour.
DEC. 16—French Chamber grants amnesty to ex-Premier Caillaux and to Louis Malvy, former Minister of Interior, convicted in 1918 of impeding prosecution of war and of communication with enemy respectively.
DEC. 19—Treaty of Oct. 10 1922 between Great Britain and 'Iraq comes into force.
DEC. 24—Republic declared in Albania.
DEC. 24—Pope Pius XI inaugurates "Holy Year" with usual ceremonial of opening Holy Door into St. Peters, Rome.
DEC. 27—Ambassador's Conference decides evacuation of Cologne bridgehead on Jan. 10 1925 to be impossible.

1925

JAN. 1—Costa Rica retires from League of Nations as of Jan. 1 1927.
JAN. 1—Christiania, Norway, resumes name of Oslo.
JAN. 2—Rioting in Italy between Fascisti and Communists.
JAN. 3—New Zealand Rugby Football Team (all Blacks) beats England in International match at Twickenham by 17 points to 11.
JAN. 5—Mrs. Nellie T. Ross becomes Governor of Wyoming. First woman governor in United States.
JAN. 6—Allied note to Germany declares intention not to evacuate Cologne area on Jan. 10.
JAN. 7—German reply to Allied note of Jan. 6 protests against prolongation of occupation of Cologne area beyond time specified in Treaty.
JAN. 10—Resignation of C. E. Hughes, U.S. Secretary of State. Succeeded by F. B. Kellogg.
JAN. 10—U.S. right to receive German payments under the Dawes plan recognised.
JAN. 10—Charles B. Warren nominated U.S. Attorney-General.
JAN. 12—Union of South Africa decides for return to gold basis on June 30.
JAN. 13—A. B. Houghton appointed U.S. Ambassador to London, succeeding F. B. Kellogg.

JAN. 14—Delegates to Allied Financial Conference at Paris sign Agreement for division of reparation receipts from Germany.
JAN. 15—Dr. Luther succeeds Herr Marx as German Chancellor, and forms Cabinet with Herr Stresemann as Foreign Minister.
JAN. 16—Russian Central Committee of Control of Communist Party dismisses Trotsky from chairmanship of Revolutionary Military Council.
JAN. 19—U.S. officially states that Paris Financial Agreement (see Jan. 14) does not surrender or modify any U.S. treaty right.
JAN. 21—U.S. Senate accepts amendment to Naval Bill requesting President to call another armaments conference.
JAN. 23—Australia wins third cricket Test Match and rubber against England at Adelaide, by 11 runs.
JAN. 25—Re-opening of Tomb of Tutankhamen at Luxor.
JAN. 26—Alan Cobham makes successful reconnaissance flight in a D. H. 50 biplane over Himalayas, reaching altitude of 17,000 ft.
JAN. 26—Note from Allies to Germany regarding non-evacuation of Cologne area. German reply on 27th.
JAN. 29—At Liberal Party Convention in London Lloyd George accepts leadership of Lord Oxford.
FEB. 3—University of Pennsylvania Expedition at Ur of the Chaldees unearths Babylonian Museum of 600 B.C., believed to contain objects dating back to 2500 B.C.
FEB. 5—U.S. Senate confirms appointment of Atty.-Gen. Stone to Supreme Court Bench.
FEB. 6—Resignation of U.S. delegates from International Opium Conference, owing to refusal of producing countries to agree to control of production and distribution.
FEB. 7—Chinese delegation withdraws from Opium Conference.
FEB. 10—Poland and the Vatican sign concordat in Rome.
FEB. 10—U.S. Senate ratifies, with reservations, commercial treaty with Germany.
FEB. 11—Explosion in Minister Stein coal-mine near Dortmund, Ruhr district. Over 100 miners killed.
FEB. 11—International Convention signed providing for cessation of opium smoking in Far East fifteen years after China curbs overproduction.
FEB. 21—$300,000 paid by China to foreign governments as compensation for outrages on May 6 1923.
FEB. 27—Ratifications exchanged of treaty between Japan and Russia.
MARCH 4—Calvin Coolidge inaugurated as President of United States, and Charles G. Dawes as Vice-President.
MARCH 5—Labour Opposition in British House of Commons leaves House owing to suspension of David Kirkwood.
MARCH 9—Harvard-Boston archeological expedition in Egypt opens tomb in Giza pyramid of period 3,000 B.C.
MARCH 9—Publication of U.S. President's award in Tacna-Arica dispute between Chile and Peru. Plebiscite ordered to determine permanent sovereignty of provinces.
MARCH 10—U.S. Senate rejects nomination of Charles B. Warren as Attorney-General, first time since 1868 that a Cabinet appointment has not been confirmed.
MARCH 12—Great Britain refuses to sign Geneva protocol.
MARCH 12—U.S. President re-nominates Charles B. Warren as Attorney-General in spite of his rejection by Senate. (See March 10.) Renomination rejected by Senate on March 16.
MARCH 13—U.S. Senate ratifies Treaty with Cuba ceding to latter all claims to the Isle of Pines in Caribbean Sea.
MARCH 14—League of Nations Council refers question of its competence to intervene in expulsion of Greek Patriarch to Permanent Court of International Justice.
MARCH 14—League of Nations Council replies to German note of Dec. 12 1924, regarding her entry into League.
MARCH 15—Government of 'Iraq signs agreement with Turkish Petroleum Co. for exploitation of petroleum in 'Iraq (excluding Basra Vilayet) for 75 years.
MARCH 17—U.S. Senate confirms appointment of John G. Sargent as Attorney-General.
MARCH 17—U.S. President nominates Dr. J. G. Schurman as Ambassador to Germany.
MARCH 18—Great fire in Tokyo. 20,000 people homeless.
MARCH 18—Tornado sweeps over Missouri, S. Illinois and Indiana. 645 killed; 1,945 injured.
MARCH 18—Chicago, Milwaukee and St. Paul Ry. goes into receiver's hands.
MARCH 23—British House of Commons approves Singapore Base in Debate on Navy estimates.
MARCH 23—Governor of Tennessee signs Act forbidding teaching of evolution in state supported schools of Tennessee.
MARCH 23—General J. J. Pershing appointed head of Tacna-Arica Plebiscite Commission.
MARCH 24—Sinclair Oil Concession on Saghalien Island declared void by Soviet Court at Moscow.
MARCH 28—Prince of Wales leaves Portsmouth for South Africa.
MARCH 29—Japanese Diet passes suffrage bill increasing electorate from 3,000,000 to 14,000,000.
APRIL 1—Lord Balfour inaugurates a Hebrew University on Mount Scopus, Jerusalem.
APRIL 3—Holland and Belgium sign new Convention regarding navigation on the Schelde.
APRIL 4—Germany and Belgium sign trade agreement regarding Belgian Congo.
APRIL 7—Launching of U.S. airplane carrier "Saratoga," largest vessel of its kind in the world.
APRIL 8—Ratifications exchanged of treaty between Great Britain and Nepal signed on Dec. 31 1923.
APRIL 9—President Coolidge refuses to re-open the Tacna-Arica arbitration.
APRIL 10—Resignation of Herriot Ministry in France owing to defeat on financial policy.
APRIL 13—Henry Ford starts first airplane commercial line—Detroit and Chicago.
APRIL 15—Governor of Northern Ireland opens new Ulster Parliament.
APRIL 15—Discovery at Ur of the Chaldees of stone slab containing record of building of the Ziggurat by King Ur-Engur of Babylonia, about 2,300 B.C. announced.
APRIL 15—Miss Lucile Atcherson appointed 3rd Secretary of U.S. Legation in Switzerland, first woman in U.S. diplomatic service.
APRIL 16—Explosion of bomb in Sofia Cathedral during funeral of General Gheorghiev. 123 killed.
APRIL 17—Painlevé Cabinet formed in France. M. Caillaux Finance Minister.
APRIL 22—U.S. and Canada agree as to joint action for improvement of St. Lawrence river above Montreal.
APRIL 26—Field-Marshal von Hindenburg elected President of Germany.
APRIL 28—Holland adopts gold standard.
APRIL 28—William S. Culbertson appointed U.S. Minister to Rumania.
APRIL 29—Frank Hodges appointed permanent secretary of International Miners' Federation.
APRIL 30—Prince of Wales lands at Cape Town.
MAY 1—Cyprus declared a Crown colony.
MAY 2—Nicholas Murray Butler succeeds Elihu Root as head of Carnegie Endowment for International Peace.
MAY 4—International Conference on Traffic in Arms meets at Geneva, 43 nations represented.
MAY 8—Completion of Makwar Dam on Blue Nile Sudan.
MAY 9–11—Conference at Bucharest of representatives of Little Entente.
MAY 9—British Empire Exhibition at Wembley, England, re-opened by King George.
MAY 12—Soviet Union Constitution formally ratified by Soviet Congress.
MAY 13—Gold Standard Bill in Great Britain receives Royal assent.
MAY 17—Martial law ends in Spain.
MAY 18–21—Conference at Malines on problem of reunion of the Churches.
MAY 18—Sir John Baird (Lord Stonehaven) appointed Governor-General of Australia.
MAY 21—Captain Roald Amundsen and Lincoln Ellsworth leave Spitzbergen on attempt to reach North Pole with flying boats.
MAY 24—Empire Thanksgiving Service held in Stadium at Wembley, England.
MAY 25—Prince of Wales arrives at Bloemfontein.
MAY 25—J. T. Scopes of Dayton, Tenn., indicted for teaching evolution in high school, an offence under anti-evolution law recently passed (see March 23).
MAY 29—Alan Cobham flies from Croydon to Zurich and back in 13 hours, 49 min. at average speed of 74.5 m.p.h.
MAY 29—British note on German proposals for Security Pact handed to French Government.
MAY 30—Riot at Shanghai of Chinese students and strikers against foreigners. Fired on by police.
MAY 30—J. G. Coates becomes Prime Minister of New Zealand.
JUNE 1—Tangier Convention of Dec. 18 1923 comes into force.
JUNE 1—U.S. Supreme Court holds unconstitutional Oregon state law prohibiting instruction in other than state schools.
JUNE 3—Further disturbances in Shanghai—arrival of British cruiser.
JUNE 3—Prince of Wales arrives at Durban.
JUNE 4—Allies present Collective Note to Germany on disarmament requirements and conditions of Cologne evacuation.
JUNE 5—William D. Mitchell appointed U.S. Solicitor-General, succeeding James M. Beck.
JUNE 6—Great heat-wave in United States reaches height. More than 300 deaths.
JUNE 8—Agreement between France and Great Britain upon reply to German proposals for Security Pact.
JUNE 11—Creation in Great Britain of new Secretaryship of State for Dominion Affairs.
JUNE 12–13—Peruvian Senate and Chamber of Deputies approve Tacna-Arica plebiscite.
JUNE 16—French note to German Government on Security Pact proposals.
JUNE 16—51 killed in railway accident near Rockport, N.J.
JUNE 17—Close of Geneva Conference on Traffic in Arms. Convention for control of traffic signed, and protocol forbidding use of poison gas and bacteria in war.
JUNE 17—The MacMillan arctic expedition sails from Charlestown, Mass. in S.S. "Peary."
JUNE 18—Return of Captain Amundsen to Spitzbergen, machines having been ice-blocked. He flew to within 150 miles of N. Pole. (See May 21.)
JUNE 19–22—Prince of Wales at Pretoria and Johannesburg.
JUNE 25—Coup d'état in Athens. General Pangalos becomes Premier.
JUNE 26—Liberal Party of Nova Scotia defeated in elections, after 43 years in power.
JUNE 27—Coal-owners in Great Britain give notice to Miners' Federation to terminate existing national agreement on July 31.
JUNE 28—Ruins of pre-Mayan city discovered near Orizaba, Mexico.
JUNE 29—New building of Canadian Government in London opened by King George V.
JUNE 29—Large part of business section of Santa Barbara, Cal., destroyed by earthquake.
JUNE 29—Sovereignty over greater part of Jubaland transferred from Great Britain to Italy.
JULY 2—Commission consisting of French and Italian Ministers and American charge d'affaires at Peking appointed to negotiate with Chinese delegates regarding Shanghai outrages of May 30.
JULY 2—Miners' Federation in Great Britain rejects proposals of Mining Association regarding return to longer hours and reduction of wages.
JULY 7—South African Senate rejects Colour Bar Bill.
JULY 7—Kelvin Hall, great exhibition building in Glasgow, destroyed by fire.
JULY 9—Revolution in Ecuador. President Cordova resigns and flees the country.
JULY 10—Franco-Spanish Agreement signed for political collaboration in Morocco.
JULY 11—United States insists that Chinese Government must observe treaty obligations and adequately protect foreigners.
JULY 12—Report that British National Institute of Medical Research has isolated germ of cancer through research of W. E. Gye and J. E. Barnard.
JULY 13—French troops begin evacuation of Ruhr.
JULY 13—Government Court of Enquiry into coal dispute established in Great Britain.
JULY 15—E. N. Rhodes, new Conservative Premier of Nova Scotia, takes office.
JULY 16—Opening of first elected Parliament of 'Iraq at Baghdad.
JULY 19—U.S. President issues executive order remitting balance ($6,137,552) of Boxer indemnity from China, to be devoted to education in China.
JULY 20—German reply to French note of June 16.
JULY 21—Jury find J. T. Scopes guilty under Tennessee anti-evolution law.
JULY 26—Abdul Krim replies to Franco-Spanish note. Willing to make peace on basis of independence of the Rif.
JULY 26—Death of William Jennings Bryan.
JULY 28—Court of Enquiry into coal trade in Great Britain reports disapproval of owners' proposals. Conference recommended.
JULY 30—Supreme Court at Nairobi declares that forced labour cannot be used in Kenya Colony without authority of Secretary of State for Colonies.
JULY 31—British House of Commons passes Unemployment Insurance Bill.
JULY 31—Provisional settlement of coal dispute in Great Britain involving Government subsidy for industry until following spring.
JULY 31—Evacuation of Essen by French forces.
AUG. 1—New regulations for British emigrants to United States come into operation. All intending emigrants to be examined before embarking.
AUG. 5—Ratifications exchanged at Washington of two nine-power treaties concerning China, signed Feb. 6 1922.
AUG. 6—English Bank rate reduced from 5% to 4½%.
AUG. 6—British House of Commons votes £10,000,000 as subsidy to coal industry.
AUG. 7—League of Nations Commission on Mosul reports against partition of disputed area.
AUG. 7—French reverse at Sueida, Syria, at hands of Druse rebels.
AUG. 12—French airmen, Arrachard and Carol, complete flight from Paris to Constantinople, Moscow, Copenhagen, and back to Paris, in 3 days (4,594 miles).
AUG. 17—French offensive begins in eastern sector of Morocco.
AUG. 18—Peking Government invites Foreign Powers to conference on Chinese customs.
AUG. 18—United States and Belgium sign Debt Funding Agreement. Signed by President on Aug. 20.
AUG. 23—Seven men executed at Cairo for murder of Sir Lee Stack. (See Nov. 19 1924.)
AUG. 25—French troops evacuate Düsseldorf, Duisburg and Ruhrort.
AUG. 26—Marshal Pétain assumes command of French troops in Morocco.
AUG. 27—Fund for preservation of St. Paul's Cathedral, London, organised by *Times*, exceeds £250,000.
AUG. 27—Germany accepts invitation to Conference on Security Pact.
AUG. 28—Great Britain accepts invitation to Peking Tariffs Conference.
AUG. 28—Diplomatic relations resumed between Great Britain and Mexico, after eight years interval.
AUG. 31—Strike of 158,000 anthracite miners begins in United States.
SEPT. 1–4—German and Allied Jurists meet in London to discuss Security Pact.
SEPT. 3—U.S. Navy dirigible "Shenandoah" destroyed in storm.
SEPT. 4—British Coal Commission consists of Sir Herbert Samuel (Chairman), Sir W. Beveridge, Gen. Sir H. Lawrence and Mr. Kenneth Lee.
SEPT. 4—British Government agrees to consider modification of existing treaties, if China will protect foreign rights and interests.
SEPT. 5—Canadian Parliament dissolved.
SEPT. 8—Spanish troops land on Rif coast at Alhucemas Bay.
SEPT. 10—Fresh French offensive in Morocco begins.
SEPT. 12—Indian Council of State adopts Government resolution on Muddiman Report (Indian Constitutional Reforms) and rejects Nationalist Amendment passed by Legislative Assembly.

SEPT. 14–15—Imprisonment of large number of seamen strikers in Australia.
SEPT. 15—State Senator J. J. Walker wins democratic primary nomination for Mayor of N. Y. City.
SEPT. 16—U.S. Passport visa granted to S. Saklatvala, Communist member of British Parliament and member of inter-Parliamentary Union Conference, revoked.
SEPT. 18—Fire destroys Parliament buildings at Tokyo.
SEPT. 18—Australian Premier announces general election on issue of government by Parliament or outside influences.
SEPT. 21—Chinese Govt. expresses disapproval of British proposal for judicial enquiry into Shanghai riots of May 30.
SEPT. 26—U.S. submarine S51 sinks off Rhode Island in collision. 34 of crew lost.
SEPT. 29—Sir William Pryke elected Lord Mayor of London.
SEPT. 29—Republican Constitution promulgated in Greece.
SEPT. 29—British Labour Party Conference at Liverpool approves proposal excluding Communists from membership of local Labour Parties.
OCT. 1—Temporary settlement reached of Franco-American Debt question.
OCT. 2—Spanish troops occupy Ajdir, Morocco.
OCT. 5—Conference opens at Locarno on proposed Security Pact.
OCT. 7—International Judicial Commission on Shanghai riots holds first sitting.
OCT. 7—Dixie Highway, 1,989 miles long, Sault Ste. Marie, Mich., to Miami, Fla., completed.
OCT. 9—MacMillan Arctic Expedition returns.
OCT. 12—Collapse of seamen's strike in S. Africa.
OCT. 13—Dwight F. Davis appointed U.S. Secretary of War.
OCT. 14—Several leading Communists arrested in Great Britain on charge under Incitement to Mutiny Act.
OCT. 15—Royal Commission on coal industry in Great Britain holds first sitting.
OCT. 16—Security Pact Treaties initialled at Locarno, including agreement by which Germany shall be admitted to League of Nations.
OCT. 18–20—Moslem revolt in Damascus. City bombarded by order of General Sarrail.
OCT. 19—Italy completes occupation of Italian Somaliland, under protectorate of 1889 (hitherto unexercised).
OCT. 20—Civil war resumed near Peking, China.
OCT. 21—U.S. authorities refuse permission to Countess Karolyi to visit the United States.
OCT. 22—Greek troops cross Bulgarian frontier after ultimatum seeking redress for murder of a Greek officer. Bulgaria appeals to League of Nations.
OCT. 24—Austen Chamberlain elected Lord Rector of Glasgow University.
OCT. 25—Resignation of three Nationalist members of German Cabinet on account of Locarno Agreements.
OCT. 25—17 seaplanes of U.S. Navy break moorings in gale at Baltimore. Majority total wrecks.
OCT. 26—League of Nations Council demands withdrawal of Greek and Bulgarian troops behind own boundaries within 24 hours. Demand complied with on 29th.
OCT. 26—Opening of Chinese Customs Conference at Peking. Thirteen nations represented.
OCT. 27—International Judicial Commission on Shanghai riots adjourns sine die.
OCT. 29—Turkey and S. C. S. Kingdom sign Peace Treaty.
OCT. 29—M. Painlevé heads new French Government.
OCT. 29—General election in Canada. Defeat of Liberal party. Conservatives become largest party in Parliament.
OCT. 29—Appointment of Hon. E. F. L. Wood as Viceroy of India from following April, to succeed Lord Reading.
OCT. 30—French Cabinet recall General Sarrail from Syria. (See Oct. 18–20.)
OCT. 31—Persian Mejliss deposes Shah Ahmed Shad. Rhiza Khan becomes temporary head of state.
OCT. 31—Dr. Nansen elected Lord Rector of St. Andrew's University, Scotland.
NOV. 1–2—Great Britain signs treaty with Sultan of Nejd regarding tribal raids between 'Iraq and Nejd (Bahra Treaty) and treaty defining common frontiers of 'Iraq, Transjordan and Nejd.
NOV. 3—State Senator J. J. Walker elected Mayor of New York City. Tammany Hall wins city elections by large majorities.
NOV. 4—New Zealand elections result in clear majority for Coates (Reform) government.
NOV. 5—Great Britain provisionally recognises new régime in Persia.
NOV. 6—New frontier line between Albania and S. C. S. Kingdom formally approved by Ambassadors Conference.
NOV. 11—Announcement that Belgium, Egypt, Germany, Great Britain, Italy, Poland, Russia and United States had recognised new régime in Persia.
NOV. 12—The U.S. and Italian Debt Commissions arrive at agreement at Washington.
NOV. 13—Inner coffin of King Tutankhamen at Luxor opened, revealing mummy of 15 year old boy.
NOV. 14—Italian Council of Ministers approves Bill giving extensive new rights to Premier.
NOV. 14—General elections in Australia. Stanley M. Bruce, Prime Minister, returned to power.
NOV. 16—Allies inform Germany that evacuation of Cologne would begin on Dec. 1.
NOV. 18—British House of Commons approves ratification of Locarno Treaties.
NOV. 19—Chinese plan for tariff autonomy based on abolition of likin tax agreed to by Customs Conference at Peking.
NOV. 20—Death of Queen Alexandra.
NOV. 22—Professor John MacNeill, Free State representative on Irish Boundary Commission, resigns.
NOV. 25—Law Officers of Crown advise that Irish Boundary Commission is still effective despite resignation of Professor MacNeill on Nov. 22.
NOV. 25—Five Communists in England sentenced to 12 months' imprisonment in 2nd division.
NOV. 27—German Reichstag ratifies Locarno Treaties and authorises German application for admission to League of Nations.
NOV. 28—Briand Cabinet formed in France.
DEC. 1—British troops begin evacuation of Cologne.
DEC. 1—Pact of Locarno signed by Germany, Belgium, France, Italy, Great Britain, Poland and Czechoslovakia.
DEC. 1—Agreement concluded for funding Rumanian war debt to United States.
DEC. 3—End of de Rivera's military dictatorship in Spain.
DEC. 3–4—Finance Bill passes French Chamber and Senate.
DEC. 3—British, Irish Free State and Northern Ireland Governments sign agreement for settlement of Boundary problem.
DEC. 8—Ireland (Confirmation of Agreement) Bill passes British House of Commons. Receives Royal Assent on 10th.
DEC. 9—Northern Ireland Parliament approves Boundary agreement.
DEC. 9—Tacna-Arica Commission fixes April 15 1926 as the date for holding the plebiscite.
DEC. 12—Italian Chamber passes Bill compelling all trade unions to be Fascist.
DEC. 13—Rhiza Khan, late Prime Minister of Persia, elected Shah of Persia by Constituent Assembly.
DEC. 13—Germany ratifies Trade Treaty with Russia.
DEC. 13—Allied Powers issue invitations to attend Disarmament Conference.
DEC. 14–20—Exchange of Anglo-Italian notes regarding Abyssinia.
DEC. 15—Greece agrees to penalty (indemnities, etc.) imposed by League of Nations Council as result of her recent dispute with Bulgaria.
DEC. 15—Russia and Japan sign concession for 45 years for oil and coal fields in North Saghalien.
DEC. 15–16—Free State Parliament passes Ireland (Confirmation of Agreement) Bill.
DEC. 16—League of Nations Council awards Mosul region to Brussels line to 'Iraq. Britain asked to accept mandate of 'Iraq for 25 years.
DEC. 17—Turkey and Russia sign treaty in Paris binding each party not to attack the other, and to be neutral in case of attack by third party.
DEC. 17—Italian Chamber ratifies War Debt settlement with United States.
DEC. 21—British House of Commons approves Mosul award (see Dec. 16). Labour members protest and leave the House before Debate.
DEC. 23—International Commission of Enquiry on Shanghai riots of May 30 issues report. Resignation of British Police officers.
DEC. 31—Crown Prince Carol of Rumania renounces succession to throne in favour of his son Michael.
DEC. 31—Inter-Allied Military Commission begins. Withdrawal from Germany begins.

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JAN. 3—General Pangalos declared Dictator of Greece.
JAN. 6—Egyptian Ex-Ministers charged with complicity in murders of Egyptians and British during 1922.
JAN. 9—U.S. Ambassador to Mexico protests against retroactive provisions of Mexican Petroleum and Anti-Alien Land Acts.
JAN. 11—Ibn Saud proclaimed King of the Hejaz at Mecca.
JAN. 12—Coal owners in Great Britain present proposals to Coal Commission, *i.e.* (1) return to 8-hour day, (2) reductions in wages, (3) cut of 25% in rail rates.
JAN. 13—Great Britain and 'Iraq sign Treaty in accordance with terms laid down by League Council.
JAN. 14—Royal Commission on Coal Industry in Great Britain concludes public sittings.
JAN. 15—Russian Govt. accepts invitation to take part in Preparatory Commission for Disarmament on condition it does not meet in Switzerland.
JAN. 19—Herr Luther forms Government in Germany. Herr Stresemann becoming Foreign Minister.
JAN. 21—Lord Lloyd opens Sennar Dam at Makwar on Blue Nile.
JAN. 23—Death of Cardinal Mercier.
JAN. 25—Germany accepts invitation to Preparatory Disarmament Conference.
JAN. 27—Italy and Great Britain sign Debt. Agreement in London.
JAN. 27—U.S. liner "President Roosevelt" rescues crew of British ship "Antinoe."
JAN. 27—U.S. Senate passes resolution of adhesion to Permanent Court of International Justice.
JAN. 30—British evacuation of Cologne completed.
JAN. 31—Diplomatic deadlock between U.S. and Mexico over Mexican Land and Petroleum Laws.
FEB. 4—Colour Bar Bill passes third reading in S. Africa.
FEB. 5—Italian Chamber ratifies Debt Agreement with Great Britain of Jan. 27.
FEB. 5–9. Protest by Bavarian Premier against Italianisation of South Tyrol.
FEB. 11—Ratifications exchanged in Berlin of German-Soviet Trade Treaty of Oct. 12 1925.
FEB. 12—Anthracite coal strike in United States settled. (See Sept. 1 1925.)
FEB. 14—French abandon Biban, Morocco, owing to threat of Rif offensive.
FEB. 16—French Chamber passes amended Finance Bill.
FEB. 18—Great Britain ratifies Treaty with 'Iraq of Jan. 13.
FEB. 27—French Senate passes Finance Bill.
MARCH 2—French Chamber ratifies Locarno Treaty.
MARCH 6—Defeat in Chamber followed by resignation of M. Briand, French Premier.
MARCH 6 — Shakespeare Memorial Theatre at Stratford, England, destroyed by fire.
MARCH 7—Radio telephone conversation maintained for 4 hours between New York and London.
MARCH 10—Spain threatens to resign from League of Nations if she is not given a seat on Council. Brazilian representative threatens to vote against Germany's entry unless Brazil is given a seat. Swedish representative (M. Unden) re-affirms his intention to oppose election of any country other than Germany.
MARCH 10—Report of Coal Commission in Great Britain published.
MARCH 10—Ninth Briand Cabinet formed in France.
MARCH 11—De Valera resigns Presidency of Irish Republican Party.
MARCH 11—League of Nations Council approves Anglo-'Iraq Treaty.
MARCH 12—Germany refuses to consent to proposal that a seventh non-permanent seat on League Council be created to which Poland shall be elected. M. Unden volunteers offer that Sweden give up her seat.
MARCH 14—248 people killed in railway disaster in Costa Rica.
MARCH 16—M. Briand and Sir Austen Chamberlain inform Germany that her admission to League cannot be considered at present.
MARCH 17—South African Senate rejects Colour Bar Bill.
MARCH 17—Extraordinary Session of League of Nations Assembly adjourns.
MARCH 24—British Premier announces that Government accepts Coal Commission's Report.
MARCH 25–APRIL 22—Abortive meetings between Coal-owners and miners in Great Britain.
MARCH 26—Poland and Rumania sign Treaty of Guarantee on lines of Locarno.
MARCH 27—Cambridge wins University Boat Race by 5 lengths.
MARCH 29—Mexico's new land laws come into effect.
APRIL 2—Serious riots in Calcutta between Hindus and Moslems.
APRIL 2—Bombardment of Peking begun by troops of Wu Pei-fu and Chang Tso-lin.
APRIL 9—Miners' Federation in Great Britain unanimously against increase of hours, reduction in wages or sacrifice of principle of national agreements.
APRIL 14—Agreement signed between British Government and Government of Irish Free State for reciprocal exemption and relief from double income tax.
APRIL 14—Demonstration in Paris of Civil servants and Government employees, resulting in 400 arrests.
APRIL 15—Meeting opens in Brussels of International Miners' Federation. Conference decides on 16th to prevent export of coal to Great Britain in event of a stoppage.
APRIL 17—Demonstration in London of nearly 20,000 women against strikes and lock-outs as methods of settling industrial disputes.
APRIL 21—U.S. Senate ratifies Debt Settlement with Italy.
APRIL 23—Renewed rioting between Hindus and Moslems in Calcutta. (See April 2.)
APRIL 24—German-Soviet Treaty, supplementing Rapallo Treaty, signed in Berlin. Text published on 27th. Valid for 5 years. Comes into force on day of exchange of ratifications.
APRIL 25—Rhiza Shah Pahlevi crowned Shah of Persia.
APRIL 26—Peace conference between French and Spanish and Riffian delegates opens at Ujda. On May 6 negotiations are broken off, deadlock having been reached.
APRIL 29—Agreement arrived at Washington between U.S. and France for settlement of French War Debt to former.
APRIL 30—Coal-owners in Great Britain make proposals involving 8-hour day for miners and reduction of wages. Rejected by miners. Lock-out of over 1,000,000 miners begins at midnight.
MAY 1—Trades Union executives in Great Britain decide to call General Strike on May 3rd, at midnight in support of miners. Government declares State of Emergency.
MAY 2—British Govt. insists on orders for general strike being withdrawn before resumption of negotiations.
MAY 3—General Strike in Great Britain begins at midnight.
MAY 5—Christian Churches in Great Britain issue appeal for peace in industrial dispute. This appeal not broadcast and not published in the *British Gazette* till later.
MAY 8—Franco - Spanish offensive against Abdel-Krim begins in Morocco.
MAY 9—Lieut. Commander R. E. Byrd, U.S. Navy, reaches North Pole by aeroplane from Spitsbergen.
MAY 10—Samuel Memorandum in connection with British coal dispute framed.
MAY 12—General strike in Great Britain called off by leaders of Trades Union Congress.

MAY 12—Captain Amundsen crosses North Pole in airship "Norge."
MAY 12—Revolution in Poland. Marshal Pilsudski occupies Praga, a suburb of Warsaw, and demands resignation of Witos Government.
MAY 13—Resignation of Luther Cabinet in Germany, on question of German flag.
MAY 14—Amundsen lands at Tellar, Alaska, having started from Spitsbergen May 11 and traversed 2,700 miles in 71 hours.
MAY 14—Belvedere Palace, Warsaw, seized by Marshal Pilsudski, after 2 days fighting.
MAY 15—Resignation of Premier Witos and President Wojciechowski in Poland. Temporary Government formed.
MAY 17—Dr. Marx becomes Chancellor of Germany, and forms new Cabinet.
MAY 18—Heavy fighting reported in Morocco. Spaniards attacked near Tetuan.
MAY 20—Lord Oxford and Asquith addresses letter to Lloyd George criticising his action during general strike.
MAY 22—General Elections held in Egypt under direct voting system result in sweeping victory for Zaghlul Pasha.
MAY 24—Volcanic eruption in Tokachi, Japan. 900 lives reported lost.
MAY 26—Surrender of Abdel Krim to French.
MAY 30—Zaghlul Pasha has interview with Lord Lloyd at British Residency, Cairo, following his announcement of intention to form Ministry himself.
MAY 29–30—Resignation of Cabinet in Portugal, following revolution started by General Gomez da Costa. Cabecadas Ministry formed.
MAY 31—Marshal Pilsudski elected President of Poland, but refuses to accept election.
JUNE 1—M. Ignacy Mosiecki elected President of Poland.
JUNE 1—Franco-Turkish Agreement concerning Syria (initialled in February) signed at Angora.
JUNE 2—Derby at Epsom won by Lord Woolavingon's "Coronach."
JUNE 2—U.S. House of Representatives approves French War Dept Agreement.
JUNE 3—Zaghlul Pasha announces decision not to form Cabinet in Egypt.
JUNE 4—French Senate ratifies Locarno Treaty.
JUNE 5–6—Revolutionary troops, under General Gomez da Costa, enter Lisbon.
JUNE 5—Adly Pasha forms Cabinet in Egypt.
JUNE 5—Announcement of discovery of illinium, Number 61 in Periodic table, rare earth element, identified by absorption bands and confirmed by X-ray analysis.
JUNE 5—Mosul Treaty signed between United Kingdom, 'Iraq and Turkey, regarding settlement of frontier between Turkey and 'Iraq.
JUNE 7—Angora Assembly ratifies Mosul Treaty (of June 5), also the Franco-Turkish Agreement re Syria.
JUNE 9—Appointment of Lord Willingdon as Governor-General of Canada.
JUNE 11—British Note to Russia regarding transmission of funds from that country to Great Britain during general strike.
JUNE 11–12—Brazil resigns from League of Nations Council, and gives formal notice of her intention to withdraw from League.
JUNE 14—Convention signed between Rumania, Yugoslavia and Czechoslovakia extending defensive alliance for further three years.
JUNE 14—'Iraq Parliament ratifies Mosul Treaty.
JUNE 14—Franco-Spanish Conference opens in Paris re pacification of the Rif.
JUNE 15—Resignation of Briand Cabinet in France, following resignation of Raoul Peret, Finance Minister, after record fall of the franc to 180.
JUNE 15—Soviet Note in reply to British Govt. note of June 11.
JUNE 15—New proposals regarding Coal crisis made by British Prime Minister, involving suspension of 7-hours Act.
JUNE 16—Eighteen lives lost in railway collision on Pennsylvania Railway, fifty miles from Pittsburgh.
JUNE 20—Referendum in Germany on Socialist - Communist proposal for confiscation of property of former ruling houses. Requisite votes (50% of electorate) not obtained. 36.3% of electorate vote in favour.
JUNE 22—Canadian House of Commons passes resolution that ratification by Canadian Parliament necessary to establish validity for Canada of any treaty involving military or economic responsibilities.
JUNE 22—Miners' Executive and General Council of Trades Union Congress in Great Britain sign concordat agreeing to oppose Government's coal proposals, more especially increased hours of labour.
JUNE 22—Agreement signed in Cape Town fixing boundary between Angola and S.W. Africa.
JUNE 23—Tenth Briand Cabinet formed in France. M. Caillaux Finance Minister.
JUNE 24—Bill enabling peeresses in their own right to sit in British House of Lords rejected in Upper House by 125 votes to 80.
JUNE 25—A. J. Cook, Secretary of Miners' Federation in Great Britain, suggests withdrawal of Eight Hours Bill, resumption of work on basis of 1924 agreement, and immediate and final settlement without compulsory arbitration.
JUNE 26—Severe earthquake in Crete and Rhodes. Shocks felt in Palestine, Egypt, Malta, Sicily, Southern Italy and parts of Greece.
JUNE 26 – 26 — Captain Arrachard, French Pilot, does non-stop flight from Paris to Basra (over 2,700 miles) in a Potez biplane in 26 hours, 35 mins.
JUNE 26—D. G. A. Lowe runs 600 yards in 1 min. 10 2.5 secs. at Stamford Bridge, England (World's amateur record).
JUNE 28—Resignation of Mackenzie King (Liberal) Ministry in Canada, after being defeated three times in House of Commons on report of the Customs Inquiry Committee. Governor-General refuses to grant a dissolution and sends for A. Meighen, Conservative leader.
JUNE 29—Arthur Meighen sworn in as Prime Minister of Canada.
JUNE 29—Ratifications exchanged in Berlin of Russo-German Treaty of April 24.
JUNE 30—Alan Cobham leaves Rochester on first stage of 26,000 mile flight to Australia and back.
JUNE 30—League of Nations control withdrawn from Austria and Hungary.
JULY 1—British order in council providing for establishment of a legislature for Tanganyika Territory comes into force.
JULY 1—Announcement by Professor W. H. Keesom (University of Leyden) of successful solidification of helium.
JULY 2—Canadian Parliament dissolved after defeat of new Conservative Government by one vote on motion challenging right of acting ministers to occupy places in House of Commons.
JULY 2—J. Borotra (France) wins Singles Lawn Tennis Championship at Wimbledon, England.
JULY 3—Suffrage demonstration in Hyde Park, London. Resolution passed demanding immediate Government measure granting votes to women at 21 on same terms as men.
JULY 3—Express train from Le Havre to Paris wrecked at Achères. 18 killed, 73 injured.
JULY 3—Mrs. L. A. Godfree (Great Britain) wins Ladies' Lawn Tennis Singles Championship at Wimbledon, England.
JULY 6—Serious earthquake on west coast of Sumatra. 400 lives lost.
JULY 6—Canton Government, China, hands note to British consul-general protesting against blockade of port of Wuchow.
JULY 8—Coal Mines Bill receives royal assent.
JULY 9—General Gomes da Costa, Prime Minister of Portugal and leader of military revolt, arrested by General Carmona. Latter declares himself Prime Minister and forms Ministry.
JULY 10—U.S. naval ammunition depot at Lake Denmark, near Dover, N.J., destroyed by explosion.
JULY 11—Death of Gertrude Lowthian Bell.
JULY 12—Agreement signed in London by Joseph Caillaux and Winston Churchill to fund French war debt to Great Britain.
JULY 12—Death of John W. Weeks, former U.S. Secretary of War.
JULY 13—Franco-Spanish agreement on Moroccan affairs signed.
JULY 14—Execution in Constantinople of 15 persons sentenced for plotting to kill Mustafa Kemal Pasha, President of Turkey.
JULY 14—Treaty of Commerce between Germany and Switzerland signed at Berne.
JULY 15—Official communiqué issued in Peking announcing Wu Pei-fu's decision to release the salt revenues.
JULY 15—Arrival at Omsk (Siberia) of Captain Girier and Lieut. Dordilly after 29 hours flight from Paris (2,940 miles), making new non-stop record flight.
JULY 17—Belgian Chamber assents, by 98 votes to 1, to ratification of Belgian-Dutch agreement regarding navigation of the Schelde.
JULY 17—Briand Cabinet in France defeated by 288 votes to 243 on Caillaux's financial proposals. Cabinet resigns.
JULY 18—Ratifications of Mosul Treaty of June 5 exchanged at Angora.
JULY 19—Herriot Ministry formed in France; M. de Monzie, Finance Minister and M. Painlevé, Minister for War.
JULY 20—French franc falls to 240.25 to the pound, 50.59 to the dollar.
JULY 20—Death of Felix Dzerzhinsky, Chairman of Supreme Economic Council of Soviet Union, head of the Soviet State Political Department.
JULY 21—Herriot Government defeated in French Chamber by 290 votes to 237, and resigns.
JULY 23—Poincaré forms Cabinet in France, including members of all groups excepting Communists, Socialists and Democrats of extreme Right. M. Poincaré, Finance Minister; M. Briand, Foreign Secretary.
JULY 24—Governor "Ma" Ferguson loses Democratic nomination for governor in Texas state primary.
JULY 24—Central Committee of Communist Party in Russia expels Zinoviev from political bureau.
JULY 25—Spanish custom houses withdrawn from frontier between Spanish and Tangier zones.
JULY 26—Death of Robert Todd Lincoln, eldest son of Abraham Lincoln and former U.S. Secretary of War and Minister to London.
JULY 27—French Chamber passes vote of confidence in Poincaré Government by 358 to 131.
JULY 28—Portrait by Romney of Mrs. C. Davenport of Capesthorne, Cheshire for 58,000 guineas at Christie's, London.
JULY 28—Agreement between Chang tso Lin and Kuominchum over the government of China announced; leaders agree to suppress Wu Pei-fu.
JULY 28—Regent of Abyssinia protests against Anglo-Italian agreement.
JULY 29—Protocol regarding amendment of Article iv. of League of Nations Covenant comes into force.
JULY 30—All Roman Catholic churches in Mexico closed at midnight. President Calles deports Mgr. Tito Crespi, Papal Envoy.
JULY 30—Late Canadian Minister of Customs charged regarding grants of alcohol permits as the result of deaths in Ontario and New York State from alcoholic poisoning.
JULY 31—Finance Bill passes French Chamber by 304 votes to 177.

INDEX

HOW TO USE THIS INDEX: The following index gives the references to the Three New Supplementary Volumes (**i., ii., iii.**) of the *Encyclopædia Britannica* (13th Edition) which cover the period 1910–26. It has been prepared on the same principles as the previous index in Volume 29, a full description of which will be found at the beginning of that volume. For the convenience of the reader, a brief explanation of these principles is repeated here:

HEADINGS: The use of heavy black capitals indicates that the heading refers to a separate article, thus: **AALAND ISLANDS i-1a.** Headings in lighter type (thus: Sunspots **i-242b**) show that this subject is not treated separately, but that there is a reference to it in another article.

VOLUME AND PAGE: After each entry will be found references to the volume, page and section of page to which the reader is directed. The volume is indicated by heavy black Roman numerals, the page by light-faced numerals and the section of page by the letters a, b, c, d (showing the upper and lower halves of the first and second column respectively), thus: **iii-16d**, refers the reader to an item of information which will be found in Vol. iii., on p. 16, and in the lower half of the right hand column.

NAMES OF PERSONS: Surnames are followed by Christian names, or initials, wherever possible. Otherwise some description is given, thus: Nefertete (Egy. queen.) Kings, queens and princes are usually indexed under their Christian names thus: Edward, Prince of Wales (*not* Wales, Prince of).

GEOGRAPHICAL REFERENCES: Names of places are followed by the country or state in which they are situated. Other geographical headings are followed by descriptions such as riv., isl., mt., etc. Map references can be readily distinguished; for after the volume and page, an additional letter and number, indicating the map square, will be found in parentheses. Thus: Innsbruck **i-284** (C2).

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YUGOSLAVIA iii-1130c, 1131a (map); child labour i-608a; copper i-733b; currency i-777a; exchange (table) i-774b; flag ii-39c, 38 (plate) folklore ii-55d; land tenure ii-656d foll, 659b; loans i-833a; iii-884a; newspapers ii-1059b; population iii-916a; religion ii-1134b; sculpture iii-490a.
—: *History* iii-1130d, 511d foll.; Adriatic i-8d; Albania i-87a; Bosnia and Hercegovina i-412a; Croatia-Slavonia i-762b; Dalmatia i-806b; Greece ii-284d; Italy i-1065b; ii-39a; Little Entente ii-720b; Rumania i-1065a. *See also* Serbia.
YUKON TERRITORY, Can. iii-1134d.
Yuktas, mt., Crete (archae.) i-178a.
Yushkevich, Semen iii-435d.
Y. W. C. A. iii-1060b.

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Zabern incident ii-207a; i-100d, 368b; ii-89b; Crown Prince iii-1028d.
Zacconi, Ermete i-883c.
ZAGHLUL, SAAD iii-1135a; i-934c foll.; iii-676b foll.
ZAGREB, Yugos. iii-1135b. 511b, 1131 (B2).
Zaidis (Sect) ii-768c.
ZAÏMIS, ALEXANDER iii-1135c, 938c foll.
Zamenhof, L. L. iii-905d.
Zamyatin, Evgeni iii-438c.
Zandfontein, Af. iii-607b.
Zaniboni, T. to ii-570d, 1010b.
Zante, isl., Gr. ii-238d, 281B3.
ZANZIBAR iii-1135d; i-447a.
Zaphtetic languages iii-115a.
Zara, It. i-9a; iii-1131d.
Zauditu, Abyssinian empress i-3c.
Zavikhost, Gal. iii-968a.
Zayas, Alfredo i-768c.
Zech, Paul ii-191a.
ZEEBRUGGE, ATTACK ON iii-1136b, 1008 (C1), 1136c (map), 1106d; i-664c; submarine base iii-669b.
Zeeman effect, (spectroscopy) i-255b; iii-624b.
Zeigner (politician) ii-215b.
Zeiss range-finder iii-297d.
Zeitlin, Hillel ii-337a.
Zemgale, Latvia ii-665b.
Zemstvos i-366d; iii-401d.
Zeomorphi iii-1143b.
ZEPPELIN, Count iii-1137b.
— (airship) i-77a; raids i-70d foll.; iii-483c.
ZEROMSKI, STEPHEN iii-1137b, 181a.
Zero zone ii-1024d.
Zeta-function, Riemann ii-832b.
Zev (racehorse) ii-367d.
Zeyer, Julius i-789a.
ZICHY, EUGEN, Count iii-1137c.
Ziehen, Th. ii-729d.
ZIEM, FELIX FRANÇOIS G. P. iii-1137c.
Zijl, Lambertus iii-490d.
Zimbabwe ruins, Af. i-1092c.
ZIMMERMANN, ARTHUR iii-1137c; Mexico ii-896b.
—, (soldier) i-494c, 495b.
Zimmerwald manifesto ii-699a; iii-408b, 772c.
ZINC iii-1137c; i-479b, 780d; ii-406b; Australia ii-1049b; electrolytic process i-963a; Indo-China ii-452c; metallurgy ii-883c; oxide i-551c; U.S. ii-936b; iii-893b, 922b.
ZINOVIEV, GRIGORY Evseevich iii-1138a, 425d; letter i-1004d.
ZIONISM iii-1138b, 21b; i-312c; ii-336b, 607b.
Zita, Empress of Austria and Queen of Hungary i-571b.
Ziwar Pasha i-939b.
Zlatorog i-476b.
Zlatovratsky (writer) iii-407d.
ZOBEIR, RAHAMA iii-1140c.
Zogu, Ahmed i-87b.
Zoning i-201b, 641d, 644c.
ZOOLOGY iii-1140c.
Zoppot, Danzig i-813 (B1), 813d.
ZORN, ANDERS iii-1146b; i-1026a.
Zoroaster ii-863c.
Zoser (Egy. king) i-172c.
Zouaves i-95c.
"ZR 3", i-77b; ii-48a.
ZUBATY, JOSEF iii-1146c.
Zukunft Die i-341a.
ZULOAGA, IGNACIO iii-1146b, 6a.
ZULULAND iii-1146c.
ZÜRICH, Switz. iii-1146d; referendum iii-317c.
—, **UNIVERSITY OF** iii-1147a.
ZUYDER ZEE, Holl. iii-1147a.
Zycie iii-180d.
Zygote i-826b, 971c; ii-161b.
Zygotene i-786b.
Zymose i-598b.

X

Y

Z

CLASSIFICATION OF ARTICLES ACCORDING TO SUBJECT

THESE Three New Volumes of *The Encyclopædia Britannica* (13th Edition) survey the world in which we live today; review the tremendous events through which we have come from 1910 to 1926 and the leading actors in those events; summarize the advance in science and industry and art and the humanities, and the persons to whom we owe that advance. In the following pages is offered a scheme by which the 3,500 articles can be transformed from their alphabetical array into a series of handbooks on various subjects, a collection of outlines for courses of study covering the usual university curriculum and a great deal more.

In its general scheme this classification follows the plan adopted for the classification of articles in the Eleventh Edition (29.879). The main groups, from I. Anthropology and Ethnology through XXIII. Sports and Pastimes, are the same. Group XXIV. Miscellaneous, was not needed. Sub-divisions of the main groups follow as nearly as possible the sub-divisions in the earlier classification; but they have been modified, now by consolidation and now by further sub-division, to accommodate changes in the relative importance of subjects and to provide for the new topics which have emerged in some fields of knowledge. The most important additions are the two sections at the end of Group XII (History): 8. The World War, and 9. International Relations, 1910 to 1926.

The arrangement of this classification within the same general framework as that of the older one has obvious advantages, among which is the possibility of comparisons between the past and the present. Group X (Geography), for example, on pages 1224 to 1227 shows at a glance the political configuration of the world in 1926; while the corresponding outline beginning on page 895 of Volume 29 shows how it looked in 1910. Quite as impressive, if less obvious, are changes in other groups: the new subjects which appear in Chemistry and in Physics; the lengthening list under Economics and Social Science; the relatively static condition of some of the other subjects.

In preparing this classification the interest of the general reader has been the controlling consideration, and the object has been to give him assistance in finding his way to the material he wants. The content of each article has been considered. It has not been assigned arbitrarily to one group or another according to its title alone. The article on Salvaging, for example, which one might expect to find in the group on Law, where it was in the earlier classification, is placed under Engineering, since it is occupied with the discussion of technical problems and methods. Articles which contain a substantial contribution to the understanding of more than one subject are listed more than once. The article on Motor Vehicles, for example, discussing in its numerous sections the economic aspects of the industry, technical problems of construction, laws regulating the use of motor cars, taxation of owners, and motor races, belongs properly in Groups VII, IX, XIII, XV, and XXI. All the articles in the Three New Volumes have been classified, since even the shortest, though they may not contain much information themselves, point the way to other articles in the New Volumes or in the volumes of the Eleventh Edition, where further material on the subject is to be found.

The biographical sketches appear in connection with the subject in which the person has done his best-known work. In the case of persons who appeared in the Eleventh Edition, it occasionally happens that one is listed in this classification in a different group, because he has shifted his activity from the field in which he was conspicuous in his earlier days to another in which he has been better known recently. A man conspicuous in more than one field may be found in two or more lists. As the nationality has been given after each name, it is possible to go through the classification and assemble a list for any particular country of the outstanding figures in the various fields of human activity.

The classification cannot take the place of the index. Nor can it undertake to exhaust the resources of the volumes on any particular subject. There is still a place for the imagination of the student. The interlocking of all phases of human life and knowledge, which is quite as conspicuous a characteristic of modern civilisation as specialisation, makes it impossible to sort out the articles in neat piles. Chemistry and Physics, Chemistry and Biology, Biology and Physics, find themselves on one another's ground, as in the days before the sciences were differentiated from one another. The distinction between plant and animal life tends to lose significance. Economics and Social Science, as fast as possible, appropriate the data of the physical sciences and apply them to human relations. What the classification can do for the student is to furnish him a suggestive guide. If it does no more than stimulate his curiosity and give him a start, he will find himself launched on a fascinating course of reading and investigation. The classification is followed by a list of the plate illustrations in the three new volumes.

LONDON

September 1 1926

CLASSIFICATION OF ARTICLES ACCORDING TO SUBJECT

I. ANTHROPOLOGY AND ETHNOLOGY

1. Subjects

Anthropology
Anthropology, Applied
Social Anthropology
Africa §III
Folklore
Human Geography
Indians, North American
Man, Evolution of
Races of Mankind

2. Biographies

Bastian, Adolf (German)
Bertillon, Alphonse (French)
Deniker, Joseph (French)
Frazer, Sir James George (British)
Hrdlicka, Ales (American)
Keith, Sir Arthur (British)
Luscher, Felix von (Austrian)
Tylor, Sir Edward Burnett (British)
Westermarck, Edward Alexander (Finnish)

II. ARCHAEOLOGY AND ANTIQUITIES

1. Subjects

Archaeology
Medicine, Pre-Scientific
(For recent discoveries on ancient sites *see* topographical headings in group X)

2. Biographies

Bandelier, Adolph Francis Alphonse (American)
Boni, Giacomo (Italian)
Breasted, James Henry (American)
Burrows, Ronald Montagu (British)
Carnarvon, 5th Earl of (British)
Clermont-Ganneau, Charles Simon (French)
De Prorok, Byron Kuhn (American)
Evans, Sir Arthur John (British)
Hrozny, Friedrich (Czech)
Jastrow, Morris (American)
Lanciani, Rodolfo Amadeo (Italian)
Maspero, Sir Gaston Camille Charles (French)
Montelius, Oskar (Swedish)
Niederle, Lubor (Czech)
Rhys, Sir John (British)
Rivoira, Giovanni Terresio (Italian)
Stein, Sir Marc Aurel (British)
Strzygowski, Josef (Austrian)

III. ART

1. General

(a) Subjects

Aesthetics
Art Sales
Art Treasures
Decorative Art
Mural Decoration
Museums

(b) Biographies

Altman, Benjamin (American collector)
Lane, Sir Hugh Percy (Irish collector)
Morgan, John Pierpont (American collector)
Ross, Robert Baldwin (British critic)
Stieglitz, Alfred (American writer)

2. Architecture

(a) Subjects

Architecture
Factory Design
Railway Stations

(b) Biographies

Bacon, Henry (American)
Berlage, Hendrik Petrus (Dutch)
Bruno, Paul (German)
Burnham, Daniel Hudson (American)
Cram, Ralph Adams (American)
Cuypers, Petrus Josephus Hubertus (Dutch)
Daumet, Pierre Jerome Honoré (French)
Flagg, Ernest (American)
Gilbert, Cass (American)
Goodhue, Bertram Grosvenor (American)
Lutyens, Sir Edwin Landseer (British)
Menot, Paul Henri (French)
Parsons, William Edward (American)
Pascal, Jean Louis (French)
Platt, Charles Adams (American)
Poelzig, Hans (German)
Pope, John Russell (American)
Scott, Sir Giles Gilbert (British)
Shaw, Richard Norman (British)
Warren, Whitney (American)
Webb, Sir Aston (British)

3. Music

(a) Subjects

Music
Choral Singing
Eurhythmics
Musical Comedy
Musical Instruments, Mechanical
Opera
Orchestration
Singing

(b) Biographies

(Musicians, composers, conductors, directors, impresarios and critics)

Balakirev, Mili Alexeivich (Russian)
Baline, Israel (Irving Berlin, American)
Barnett, John Francis (British)
Bartók, Bela (Hungarian)
Beecham, Sir Thomas (British)
Boito, Arrigo (Italian)
Bruch, Max (German)
Busoni, Ferruccio (Italian)
Carpenter, John Alden (American)
Caruso, Enrico (Italian)
Cary, Annie Louise (American)
Chaliapin, Feodor Ivanovich (Russian)
Damrosch, Walter Johannes, and Frank Heino, his brother (American)
Debussy, Claude Achille (French)
Delius, Frederick (British)
Dohnányi, Ernst von (Hungarian)
Dubois, François Clément Théodore (French)
Elgar, Sir Edward (British)
Fauré, Gabriel (French)
Foerster, Josef Bohnslav (Czech)
Fürtwangler, Wilhelm (German)
Galli-Curci, Amelita (Italo-American)
Garden, Mary (American)
Goldmark, Karl (Austrian)
Hadley, Henry Kimball (American)
Hadow, Sir William Henry (British)
Halle, Wilna Maria Francisca, Lady (Anglo-German)
Hammerstein, Oscar (American)
Herbert, Victor (American)
Hubay, Eugene de (Hungarian)
Humperdinck, Engelbert (German)
Huneker, James Gibbons (American)
Janácek, Leos (Czech)
Jaques-Dalcroze, Emile (Swiss)
Kellogg, Clara Louise (American)
Kodály, Zoltan (Hungarian)
Krehbiel, Henry Edward (American)
Kreisler, Fritz (Austrian)
Lecocq, Alexandre Charles (French)
Lehár, Franz (Hungarian)
Leoncavallo, Ruggiero (Italian)
MacCunn, Hamish (British)
Mahler, Gustav (Austrian)
Massenet, Jules Émile Frédéric (French)
Mattei, Tito (Italian)
Maurel, Victor (French)
Mottl, Felix (German)
Nikisch, Arthur (Hungarian)
Nilsson, Christine (Swedish)
Nordica, Lilian (American)
Novák, Vítêzslav (Czech)
Paderewski, Ignace Jan (Polish)
Parker, Horatio William (American)
Parry, Sir Charles Hubert Hastings (British)
Patti, Adelina Juaña Maria (British)
Planquette, Robert (French)
Popper, David (Bohemian)
Puccini, Giacomo (Italian)
Randegger, Alberto (Italian)
Ravel, Maurice (French)
Reszke, Jean de (Polish)
Reyer, Ernest (French)
Richter, Hans (Hungarian)
Saint-Saëns, Charles Camille (French)
Santley, Sir Charles (British)
Schönberg, Arnold (Austrian)
Scriabin, Alexander Nicholaevich (Russian)
Sgambati, Giovanni (Italian)
Sharp, Cecil James (British)
Sibelius, Johan Julius (Jean) (Finnish)
Smyth, Ethel Mary (British)
Sousa, John Philip (American)
Stanford, Sir Charles Villers (British)
Strauss, Richard (German)
Stravinsky, Igor Fedorovich (Russian)
Suk, Josef (Czech)
Svendsen, Johann Severin (Norwegian)
Terry, Sir Richard Runciman (British)
Tosti, Sir Francesco Paolo (Italian)
Walter, Bruno (German)
Weiner, Leo (Hungarian)
Williams, Ralph Vaughan (British)

4. Painting and Engraving

(a) Subjects

Painting
Caricature
Etching
Illustration
Poster

(b) Biographies

(Painters, etchers, cartoonists)

Abbey, Edwin Austin (American)
Alexander, John White (American)
Alma-Tadema, Sir Laurence (British)
Bakst, Léon (Russian)
Bartels, Hans von (German)
Beckwith, James Carroll (American)
Beerbohm, Max (British)
Bellows, George Wesley (American)
Benson, Frank Weston (American)
Blakelock, Ralph Albert (American)
Blashfield, Edwin Howland (American)
Bonnat, Léon Joseph Florentin (French)
Bracquemond, Félix (French)
Breitner, George Hendrik (Dutch)
Breton, Jules Adolphe Aimé Louis (French)
Brown, John George (American)
Carolus-Duran (French)
Cassatt Mary (American)
Chase, William Merritt (American)
Clarke, Thomas Shields (American)
Claus, Émile (Belgian)
Colman, Samuel (American)
Corinth, Lovis (German)
Cormon, Fernand, (French)
Cox, Kenyon (American)
Crane, Walter (British)
Daingerfield, Elliott (American)
Davies, Arthur B. (American)
Davis, Henry William Banks (British)
De Camp, Joseph Rodefer (American)
Degas, Edgar (French)

(b) **Biographies**—*continued*

Denis, Maurice (French)
Derain, André (French)
Détaille, Jean Baptiste Édouard (French)
Dougherty, Paul (American)
Duveneck, Frank (American)
Eakins, Thomas (American)
East, Sir Alfred (British)
Fildes, Sir Luke (British)
Fraser, Claud Lovat (British)
Fry, Roger Elliott (British)
Gaul, Gilbert William (American)
Grant, Duncan (British)
Haag, Carl (British)
Harpignies, Henri (French)
Hemy, Charles Napier (British)
Henri, Robert (American)
Henry, Edward Lamson (American)
Herkomer, Sir Hubert von (British)
Hitchcock, George (American)
Hodler, Ferdinand (Swiss)
Holroyd, Sir Charles (British)
Israëls, Josef (Dutch)
John, Augustus Edwin (British)
Keller, Albrecht (German)
Kent, Rockwell (American)
Klinger, Max (German)
Knight, Daniel Ridgway (American)
Krohg, Christian (Norwegian)
Kupka, Frantisek, (Czech)
Laermans, Eugène (Belgian)
Leader, Benjamin Williams (British)
Legros, Alphonse (Anglo-French)
Lieberman, Max (German)
Lindsay, Norman (Australian)
Lockwood, Wilton (American)
Lucas, John Seymour (British)
Macke, August (German)
Marc, Franz (German)
Marchand, Jean (French)
Matisse, Henri (French)
Metcalf, Willard Leroy (American)
Millet, Francis Davis (American)
Mosler, Henry (American)
Munch, Edward (Norwegian)
Murphy, John Francis (American)
Nash, Paul, and John Northcote, his brother (British)
Neal, David Dalhoff (American)
Oberländer, Adam Adolf (German)
Orpen, Sir William Newenham Montague (British)
Pearce, Charles Sprague (American)
Picasso (Pablo Ruiz) (Spanish)
Poynter, Sir Edward John, Bart. (British)
Pyle, Howard (American)
Raemaekers, Louis (Dutch)
Ranger, Henry Ward (American)
Reid, Sir George (British)
Renoir, Auguste (French)
Repin, Ilja Jefimovich (Russian)
Richmond, Sir William Blake (British)
Rivière, Briton (British)
Robert-Fleury, Tony (French)
Roerich, Nicolas Constantinovich (Russian)
Roll, Alfred Philippe (French)
Rosenthal, Toby Edward (American)
Ryder, Albert Pinkham (American)
Sargent, John Singer (Anglo-American)
Shagall, Mar (Russian)
Shannon, Charles Hazelwood (British)
Shannon, Sir James Jebusa (Anglo-American)
Sickert, Walter Richard (British)
Smedley, William Thomas (American)
Somov, Constantine Andreevich (Russian)
Sorolla y Bastida, Joaquin (Spanish)
Spadini, Armando (Italian)
Stewart, Julius L. (American)
Stone, Marcus (British)
Story, Julian (American)
Strang, William (British)
Svabinsky, Max (Czech)
Szinyei-Merse, Paul de (Hungarian)
Tenniel, Sir John (British)
Thayer, Abbott Henderson (American)
Thoma, Hans (German)
Uhde, Fritz Karl Hermann von (German)
Vedder, Elihu (American)
Vinton, Frederic Porter (American)
Waterhouse John William (British)
Waterlow, Sir Ernest Albert (British)
Werner, Anton Alexander von (German)
Ziem, Félix François George Philibert (French)
Zorn, Anders (Swedish)
Zuloaga, Ignacio (Spanish)

5. Sculpture

(a) Subjects

Sculpture

(b) Biographies

Adamsen, Amandus Heinrich (Estonian)
Ball, Thomas (American)
Barlach, Ernst (German)
Barnard, George Grey (American)
Bartlett, Paul Wayland (American)
Begas, Reinhold (German)
Bissell, George Edwin (American)
Bitter, Karl Theodore Francis (American)
Borglum, Gutzon (American)
Borglum, Solon Hannibal (American)
Boyle, John J. (American)
Brock, Sir Thomas (British)
Dobson, Frank (British)
Epstein, Jacob (American-born, Russian-Polish parentage)
Frémiet, Emmanuel (French)
French, Daniel Chester (American)
Hartley, Jonathan Scott (American)
Hoffman, Malvina (American)
Hyatt, Anna Vaughn (American)
Koort, Jan (Estonian)
Lehmbruck, Wilhelm (German)
Lukeman, Henry Augustus (American)
Manship, Paul (American)
Mead, Larkin Goldsmith (American)
Mercié, Marius Jean Antonin (French)
Mestrovic, Ivan (Yugoslav)
Myslbek, Josef Václav (Czech)
O'Donovan, William Rudolf (American)
Rodin, François Auguste (French)
Rousseau, Victor (Belgian)
Saloun, Ladislav (Czech)
Stursa, Jan (Czech)
Taft, Lorado (American)
Thornycroft, Sir William Hams (British)
Vigeland, Adolf Gustav (Norwegian)
Young, Mahonri Mackintosh (American)

6. Minor Arts

(a) Subjects

Ceramics
Handicrafts, Artistic
Medals and Decorations

7. Stage and Dancing

(a) Subjects

Theatre
Acting
Ballet
Dancing
Motion Pictures §III
Musical Comedy
Stage and Stage Production
Variety Theatre

(b) Biographies

(Actors, including motion picture actors, theatrical designers, managers and producers, dancers; for playwrights *see* biographies in group XVI)

Adams, Maude (American)
Alexander, Sir George (British)
Bakst, Léon (Russian)
Bancroft, Sir Squire (British)
Barrymore, Ethel, John, and Lionel (American)
Bateman, Kate (American)
Belasco, David (American)
Bernhardt, Sara (French)
Chaplin, Charles Spencer (Anglo-American)
Chevalier, Albert (British)
Cohan, George Michael (American)
Craig, Edith (British)
Crane, William Henry (American)
Diaghilev, Sergei Pavlovich (Russian)
Duncan, Isadora (American)
Duse, Eleanora (Italian)
Fairbanks, Douglas (American)
Febvre, Alexandre Frédéric (French)
Félix, Lia (French)
Frohman, Charles (American)
Goodwin, Nathaniel Carl (American)
Granville-Barker, Harley Granville (British)
Grossmith, George, father and son (British)
Guitry, Lucian Germain (French)
Haase, Friedrich (German)
Hare, Sir John (British)
Harrigan, Edward (American)
Hawtrey, Sir Charles Henry (British)
Horniman, Annie Elizabeth Fredericka (British)
Jones, Robert Edmond (American)
Kendal, William Hunter (British)
Meyerhold, Vsevolod Emilievich (Russian)
Mounet-Sully, Jean (French)
Novelli, Ermete (Italian)
Pavlova, Anna (Russian)
Penley, William Sydney (British)
Pickford, Mary (American)
Playfair, Nigel (British)
Rehan, Ada (American)
Reinhardt, Max (German)
Réjane, Gabrielle (French)
Salvini, Tommaso (Italian)
Stanislavsky (Russian) (Constantine Sergeevich Alexeev)
Terry, Edward O'Connor (British)
Thorndyke, Sybil (British)
Tree, Sir Herbert Beerbohm (British)
Waller, Lewis (British)
Wyndham, Sir Charles (British)

IV. ASTRONOMY

1. Subjects

Astronomy
Solar Energy
Telescope

2. Biographies

Crawford, 26th Earl of (British)
Darwin, Sir George Howard (British)
Dyson, Sir Frank Watson (British)
Eddington, Arthur Stanley (British)
Hale, George Ellery (American)
Huggins, Margaret Lindsay, Lady (British)
Kövesligethy, Radó de (Hungarian)
Lockyer, Sir Joseph Norman (British)
Pickering, Edward Charles (American)

V. BIOLOGY

1. General

Biology
Biochemistry
Cytology
Death, Why and Wherefore
Ecology
Embryology
Evolution
Genetics
Heredity
Mendelism
Parasitology
Sex

2. Botany

Botany
Bacteriology
Mycology
Palaeobotany
Photosynthesis
Plant Pathology
Plant Physiology
(Articles on plants, since in these volumes they deal primarily with the economic aspects of their production or distribution or with their industrial uses, are listed in groups VII and XIII)

3. Zoology

(a) General

Zoology
Colours of Animals
Distribution of Animals
Entomology, Economic
Intelligence, Animal
Man, Evolution of
Protozoology

(b) Natural History

Birds, Migration of
Bison
Boll Weevil, Cotton

(c) Palaeontology

Palaeontology
Evolution §III
Mongolia, Palaeontological Discoveries in

4. Biographies

Andrews, Roy Chapman (American)
Bateson, William (British)
Beebe, Charles William (American)
Bose, Sir Jagadis Chandra (Indian)
Burbank, Luther (American)
Burroughs, John (American)
Fabre, Jean Henri (French)
Geddes, Patrick (British)
Haeckel, Ernst Heinrich (German)
Hagenbeck, Carl (German)
Hooker, Sir Joseph Dalton (British)
Hornaday, William Temple (American)
Howard, Leland Ossian (American)
Hudson, William Henry (British)
Jäger, Gustav (German)
Kellogg, Vernon Lyman (American)
Lankester, Sir Edwin Ray (British)
Lazarev, Petr Petrovich (Russian)
Lefroy, Harold Maxwell (British)
Mitchell, Peter Chalmers (British)
Osborn, Henry Fairfield (American)
Pearl, Raymond (American)
Ramon y Cajal, Santiago (Spanish)
Thomson, John Arthur (British)
Vejdovsky, Frantisek (Czech)
Wallace, Alfred Russel (British)
Weismann, August (German)

VI. CHEMISTRY

1. General

Chemistry
Biochemistry
Physical Chemistry
Antiseptics
Atom
Atomic Energy
Atomic Weights
Catalysts
Chemical Engineering
Chemical Warfare
Colloids
Explosives, Military
Fuel Problems
Gases, Electrical Properties of
Isotopes
Radioactivity
Transmutation of Elements

2. Inorganic

Aluminium
Ammonia
Antimony
Bakelite
Copper
Gold
Helium
Lead
Manganese
Nickel
Radium
Selenium
Silver
Tin
Zinc

3. Organic

Alcohol
Carbon, Syntheses of
Casein
Celluloid
Cellulose
Coal-Tar Products
Cyanamides
Cyanides
Ethyl Chloride
Ethylene
Nitrogen, Fixation of
Synthetic Resins

4. Biographies

Acheson, Edward Goodrich (American)
Armstrong, Henry Edward (British)
Arrhenius, Svante August (Swedish)
Aston, Francis William (British)
Baeyer, Johann Friedrich Wilhelm Adolf von (German)
Beilby, Sir George Thomas (British)
Bergius, Friedrich (German)
Brauner, Bohnslav (Czech)
Buchner, Eduard (German)
Caro, Nikodem (German)
Crookes, Sir William (British)
Curie, Marie (French)
Fischer, Emil (German)
Haber, Fritz (German)
Langmuir, Irving (American)
Ostwald, Wilhelm (German)
Perkin, William Henry (British)
Pope, Sir William Jackson (British)
Ramsay, Sir William (British)
Redwood, Sir Boverton (British)
Richards, Theodore William (American)
Roscoe, Sir Henry Enfield (British)
Rutherford, Sir Ernest (British)
Soddy, Frederick (British)
Van't Hoff, Jacobus Hendricus (Dutch)
Wallach, Otto (German)
Wiley, Harvey Washington (American)
Willstätter, Richard (German)

VII. ECONOMICS AND SOCIAL SCIENCE

(For economic geography and the economic and financial history of countries and cities, consult groups X and XII; for agricultural and manufacturing industries, group XIII; for vocational education, group VIII; for improvement of waterways and development of hydroelectric power, groups IX and X)

1. General

Capitalism
Economics
Sociology

Advertising
Agriculture (*see also* group XIII)
Agriculture, Census of
Allotments
Apprenticeship
Architecture §§II, III, IV
Asbestos
Baghdad Railway
Balance of Payments
Birth Control
Blind, Training and Welfare of the
Bolshevism
Bookkeeping
Bootlegging and Smuggling
Boy Scouts
Carnegie Trusts
Cartel
Child Labour and Child Welfare
Chinese Eastern Railway
City-Planning
Coal §§II–V
Colour and Race, Problems of
Commercial Treaties
Communism
Companies and Corporations
Control, Inter-Allied
Co-operation
Co-operation, Agricultural
Co-partnership
Cost Accounting
Cost of Living
Costume
Cotton
Culture Contact, Psychology of
Daylight Saving
Deaf and Dumb
Eugenics
Exhibition
Exhibition, British Empire
Factory and Workshop Law
Family Allowances
Farmers' Organisations
Farm Organisation and Equipment
Federal Trade Commission
Fire Prevention
Food Service
Food Supply (*see also* group XIII)
Freemasonry
Gasolene
Girl Guides
Grain Production and Trade
Hospitals
Hours of Labour
Household Appliances
Housing
Human Geography
Illegitimacy
Index Numbers
Industrial Psychology
Industrial Relations
Industrial Schools
Industrial Welfare and Medicine
Industry, War Control of
Inland Water Transport
Instalment Selling
Insurance, Social
International Labour Organisation, The
Interstate Commerce
Inventions
Job Analysis
Labour, Department of
Labour, Ministry of
Land Tenure
League of Nations §§ Economic and Financial Reconstruction; Miscellaneous Questions
Marketing
Marriage Laws
Mass Production
Maternity and Infant Welfare
Mental Deficiency
Mica
Migration
Milk and Dairy Products
Motoring
Motor Vehicles §§I, V, VI, VII, X
National Parks and Game Preserves
Natural Resources, Conservation of
Office Appliances
Office Management
Oils and Fats §II
Opium, Traffic in
Pensions
Petroleum
Poor Law
Population
Prices
Production, Census of
Profiteering
Profit Sharing
Prohibition
Railways
Rationing
Raw Materials (*see also* groups VI and XIII)
Red Cross
Refugees
Relief Work
Research, Industrial
Rockefeller Benefactions
Rubber
Rural Life
Safeguarding of Industry
Safety First
Savings Movement
Scientific Management
Second (socialist) International
Shipping
Slavery and Forced Labour
Smoke and Smoke Prevention
Socialism
Social Service
Standardisation
Statistics and Graphs
Strikes and Lockouts
Super Power
Tariffs
Third (Communist) International
Titanic, Loss of the
Tobacco
Trade Boards
Trade Cycle
Trade Facilities
Trade Forecasts
Trade, International
Trade Unionism
Traffic Problems
Trusts
Unemployment
Urbanisation
Urban Transportation
Wages
Wealth and Income
White Slave Traffic
Woman Suffrage
Women, Legal Position of
Women, Professional
Workers' Education
Works Councils
World Recovery

2. Finance and Currency

Banking and Credit
Betting Tax
Blue Sky Laws
Budget, National
Capital, Export of
Capital Levy
Coinage
Currency
Debts, Inter-Allied
Dollar Stabilisation
Excess Profits Duty
Exchanges, Foreign
Export Credits
Federal Farm Loan System
Imperial Preference
Income Tax
Insurance
Liberty Loans
Money Market
Motor Vehicles §IX
Reparations and the Dawes Plan
Stock Exchanges
Taxation
Turnover Tax

3. Biographies

(Economists, sociologists, social workers and reformers, bankers, railway officials, philanthropists, financial experts, labour leaders. Industrialists and merchants are classified in group XIII. Additional names of labour leaders, socialists and political reformers will be found in group XII, in connection with the history of their respective countries)

Abbott, Grace (American)
Adams, Henry Carter (American)
Addams, Jane (American)
Avebury, John Lubbock, 1st Baron (British)
Baker, George Fisher (American)
Barnett, Samuel Augustus (British)
Barton, Clara (American)
Baruch, Bernard Mannes (American)
Bebel, Ferdinand August (German)
Belmont, August (American)
Boehm von Bawerk, Eugen (Austrian)
Booth, Charles (British)
Braun, Lily (German)
Brentano, Ludwig Joseph (German)
Carnegie, Andrew (American)
Cassel, Sir Ernest Joseph (Anglo-German)
Cassel, Gustav (Swedish)
Catt, Carrie Chapman (American)
Cohn, Gustav (German)
Cunningham, William (British)
Elliott, Howard (American)
Fawcett, Millicent Garrett (British)
Fisher, Irving (American)
Galton, Sir Francis (British)
Geddes, Patrick (British)
Gide, Charles (French)
Gilbert, Seymour Parker (American)
Gompers, Samuel (American)
Grenfell, Wilfrid Thomason (British)
Hadley, Arthur Twining (American)
Higginson, Henry Lee (American)
Hill, James Jerome (American)
Hill, Octavia (British)
Hobhouse, Leonard Trelawney (British)
Inchcape, James Lyle Mackay, 1st Viscount (British)
Iwasaki, Koyata, 2nd Baron (Japanese)
Jaurès, Auguste Marie Joseph Jean (French)
Key, Ellen
Keynes, John Maynard
Knutsford, Sydney George Holland, 2nd Viscount (British)
Lamont, Thomas William (American)
Leacock, Stephen Butler (Canadian)
Legien, Carl (German)
Lenin, Vladimir Ilyich Ulyanov (Russian)
Leroy-Beaulieu, Pierre Paul (French)
Levasseur, Pierre Émile (French)
Leverhulme, William Hesketh Lever, 1st Viscount (British)
Liebknecht, Karl (German)
Loeb, James (American)
Luxemburg, Rosa (German)
Macarthur, Mary Reid (British)
Mackay, Clarence Hungerford (American)
Marshall, Alfred (British)
Mellon, Andrew William (American)
Morgan, John Pierpont, father and son (American)
Norman, Montagu Collet (British)
Palgrave, Sir Robert Harry Inglis (British)
Pankhurst, Emmeline, Christabel and Sylvia (British)
Pantaleoni, Maffeo (Italian)
Pearson, Karl (British)
Plekhanov, Georgy Valentinovich (Russian)
Radek, Karl (Russian)
Rakovsky, Christian Georgievich (Russian)
Rathenau, Walther (German)
Rea, Samuel (American)
Rockefeller, John Davison, father and son (American)
Rosenwald, Julius (American)
Royden, Agnes Maude (British)
Ryan, John Denis (American)
Rykov, Alexei Ivanovich (Russian)
Sage, Margaret Olivia Slocum (American)
Schacht, Hjalmar (German)
Schiff, Jacob Henry (American)
Schmoller, Gustav (German)
Schwab, Charles Michael (American)
Shaughnessy, Thomas George Shaughnessy, 1st Baron (Canadian)
Shaw, Anna Howard (American)
Shibusawa, Ei-Ichi, Viscount (Japanese)
Simmel, Georg (German)
Smith, Alfred Holland (American)
Smith, Jeremiah, Jr. (American)
Sokolnikov, Gregory Yakoblevich (Russian)
Sombart, Werner (German)
Stamp, Sir Josiah (British)
Taussig, Frank William (American)
Thomas, Albert (French)
Tönnies, Ferdinand (German)
Vail, Theodore Newton (American)
Vandervelde, Émile (Belgian)
Veblen, Thorstein B. (American)
Vissering, Gerard (Dutch)
Wagner, Adolf (German)
Wallenberg, Knut Agathon (Swedish)
Wallenberg, Marcus (Swedish)
Ward, Lester Frank (American)
Webb, Sidney (British)
Weber, Max (German)
Willard, Daniel (American)
Willett, William (British)
Young, Owen D. (American)
Zinoviev, Grigory Evseevich (Russian)

VIII. EDUCATION

(For the history and present status of education in particular countries and cities, *see* articles listed in groups X and XII)

EDUCATION—*continued*

1. Subjects

Education
Teaching

Adult Education
Apprenticeship
Architecture §V
Blind, Training and Welfare of the
Broadcasting
Classical Education
Co-education
Commercial Education
Continuation Schools
Deaf and Dumb
Elementary Education
Examinations
Foreign Languages
Industrial Education
Intelligence Tests
Learned Societies
Legal Education
Libraries
Medical Education
Mental Deficiency
Montessori System
Museums
Physical Training
Public Schools (English)
Reformatory Schools
Rhodes Scholarships
Secondary Schools
Summer Schools
Technical Education
University Development
University Extension, British
Vocational Training
Women, Education of
Workers' Education

2. Universities and Colleges

(Many institutions which are not the subject of separate articles are mentioned in the article on the town in which they are located)

Aberdeen, University of
Antioch College
Belfast, Queen's University of
Birmingham, University of
Bombay, University of
Brussels, University of
Calcutta, University of
California, University of
Cambridge
Cape Town, University of
Chicago, University of
Columbia University
Cornell University
Dacca, University of
Dartmouth College
Dublin, University of
Durham, University of
Edinburgh, University of
Glasgow, University of
Hamburg, University of
Harvard University
Ireland, National University of
Jena, University of
Jerusalem, University of
Johns Hopkins University
Leeds, University of
Leland Stanford Junior University
Liverpool, University of
London, University of
McGill University
Madras, University of
Manchester, Victoria University of
Michigan, University of
Munich, University of
Naval Academy
Oxford
Paris, University of
Pennsylvania, University of
Princeton University
Punjab, University of the
Reading, University of
St. Andrews, University of
Sheffield, University of
Smith College
Tokyo, University of
Toronto, University of
University of London
Vassar College
Wales, University of
West Point
Yale University
Zürich, University of

3. Biographies

(Teachers and administrators)

Alington, Cyril Argentine (British)
Angell, James Rowland (American)
Baker, George Pierce (American)
Bascom, John (American)
Bryant, Sophia (English)
Butler, Henry Montagu (British)
Butler, Nicholas Murray (American)
Compayre, Jules Gabriel (French)
Eliot, Charles William (American)
Farrand, Livingston (American)
Fisher, Herbert Albert Laurens (British)
Flexner, Abraham (*see* Flexner, Simon) (American)
Giner de los Rios, Francisco (Spanish)
Goodnow, Frank Johnson (American)
Hall, Granville Stanley (American)
Hadley, Arthur Twining (American)
Hibben, John Grier (American)
Jordan, David Starr (American)
Low, Seth (American)
Lowell, Abbott Lawrence (American)
Mason, Max (American)
Mathews, Shailer (American)
Montessori, Maria (Italian)
Morgan, Arthur Ernest (American)
Parken, Sir George Robert (British)
Paton, John Lewis Alexander (British)
Schurman, Jacob Gould (American)
Sidgwick, Arthur (British)
Vincent, George Edgar (American)
Washington, Booker Taliaferro (American)
White, Andrew Dickson (American)
Wilbur, Ray Lyman (American)
Woolley, Mary Emma (American)

IX. ENGINEERING

(For Military and Naval Engineering *see* group XIX)

1. General

Chemical Engineering
Electrical Engineering (*see* group XXI)
Ferro-Concrete Engineering
Hydroelectric Engineering
Illuminating Engineering
Irrigation Engineering
Marine Engineering
Port Engineering
River and Canal Engineering

Aerodrome
Aero Engines
Alcohol §II
Aqueduct
Boilers
Bridges
Coast Protection
Dams
Diving
Elevators and Escalators
Filtration
Gasolene
Household Appliances
Internal Combustion Engines
Inventions
Machine Tools
Materials, Strength of
Measuring Instruments
Meter: Electric and Gas
Musical Instruments
Office Appliances
Pumps
Refrigeration
Road Construction
Smoke and Smoke Prevention
Speed Indicators
Steam-Engine
Super Power
Testing Machinery
Textile Machinery
Thermo-Electric Pyrometer
Tidal Power
Transmission Gears, Variable
Turbine, Steam
Water Purification
Wind Power

2. Building

Heating and Ventilation
Factory Design
Railway Stations

3. Locomotion

(a) Transportation by Land

Motoring
Motor Vehicles §II
Railways
Tanks §I
Telpherage
Tires

(b) Aviation

Aerial Navigation
Aeronautics
Aeroplane
Airship
Flying, Commercial
Parachutes
Seaplanes

4. Shipping

Shipping

Aircraft Carrier
Flettner Rudder
Navigation
Rotor Ship
Salvaging
Star-Contra Propeller
Shipbuilding, Mercantile
Submarine

5. Mining and Metallurgy

Mining
Metallurgy

Fatigue of Metals
Iron and Steel
Metallography
Rustless Steel
Thermit
Welding

6. Engineering Projects

Information about engineering projects will be found in many of the articles in group X: as, for example,

Mississippi River
Muscle Shoals
Nile
Panama Canal §I
Shannon
Thames
Trent River
Zuyder Zee

7. Biographies

(Engineers, metallurgists and inventors; *see also* group XXI)

Benz, Karl (German)
Bréguet, Louis Charles (French)
Cramp, Charles Henry (American)
Curtis, Charles Gordon (American)
Diesel, Rudolf (German)
Fokker, Anthony Herman Gerard (Dutch)
Garstin, Sir William Edmund (British)
Goethals, George Washington (American)
Hadfield, Sir Robert Abbott (British)
Hammond, John Hays (American)
Hartley, Sir Charles Augustus (British)
Holland, John Philip (American)
Hoover, Herbert Clark (American)
Lewis, Isaac Newton (American)
Lindenthal, Gustav (American)
Maxim, Sir Hiram Stevens (Anglo-American)
Modjeski, Ralph (American)
Noble, Sir Andrew (British)
Parsons, Sir Charles Algernon (British)
Parsons, William Barclay (American)
Sopwith, Thomas Octave Murdoch (British)
Stevens, John F. (American)
Taylor, Frederick Winslow (American)
White, Sir William Henry (British)
Willcocks, Sir William (British)
Wright, Wilbur and Orville (American)
Zeppelin, Ferdinand, Count von (German)

X. GEOGRAPHY

1. General Subjects and Cartography

Geography
Human Geography
Map

Antarctica
Arctic Regions
British Empire
Exploration
Geodesy
Isostasy
Mountaineering
Polar Exploration
Surveying

2. Physical Features and Oceanography

Oceanography
Sounding
Tides

3. Meteorology

Meteorology
Climate and Climatology
Atmospheric Electricity
Kata Thermometer

4. Europe

(a) General Article

Europe

(b) Physical Features

Cyprus (island)
Danube (river)
Dardanelles (strait)
Elbe (river)
Gibraltar
Malta (island)
Oder (river)
Ouse (river)
Rhine (river)
Schelde (river)
Severn (river)
Shannon (river)
Thames (river)
Trent (river)
Vistula (river)
Volga (river)
Zuyder Zee

(c) Countries and towns

(Districts which changed their political status or affiliation between 1910 and 1925 are listed in group XII, subdivision 9)

Albania

Andorra

Austria, Republic of

Vienna

Belgium

Antwerp
Bruges
Brussels
Ghent
Liége
Louvain
Malines
Namur
Ostend
Ypres

Bulgaria

Czechoslovakia

Bratislava (Pressburg)
Brünn (Brno)
Prague

Dantzig, Free City of

Denmark
Copenhagen

Estonia
Revel (Tallinn)

Finland
Helsingfors

France
Amiens
Bordeaux
Boulogne-sur-Mer
Château-Thierry
Calais
Cantigny
Havre, Le
Lille
Lyons
Marseille
Mulhouse (Mulhausen)
Paris
Reims
Roubaix
Rouen
Strasbourg

Germany
Baden
Bavaria
Prussia
Saxony
Thuringia
Württemberg
Berlin
Bremen
Breslau
Coblenz
Cologne (Köln)
Dresden
Essen
Frankfort-on-Main
Hamburg
Leipzig
Munich

Great Britain and Ireland, United Kingdom of
Great Britain
United Kingdom of Great Britain and Ireland
Wales
Scotland
Ireland, Northern
Channel Islands
Barrow-in-Furness, England
Birkenhead
Birmingham
Blackburn
Blackpool
Bolton
Bournemouth
Bradford
Brighton
Bristol
Cambridge
Chequers
Coventry
Croydon
Dover
Folkestone
Grimsby
Hartlepool
Harwich
Hull
Immingham
Leeds
Leicester
Liverpool
London
London, Port of
Manchester
Margate
Middlesbrough
Newcastle-upon-Tyne
Newport
Northampton
Norwich
Nottingham
Oxford
Plymouth
Portsmouth
Preston
Ramsgate
Reading
Richborough
Salford
Scarborough
Sheffield
Southampton
Southend-on-Sea
South Shields
Stockport
Stoke-on-Trent
Stratford-on-Avon
Sulgrave Manor
Sunderland
Wembley
Winchester
Yarmouth
Cardiff, Wales
Port Talbot
Swansea
Aberdeen, Scotland
Cromarty
Dundee
Edinburgh
Glasgow
Greenock
Perth
Rosyth
Belfast, Northern Ireland

Greece
Corfú (island)
Athens
Kavalla
Salonika

Holland (article *Netherlands*)
Amsterdam
Hague, The
Rotterdam

Hungary
Budapest

Irish Free State
Cork
Dublin

Italy
Castellorizo (island)
Dodecanese (islands)
Fiume
Genoa
Milan
Naples
Rome
Trieste
Turin
Venice

Latvia

Lithuania
Kovno (Kaunas)
Memel

Luxembourg

Monaco

Norway
Bergen
Oslo (Christiania)
Trondhjem

Poland
Cracow
Gdynia
Lódz
Vilna (Wilno)
Warsaw

Portugal

Rumania
Bessarabia
Bukowina
Transylvania
Braila
Bucharest
Constantsa
Galatz (Galati)

Russia in Europe
Ukraine
White Russia
Archangel
Moscow
Murmansk
Odessa
Petrograd

San Marino

Spain
Barcelona
Madrid

Sweden
Göteborg (Gothenburg)
Stockholm

Switzerland
Basle
Geneva
Zürich

Turkey, Republic of
Adrianople
Constantinople

Yugoslavia
Bosnia-Hercegovina
Dalmatia
Croatia-Slavonia
Montenegro

5. Asia

(a) Physical Features and "Geographical Expressions"
Asia Minor
Everest, Mount
Hwang-Ho (river)
Kurdistan
Persian Gulf

(b) Countries, Divisions and Towns

Afghanistan

Arabia
Aden
Bahrein (islands)
Hejaz
Mecca
Medina
Oman

Ceylon
Colombo

China
Manchuria
Mongolia
Shantung
Canton
Foochow
Hankow
Nanking
Peking
Shanghai
Suchow
Tientsin
Wei-Hai-Wei

East Indies, Netherlands
Borneo

Hongkong (Hiang-Kiang)

India
Baluchistan
Burma
Amritsar
Bombay
Calcutta
Delhi
Karachi
Lahore
Madras
Rangoon

Indo-China, French

Iraq
Baghdad
Basra
Mosul

Japan
Formosa (island)
Korea (Chosen)
Kobe
Osaka
Tokyo
Yokohama

Malay States, Federated

Malay States, Non-Federated

Nepal

Palestine
Jerusalem

Persia
Tabriz
Tehran

Russia in Asia
Siberia
Turkmenistan
Uzbegistan
Khiva
Vladivostok
Kara-Kirghiz
Tadjikistan

Siam
Bangkok

Straits Settlements
Singapore

Syria
Aleppo
Beirut
Damascus

Tibet

Transcaucasia
Armenia
Azerbaijan
Baku
Georgia

Transjordan

Turkey, Republic of
Angora
Brusa
Smyrna

6. Africa

(a) General

Africa
Nile
Senussi
Suez Canal

(b) Countries

Abyssinia

Algeria

Angola

Ashanti

Basutoland

Bechuanaland

Belgian Congo

Cameroons

Egypt
Alexandria
Cairo

Equatorial Africa, French

Eritrea

Gambia

Gold Coast

Kenya Colony
Mombasa
Nairobi

Liberia

(b) Countries—*continued*

Libya
Cyrenaica
Tripolitania
Tripoli

Madagascar

Morocco

Morocco, Spanish
Casablanca
Fez
Marrakesh
Tangier

Mozambique
Beira

Nigeria
Lagos

Nyasaland Protectorate

Rhodesia
Barotseland
Bulawayo
Salisbury

Rio de Oro

Sierra Leone

Somaliland

South Africa, Union of
Cape Province
Natal
Orange Free State
Transvaal
Bloemfontein
Cape Town
Durban
East London
Johannesburg
Lourenco Marques (Delagoa Bay)
Pietermaritzburg
Port Elizabeth
Pretoria
Zululand

Southwest Africa

Sudan, The Anglo-Egyptian

Swaziland

Tanganyika Territory
Ruanda-Urundi

Togo

Tunisia

Uganda

West Africa, French
Dahomey
Guinea, French
Ivory Coast
Mauritania
Senegal

Zanzibar

7. North America

(a) General
Caribbean, The
Colorado River
Great Lakes and St. Lawrence
Mississippi River
Muscle Shoals
Panama Canal

(b) Countries, Divisions and Towns

Canada
Alberta
British Columbia
Manitoba
New Brunswick
Northwest Territories
Nova Scotia
Ontario
Prince Edward Island
Quebec
Saskatchewan
Yukon Territory
Calgary, Alberta
Edmonton, Alberta
Halifax, Nova Scotia
Hamilton, Ontario
Montreal
Ottawa, Ontario
Quebec, P.Q.
Regina, Saskatchewan
Toronto, Ontario
Vancouver, British Columbia
Winnipeg, Manitoba

Labrador

Newfoundland

United States
Alabama
Alaska
Arizona
Arkansas
California
Colorado
Connecticut
Delaware
Florida
Georgia
Idaho
Illinois
Indiana
Iowa
Kansas
Kentucky
Louisiana
Maine
Maryland
Massachusetts
Michigan
Minnesota
Mississippi
Missouri
Montana
Nebraska
Nevada
New Hampshire
New Jersey
New Mexico
New York
North Carolina
North Dakota
Ohio
Oklahoma
Oregon
Pennsylvania
Rhode Island
South Carolina
South Dakota
Tennessee
Texas
Utah
Vermont
Virginia
Washington
West Virginia
Wisconsin
Wyoming

Akron, Ohio
Albany, N.Y.
Atlanta, Georgia
Atlantic City, New Jersey
Baltimore, Md.
Birmingham, Ala.
Boston, Mass.
Bridgeport, Conn.
Buffalo, New York
Cambridge, Mass.
Camden, N.J.
Chicago, Illinois
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio
Dallas, Texas
Dayton, Ohio
Denver, Colorado
Des Moines, Iowa
Detroit, Michigan
Duluth, Minnesota
El Paso, Texas
Fall River, Mass.
Flint, Michigan
Fort Worth, Texas
Gary, Indiana
Grand Rapids, Michigan
Hollywood, Cal.
Houston, Texas
Indianapolis, Ind.
Jersey City, N.J.
Kansas City, Kan.
Kansas City, Mo.
Los Angeles, Cal.
Louisville, Ky.
Lowell, Mass.
Lynn, Mass.
Memphis, Tenn.
Miami, Florida
Milwaukee, Wis.
Minneapolis, Minn.
Nashville, Tenn.
Newark, N.J.
New Bedford, Massachusetts
New Haven, Conn.
New Orleans, La.
New York City
Norfolk, Virginia
Oakland, Cal.
Oklahoma City, Oklahoma
Omaha, Nebraska
Palm Beach, Fla.
Paterson, N.J.
Philadelphia, Penn.
Pittsburgh, Penn.
Portland, Oregon
Providence, R.I.
Reading, Penn.
Rochester, N.Y.
St. Louis, Mo.
St. Paul, Minn.
Salt Lake City, Utah
San Antonio, Tex.
San Francisco, Cal.
Schenectady, N.Y.
Scranton, Penn.
Seattle, Wash.
Spokane, Wash.
Springfield, Mass.
Syracuse, N.Y.
Tacoma, Wash.
Toledo, Ohio
Trenton, N.J.
Tulsa, Oklahoma
Utica, New York
Washington, D.C.
Wilmington, Del.
Worcester, Mass.
Youngstown, Ohio

Mexico
Mexico City

Costa Rica

Guatemala

Honduras

Honduras, British

Nicaragua

Panama

Salvador

West Indies, British
Bahamas
Jamaica

Cuba
Havana

Haiti

Porto Rico

Santo Domingo

Virgin Islands

8. South America

(a) General
Amazon
Orinoco
Plata, Rio de la

(b) Countries and Towns

Argentina
Buenos Aires

Bolivia

Brazil
Bahia (Sao Salvador)
Recife
Rio de Janeiro
Santos
Sao Paulo

Chile
Santiago
Valparaiso

Colombia

Ecuador

Guiana, British

Guiana, Dutch

Guiana, French

Paraguay

Peru
Lima

Uruguay
Montevideo

Venezuela

9. Australasia

Australia
Adelaide
Brisbane
Canberra
Hobart
Melbourne
Perth
Sydney
New South Wales
Queensland
South Australia
Tasmania
Victoria
Western Australia
Northern Territory
Papua (territory)

New Zealand
Christchurch
Wellington

10. Oceans, Seas and Oceanic Islands

Adriatic Sea
Black Sea
Caribbean, The
Mediterranean Sea
Pacific, Command of the
Sargasso Sea

Faeroe Islands

Iceland

Mauritius

Fiji Islands

Guam

Hawaii

Nauru

Oceania (Oceanica)

Philippine Islands

Samoa

Yap

Antarctica

Spitsbergen

11. Biographies

(Travellers, explorers, cartographers, meteorologists)

Abbe, Cleveland (American)
Abruzzi, Duke of the (Italian)
Amundsen, Roald (Norwegian)
Andree, Richard (German)
Bingham, Hiram (American)
Blache, Vidal de la (French)
Byrd, Richard Evelyn (American)
Bjerknes, Vilhelm (Norwegian)
Charnay, Désiré (French)
De Filippi, Filippo (Italian)
Forrest, John Forrest, 1st Baron (Australian)
Greeley, Adolphus Washington (American)
Hann, Julius (Austrian)
Hedin, Sven (Swedish)
Hildebrandssen, Hugo Hildebrand (Swedish)
Kropotkin, Peter Alexeivich, Prince (Russian)

Markham, Sir Clements Robert (British)
Mohn, Henrik (Norwegian)
Murray, Sir John (British)
Nansen, Fridtjof (Norwegian)
Nares, Sir George Strong (British)
Peary, Robert Edwin (American)
Penck, Albrecht (German)
Peters, Karl (German)
Rasmussen, Knud Johan Victor (Danish)
Ravenstein, Ernst Georg (British)
Russell, Israel Cook (American)
Schweinfurth, Georg August (German)
Scott, Robert Falcon (British)
Selous, Frederick Courtney (British)
Shackleton, Sir Ernest Henry (British)
Stefansson, Vilhjálmur (Icelandic?)
Sykes, Sir Mark (British)
Teisserenc de Bort, Léon Philippe (French)
Teleki, Paul, Count (Hungarian)
Whymper, Edward (British)
Zichy, Eugen, Count (Hungarian)

XI. GEOLOGY

1. Subjects

Geology
Geology: New Theories
Crystallography
Mineralogy
Palaeontology
Petrology
Earthquakes
Isostasy

2. Biographies

Boule, Pierre Marcelin (French)
Geikie, Sir Archibald (Scotch)
Gilbert, Grove Karl (American)
Jones, Thomas Rupert (British)
Kövesligethy, Radó de (Hungarian)
Lapworth, Charles (British)
Lévy, Auguste Michel (French)
Lóczy, Lájos de Lócz (Hungarian)
Renevier, Eugène (Swiss)
Russell, Israel Cook (American)
Suess, Eduard (Austrian)
Whiteaves, Joseph Frederick (British)
Woodward, Henry (British)
Woodward, Horace Bolingbroke (British)

XII. HISTORY

1. General (*see also* section 9, foll.)

Ambassadors, Conference of
Arctic Regions
Bolshevism
British Empire
British Legion
Exhibition, British Empire
Imperial Preference
(*See also* articles on the component parts of the Empire, scattered through this group and group X)
Capitulations
Diplomacy
Disarmament
Human Geography
League of Nations
Mandate
Migration
Minorities
Plebiscite
Sanctions and Guarantees
Security
Self-Determination
Slavery and Forced Labour
Treaties
War

2. Heraldry, Titles and Offices

Flag
Knighthood and Chivalry

3. Europe

(a) General

(*See also* section 9, foll.)

Europe
Archaeology §§III, IV, IX
Little Entente
Pan-Germanism

(b) Wars

Balkan Wars
Italo-Turkish War, 1911–2
Russo-Polish Campaign, 1920
World War (*see* sections 8 and 9, below)

(c) Battles

See section 8, foll.

(d) Countries

(*See also* sections 8 and 9, foll., for special articles on engagements of the World War and on territories which changed their political affiliation between 1910 and 1925)

Albania

Andorra

Austria-Hungary

Aehrenthal, Aloys Lexa von, Count
Auffenberg-Komarov, Moritz, Ritter von*
Badeni, Kasimir, Count
Berchtold von und zu Ungarschitz, Leopold, Count
Burian von Rajecz, Stephen, Count
Charles I.
Conrad von Hötzendorf, Franz*
Czernin, Ottokar, Count
Francis Ferdinand, Archduke
Francis Joseph I.
Goluchowski, Agenor, Count
Görgei, Arthur
Habsburg (family)
Körber, Ernst von
Pernerstorfer, Engelbert
Plener, Ernst, Freiherr von
Sturgkh, Carl, Count

Austria, Republic of

Bauer, Otto
Hainisch, Michael
Hanusch, Ferdinand
Renner, Karl
Schober, Johann
Seipel, Ignaz
Seitz, Karl

Belgium

Albert I.
Broqueville, Charles Marie Pierre Albert, Comte de
Huysmans, Camille
Hymans, Paul
Jaspar, Henri†
Mau, Adolphe
Mercier, Desire*
Theunis, Georges†
Vandervelde, Emile†

Bulgaria

Boris III.
Ferdinand
Gueschoff, Ivan Evstratiew
Stambolisky, Alexander†
Stancioff, Dimitri†

Czechoslovakia

Benes, Edward†
Masaryk, Thomas Garrigue
Rasin, Alois
Svehla, Antonín

Denmark

Bang, Nina Henriette Wendeline
Christensen, Jens Christian
Christian X.
Frederick VIII.

Estonia

Laidoner, Johan†
Päts, Konstantin
Tönisson, Jaan

Finland

Stahlberg, Kaarlo Juho

France

Barthou, Jean Louis†
Bérenger, René
Berthelot, Philippe
Bourgeois, Léon Victor Auguste
Briand, Aristide*†
Brisson, Eugène Henri
Caillaux, Joseph-Marie-Auguste
Cambon, Jules Martin
Cambon, Pierre Paul
Castelnau, Edouard de Curières de*
Clemenceau, Georges*†
Clémentel, Etienne
Cochery, George Charles Paul
Cochin, Denys Marie Pierre Augustin
Combes, Emile
Constans, Jean Antoine Ernest
Degoutte, Joseph*
Delcassé, Théophile
Deschanel, Paul Eugène Louis
Dodds, Alfred Amédée
Doumer, Paul
Doumergue, Gaston
Dupuy, Charles Alexandre
Eugénie
Fayolle, Marie Emile*
Foch, Ferdinand*
Franchet d'Esperey, Louis*
Freycinet, Charles Louis de Saulces de
Gallieni, Joseph Simon*
Gérault-Richard, Alfred, Léon
Gouraud, Henri Joseph Etienne*
Guesde, Jules Basile
Guillamat, Marie Louis Adolphe*
Herriot, Edouard†
Jaurès, Auguste Marie Joseph Jean
Joffre, Joseph Jacques Césaire†
Jouvenel, Henri de†
Laguerre, Jean Henri Georges
Laisant, Charles Anne
Lanessan, Jean Marie Antoine de
Leygues, Georges
Lockroy, Edouard
Loucheur, Louis
Malvy, Louis Jean
Mangin, Charles Emmanuel*
Marchand, Jean Baptiste
Maunoury, Michel Joseph*
Méline, Félix, Jules
Millerand, Alexandre†
Mun, Adrian Albert Marie, Count de
Naquet, Alfred Joseph
Nivelle, Robert George*
Ollivier, Olivier Emile
Orleans, Louis Philippe Robert, Duke of
Painlevé, Paul
Paléologue, Maurice Georges
Paul-Boncour, Joseph†
Pelletan, Charles Camille
Pétain, Henri Philippe Benoni Omer Joseph
Poincaré, Raymond*†
Reinach, Joseph
Ribot, Alexandre Félix Joseph
Rochefort, Henri
Rouvier, Maurice
Sarrail, Maurice Paul Emmanuel*
Sembat, Marcel
Tardieu, André Pierre Gabriel Amédée†
Thomas, Albert†
Viviani, Rene*
Weygand, Max*

Germany

Bauer, Gustav
Bernhardi, Friedrich von*
Bernstein, Eduard
Bernstorff, Johann Friedrich, Count von
Bethman Hollweg, Theobald von
Brockdorff-Rantzau, Ulrich, Count von†
Bülow, Bernhard Heinrich Karl Martin, Prince von*
Bülow, Karl von*
Ebert, Friedrich
Eisner, Kurt
Erzberger, Matthias
Falkenhayn, Erich von*
Haase, Hugo
Helfferich, Karl
Hertling, Georg, Count von
Hindenburg, Paul von*
Kapp, Wolfgang
Kluck, Alexander von*
Lichnowsky, Karl Max, Prince
Liebknecht, Karl
Liman Von Sanders, Otto*
Louis, ex-king of Bavaria
Ludendorff, Erich*
Luther, Hans†
Luxemburg, Rosa
Mackensen, August von*
Marx, Wilhelm
Maximilian, Prince of Baden
Moltke, Helmuth von*
Müller, Hermann†
Noske, Gustav
Rathenau, Walther
Rupert, Prince of Bavaria*
Scheer, Reinhard*
Scheidemann, Philipp
Seeckt, Hans von*
Spee, Maximilian, Count von*
Stresemann, Gustav†
Tirpitz, Alfred von*
Vollmar, Georg Heinrich von
William II.*
William, former Crown Prince*
Wirth, Karl Joseph
Zimmermann, Arthur*

Great Britain and Ireland, United Kingdom of

Anglo-Japanese Alliance
Channel Islands
Conservative Party
Great Britain
Health, Ministry of
Ireland
Ireland, Northern
Labour, Ministry of
Labour Party
Liberal Party
Pensions, Ministry of
Rural Life
Safeguarding of Industry
Scotland
Trade Boards
Trade Facilities
Wales

Abercorn, James Hamilton, 2nd Duke of
Abraham, William
Alexandra, Queen
Allenby, Edmund Henry Hynman, 1st Viscount*
Amery, Leopold Charles Maurice Stennett
Arch, Joseph
Astor, John Jacob
Astor, Nancy Witcher, Viscountess
Astor, Waldorf Astor, 2nd Viscount
Baldwin, Stanley
Balfour, Arthur James Balfour, 1st Earl of*
Beatty, David Beatty, 1st Earl*
Beaverbrook, William Maxwell Aiken, 1st Baron*

*See XII, 8 (c). †See XII, 9 (c).

Great Britain and Ireland—*continued*

Benn, William Wedgwood
Beresford, Charles William de la Poer Beresford, 1st Baron
Birdwood, Sir William Riddell*
Birkenhead, Frederick Edwin Smith, 1st Earl of
Birrell, Augustine
Bondfield, Margaret
Bradbury, John Swanwick Bradbury, 1st Baron
Brassey, Thomas Brassey, 1st Earl
Bridgeman, William Clive
Bryce, James, 1st Viscount
Buccleugh, William Henry Walter Montagu-Douglas-Scott, 6th Duke of
Burns, John
Butler, Sir William Francis
Byng, Julian Hedworth John Byng, 1st Baron*
Carson, Edward Henry Carson, Baron*
Casement, Roger David
Cavan, Frederick Rudolph Lambert, 10th Earl of*
Cave, George Cave, 1st Viscount
Cavell, Edith Louisa*
Cecil, Lord Hugh Richard Heathcote
Cecil of Chelwood, Edgar Algernon Robert Cecil, 1st Viscount†
Chamberlain, Arthur Neville
Chamberlain, Joseph
Chamberlain, Sir Joseph Austen†
Chaplin, Henry Chaplin, 1st Viscount
Chelmsford, Frederick John Napier Thesiger, 1st Viscount
Chetwode, Sir Philip Walhouse*
Churchill, Winston Leonard Spencer
Clynes, John Robert
Collings, Jesse
Connaught, Arthur William Patrick Albert, Duke of
Courtney, Leonard Henry Courtney, 1st Baron
Cowans, Sir John Steven
Cowdray, Weetman Dickinson Pearson, 1st Viscount
Cradock, Sir Christopher George Francis Maurice
Craig, Sir James
Crewe, Robert Offley Ashburton Crewe-Milnes, 1st Marquess of
Cromer, Evelyn Baring, 1st Earl of
Crowe, Sir Eyre Alexander
Cunliffe-Lister, Sir Philip
Curzon of Kedleston, George Nathaniel Curzon, 1st Marquess*†
D'Abernon, Edgar Vincent, 1st Viscount
Derby, Edward George Villiers Stanley, 17th Earl of
Dilke, Sir Charles Wentworth
Edward, Prince of Wales
Elgin, Victor Alexander Bruce, 9th Earl of
Eliot, Sir Charles Norton Edgcumbe
Ernle, Rowland Edmund Prothero, 1st Baron
Esther, Reginald Baliol Brett, 2nd Viscount
Finlay, Robert Baumatyne Finlay, 1st Viscount
Fisher, John Arbuthnot Fisher, 1st Baron*
Fisher, Herbert Albert Laurens
Fryatt, Charles*
Geddes, Sir Auckland Campbell
Geddes, Sir Eric Campbell
George V.
George, David Lloyd*†
Gorst, Sir John Eldon
Gough, Sir Hubert de la Poer*
Grey, Albert Henry George, 4th Earl
Grey of Falloden, Edward Grey, 1st Viscount*
Grierson, Sir James Moncrieff
Haldane, Richard Burdon Haldane, 1st Viscount
Haig, Douglas Haig, 1st Earl*
Hamilton, Sir Ian Standish Monteith*
Harcourt, Lewis Vernon Harcourt, 1st Viscount
Hardie, James Keir
Hardinge of Penshurst, Charles Hardinge, 1st Baron
Harington, Sir Charles Harington*
Healy, Timothy Michael
Henderson, Arthur
Hodges, Frank
Horne, Henry Sinclair Horne, 1st Baron*
Horne, Sir Robert Stevenson
Hyndman, Henry Mayers
Irwin, Edward Frederick Lindley Wood, 1st Baron
Jellicoe, John Rushworth Jellicoe, 1st Earl*
Joynson-Hicks, Sir William
Keyes, Sir Roger John Brownlow*
Kitchener, Horatio Herbert Kitchener*
Labouchère, Henry du Pré
Lansbury, George
Lansdowne, Henry Charles Keith Petty Fitzmaurice, 5th Marquess of
Lascelles, Henry George Charles, Viscount
Law, Andrew Bonar
Lee of Fareham, Arthur Hamilton Lee, 1st Viscount
Llandaff, Henry Mathews, 1st Viscount
Lloyd of Dolobran, George Ambrose Lloyd, 1st Baron
Londonderry, Charles Stewart Henry Vane-Tempest-Stewart, 7th Marquess of
Long, Walter Hume Long, 1st Viscount
Lyttleton, Alfred
Macarthur, Mary Reid
Macdonald, James Ramsay
McKenna, Reginald
Maclean, Sir Donald
M'Neill, Ronald John
Mary, Queen Consort of England
Maude, Sir Frederick Stanley*
Maurice, Sir Frederick Barton
Maxse, Sir Ivor*
Middleton, William St. John Fremantle Brodrick, 1st Earl of
Milford Haven, Louis Alexander, 1st Marquess of
Milne, Sir George Frederick*
Milner, Alfred Milner, Viscount†
Minto, Gilbert John Elliott-Murray-Kynynmond, 4th Earl of
Mond, Sir Alfred Moritz
Monro, Sir Charles Carmichael*
Montagu, Edwin Samuel
Morant, Sir Robert Laurie
Morley of Blackburn, John Morley, Viscount
Nicholson, William Gustavus Nicholson, 1st Baron
Norfolk, Henry Fitzalan Howard, 15th Duke of
Northcliffe, Alfred Charles William Harmsworth, Viscount*
Northumberland, Alan Ian Percy, 8th Duke of
Oxford and Asquith, 1st Earl of*
Peel, Arthur Wellesley Peel, 1st Viscount, and his son, William Robert Wellesley Peel
Plumer, Herbert Charles Onslow Plumer, 1st Baron*
Power, Sir William Tyrone
Rawlinson, Henry Seymour Rawlinson, 1st Baron*
Reading, Rufus Daniel Isaacs, 1st Marquess of*
Redesdale, Algernon Bertram Freeman-Mitford, 1st Baron
Rhondda, David Alfred Thomas, 1st Viscount*
Roberts, Frederick Sleigh Roberts, Earl
Robertson, Sir George Scotte
Robertson, Sir William Robert*
Ronaldshay, Lawrence John Lumley Dundas, Earl of
Roseberry, Archibald Philip Primrose, 5th Earl of
Runciman, Walter
St. Aldwyn, Michael Edward Hicks-Beach, 1st Earl
Salisbury, James Edward Hubert Gascoyne-Cecil, 4th Marquess of
Samuel, Sir Herbert Louis
Scott, Sir Percy Moreton
Seely, John Edward Bernard
Selborne, William Waldegrave Palmer, 2nd Earl of
Smillie, Robert
Smith-Dorrien, Sir Horace Lockwood*
Snowden, Phillip
Spring-Rice, Sir Cecil Arthur
Sturdee, Sir Frederick Doveton*
Swinton, Sir Ernest Dunlop*
Sydenham, George Sydenham Clarke, 1st Baron
Thomas, James Henry
Thomson, Christopher Birdwood, 1st Baron
Trenchard, Sir Hugh Montague*
Weir, William Douglas Weir, 1st Baron
Wester Wemyss, Rosslyn Erskine Wemyss, 1st Baron
Wheatley, John
White, Sir George Stuart
Wilson, Sir Henry Hughes*
Wingate, Sir Francis Reginald
Wolseley, Garnet Joseph Wolseley, Viscount
Wolverhampton, Henry Hartley Fowler, 1st Viscount
Wood, Sir Henry Evelyn
Worthington-Evans, Sir Laming
Wyndham, George
York, Albert Frederick Arthur George, Duke of
Ypres, John Denton Pinkstone French, Earl of*

Greece

Alexander, King of the Hellenes
Condouriotes, Paul
Constantine, King of the Hellenes*
George I.
George II.
Pangalos, Theodor
Veniselos, Eleutherios†
Zaimes, Alexander

Holland (*see* article *Netherlands*)

Colyn, Hendrick
Cort van der Linden, Pieter Willem Adrian
Karnebeek, Herman Adriaan van
Troelstra, Pieter Jelles

Hungary

Andrássy, Julius, Count
Apponyi, Albert, Count†
Banffy, Dezsö, Baron
Berzeviczy, Albert de
Bethlen, Stephen Bethlen de, Count
Horthy de Nagybanya, Nicholas*
Károlyi, Michael, Count
Kossuth, Francis
Kun, Béla
Teleki, Paul, Count
Tisza, Stephen, Count
Wekerle, Santor

Iceland

Christian X.
Hafstein, Hannes Thordur

Irish Free State

Childers, Robert Erskine
Collins, Michael
Cosgrave, William Thomas
De Valera, Eamon
Dillon, John
Griffith, Arthur
Healy, Timothy Michael
Mulcahy, Richard James
Pearse, Patrick Henry
Plunkett, Sir Horace Curzon
Redmond, John Edward

Italy

Fascism

Amendola, Giovanni
Aosta, Emanuele Filiberto, Duke of*
Badoglio, Pietro*
Bertolini, Pietro
Bissolati-Bergamaschi, Leonida
Cadorna, Luigi*
Caneva, Carlo
Capello, Luigi
Caviglia, Enrico*
Colajanni, Napoleone
D'Annunzio, Gabriele*
De Stefani, Alberto
Diaz, Armando
Farinacci, Roberto
Federzoni, Luigi
Garibaldi, Giuseppe
Gentile, Giovanni
Giardino, Gaetano*
Giolitti, Giovanni
Mussolini, Benito
Nathan, Ernesto
Nitti, Francesco Saverio
Orlando, Vittorio Emanuele†
Pelloux, Luigi
Ricotti-Magnani, Cesare
Salandra, Antonio
San Giuliano, Antonino Paterno-Castelli, Marquis di
Scarfoglio, Edoardo
Sonnino, Sidney, Baron†
Sturzo, Luigi
Tittoni, Tommaso
Treves, Claudio
Victor Emmanuel III.
Visconti-Venosta, Emilio, Marquis

Latvia

Meirovics, Zigfrids
Tschakste, Jan

Lithuania

Basanavicius, Jonas
Galvanauskas, Ernest
Smetona, Antanas

Luxembourg

Monaco

Montenegro

Nicholas

Norway

Michelsen, Peter Christian Hersleb Kjerschow

Ottoman Empire, The

Abdul Hamid II.
Djemal Pasha, Ahmed*
Kiamil Pasha
Mahommed V.
Said, Halim, Prince
Said Pasha, Mohammed
Tewfik, Ahmed Pasha

Papacy

Agliardi, Antonio
Benedict XV.
Merry del Val, Raphael
Pius X.
Pius XI.
Rampolla, Count Mariano del Tindaro

Poland

Paderewski, Ignace Jan†
Pilsudski, Joseph*
Skrzynski, Alexander, Count†

Portugal

Arriaga Brun da Silviera e Peyrelongue, Manoel Jose D'
Manoel II.

Rumania

Argetoianu, Constantin
Averescu, Alexandre*
Bratianu, Jon*†
Charles, King
Elizabeth, Queen
Ferdinand I.
Jonescu, Take
Lupu, Nicholas
Maniu, Julius
Marghiloman, Alexandre
Marie, Queen
Mihalache, Ion
Sturdza, Demetrius
Vaida-Voevod, Alexandre†

Russia in Europe

Bolshevism

Alexeyev, Mikhail
Benckendorff, Alexander, Count
Brusilov, Alexei Alexeivich*

Budenny, Simeon Mikhail
Chicherin, Georghy Valentinovich
Denikin, Anton
Dzerzhinsky, Felix Edmundovich
Frunze, Mikhail*
Guchkov, Alexander
Izvolsky, Alexander Petrovich
Kerensky, Alexander Feodorovich
Kolchak, Vladimir Vasilievich*
Kornilov, Lavr Georgievich*
Krassin, Leonid
Kuropatkin, Alexei Nikolaievich
Lenin, Vladimir Ilyich Ulyanov
Litvinov, Maxim†
Lunacharsky, Anatoly Vasilievich
Lvov, Prince George Eugenievich
Milyukov, Paul Nikolayevich
Nicholas II.
Nicholas, Grand Duke*
Plekhanov, Georgy Valentinovich
Radek, Karl
Rakovsky, Christian Georgievich
Rasputin, Gregory Efimovich
Rykov, Alexei Ivanovich
Sazonov, Sergius Dmitrievich
Sokolnikov, Gregory Yakoblevich
Stalin, Joseph
Stolypin, Peter Arcadievich
Tomsky (Michael Pavlovich Efremov)
Trotsky, Lev Davidovich
Tukhachevsky, Mikhail*
Voroshilov, Klementiy
Wrangel, Peter, Nickolaievich, Baron*
Yudenich, Nikolai Nikolaevich*
Zinoviev, Grigory Evseevich

San Marino

Serbia

Milovanovic, Milovan
Misic, Zivojin*
Pasic, Nicholas
Putnik, Radomir
Vesnic, Milenko†

Spain

Alfonso XIII.
Azcarate, Gumersindo
Canalejas, Jose
Dato, Eduardo
Maura, Antonio Montaner
Montero Rios, Eugenio
Moret y Prendergast, Segismundo
Primo de Rivera, Miguel (Marquis de Estella)
Romanones, Alvaro de Figueroa y Torres, Count de

Sweden

Branting, Karl Hjalmar†
Hammarskjöld, Hjalmar†
Unden, Osten†

Switzerland

Ador, Gustave
Motta, Giuseppe†

Turkey (*see Turkey, Republic of*, under Asia, below)

Yugoslavia

Alexander I.
Davidovic, Ljubomir
Peter I.
Protic, Stojan
Supilo, Frano
Trumbic, Ante†

4. Asia

(a) General

(*See* also section 9, foll.)

Archaeology §§ X, XI, XII

(b) Countries

(*See* also sections 8 and 9, foll.)

Afghanistan

Amanulla Khan
Ayub Khan
Yakub Khan

Arabia

Wahibi
'Abdulaziz Ibn Sa'ud
Husain Ibn 'Ali

Asia Minor

Caliphate

Ceylon

China

Secret Societies, Chinese
Taoism

Chang Tso-Lin
Feng Yu-Hsiang
Hart, Sir Robert
Liang Shih-yi
Sun Yat-Sen
Tang Shao Yi
Tuan, Chi-Jui
Wu Pei Fu
Yuan Shih-K'ai

East Indies, Netherlands

Hong-Kong (*Hiang-Kiang*)

India

Aga Khan III.
Amir 'Ali, Seyyid
Banerjea, Sir Surandranath
Bhopal, Begum of
Bikaner, Sir Ganga Singh, Maharaja of
Cotton, Sir Henry John Stedman
Das, Chitta Ranjar
Gandhi, Mohandas Karamchad
Gokhale, Gopal Krishna
Gwalior, Mahdo Rao Sindhia, Maharaja of*
Hyderabad, Sir Mir Osman Ali Khan, 7th Nizam of
Mehta, Sir Pharozeshah Merwanji
Montagu, Edwin Samuel
Naoroji, Dadabhai
Patiala, Sir Bhupindar Singh, Maharaja of
Pertab Singh
Ranjitsinji, Kumar Shri, Maharaja of Navanagar†
Reading, Rufus Daniel Isaacs, 1st Marquess of
Sinha, Satyendra Prasano, 1st Baron†
Tilak, Bal Gangadhar

Indo-China, French

'Iraq

Faisal al Husain
Lawrence, Thomas Edward†

Japan

Anglo-Japanese Alliance
Shintoism

Goto, Shipei, Viscount
Hanihara, Masanao
Hara, Takashi
Hayashi, Tadasu, Count
Inouye, Kaoru, Marquess
Ishii, Kikujiro, Viscount†
Itagaki, Taisuke, Count
Iwasaki, Koyata, 2nd Baron
Kato, Taka-Akira, Count
Katsura, Taro, Prince
Komura, Jutaro, Marquess
Kuroki, Itei, Count
Matsudaira, Tsuneo
Matsukata, Masayoshi, Prince
Mutsuhito, Emperor
Nogi, Maresuke
Okuma, Shigenobu, Prince
Oyama, Iwao, Prince
Saionji, Kimmochi†
Saito, Minoru, Viscount
Tokugawa, Yoshinobu, Prince
Yamagata, Aritomo, Prince
Yoshihito, Emperor
Yoshizawa, Kenkichi

Jews

Judaism
Zionism

Malay States, Federated

Malay States, Non-Federated

Nepal

Palestine

Persia

Riza Pahlavi

Russia in Asia

Siam

Straits Settlements

Syria

Druses

Tibet

Transcaucasia

Transjordan

Turkey, Republic of

Enver Pasha
Ismet Pasha†
Mustafa Kemal*
Shevket, Mahmud

Turkistan

5. Africa

(a) General

Africa

Archaeology §V

(b) Countries

(For articles on countries not listed in this section, *see* the list in group X)

Egypt

Abbas II.
Akhenaton
Archaeology VII
Arabi Pasha
Fuad I.
Riaz Pasha
Tutankhamun
Zaghlul, Saad
Zobeir Rahama

Jubaland

Morocco

Abdel Krim
Lyautey, Louis Hubert Gonzalve*

Nigeria

Goldie, Sir George Dashwood Taubman
Lugard, Sir Frederick John Dealtry†

South Africa

Beyers, Christian Frederick
Botha, Louis
Cronje, Piet Arnoldus
De la Rey, Jacobur Hercules
Deventer, Sir Jacob Louis Van
De Villiers, John Henry, Baron
De Wet, Christian
Hertzog, James Barry Munnik
Jameson, Sir Leander Starr
Merriman, John Xavier
Smuts, Jan Christiaan†
Steyn, Martinus Theunis

Zanzibar

Kirk, Sir John

6. America

(a) General

Archaeology §§ XVI, XVII, XVIII
Indians, North American
Pan-American Conferences
Pan-American Union
Tacna-Arica Question

(b) Countries

(For articles on the countries not listed in this section, see the list in group X)

Argentina

Alvear, Marcelo Torcuato de

Canada and Newfoundland

Blake, Edward
Borden, Sir Frederick William
Borden, Sir Robert Laird
Bowell, Sir Mackenzie
Bourassa, Henri
Cartwright, Sir Richard John
Cashin, Sir Michael Patrick
Currie, Sir Arthur William*
Davies, Sir Louis Henry
Denison, George Taylor
Fleming, Sir Sandford
Foster, Sir George Eulas†
Gouin, Sir Lomer
Hughes, Sir Samuel
King, William Lyon Mackenzie
Laurier, Sir Wilfrid
McBride, Sir Richard
Meighan, Arthur
Morris, Edward Patrick Morris, 1st Baron
Mount Stephen, George Stephen, 1st Baron
Parent, Simeon Napoleon
Ross, Sir George William
Rowell, Newton Wesley†
Strathcona and Mount Royal, Donald Alexander Smith, 1st Baron
Tupper, Sir Charles
Van Horne, Sir William Cornelius

Chile

Alessandri, Arturo

Mexico

Diaz, Porfirio

United States

American Legion
Commerce, Department of
Democratic Party
Federal Farm Loan System
Federal Trade Commission
Initiative
Ku Klux Klan
Labor, Department of
Liberty Loans
Navy Department
Negro
Panama Canal
Progressive Party
Prohibition
Recall
Republican Party
Sulgrave Manor, England
Training Camps

*See XII, 8 (c). †*See XII, 9 (c).*

United States—*continued*

Aldrich, Nelson Wilmarth
Bacon, Robert
Baker, Newton Diehl*
Benson, William Shepherd*†
Bigelow, John
Bingham, Hiram*
Bliss, Cornelius Newton
Bliss, Howard Tasker*†
Borah, William Edgar
Bryan, William Jennings
Buckner, Simon Bolivar
Bullard, Robert Lee*
Cameron, James Donald
Chaffee, Adna Romanza
Chamberlain, Joshua Lawrence
Choate, Joseph Hodges
Clark, Champ
Cody, William Frederick ("Buffalo Bill")
Colby, Bainbridge
Coolidge, Calvin
Cox, James Middleton
Croker, Richard
Crowder, Enoch Herbert*
Crozier, William
Cummins, Albert Baird
Daniels, Josephus
Dawes, Charles Gates†
Debs, Eugene Victor
Denby, Edwin
Dewey, George
Doherty, Charles Joseph
Edmunds, George Franklin
Fairbanks, Charles Warren
Foraker, Joseph Benson
Gerard, James Watson
Glass, Carter
Goethals, George Washington
Harbord, James Guthrie*
Harding, Warren Gamaliel
Hearst, William Randolph
Hill, David Jayne
Hitchcok, Gilbert Monell
Hoover, Herbert Clark*
Houghton, Alanson Bigelow
House, Edward Mandell†
Hughes, Charles Evans†
Johnson, Hiram Warren
Kellogg, Frank Billings
Knox, Philander Chase
La Follette, Robert Marion, and his son, Robert M.
Lane, Franklin Knight
Lansing, Robert†
Liggett, Hunter
Lodge, Henry Cabot
Long, John Davis
McAdoo, William Gibbs
MacVeagh, Wayne
March, Peyton Conway*
Marshall, Thomas Riley
Mellon, Andrew William†
Merritt, Wesley
Miles, Nelson Appleton
Mills, Roger Quarles
Morgan, John Pierpont*†
Morton, Levi Parsons
Mosby, John Singleton
Olney, Richard
Page, Thomas Nelson
Page, Walter Hines
Pershing, John Joseph*
Porter, Horace
Pryor, Roger Atkinson
Reid, Whitelaw
Roosevelt, Theodore
Root, Elihu†
Schwab, Charles Michael*
Sherman, James Schoolcraft
Sickles, Daniel Edgar
Sims, William Sowden*
Smith, Alfred Emanuel
Smoot, Reed
Stevenson, Adlai Ewing
Taft, William Howard
Tracy, Benjamin Franklin
Underwood, Oscar Wilder
Weaver, James Baird
Weeks, John Wingate
Whitlock, Brand†
Wilson, James
Wilson, Woodrow*†
Wood, Leonard*

7. Australasia

Australia

Barton, Sir Edmund
Bruce, Stanley Melbourne
Cook, Sir Joseph
Deakin, Alfred
Fisher, Andrew
Hughes, William Morris
Monash, Sir John*
Reid, Sir George Houston
Watson, John Christian

New Zealand

Allen, Sir James
Coates, Joseph Gordon
Massey, William Ferguson
Pomare, Sir Maui
Stewart, William Downie
Ward, Sir Joseph George†

8. The World War

(For the part played by the different countries in the World War, and its effects on them, *see* articles in the preceding sections of this group and in group X; for developments in military and naval science during the War, *see* group XIX; for readjustments of territory and relations among the nations after the War, *see* section 9 of this group, immediately following this section; for the effects of the War on science, medical practice, production, commerce, and in fact almost all phases of human activity, including stamp collecting, *see* the leading articles on such subjects throughout the twenty-three groups of this Classification.)

(a) General Subjects

World War
World War, Naval
World War, Bibliography

Air Forces
Air Ministry
Air Raids
Air, The War in the
Censorship
Chemical Warfare
Control, Inter-Allied
Convoy
Food Supply
"Goeben" and "Breslau"
Industrial Relations
Industry, War Control of
Medals and Decorations
Poster
Prisoners of War
Profiteering
Propaganda
Rationing
Refugees
Relief Work
Savings Movement
Sea Power
Submarine
Submarine Campaigns
War Graves
Women, War Work of

(b) Military and Naval Operations

Amiens, France
Antwerp, Siege of
Arras, Battle of
Asiago, Battle of
Belgium, Invasion of
Belleau Woods, France
Brest-Litovsk, Battles of
Cambrai, Battle of
Cameroons, Operations in
Cantigny, France
Caporetto, Battle of
Carpathians, Battles of the
Caucasus, Campaign in the
Champagne, Battles in
Château-Thierry, France
Coronel, Battle of
Dardanelles Campaign
Dogger Bank, Battle of the
Dunajec-San, Battles of the
East Africa: Military Operations in
Eastern European Front Campaigns
Falkland Islands, Battle of the
Frontiers, Battles of the
German Offensive
Heligoland Bight, Battle of the
Italian Campaigns
Jutland, Battle of
Lemberg, Battles of
Liége, Belgium
Lille, France
Lodz-Cracow, Battles of
Loos, Battle of
Louvain, Belgium
Luck, or Lutsk, Battles of
Luxembourg
Malines, Belgium
Marne, First Battle of the
Marne, Second Battle of the
Masurian Lakes, Battles of the
Mesopotamia, Operations in
Morocco, Campaigns in
Namur, Belgium
Narew, Battles of the
Narocz, Battle of Lake
Neuve Chapelle, Battle of
Ostend, Belgium
Palestine, Operations in, 1914–8
Persia, Campaigns in
Przemysl, Siege of
Reims, France
Russia, Campaign in
St. Mihiel, Battle of
Salonika Campaigns
Scapa Flow
Senussi, Operations against the
Serbian Campaigns
Somme, Battle of the, 1916
Southwest Africa, Campaign in
Tannenberg, Battle of
Tsingtao, Capture of
Verdun, Battles of
Victory, Advance to
I. Battle of Amiens
II. Battle of Bapaume-Peronne
III. The Breaking of the Hindenburg Line
IV. Battle of Meuse-Argonne
V. The Offensive in Flanders
VI. The French Armies
Vistula-San, Battles of
Vittorio Veneto, Battle of
Western Front, 1914–8
Ypres, First Battle of
Ypres, Second Battle of
Ypres, Third Battle of
Yser, Battle of the
Zeebrugge, Attack on

(c) Biographies

The names which are followed by an asterisk (*) under the various countries in the preceding sections of this group are names of persons who had an important part, in one capacity or another, in the events of the World War.

9. International Relations, 1910–26

(a) General Subjects

(Treaties, diplomatic conferences, economic and social organisation among nations, and questions which have received international consideration or are of international concern)

Adriatic Sea
Aerial Law
Aerodrome
Ambassadors, Conference of
Anglo-Japanese Alliance
Arbitration, International
Baghdad Railway
Balance of Payments
Boulogne, Conference of
Brest-Litovsk, Treaty of
Cannes, Conference of
Caribbean, The
Central American Union
Chemical Warfare
Child Labour and Child Welfare
Chinese Eastern Railway
Commercial Treaties
Control, Inter-Allied
Copyright
Covenant (of the League of Nations)
Danube
Dardanelles
Debts, Inter-Allied
Diplomacy
Disarmament
Elbe
English-Speaking Peoples, Relations of
Flying, Commercial
Fourteen Points, The
Genoa, Conference of
Great Lakes and St. Lawrence
Hours of Labour
Hythe, Conference of
Intellectual Co-operation
International Labour Organisation, The
International Law
Kiel Canal
Lausanne, Conference
League of Nations
Locarno, Pact of
London, Conferences of
Mandate
Mediterranean Sea
Migration §VII
Minorities
Money Market
Navy §IV
Neuilly, Treaty of
Nile
Oder
Olympic Games
Opium, Traffic in
Pacific, Command of the
Panama Canal
Pan-American Conferences
Pan-American Union
Pan-Islamism
Pan-Turanianism
Paris, Conference of
Permanent Court of International Justice
Plebiscite
Postal Services
Rapallo, Treaty of
Raw Materials
Red Cross
Refugees
Reparations and the Dawes Plan
Rhine
Rhodes Scholarships
Sanctions and Guarantees
San Remo Conference
Security
Self-Determination
Sèvres, Treaty of
Slavery and Forced Labour
Sleeping Sickness
Socialism
Spa, Conference of
Submarine
Suez Canal
Supreme Council
Trade, International
Trade Unionism §III
Treaties
Trianon, Treaty of
Universal Language
Versailles, Treaty of
Vistula
Washington Conference, 1921
White Slave Traffic
World Recovery

*See XII, 8 (c). †See XII, 9 (c).

(b) Territories involved in political disputes and readjustments

Aaland Islands
Africa: Political History
Allenstein-Marienwerder
Alsace-Lorraine
Burgenland
Croatia-Slavonia
Dalmatia
Danzig, Free City of
Dedeagatch
Dobruja
Dodecanese
Eupen and Malmedy
Fiume
Galicia, East
'Iraq
Jubaland, East Africa
Kavalla
Kenya Colony
Macedonia
Memel
Mongolia
Montenegro
Mosul
Palestine
Ruanda-Urundi
Rhineland
Ruhr
Saar (Sarre) Territory
Sakhalin (Saghalien)
Samoa
Schleswig (Slesvig)
Senussi
Shantung
Silesia, Upper
Singapore
Smyrna
South Africa, Union of
South-West Africa
Spitsbergen
Syria
Tacna-Arica Question
Tanganyika Territory
Teschen
Thrace
Tirol
Togo
Transjordan
Transylvania
Trieste
Tripolitania
Uganda
Ukraine
Vilna (Wilno)
Virgin Islands
Wei-Hai-Wei
Yap

(c) Biographies

The names which are followed by a dagger (†) in the preceding sections of this group, and in groups VII, XV and XXII, are names of persons who were conspicuous in the diplomatic or the economic negotiations following the World War, in the councils of the League of Nations or in other affairs of international scope.

XIII. INDUSTRIES, MANUFACTURES AND OCCUPATIONS

(For topics in business organisation and "scientific management" *see* group VII; for articles on inventions, *see* group IX; for publishing and publishers, *see* group XVI)

1. General

Alcohol, Industrial Uses
Architecture §§II, III
Automatic Machinery
Bacteriology §II
Factory Design
Mass Production
Research, Industrial
Standardisation
Bakelite
Celluloid
Dry Cleaning
Dyeing
Fisheries
Flour Milling
Fur Trade
Gas, Manufacture of
Glass
Grain Elevator
Laundry Work
Leather
Motion Pictures §§I and II
Motor Vehicles
Oils and Fats §I
Optical Glass
Paper Making
Peat
Petroleum §II
Photo-Engraving
Photography §II
Printing
Rubber §II
Synthetic Resins
Tires
Whales and Whaling

2. Textiles

Artificial Silk
Cotton and the Cotton Trade
Fibres
Silk
Textile Machinery
Wool Trade

3. Agriculture

Agriculture
Bacteriology §I
Boll Weevil, Cotton
Dairying
Entomology, Economic
Farm Machinery
Farmers' Organisations
Farm Organisation and Equipment
Forestry
Grain Production and Trade
Milk and Dairy Products
Plant Pathology
Tractors

4. Foods and Beverages

Beer
Bread Making
Canning
Cocoa
Coffee
Margarine
Tea
Wine

5. Biographies

(Merchants, manufacturers and "business men")

Altman, Benjamin (American)
Andersen, Hans Niels (Danish)
Armour, J. Ogden
Ashfield, Albert, Henry Stanley, 1st Baron (British)
Ballin, Albert (German)
Browning, John M. (American)
Burbidge, Sir Richard (British)
Cadbury, George (English)
Du Pont, Thomas Coleman (American)
Eastman, George (American)
Ford, Henry (American)
Frick, Henry Clay (American)
Gary, Elbert Henry (American)
Gilbey, Sir Walter (British)
Inchcape, James Lyle Mackey, 1st Viscount (British)
Leverhulme, William Hesketh Lever, 1st Viscount (British)
Lyons, Sir Joseph (British)
Rivington, Francis Hansard (British)
Rosenwald, Julius (American)
Schlich, Sir William (British)
Selfridge, Harry Gordon (American)
Stinnes, Hugo (German)
Tata, Sir Dorabji Jamsetji (Indian)
Wanamaker, John (American)
Westinghouse, George (American)
Woolworth, Frank Winfield (American)

XIV. LANGUAGE AND WRITING

1. General

Philology
Americanism
Irish Language
Phonetics
Universal Language
Voice Sounds

2. Biographies

Bradley, Henry (British)
Brandl, Alois (German)
Bréal, Michel Jules Alfred (French)
Brown, Francis (American)
Browne, Edward Granville (British)
Conrady, August (Austrian)
Curtius, Ernst Robert (German)
Dibelius, Wilhelm (German)
Fitzmaurice-Kelly, James (British)
Geiger, Wilhelm (German)
Henry, Victor (French)
Jespersen, Jens Otto Harry (Danish)
Lévi, Sylvain (French)
March, Francis Andrew (American)
Menendez Pidal, Ramón (Spanish)
Meyer, Marie Paul Hyacinthe (French)
Murray, Sir James Augustus Henry (British)
Oldenburg, Sergei Fedorovich (Russian)
Pastrnek, Frantisek (Czech)
Polivka, Jiri (Czech)
Sachau, Carl Eduard (German)
Schmidt, Wilhelm (Austrian)
Schroeder, Eduard (German)
Skeat, Walter William (British)
Stsherbatsky, Fedor Ippolitovich (Russian)
Thomsen, Vilhelm Ludwig Peter (Danish)
Vondrak, Vaclav (Czech)
Wilamowitz-Möllendorff, Ulrich von (German)
Zubaty, Josef (Czech)

XV. LAW AND POLITICAL SCIENCE

1. General

Legal Education
Aerial Law
Arbitration, International
Blue Sky Laws
Censorship
Child Labour and Child Welfare
Children's Court
City Government
Civil Service
Companies and Corporations
Copyright
Diplomacy
Electoral Laws, Changes in
Factory and Workshop Law
Food, Pure
Government
Initiative
International Labour Organisation, The
International Law
Inland Water Transport
Insurance, Social
Interstate Commerce
Judicial Reform
Land Tenure
Liquor Control
Mandate
Marriage Laws
Medical Legislation
Mental Deficiency
Minorities
Motor Vehicles §VII
Naturalisation
Pensions
Permanent Court of International Justice
Plebiscite
Poor Law
Postal Services
Property, Law of
Recall
Sanctions and Guarantees
Treaties
Woman Suffrage
Women, Legal Position of

2. Crime and Punishment

Criminology
Punishment
Borstal System
Children's Courts
Habitual Offenders
Probation
Reformatory Schools

3. Biographies

Alverstone, Richard Everard Webster, 1st Baron (British)
Anson, Sir William Reynell (British)
Barclay, Sir Thomas (English)
Barton, Sir Edmund (Australian)
Birkenhead, Frederick Edwin Smith, 1st Earl of (British)
Brandeis, Louis Dembitz (American)
Buckmaster, Stanley Owen, 1st Baron (English)
Darling, Charles John, 1st Baron (British)
Darrow, Clarence Seward (American)
Davis, John William (American)
Fry, Sir Edward (English)
Halsbury, Hardinge Stanley Giffard, 1st Earl of (British)
Harlan, John Marshall (American)
Hewart, Gordon Hewart, 1st Baron (British)
Hines, Walker Downer (American)
Hogg, Sir Douglas McGarel (British)
Holmes, Oliver Wendell (American)
Huber, Max (Swiss)†
Hughes, Charles Evans (American)†
Hurgronje, Christiaan Snouck (Dutch)
James of Hereford, Henry James, 1st Baron (British)
Jellinek, George (Hungarian)
Jirecek, Hermenegild, Ritter von Samakow (Bohemian)
Kindersley, Sir Robert Molesworth (British)
Labori, Fernand (French)
Lammasch, Heinrich (Austrian)
Lindley, Nathaniel Lindley, Baron (English)
Lindsey, Benjamin Barr (American)
Liszt, Franz von (German)
Loder, Bernard Cornelius Johannes (Dutch)
Loreburn, Robert Threshie Reid, 1st Earl (British)
Macdonell, Sir John (British)
Markby, Sir William (Anglo-Indian)
Mookerjee, Sir Asutosh (Indian)
Moore, John Bassett (American)†
Moulton of Bank, John Fletcher Moulton, Baron (British)
Parker, Alton Brooks (American)
Phillimore, Walter George Frank Phillimore, 1st Baron (British)
Pound, Roscoe (American)
Roby, Henry John (British)
Root, Elihu (American)†
Schücking, Walter (German)
Simon, Sir John Allsebrook (British)
Taft, William Howard (American)
Untermeyer, Samuel (American)
Vinogradov, Sir Paul Gabrilovich (Anglo-Russian)
Vollenhoven, Cornelis van (Dutch)
White, Edward Douglass (American)

XVI. LITERATURE

(The biographies in this group include poets, novelists, dramatists, essayists, historians, scholars not classified elsewhere, publishers, newspaper proprietors, editors and journalists)

1. General

Drama
Libraries
Newspapers
Periodicals
Publishing

2. Arabia

Arabic Literature

**See* XII, 7 (c).

LITERATURE—*continued*

3. Austria

Austrian Literature

Ebner-Eschenbach, Marie, Freifrau von
Friedjung, Heinrich
Hofmannsthal, Hugo von
Kraus, Karl
Rosegger, Peter
Schnitzler, Arthur
Schönherr, Karl
Suttner, Bertha, Baroness von

4. Belgium

Belgian Literature: Flemish
Belgian Literature: French

Buysse, Cyriel
Lemonnier, Antoine Louis Camille
Maeterlinck, Maurice
Pirenne, Henri
Streuvels, Styn (Frank Lateur)
Verhaeren, Emile

5. British Empire

Australian Literature
Canadian Literature: English
Canadian Literature: French
English Literature
Indian Literature
Irish Literature: English
Irish Literature: Gaelic
Scottish-Gaelic Literature
South African Literature: Afrikaans
South African Literature: English
Welsh Literature

Arber, Edward
Archer, William
Austin, Alfred
Baring-Gould, Sabine
Barrie, Sir James Matthew, Bart.
Beaverbrook, William Maxwell Aitken, 1st Baron
Beerbohm, Max
Bell, Charles Frederick Moberly
Belloc, Joseph Hilaire Pierre
Bennett, Enoch Arnold
Benson, Arthur Christopher
Birdwood, Sir George Christopher Molesworth
Blunt, Wilfrid Scawen
Braddon, Mary Elizabeth
Bridges, Robert Seymour
Brooke, Rupert
Brooke, Stopford Augustus
Browning, Oscar
Bryce, James
Buchan, John
Buckle, George Earle
Burnand, Sir Francis Cowley
Burnham, Edward Levy Lawson, 1st Baron
Burnham, Harry Lawson Webster Lawson, 1st Viscount
Butcher, Samuel Henry
Bywater, Ingram
Chisholm, Hugh
Conrad, Joseph
Cook, Sir Edward Tyas
Corelli, Marie
Cotton, James Sutherland
Courthope, William John
Courtney, William Leonard
Crockett, Samuel Rutherford
Cunninghame Graham, Robert Bontine
Davis, Henry William Carless
Dawson, George Geoffrey
De la Mare, Walter John
De Morgan, William Frend
Dicey, Edward
Dobson, Henry Austin
Doughty, Charles Montagu
Dowden, Edward
Drinkwater, John
Dunsany, Edward John Moreton Drax Plunkett, 18th Baron
Flecker, James Elroy
Forster, Edward Morgan
Gairdner, James
Galsworthy, John
Garvin, James Louis
Gilbert, Sir William Schwenk
Gollancz, Sir Israel
Gosse, Sir Edmund
Granville-Barker, Harley Granville
Gregory, Isabella Augusta, Lady
Grundy, Sydney
Haggard, Sir Henry Rider
Hardy, Thomas
Harrison, Frederic
Hazlitt, William Carew
Hewlett, Maurice Henry
Hodgkin, Thomas
Houghton, William Stanley
Housman, Alfred Edward
Hudson, William Henry
Hudson, William Henry
Hyde, Douglas
James, Henry
Joyce, James
Ker, William Paton
Kipling, Rudyard
Lang, Andrew
Lawrence, David Herbert
Leacock, Stephen Butler
Lee, Sir Sidney
Lee, Vernon (Violet Paget)
Lucas, Edward Verrall
Lucy, Sir Henry
Lyall, Sir Alfred Comyn
M'Carthy, Justin
Mackenzie, Edward Montague Compton
Mallock, William Hurrell
Mansfield, Katherine
Masefield, John
Massingham, Henry William
Meynell, Alice
Molesworth, Mary Louisa
Monypenny, William Flavelle
Moore, George
Morley of Blackburn, John Morley, Viscount
Morrison, George Ernest
Murray, George Gilbert Aimé
Nevill, Lady Dorothy Fanny
Nicoll, Sir William Robertson
Norris, William Edward
Northcliffe, Alfred Charles William Harmsworth, Viscount
Oman, Sir Charles William Chadwick
Oxford and Asquith, Margot, Countess of
Pearson, Sir Cyril Arthur
Phillips, Stephen
Prothero, Sir George Walter
Riddell, George Allardice Riddell, 1st Baron
Ritchie, Anne Isabella, Lady
Rothermere, Harold Sidney Harmsworth, 1st Viscount
Russell, George William (AE)
Russell, William Clark
Rutherford, Mark
Schreiner, Olive
Scott, Charles Prestwich
Service, Robert William
Shaw, George Bernard
Sims, George Robert
Sorabji, Cornelia
Spender, John Alfred
Squire, John Collings
Stead, William Thomas
Steed, Henry Wickham
Strachey, Giles Lytton
Strachey, John St. Loe
Synge, John Millington
Tagore, Sir Rabindranath
Thomas, Edward
Townsend, Meredith White
Trench, Frederick Herbert
Trevelyan, George Macaulay
Wallace, Sir Donald Mackenzie
Ward, Sir Adolphus William
Ward, Mary Augusta (Mrs. Humphry)
Ward, Wilfred Philip
Watts-Dunton, Walter Theodore
Wedmore, Sir Frederick
Wells, Herbert George
Winter, John Strange
Wright, William Aldis
Yeats, William Butler

6. Bulgaria

Bulgarian Literature

Vazov, Ivan

7. China

Chinese Literature

8. Classics and Classical Scholars

Greek Literature, Ancient
Latin Literature

Bennett, Charles Edwin (American)
Capps, Edward (American)
Donaldson, Sir James (British)
Ellis, Robinson (British)
Farnell, Lewis Richard (British)
Gildersleeve, Basil Lanneau (American)
Goodwin, William Watson (American)
Jackson, Henry (British)
Kenyon, Sir Frederic George (British)
Leaf, Walter (British)
Mahaffy, Sir John Pentland (Irish)
Mayor, John Eyton Bickersteth (British)
Murray, George Gilbert Aimé (British)
Shorey, Paul (American)
Smyth, Herbert Weir (American)
Verrall, Arthur Woollgar (British)

9. Czechoslovakia

Czech Literature

Capek, Karel
Jebavy, Vaclav (Otakar Brezina)
Machar, Jan Svatopluk
Sova, Antonin

10. Denmark

Danish Literature

Jensen, Johannes Vilhelm
Lund, Troels Frederick
Pontoppidan, Henrik

11. Estonia

Vilde, Eduard

12. Finland

Finnish Literature

Borenius, Tancred

13. France

French Literature
French African Literature

Adam, Paul
Aicard, Jean Francois Victor
Bainville, Jacques
Barbusse, Henri
Barres, Maurice
Bataille, Henri
Bédier, Joseph
Blum, Léon
Boylesve, René (René Tardiveau)
Calmette, Gaston
Capus, Alfred
Chantavoine, Henri
Claretie, Jules
Claudel, Paul
Daudet, Léon
Delisle, Leopold Victor
Deroulede, Paul
Dierx, Leon
Faguet, Emile
Ferrier, Paul
Filon, Pierre Marie Augustin
France, Anatole
Gauvain, Auguste
Gide, Andre
Gourmont, Rémy de
Hermant, Abel
Hervieu, Paul
Houssaye, Henry
Jammes, Francis
Kératry, Emile, Comte de
Legouis, Emile
Lemaitre, Francois Elie Jules
Leroy-Beaulieu, Henri Jean Baptiste Anatole
Margueritte, Paul
Masson, Louis Claude Frédéric
Maurras, Charles
Mirbeau, Octave Henri Marie
Mistral, Frédéric
Monod, Gabriel
Ohnet, Georges
Proust, Marcel
Rolland, Romain
Romain, Jules
Rostand, Edmond
Scholl, Aurelien
Ségur, Pierre Marie Maurice Henri, Marquis de
Seignobos, Charles
Tourneux, Jean Maurice
Vogué, Eugene Melchior, Comte de

14. Germany

German Literature

Brunner, Heinrich
Dahn, Julius Sophus Felix
Dehmel, Richard
Delbruck, Hans
Droysen, Gustav
George, Stefan
Goltz, Colmar von der
Hauptmann, Gerhart
Heyse, Paul Johann Ludwig
Huch, Ricarda
Jensen, Wilhelm
Kaiser, Geor
Kellerman, Bernhard
Kokoschka, Oskar
Linden, Paul
Mann, Thomas
Meyer, Eduard
Nordau, Max Simon
Ortzen, Georg, Baron von
Rilke, Rainer Maria
Spielhagen, Friedrich von
Toller, Ernst
Voss, Richard
Wasserman, Jakob
Wedekind, Frank
Werfel, Franz
Wilbrandt, Adolf

15. Greece

Greek Literature, Modern

Palamas, Kostes

16. Hebrew Literature

Hebrew Literature

17. Hungary

Hungarian Literature

Ady, Andre
Goldziher, Ignaz
Herczeg, Férencz
Molnar, Férencz
Vambery, Armin

18. Iceland

Icelandic Literature

Hafstein, Hannes Thordur

19. Italy

Italian Literature

Albertini, Luigi
Barrili, Antonio
D'Ancona, Alessandro
D'Annunzio, Gabriele
De Bosis, Adolfo

De Gubernatis, Angelo, Count
Farina, Salvatore
Ferrero, Guglielmo
Fogazzaro, Antonio
Graf, Arturo
Guerrini, Olindo
Marinetti, Filippo Tomaso
Papini, Giovanni
Pascoli, Giovanni
Pirandello, Luigi
Salvemini, Gaetano
Tozzi, Federigo
Verga, Giovanni
Villari, Pasquale

20. Japan

Japanese Literature

Tokutomi, Iichiro

21. Latvia

Plieksans, Jan

22. Lithuania

Maironis (Jonas Maciulas)

23. Netherlands

Dutch Literature

Blok, Petrus Johannes
Couperus, Louis
Heijermans, Herman
Schimmel, Hendrik Jan
Verwey, Albert

24. Norway

Norwegian Literature

Hamsun, Knut
Undset, Sigrid

25. Poland

Polish Literature

Orzeszko, Eliza
Ossendowski, Ferdinand Anthony
Reymont, Ladislas Stanislas
Sienkiewicz, Henryk
Zeromski, Stephen

26. Portugal

Portuguese Literature

Braga, Theophile

27. Rumania

Rumanian Literature

Jorga, Nicolas

28. Russia

Russian Literature

Aldanov, Mark Alexandrovich
Andreyev, Leonid Nicolaevich
Balmont, Constantine
Blok, Alexander
Bryusov, Valery Jakovlovich
Bunin, Ivan
Byeluv, Andrei (Boris Bugaiev)
Chekhov, Anton Pavlovich
Esenin, Sergius
Hippius, Zinaida
Lunacharsky, Anatoly Vasilievich
Mershkovsky, Dimitry
Minsky (Nicolas Maximovich Wilenkine)
Pilnyak (Boris Andreevich Vogan)
Remizov, Alexis
Sologub, Fedor (Fedor Kusmich Teternikov)

29. South Africa

South African Literature: Africaans
South African Literature: English

30. Spain

Spanish Literature (including Latin America)

Benavente y Martinez, Jacinto
Ibanez, Vincente Blasco
Menéndez y Pelayo, Marcelino
Pardo Bazan, Emilia
Pérez Galdos, Benito
Unamuno, Miguel de

31. Sweden

Swedish Literature

Heidenstam, Verner Von
Lagerlof, Selma
Strindberg, August

32. Switzerland

Spitteler, Carl

33. United States of America

American Literature

Abbott, Lyman
Adams, Henry
Ade, George
Allen, James Lane
Anderson, Sherwood
Austin, Mary Hunter
Bancroft, Hubert Howe
Bennett, James Gordon
Bok, Edward William
Brisbane, Arthur
Burnett, Francis Eliza Hodgson
Cabell, James Branch
Cable, George Washington
Cather, Willa Sibert
Churchill, Winston
Colby, Frank Moore
Corson, Hiram
Craddock, Charles Egbert
Curtis, Cyrus Hermann Kotzschmar
Davis, Richard Harding
Deland, Margaretta Wade
Dreiser, Theodore
Eggleston, George Cary
Frost, Robert
Furness, Horace Howard
Gale, Zona
Garland, Hamlin
Harvey, George Brinton McClellan
Henry, O. (William Sydney Porter)
Hergesheimer, Joseph
Herrick Robert
Higginson, Thomas Wentworth
Hooper, Horace Everett
Howells, William Dean
James, Henry
Lardner, Ring W.
Lawson, Victor Fremont
Lewis, Sinclair
Lindsay, Nicholas Vachel
London, Jack
Lorimer, George Horace
Lowell, Amy
McCormick, Robert Rutherford
MacKaye, Percy
Masters, Edgar Lee
Mencken, Henry Louis
Millay, Edna St. Vincent
Miller, Joaquin
Moody, William Vaughn
More, Paul Elmer
Muir, John
Munsey, Frank Andrew
Nicholson, Meredith
Ochs, Adolph Simon
O'Neill, Eugene Gladstone
Otis, Harrison Gray
Page, Thomas Nelson
Page, Walter Hines
Patterson, Joseph Medill
Perry, Bliss
Pulitzer, Joseph
Rhodes, James Ford
Riley, James Whitcomb
Robinson, Edwin Arlington
Robinson, James Harvey
Sandburg, Carl
Schouler, James
Scripps, Edward Wyllis
Sedgwick, Ellery
Simonds, Frank Herbert
Smith, Francis Hopkinson
Stone, Melville Elijah
Tarkington, Newton Booth
Thayer, William Roscoe
Thomas, Augustus
Van Dyke, Henry
Villard, Oswald Garrison
Watterson, Henry
Wharton, Edith
Whitlock, Brand
Wiggin, Kate Douglas
Wister, Owen

34. Yugoslavia

Serbo-Croat Literature

XVII. MATHEMATICS

1. Pure

Mathematics

Geometry
Measurements
Probability

2. Applied

Aerodynamics
Air-Screw
Automatic Machinery
Ballistics
Calculating Machines
Gyroscope
Index Numbers
Statistics and Graphs
Tides

3. Biographies

Klein, Felix (German)
Kriloff, Alexei Nikolaievich (Russian)
Larmor, Sir Joseph (British)
Liapunov, Alexander Mikhaelovich (Russian)
Pearson, Karl (British)
Poincaré, Jules Henri (French)
Russell, Bertrand Arthur William (British)

XVIII. MEDICAL SCIENCE

1. General

Medicine, General
Medicine, Pre-Scientific
Medical Education
Medical Research

2. Anatomy and Physiology

Anatomy
Physiology

Colour Vision and Colour Blindness
Endocrinology
Immunity
Neuromuscular System
Tissue Culture
Voice Sounds

3. Pathology, Therapeutics and Surgery

Pathology
Therapeutics
Surgery

Acetylene, in Medicine
Aerotherapeutics
Alimentary System, Diseases of the
Anaemia
Anaesthetics
Antiseptics
Appendicitis
Bacteriology §III
Bilharziasis
Bloodless Surgery
Blood Transfusion
Burns and Scalds
Cancer Research
Children, Diseases of
Chiropractic
Cholera
Dentistry
Diabetes
Diagnosis
Dysentery
Ear, Nose and Throat, Diseases of the
Electrotherapy
Encephalitis, Lethargica
Epilepsy
Filter-passing Microbes
Food Poisoning
Fractures
Goitre
Heart and Lung, Surgery of
Heart, Diseases of the
Heliotherapy
Hookworm
Immunity
Infectious Fevers
Influenza
Insanity
Insect Bites and Stings
Insulin
Kala-azar
Leprosy
Malaria
Manipulative Surgery
Miners' Phthisis
Nursing
Obstetrics
Ophthalmology
Orthopaedic Surgery
Osteopathy
Parasitology
Plague
Pneumothorax
Protozoology
Psychoanalysis
Psychosis
Psychiatry
Psychotherapy
Radiotherapy and Röntgenology
Rejuvenation
Respiratory System, Diseases of the
Sandfly Fever
Serum Therapy
Skin Diseases
Sleeping Sickness
Smallpox
Spinal Meningitis
Sprue
Tetanus
Tropical Medicine
Tuberculosis
Urology
Vaccine Therapy
Venereal Disease
Vitamins
Women, Diseases of
Yellow Fever

4. Pharmacology

Pharmacology
Pharmacy

Insulin
Scopolamine

5. Public Health

Public Health
Preventive Medicine
Medical Legislation

Entomology, Medical
Epidemiology
Food, Pure
Hospitals
Industrial Welfare and Medicine
Insurance, Social §VI
Kata Thermometer
Maternity and Infant Welfare
Nursing
Physical Training

(For measures appropriate to the control of particular diseases, *see* articles listed in section 3 of this group, above)

6. Veterinary Science

Veterinary Science

MEDICAL SCIENCE—*continued.*

7. Biographies

Allbutt, Sir Thomas Clifford (British)
Anderson, Elizabeth Garrett (British)
Baccelli, Guido (Italian)
Banting, Frederick Grant (Canadian)
Bárány, Robert (Austrian)
Barker, Sir Herbert Atkinson (British)
Barnard, J. E. (British)
Bekhterev, Vladimir Mikhailovich (Russian)
Bland-Sutton, Sir John (British)
Bordet, Jules (Belgian)
Carrel, Alexis (Franco-American)
Coué, Emile (French)
Crile, George Washington (American)
Cushing, Harvey (American)
Dawson of Penn, Bertrand Edward Dawson, 1st Baron (British)
Ehrlich, Paul (German)
Flexner, Simon (American)
Freud, Sigmund (Audtrian)
Gorgas, William Crawford (American)
Gullstrand, Allvar (Swedish)
Hutchinson, Sir Jonathan (British)
Inglis, Elsie Maud (British)
Janeway, Theodore Caldwell (American)
Jex-Blake, Sophia (British)
Krogh, Shack August Steenberg (Danish)
Laveran, Charles Louis Alphonse (French)
Lazarev, Petr Petrovich (Russian)
Lister, Joseph Lister, Baron (British)
Loeb, Jacques (American)
Lorenz, Adolf (Austrian)
Macleod, John James Rickard (British)
Marinescu, George (Rumanian)
Mayo, Charles Horace (American)
Mayo, William James (American)
Mechnikov, Ilya (Russian)
Mitchell, Silas Weir (American)
Noguchi, Hideyo (Japanese)
Oppenheim, Hermann (German)
Osler, Sir William (British)
Pavlov, Ivan Petrovich, (Russian)
Rivers, William Halse Rivers (British)
Ross, Sir Ronald (British)
Sherrington, Sir Charles Scott (British)
Smith, Theobald (American)
Treves, Sir Frederick (British)
Wasserman, August von (German)
Wright, Sir Almroth Edward (British)

XIX. MILITARY AND NAVAL SCIENCE

(For descriptions of engagements and biographies of commanders, *see* group XII)

1. General

War

Admiralty, Board of
Air Forces
Air Ministry
Air Power
Air Raids
Air, The War in the
Air Warfare
Ammunition
Armoured Car
Armoured Trains
Army
Artillery
Barracks
Battleship
Blockade
Bombs
Bridging, Military
Cambrai, Battle of
Camouflage
Canteen
Cavalry
Chemical Warfare
Coast Defence
Convoy
Dreadnought
Engineers, Military
Explosives, Military
Flamethrower
Grenades
Gunnery, Naval
Infantry
Intelligence, Military and Naval
Light Railways, Military
Machine Guns
Marines
Medical Service, Army
Medical Service, Naval
Minelaying and Minesweeping
Monitor
Morale: in War
Motor Transport: Military
Mountain Warfare
Munitions of War
Naval Academy
Navy
Navy Department
Ordnance
Paravane
Pistol
Range-finder
Rifles and Light Machine Guns
Sea Power
Siegecraft and Siege Warfare
Signalling, Army
Smoke in Warfare
Sound Ranging
Staff, Military
Staff, Naval
Strategy
Submarine
Supply and Transport, Military
Surveying §I
Tactics
Tanks
Telpherage
Torpedo
Training Camps
West Point

2. Military Writers and Engineers

Bernhardi, Friedrich von (German)
Fuller, John Frederick Charles (British)
Langlois, Hippolyte (French)
Lanrezac, Charles Louis (French)
Mahan, Alfred Thayer (American)
Repington, Charles à Court (British)
Schlieffen, Alfred, Count von (Prussian)
Sydenham, George Sydenham Clarke, 1st Baron (British)
Verdy du Vernois, Julius von (German)

XX. PHILOSOPHY AND PSYCHOLOGY

1. General Subjects

Philosophy
Aesthetics
Ethics
Logic
Psychology

Behaviourism
Character
Culture Contact, Psychology of
Industrial Psychology
Intelligence, Human
Intelligence Tests
Knowledge, Theory of
Mysticism
Pragmatism
Psychoanalysis
Relativity: Philosophical Consequences
Scepticism
Space-Time
Taoism
Universe, Modern Conceptions of

2. Biographies

Baldwin, James Mark (American)
Beesly, Edward Spencer (British)
Bergson, Henri (French)
Bradley, Francis Herbert (British)
Croce, Benedetto (Italian)
Dewey, John (American)
Ellis, Henry Havelock (British)
Fouillée, Alfred Jules Emile (French)
Fraser, Alexander Campbell (British)
Giner de los Rios, Francisco (Spanish)
Gomperz, Theodor (German)
Haldane, Richard Burdon Haldane, 1st Viscount (British)
Hall, Granville Stanley (American)
Höffding, Harald (Danish)
Judd, Charles Hubbard (American)
Keyserling, Hermann, Count (German)
Ladd, George Trumbull (American)
Losski, Nikolai Onufrievich (Russian)
Mach, Ernst (Austrian)
Münsterberg, Hugo (German-American)
Ribot, Théodule Armand (French)
Royce, Josiah (American)
Russell, Bertrand Arthur William (British)
Santayana, George (American)
Simmel, Georg (German)
Spengler, Oswald (German)
Steiner, Rudolf (German)
Thorndike, Edward Lee (American)
Ward, James (British)
Watson, John Broadus (American)
Wundt, Wilhelm Max (German)

3. Psychical Research and Occultism

Psychical Research

Besant, Annie (British)
Lodge, Sir Oliver Joseph (British)

XXI. PHYSICS

1. General

Physics
Physical Chemistry

Atom
Atomic Energy
Electron
Ether
Gases, Electrical Properties of
Isotopes
Liquid Air
Matter
Measurements
Metallurgy §V
Quantum Theory
Rays
Relativity
Solar Energy
Space-Time
Transmutation of Elements
Universe, Electromagnetic-Gravitational Schemes

2. Sound

Sound

Optophone
Phonograph

3. Light

Colour
Microscopy
Periscope
Photoelectricity
Photo-engraving
Photography
Spectroscopy
Spectrum
Telescope

4. Heat

Heat

Kata Thermometer
Thermo-Electric Pyrometer

5. Magnetism

Magnetism
Magnetism, Terrestrial

6. Electricity (and Electrical Engineering)

Electricity: Nature and Uses
Atmospheric Electricity

Amplifier
Atomic Energy
Broadcasting
Conduction, Electric
Electricity, Transmission of
Electric Lighting
Electric Power, Generation of
Electric Radiation
Electrometallurgy
Dynamo-electric Machines
Fume Precipitation, Electrical
Hydroelectric Engineering
Meter: Electric and Gas
Microphone
Motion Pictures §§I and II
Phototelegraphy
Radio Receiver
Röntgen Rays
Super Power
Telegraphy
Telegraphy, Submarine
Telephony
Telephony, Submarine
Television
Thermo-electric Pyrometer
Vacuum Tubes
Wireless Telegraphy and Telephony

7. Biographies (including electric engineers)

Arrhenius, Svante August (Swedish)
Aston, Francis William (British)
Barkla, Charles Glover (British)
Barnard, J. E. (British)
Bell, Alexander Graham (American)
Bjerknes, Vilhelm (Norwegian)
Bohr, Niels Hendrik David (Danish)
Bose, Sir Jagadis Chandra (Indian)
Bragg, Sir William Henry (British)
Braun, Karl Ferdinand (German)
Dalen, Gustav (Swedish)
De Forest, Lee (American)
Dewar, Sir James (British)
Edison, Thomas Alva (American)
Einstein, Albert (German-Swiss)
Eötvös, Roland, Baron (Hungarian)
Golitsin, Prince Boris Borisovich (Russian)
Guillaume, Charles Edouard (French)
Kolácek, Frantisek (Czech)
Lane, Max von (German)
Lazarev, Petr Petrovich (Russian)
Lebedev, Petr Nikolajevich (Russian)
Lorentz, Hendrik Antoon (Dutch)
Marconi, Guglielmo (Italian)
Michelson, Albert Abraham (American)
Miller, Oskar von (German)
Millikan, Robert Andrews (American)
Moseley, Henry Gwyn-Jeffreys (British)
Nernst, Walter (German)
Onnes, Heike Kamerlingh (Dutch)
Planck, Max (German)
Poincaré, Jules Henri (French)
Poulsen, Valdemar (Danish)
Pupin, Michael Idvorsky (American)
Rayleigh, John William Strutt, 3rd Baron (British)
Röntgen, Wilhelm Konrad (German)
Rutherford, Sir Ernest (British)
Sperry, Elmer Ambrose (American)
Stark, Johannes (German)
Steinmetz, Charles Protheus (American)
Swan, Sir Joseph Wilson (British)
Tesla, Nikola (American)
Thomson, Sir Joseph John (British)
Vogt, Hans (German)
Waals, Johannes Diderik van der (Dutch)
Westinghouse, George (American)
Wien, Wilhelm (German)

XXII. RELIGION AND THEOLOGY

1. General

Theology

Missions
Mysticism

2. Christianity

(a) General

Christianity

Reunion; Church
Easter, Fixed

(b) Roman Catholic Church

Roman Catholic Church

Cardinals, College of

Baudrillart, Henri Marie Alfred
Bourne, Francis
Dougherty, Dennis J.
Dubois, Louis Ernest
Duchesne, Louis Marie Olivier
Gasquet, Francis Aiden
Gibbons, James
Hayes, Patrick Joseph
Hugel, Friedrich von, Baron

Ireland, John
Keane, John Joseph
Logue, Michael
Mercier, Désiré
Mundelein, George William
O'Connell, William Henry
Walsh, William John

(c) **Eastern Churches**

Orthodox Eastern Churches

Constantine VI.

(d) **Church of England**

Anglicanism

Prayer Book

Alexander, William
Barnes, Ernest William
Barry, Alfred
Beeching, Henry Charles
Davidson, Randall Thomas
Edwards, Alfred George
Gore, Charles
Holland, Henry Scott
Inge, William Ralph
Lang, Cosmo Gordon
Wace, Henry
Wilberforce, Albert Basil Orme
Winnington-Ingram, Arthur Foley

(e) **Modern Continental Churches (Reformed)**

Friedrich, Johann
Holtzmann, Heinrich Julius
Loyson, Charles (Père Hyacinthe)
Orelli, Hans Konrad von
Reville, Albert
Schultz, Hermann
Soderblom, Nathan†
Spitta, Friedrich
Troeltsch, Ernst
Weiss, Bernhard

(f) **Free Churches**

(British Empire and United States, including Established Church of Scotland)

Baptists
Christian Science
Congregationalism
Fundamentalism and Modernism
Lutherans
Methodism
Presbyterianism
Protestant Episcopal Church
Salvation Army

Booth, William
Booth, William Bramwell
Clifford, John
Collyer, Robert
Eddy, Mary Baker
Fairbairn, Andrew Martin
Flint, Robert
Forsyth, Peter Taylor
Fosdick, Harry Emerson
Gladden, Washington
Jacks, Laurence Pearsall
Jowett, John Henry
Manning, William Thomas
Mathews, Shailer
Murkland, William Urwick
Paton, John Brown
Royden, Agnes Maude
Savage, Minot Judson
Whyte, Alexander

3. **Bible and Biblical Criticism**

Biblical Criticism

Briggs, Charles Augustus
Cheyne, Thomas Kelly
Driver, Samuel Rolles
Ginsburg, Christian David
Soden, Hermann, Freiherr von
Toy, Crawford Howell
Wellhausen, Julius

4. **Judaism**

Judaism

Jews

Hertz, Joseph Herman

5. **Mahommedan Religion**

Mahommedanism

Pan-Islamism

6. **Comparative Religion and Folklore**

Buddhism
Confucianism
Folklore
Greek Religion
Hinduism
Shintoism
Sikhism
Taoism

XXIII. SPORTS AND PASTIMES

1. **General**

Athletics

National Parks and Game Preserves
Olympic Games

2. **Sports and Pastimes**

Acrostic
Angling
Archery
Badminton
Baseball
Basketball
Billiards
Bowls
Boxing
Bridge, Auction
Chess
Circus
Coaching
Conjuring
Cricket
Croquet
Crossword
Cycling
Dancing
Fencing
Fives
Football, Association
Football, Rugby
Fox-hunting
Golf
Gymnastics
Hockey
Horse-racing
Lacrosse
Lawn Tennis
Mah-Jongg
Mountaineering
Motor Vehicles §VIII
Polo
Racquets
Riding
Rowing
Shooting
Swimming
Table Tennis
Tennis
Winter Sports
Wrestling
Yachting

3. **Biographies**

Grace, William Gilbert
Lenglen, Suzanne

PLATE ILLUSTRATIONS AND MAPS IN THE THREE NEW VOLUMES

Like the preceding volumes, the Three New Volumes of *The Encyclopædia Britannica* contain, in addition to the numerous maps and other illustrations which will be found on the text pages, a number of plates, some in Colour. A full list of these is given below.

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THE ENCYCLOPÆDIA BRITANNICA
13th Edition

TOGETHER WITH THE INITIALS USED TO DESIGNATE THEM AND THE TITLES OF THEIR MORE IMPORTANT ARTICLES

Further acknowledgment of the collaboration of some of the Contributors—and of others, who, while not contributing articles, have by their aid and counsel enriched these volumes—will be found in the Editor's Preface to the first of these Three New Supplementary Volumes.

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Child Labour and Child Welfare (*in part*); Maternity and Infant Welfare (*in part*).

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City Planning.

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Excess Profits Duty (*in part*); Income Tax (*in part*).

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Government.

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Children's Courts: *European.*

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Red Cross.

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Entomology, Medical.

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Milk (*in part*).

ALLEN, EDWARD E. (E. E. A.*)
Blind, Training of the (*in part*).

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Tennessee (*in part*).

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Elevators and Escalators.

ALTHAM, CAPTAIN EDWARD A., C.B., R.N. (ret.) (E. A.*.)
Jellicoe, Earl; Jutland, Battle of.

AMARK KARL, Ph.D. (K. A.)
Sweden: *Financial and Economic History.*

AMIR ALI, RIGHT HON. SEYYID, C.I.E., M.A. (A. A.)
Mahommedanism.

ANDRADE, EDWARD N. da COSTA, D.Sc. (E. N. da C. A.)
Sound Ranging; Television.

ANDREWS, BRIG.-GEN. LINCOLN CLARK. (L. C. A.)
Bootlegging and Smuggling.

ANDREWS, IRENE, O. (I. A.*)
Women, Professional (*in part*)

ANDREWS, ROY CHAPMAN. (R. C. A.)
Mongolia, Paleontological Discoveries in (*in part*).

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Yale University.

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Chemistry.

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Austrian Literature.

ARNOLD, SIR THOMAS W., C.I.E., Litt.D., F.B.A. (T. W. A.*)
Caliphate; Pan-Islamism.

ARRHENIUS, SVANTE AUGUST, D.Sc., F.R.S. (Sv. A.)
Physical Chemistry.

ARTHUR, SIR GEORGE, Bart. (G. Ar.)
Kitchener, Earl.

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